Series 1952, No. 9

Issued September 1960

SOIL SURVEY

Beryl-Enterprise Area, Utah

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UTAH AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SURVEY of the Beryl-Enterprise Area will help farmers and ranchers in planning the kind of management that will provide good yields and maintain the soils. It will assist engineers in selecting sites for roads, buildings, and irrigation structures; aid those who plan wildlife management and recreational areas; and add to the fund of knowledge about soils. It describes the soils, shows their location on the map, and tells what can be done with them under certain kinds of management.

Find Your Farm on the Map

In using this survey, start with the large soil map, which is bound in the back of this report. These map sheets, if laid together, make a large map of the Beryl-Enterprise Area. The index to map sheets has numbered rectangles that show what part of the Area is covered by each sheet of the large map.

When you have found the map sheet you need, you will notice that each area of each soil is outlined by a boundary, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they appear on the map. Suppose you have found on your farm an area marked with the symbol Ce. The legend for the large soil map shows that this symbol identifies Crestline fine sandy loam, 0 to 3 percent slopes.

Learn About the Soils

Crestline fine sandy loam, 0 to 3 percent slopes, and all the other soils mapped are described in the section, Descriptions of the Soils. The section, Use, Management, and Productivity of the Soils, contains information that will help you decide what to do with each kind of soil. Those soils that are suitable for irrigation have been placed in capability units according to their possibilities under irrigation. Those soils that may be used for range have been placed in range sites according to their value for grazing. For example, Crestline fine sandy loam, 0 to 3 percent slopes, is in capability unit IIs–2 if it is irrigated and in the Semidesert sandy loam range site (capability unit VIIc–2) if it is not irrigated.

Each capability unit or range site contains soils that need about the same kind of management and respond to it in about the same way. Suitable crops, systems of management, and likely yields are given for each capability unit or range site. The Guide to Mapping Units, Capability Units, and Range Sites, which is at the back of the report, will make it easier to find the several sections that give information on each soil.

Students of soil science and related subjects will find more technical material about the soils of the Area in the section, Formation and Classification of Soils. Two of the most important problems of agriculture in this Area are discussed in the sections, Irrigation, and Salts and Alkali. The section, Description of the Area, gives a general background of the geography of the Area and its farms and rangeland. The section, Agriculture, summarizes the agricultural history and methods of the Area.

Make a Farm Plan

For the soils on your farm or ranch, compare your yields and practices with those given in this report. Look at your fields and rangeland for signs of erosion or overgrazing. Then decide whether or not you need to change your methods. The choice, of course, must be yours. This survey will aid you in planning new methods, but it is not a plan of management for any particular farm or ranch in the county.

If you want help in farm planning, consult the local representative of the Soil Conservation Service or of the Extension Service. Members of your State experiment station staff and others familiar with farming and ranching in the Beryl-Enterprise Area will also be glad to help you.

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SOIL SURVEY OF THE BERYL-ENTERPRISE AREA, UTAH

SURVEYED BY R. ULRICH, W. G. HARPER, AND G. SCHAFER SOIL CONSERVATION SERVICE, AND ORIS RUDD, UTAH AGRICULTURAL EXPERIMENT STATION

REPORT BY R. ULRICH

CORRELATED BY W. G. HARPER AND R. ULRICH, SOIL SURVEY[1]

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UTAH AGRICULTURAL EXPERIMENT STATION

THE BERYL-ENTERPRISE AREA is in the southern end of the Escalante Valley in southwestern Utah. It is a nearly level basin almost surrounded by long, gently sloping alluvial fans that lie at the foot of abruptly rising mountains.

The dry climate and the shortage of water have limited development of the Area. A limited supply of surface water is available high on the alluvial fans and in the nearby mountains. Before 1900, the Area was used almost entirely for spring and fall range for livestock, and few if any homes were established. When facilities to store and divert surface water for irrigation were developed about 1900, near Enterprise and Newcastle, the settlement and agricultural development of parts of the Area were begun. Dryland farming was tried, but it proved generally unsuccessful, except in the small area still in use. Attempts to use the underground water reservoir through irrigation wells have had some success, especially since about 1945. These wells have extended the intensive agricultural development of the Area. Most of the Area, however, is still used for range.

To provide a guide for the best agricultural use of the Area and the maximum benefit from the limited water resources available, a cooperative soil survey was begun in 1948 and completed in 1952 by the United States Department of Agriculture and the Utah Agricultural Experiment Station. This report and the accompanying soil map present the results of that survey.

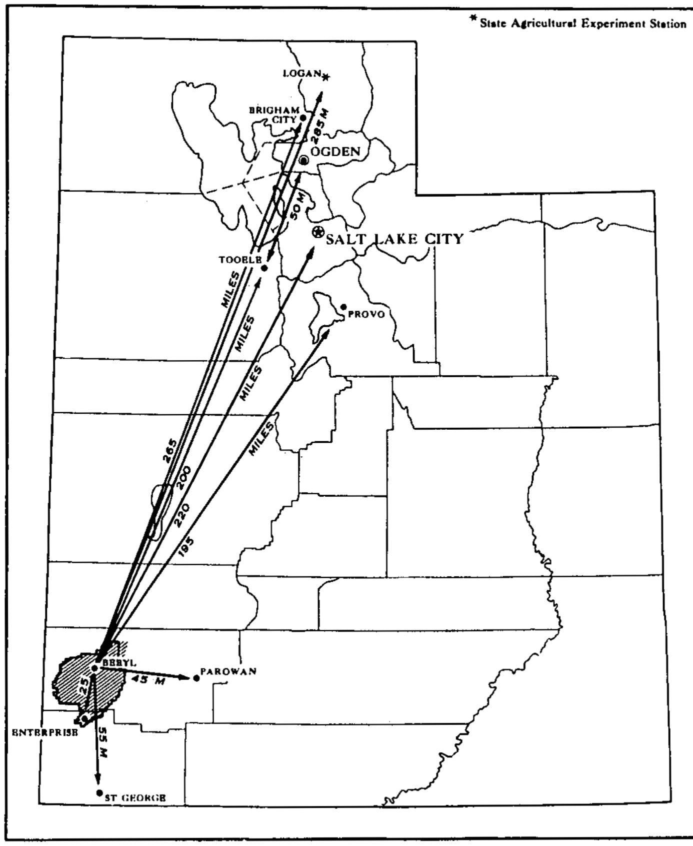

Figure 1.—**Location of the Beryl-Enterprise Area in Utah.**

Description of the Area

In this section the physical nature of the Beryl-Enterprise Area will be described. This information is a background for understanding the development of the soils of the Area.

Location and Extent

The Beryl-Enterprise Area is in the southwestern part of Utah (fig 1). It covers 380,480 acres, or about 594.5 square miles. Of this, 573.75 square miles is in western Iron County, and the remaining 20.75 square miles is in northern Washington County. Mountain ranges almost surround the Area; they are near Newcastle and Enterprise on the south, Modena on the west, Beryl on the north, and Table Butte on the east. The town of Lund is 2 miles east of the northeastern corner of the Area. Parowan, the county seat of Iron County, is about 40 miles

[1] The soil survey was made while Soil Survey was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

east of the northeastern corner of the Area. St. George, the county seat of Washington County, is 44 miles south of Enterprise. Beryl is about 220 miles from Salt Lake City in a straight line, but about 295 miles by highway.

Physiography

All of the Beryl-Enterprise Area is within the Great Basin section of the Basin and Range Physiographic Province (*4*)[2] and in the southern end of Escalante Valley. The Area consists almost entirely of a nearly level old lake basin and the adjoining, gently sloping, recent and somewhat older alluvial fans. Except along the eastern margin near Lund, the Area is entirely surrounded by mountain ranges. Except as required to form boundaries along established section lines, the surrounding mountains were excluded from the survey.

The major part of the Area is at elevations of 5,000 to 5,500 feet. The highest parts of the alluvial fans are at an elevation of about 6,000 feet, and the surrounding mountains are between 6,500 and 7,500 feet high. The elevation of Enterprise is 5,312; of Modena, 5,462; and of Beryl, 5,146 feet. The lowest point in the Area is in the playa northwest of Table Butte; the elevation there is 5,000 feet. The slopes of the alluvial fans are very gentle. They average approximately 10 feet per mile near Enterprise, 25 feet per mile near Modena, and 5 feet per mile near Lund. The predominant direction of slope in the basin is from southwest to northeast.

According to geologists, the basin portion of the Area was covered by the highest stage of ancient Lake Bonneville, a great inland sea of which Great Salt Lake is the last remnant. Based on evidence farther north, Gilbert (*5*) established the upper level of Lake Bonneville at about 5,200 feet. In this Area, however, there are few indications that the lake reached such a level. There are no wave-cut terraces, distinct shorelines, or offshore bars like those so clearly evident farther north in the State. Dennis (*3*) was able to trace to a point several miles south of Nada a distinct wave-cut and wave-built terrace at an elevation of about 5,120 feet. At this elevation, Escalante Bay, part of Lake Bonneville, probably extended into the Area. The soil and topographic findings of this survey indicate a distinct break, coincident with the distribution of the Escalante, Beryl, Antelope Springs, and Uvada soils. This break is approximately on the 5,200-foot contour, as given by the State Engineer, and agrees with the findings of Gilbert.

In the old lake basin, the topography is nearly level except for hummocky and duny areas resulting from wind action. There are no continuous stream channels across the basin, but several streams enter it and disappear.

With the exception of Shoal Creek, Pinto Creek, and Crestline Wash, the streams in the Area are small. There are no perennial streams, and few that contain enough water to maintain their courses any distance across the alluvial fans. For the most part, they carry water only during the runoff period in spring or during the occasional heavy rains in summer. Most of the water evaporates or percolates into the coarse alluvial streambeds and joins the underground water.

[2] Numbers in parentheses refer to Literature Cited, page 71.

Climate

The climate in the Beryl-Enterprise Area is semiarid and continental. Springs are late, quite cold, and always characterized by strong southwesterly winds. Summers are hot and dry, and in the later part local thunderstorms can be expected. Autumns are usually open and mild and extend well into December. Winters vary considerably; sometimes they are severe.

The only complete records on climate in the Area are for Modena. These figures most nearly represent the climate of the gently sloping old alluvial fans in the Area. Partial records have been kept at Enterprise, but these data would apply to only a small area around Enterprise. Partial records are available for Lund, just outside the Area to the northeast. These records represent the climate typical of the nearly level basin floor within the Area.

Table 1 gives information on temperature and precipitation recorded at Modena and at Lund. The floor of the basin is subject to a greater range in temperature than the alluvial fans. The highest temperature recorded at Lund was 108° F., and at Modena it was 101° F. The lowest temperatures recorded at the two stations were −34° at Lund and −32° at Modena. Temperatures at Enterprise and Newcastle are probably similar to those at Modena.

The average date of the last killing frost of spring at Modena is May 21; the average date of the first killing frost of autumn is September 29. The latest killing frost recorded was on June 13, and the earliest was on September 5. The average frost-free period at Modena and over most of the alluvial fans is 131 days.

At Lund, the average date of the last killing frost is May 27, and the average date of the first killing frost is September 19. Killing frosts have been recorded at Lund as late as July 3 and as early as September 3. The average length of the frost-free period is 115 days. These figures will probably apply to the basin floor in the Beryl-Enterprise Area.

Precipitation in the Area is greatest near the mountains. Enterprise receives the highest average amount, 15.41 inches annually, but the 10.73 inches at Modena is more typical of the average precipitation on most of the alluvial fan parts of the Area. The basin floor receives less moisture than the alluvial fans, and the average of 8.33 inches at Lund would probably apply to most of the basin. Much of the winter precipitation comes as snowfall. Snow often falls in May and has been recorded as late as June. Data on average snowfall at Modena is given in the table, but this information was not available for Lund.

The precipitation in fall, winter, and spring occurs as rather gentle, prolonged storms that cover wide areas. Summer rains are shorter, more limited in area, and frequently torrential. Many last less than half an hour, fill the drainageways to capacity, and leave water standing on nearly level places. These summer storms tend to drop most of their moisture on the mountains and upper alluvial fans. On the basin floor, these same storms consist of little or no rain but considerable wind and dust.

The Area is practically free from fog and cloudy weather. The Modena station reported an average of 3 foggy days per year The sun shines 74 percent of the

TABLE 1.—*Temperature and precipitation at two stations in the Beryl-Enterprise Area, Utah*

[Modena, Iron County, elevation 5,460 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1950)	Wettest year (1906)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	28.1	69	−24	0.76	0.13	2.13	5.7
January	26.1	65	−32	.87	1.05	.67	8.6
February	31.4	67	−27	.93	.13	.47	6.1
Winter	28.5	69	−32	2.56	1.31	3.27	20.4
March	38.4	75	−7	1.10	.25	3.22	6.4
April	46.2	85	7	.84	.09	2.91	2.4
May	54.2	93	20	.76	.09	1.31	.8
Spring	46.3	93	−7	2.70	.43	7.44	9.6
June	63.5	101	22	.41	(3)	0	(3)
July	71.1	101	31	1.19	1.49	2.30	(3)
August	69.3	101	35	1.48	.07	3.40	0
Summer	68.0	101	22	3.08	1.56	5.70	(3)
September	60.6	99	20	.83	.60	.91	(3)
October	48.9	87	7	.99	.06	.34	1.2
November	37.3	75	−11	.57	.21	1.40	3.0
Fall	48.9	99	−11	2.39	.87	2.65	4.2
Year	47.9	101	−32	0.73	4.17	19.06	34.2

[Lund, Iron County, elevation, 5,091 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1955)	Wettest year (1951)	Average snowfall
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December	28.6	72	−31	0.59	0.07	0.77	------
January	25.8	67	−34	.88	.30	.85	------
February	31.9	78	−30	.87	.61	.37	------
Winter	28.8	78	−34	2.34	.98	1.99	------
March	40.2	76	−2	.97	(3)	.54	------
April	47.4	87	0	.55	(3)	1.22	------
May	55.7	94	18	.73	.09	1.58	------
Spring	47.8	94	−2	2.25	.09	3.34	------
June	66.5	105	28	.14	.45	.11	------
July	72.6	108	32	.74	.11	.46	------
August	70.7	102	35	1.23	3.11	1.44	------
Summer	69.9	108	28	2.11	3.67	2.01	------
September	61.5	97	25	.56	(3)	.57	------
October	49.2	90	10	.60	.31	1.63	------
November	37.6	80	−6	.47	.32	1.34	------
Fall	49.4	97	−6	1.63	.63	3.54	------
Year	49.0	108	−34	8.33	5.37	10.88	------

[1] *Modena:* Average temperature based on a 55-year record, through 1955; highest and lowest temperatures on a 52-year record, through 1952. *Lund.* Average temperature based on a 5-year record, through 1955; highest and lowest temperatures on a 13-year record, through 1930.

[2] *Modena:* Average precipitation based on a 55-year record, through 1955; wettest and driest years based on a 55-year record, in the period 1901–1955; snowfall based on a 51-year record, through 1952. *Lund:* Average precipitation based on a 5-year record, through 1955; wettest and driest years based on a 5-year record, in the period 1951–1955.

[3] Trace.

time possible. The average relative humidity at Modena is 66 percent at 8 a.m., 35 percent at noon, and 37 percent at 8 p.m. These figures probably apply to the entire Area.

Hailstorms are rare. Tornadoes, hurricanes, and cyclones are unknown in this Area. The average wind velocity at Modena is 11.5 miles per hour, and the maximum is 53 miles per hour.

Vegetation

The vegetation of this Area is especially interesting, and it has been studied by a number of ecologists (7) (8).

In a general way, two broad plant associations dominate the present vegetative cover: (1) The sagebrush-galletagrass association on the alluvial fans, and (2) the greasewood-shadscale association in the lower parts of the basin. The first is widespread on old alluvial fans and terraces where Dixie, Timpahute, Sevy, and Crestline soils dominate. The second is found on the more severely salt- and alkali-affected soils in the lower part of the basin, where Antelope Springs and Uvada soils dominate (fig. 2).

These two plant associations represent the extremes in vegetative cover. There is also a somewhat mixed, or transitional, association of considerable importance. It occupies the higher lying portions of the basin, where the strongly calcareous and only slightly saline-alkali soils of the Escalante and Beryl series occur. In this association, big rabbitbrush is a major species, and there is considerable sagebrush and some shadscale and greasewood. It is in this general area and on these soils that the most extensive pump irrigation in the basin has taken place.

A plant of considerable distribution on the alluvial fans is yellowbrush (little rabbitbrush). On some areas of Neola soils, this plant occurs in almost pure stands. It has limited grazing value for sheep and almost none for cattle. Because it is so unpalatable and is utilized so little, it has spread considerably to overgrazed areas of other soils.

Three-awn grass is another low-value forage plant that has spread considerably as the result of overgrazing. It now grows in almost pure stands in small areas of abandoned cropland on the alluvial fans east of Modena and elsewhere.

In the main, the soils that are developing from recent alluvium are associated with the soils of the older alluvial fans and terraces and have similar but larger vegetation. Some of the largest sagebrush in the area grows on the Red Rock soils. In addition, some areas of Tomas and Zane soils east of Modena support nearly pure stands of winterfat, a fine forage plant.

Rough broken and stony land has a cover of juniper, sagebrush, and some galletagrass. In most places, the juniper is scattered; in others, it is absent entirely. South and east of Enterprise and northeast of Modena, the juniper extends down the slopes onto stony and very stony soils, principally of the Dixie and Timpahute series.

In addition to the dominant species in the principal plant associations, the following are present in minor, but locally conspicuous and important, amounts: (1) prickly-pear, Mormon-tea, and Indian ricegrass on the alluvial fans; (2) cheatgrass brome and tumbling Russian-thistle in overgrazed, idle, or abandoned cultivated areas; and (3) bud sage, fourwing saltbush, pickleweed, saltgrass, gray molly, foxtail barley, and lichens in the salt- and alkali-affected basin area.

The names of the principal species of vegetation that grow in the Area follow.

Scientific name	*Common name*
GRASSES	
Agropyron cristatum	Crested wheatgrass.
A. inerme	Beardless bluebunch wheatgrass.
A. trachycaulum	Slender wheatgrass.
A. smithii	Western wheatgrass.
A. spicatum	Bearded bluebunch wheatgrass; spiked wheatgrass.
Aristida spp	Three-awn.
A. fendleriana	Fendlers three-awn.
Bouteloua gracilis	Blue grama.
Bromus spp	Bromegrass.
B. tectorum	Cheatgrass brome.
Distichlis stricta	Inland saltgrass.
Elymus canadensis	Canada wildrye.
E. condensatus	Giant wildrye.
E. glaucus	Blue wildrye.
Festuca octoflora	Sixweeks fescue.
Hilaria jamesii	Galletagrass.
Hordeum jubatum	Foxtail barley.
H. nodosum	Meadow barley.
Koeleria cristata	Prairie junegrass.
Munroa squarrosa	False buffalograss.
Oryzopsis hymenoides	Indian ricegrass.
Poa spp	Bluegrass.
P. juncifolia	Alkali bluegrass.
P. longiligula	Longtongue muttongrass.
P. pratensis	Kentucky bluegrass.
P. secunda	Sandberg bluegrass.
Sitanion hystrix	Bottlebrush squirreltail.
Sporobolus airoides	Alkali sacaton.
S. contractus	Spike dropseed.
GRASSES—Continued	
S. cryptandrus	Sand dropseed.
Stipa comata	Needle-and-thread.
Triodia pulchella	Fluffgrass.
GRASSLIKE PLANTS	
Carex spp	Sedge.
Juncus spp	Rush.
FORBS	
Abronia spp	Sand verbena.
Allenrolfea occidentalis	Pickleweed.
Allium spp	Wild onion.
Amaranthus spp	Red root.
Ambrosia spp	Ragweed.
Amsinckia spp	Fiddleneck.
Antennaria spp	Pussytoes.
Arenaria spp	Sandwort.
Argemone hispida	Hedgehog pricklepoppy.
Artemisia dracunculoides	Green sagebrush.
A. vulgaris	Mugwort wormwood.
Asclepias spp	Milkweed.
Aster spp	Aster.
A. leucelene	Baby white aster.
Astragalus spp	Loco; milkvetch; poisonvetch.
A. convallarius	Timber poisonvetch.
Atriplex spp	Saltbrush.
Bassia hyssopifolia	Bassia.
Calochortus spp	Sego lily.
Castilleja spp	Indian paintbrush; painted-cup.
Chaenactis spp	False-yarrow.
Chenopodium album	Lambsquarters.
Cirsium spp	Thistle.
Comandra pallida	Bastard toadflax.
Cryptantha spp	Cryptantha.
Delphinium spp	Low larkspur.
Erigeron spp	Fleabane; daisy.
Eriogonum spp	Buckwheat.
Erodium cicutarium	Alfileria; filaree.
Erysimum asperum	Western wallflower.
Euphorbia spp	Euphorbia.
Gayophytum spp	Groundsmoke.
Gilia spp	Gilia.
Halogeton glomeratus	Halogeton.
Helianthus annuus	Common sunflower.
Hymenopappus spp	Hymenopappus.
Hymenoxys acaulis	Rubberweed.
Iva axillaris	Povertyweed.
Lactuca serriola	Prickly lettuce.
Linum lewisii	Flax.
Lupinus spp	Lupine.
Lygodesmia juncea	Skeletonweed.
Marrubium vulgare	Horehound.

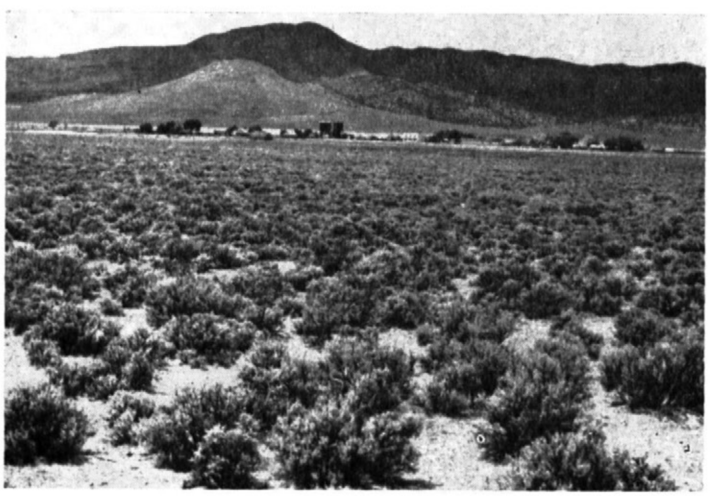

***Figure 2.*—On the left, the sagebrush-galletagrass plant association on Timpahute and Dixie soils. The town of Modena is in the background. On the right, the greasewood-shadscale plant association on Antelope Springs soil.**

Scientific name	*Common name*
FORBS—Continued	
Mentzelia albicaulis	Whitestem mentzelia.
Monolepis nuttalliana	Nuttall monolepis.
Nicotiana spp	Tobacco.
Oenothera spp	Evening primrose.
Penstemon spp	Penstemon.
Phlox spp	Phlox.
Plantago purshi	Woolly Indian-wheat.
Salsola kali tenuifolia	Tumbling Russian-thistle.
Senecio spp	Groundsel.
Sophia spp	Descurainia.
Sphaeralcea coccinea	Scarlet globemallow.
Suaeda spp	Seepweed; inkweed.
Zygadenus paniculatus	Foothill deathcamas.
SHRUBS AND TREES	
Aplopappus spp	Goldenweed.
Artemisia filifolia	Sand sagebrush.
A. nova	Black sagebrush.
A. pygmaea	Pygmy sagebrush.
A. spinescens	Bud sagebrush.
A. tridentata	Big sagebrush.
Atriplex canescens	Fourwing saltbush.
A. confertifolia	Shadscale; shadscale saltbush.
A. gardneri	Gardners saltbush.
Baccharis glutinosa	Seepwillow.
Chrysothamnus nauseosus	Big rabbitbrush; rubber rabbitbrush.
C. stenophyllus	Yellowbrush; small rabbitbrush.
Ephedra spp	Nevada joint fir.
E. viridis	Mormon-tea.
Eurotia lanata	Common winterfat; white sage.
Grayia spinosa	Spiny hopsage.
Gutierrezia sarothrae	Broom snakeweed; matchweed.
Juniperus utahensis	Utah juniper.
Kochia vestita	Gray molly.
Mammillaria spp	Mammillaria.
Opuntia spp	Pricklypear.
Pinus edulis	Pinyon pine.
Populus fremontii	Cottonwood.
Rhus trilobata	Squawbush; skunkbush sumac.
Rosa spp	Rose.
Sarcobatus vermiculatus	Greasewood; black greasewood.
Tetradymia canescens	Spineless horsebrush.
T. spinosa	Spiny horsebrush.

Soils of the Beryl-Enterprise Area

As in most of the Southwest, lack of moisture is the principal factor limiting plant growth in the Beryl-Enterprise Area. The only natural vegetation is that which can survive the dry climate. The warm semiarid climate and the sparse vegetation have determined many of the characteristics of the soils developed in this Area.

In general, the surface soils are fairly light colored. They are brownish to reddish because of oxidation of iron compounds in the parent material. Most of them are low to very low in nitrogen and contain little organic matter. For the most part, the soils contain enough phosphorus for a limited amount of plant growth but not enough for sustained high yields. Not all of the phosphorus is available to plants in the more calcareous soils. Accumulations of lime are common, and also salts of potassium, sodium, and other substances. Some soils have a surface layer that is free of lime, salts, and alkali.

In many soils, the subsoil is hardened and in some places cemented into a caliche hardpan. Many of the older soils on alluvial fans have a reddish-brown, firm clay subsoil layer above the caliche hardpan. In some places the subsoil is very slowly permeable because of the excess of adsorbed sodium.

Most of the soil materials that have accumulated on alluvial fans and in the basin area are mixtures derived from various kinds of rocks. The distance from the original source makes a considerable difference in the composition and texture. Coarse-textured materials from a single kind of rock lie on the highest parts of the alluvial fans. Finer textured materials have been transported farther, to the lower slopes and the valley floor, and have been mixed with materials from many other kinds of rock.

Some of the more recent alluvium is dark colored and contains considerable organic matter because it was washed from areas supporting denser vegetation on the mountains above this Area. In some parts of the basin area, dark-colored layers are buried beneath layers of more recent lighter colored alluvium. Generally, however, the content of organic matter is too small to modify or mask the color of the parent materials.

Many soils of the Area have serious problems that make it impractical to use them intensively, even when irrigation water is available. Such problems are coarse texture, excessive porosity, low water-holding capacity, dense impervious subsoil, caliche hardpan, and excessive quantities of soluble salts or alkali. Many of these problem soils are located in the basin area, where ground water is nearest to the surface and most economical to pump. On the alluvial fans, the soils have fewer of these problems, but the depth to ground water ranges from 20 to 120 feet. This difference in pumping lift makes irrigation more economical nearer the basin area and more expensive farther up on the alluvial fans. On the higher and older alluvial fans the relief is irregular and the soils are coarser textured, stony, shallow, and droughty. The depth to ground water is generally more than 100 feet.

Soil Associations

Over a large expanse of land, the landscape differs from place to place. Some of the more obvious differences are in the shape, steepness, and length of slopes, in stream patterns, and in the kinds of vegetation and its condition. The kinds of soils and the patterns in which they occur differ in the landscape.

The different patterns of soils, called soil associations, are shown on the general soil map that is at the back of this report, just ahead of the detailed soil map. This map is useful to those who want a general idea of the soils, or who want to locate large areas suitable for some particular kind of farming or other general land use. It does not show accurately the kinds of soil on a single farm or a small tract.

In the Beryl-Enterprise Area the patterns of soils are determined to a large extent by the topographic features on which they are located. There are four kinds of topography in this Area, each having important characteristics that influence the kinds and patterns of soil that develop on them. Some have enough range in characteristics that two or more soil associations occur.

There are seven soil associations, each of which differs from the others in pattern of soils and in suitability for various types of agricultural use. The pattern of soils is not strictly uniform within each tract of a soil association, but the same soils are present in somewhat the same arrangement. Each association is named for one or more of its dominant soil series.

Brief descriptions of the topographic divisions and the soil associations follow. For more detailed information about the soils, see the detailed soil map and the section, Descriptions of the Soils.

Soils of the Basin Areas

The basin area is a nearly level to very gently sloping plain, except in places where wind action has produced dunes. It comprises about 38 percent of the survey Area. This basin is thought to have been occupied by Escalante Bay, a part of glacial Lake Bonneville (*5*). The elevations range from 5,000 feet in a playa just west of Table Butte to about 5,200 feet. The 5,200-foot elevation corresponds to the upper level of Lake Bonneville. The general upper level of distribution of the Beryl and Escalante soils corresponds with the 5,200-foot contour.

The basin area can be considered in three soil associations, differentiated on the basis of relative elevation, texture, modification of soil and slope by wind action, and content of lime, salts, and alkali. These are the Antelope Springs-Uvada, the Escalante-Beryl, and the Dune land-Escalante associations.

1. Antelope Springs-Uvada soil association

The outstanding characteristics of this association are the large amounts of salts and alkali in the profiles and the medium to moderately fine texture of the soils. Except for some low hummocks on the Uvada soils, the slopes are nearly level to very gently sloping. This is the lowest part of the basin. Elevations range generally from 5,000 to 5,100 feet, but, where the major intermittent drainageways enter the basin, this association extends to elevations of 5,200 feet.

About 20 percent of the survey Area is in this association. Soils of the Antelope Springs and Uvada series, about equal in acreage, are dominant. Small areas of Beryl, Crestline, Escalante, and Heist soils, as well as Playas, are included.

The soils in this soil association are chiefly medium to moderately fine in texture, low in organic matter, and pinkish to reddish brown in color of the surface soil. Most of them are slowly permeable. The relatively fine textured sediments from which these soils developed are very deep. Most of the sediments were deposited in Lake Bonneville in glacial times, but some have been brought in by intermittent streams since that time.

The Uvada soils nearly everywhere are strongly saline and strongly affected by alkali. The Antelope Springs soils are strongly saline and strongly affected by alkali only in the lowest lying parts of the association, generally below 5,100 feet in elevation. The Antelope Springs soils at elevations between 5,100 and 5,200 feet are generally nonsaline and only slightly to moderately affected by alkali. The Beryl and Escalante soils are affected by salts and alkali, but the Crestline and Heist soils are free of both. Playas are very strongly affected by salts and alkali.

The vegetation in this association is dominated by greasewood and shadscale. These plants are extremely tolerant of salts and alkali. They absorb large amounts of sodium and other soluble salts. The soil immediately under these plants is even more strongly alkaline than the barren spots between the individual plants. Almost no vegetation grows in Playas.

Little use has ever been made of these soils. The vegetation has a very low carrying capacity. For many years migratory bands of sheep have used them for limited spring and fall range during their annual treks between winter and summer pastures. Some attempts have been made to dry-farm parts of this association, but all were unsuccessful and have been abandoned.

Small areas of the higher lying soils that are less strongly affected by alkali have been pump irrigated and used for alfalfa, barley, and potatoes. Potatoes are poorly suited to these soils, but alfalfa and barley are more tolerant of salts and alkali. On the soils less strongly affected by alkali, fertilization with phosphorus for legumes and with nitrogen and phosphorus for other crops may produce some response. Where the concentrations of salts and alkali are stronger, crops make little or no response to fertilizers.

The excess of salts and alkali in most soils at the lower elevations in this association is nearly impossible to correct. The higher lying areas are less strongly affected by salts and alkali, but their reclamation is expensive. Reclamation usually includes adequate natural or artificial drainage, addition of manure or other organic materials, deep leaching to remove the excess of soluble salts, and addition of gypsum or sulfur for chemical replacement of the excess sodium, or alkali.

Under natural conditions, drainage is not a problem on these soils. When they are used more intensively, drainage is important because of the nearly level topography and slow permeability.

The depth to the water table ranges from about 5 to 45 feet. Just west of Table Butte, the water table is 4 feet from the surface, and near Garyville it is at a depth of about 45 feet. Water from the upper part of the ground water generally is of poor quality because of the salts dissolved in it. It is necessary, especially in the lower lying parts of the basin, to draw water from greater depths where the quality is better.

Slopes are relatively uniform in this association, and leveling is not a major problem. The vegetation is sparse, and it is not especially difficult to remove. The vegetation accumulates so much salt that it is advisable to remove it completely instead of burning it or incorporating it into the soil.

Erosion by either wind or water is not a special problem.

2. Escalante-Beryl soil association

The characteristic soils in this association are moderately coarse in texture, and they contain large amounts of lime. In some places the surface has been blown into low hummocks; elsewhere it is nearly level to very gently sloping.

This association occupies the higher lying parts of the old lake basin, where elevations range from 5,100 to 5,200 feet. It covers about 15 percent of the survey Area. There are few intermittent streams or drainageways. Some enter the area, deposit thin overwash in places, and disappear by infiltration or evaporation.

Soils of the Escalante series cover the largest acreage in this association, and the Beryl soils are also extensive. Small areas of Antelope Springs, Bullion, Navajo, Crestline, and Heist soils and Dune land are included.

These soils generally range from moderately coarse to medium in texture. The textures are coarser than those in the lowest part of the basin, probably because of the sorting action of waves and currents in the shallow water of Lake Bonneville. Little additional material has been deposited over this area since the disappearance of Lake Bonneville. The large quantities of lime, salts, alkali, and gypsum probably were left when the lake water evaporated.

The soil materials are pinkish in surface color. They contain little organic matter. They are moderately permeable.

These soils are moderately alkaline. The surface soil generally contains 5 to 15 percent of lime and the subsoil up to twice this amount. The lime horizon in the Beryl soils is comparatively soft and easy to penetrate. In the Escalante soils, the lime horizon is prominent, somewhat hardened, and caliche-like.

Both the Beryl and Escalante soils contain excessive salts and alkali. At the higher elevations, the salts and alkali are mainly in the lower part of the profile. At the lower elevations, the Beryl soils are strongly saline and strongly affected by alkali.

The vegetation on these soils is dominated by big rabbitbrush. Some sagebrush, greasewood, and shadscale are present, as well as a sparse growth of alkali sacaton.

Until recently, little use was made of most of this association. It was used as fall and spring range for migratory bands of sheep, but the carrying capacity was very low. The lower lying soils that are more strongly saline and strongly affected by alkali are still used mostly for this limited range.

These soils are not used for dry-farming, but attempts have been made to dry-farm them. All attempts were unsuccessful because the surface soil erodes very readily under dryland farming.

Since the introduction of pump irrigation, large areas near Garyville and northward and westward toward Beryl have been irrigated with considerable success. The principal irrigated crops are alfalfa, barley, and potatoes. Small acreages of carrots and sugar beets have been grown and some irrigated pasture. Little fertilizer has been used. Legumes respond to phosphorus but both nitrogen and phosphorus are needed for the best response from other crops.

The problem of excess salts and alkali is not so serious on the higher lying soils, for the concentrations are slight and are mostly in the lower subsoil. Only the soils less affected by salts and alkali have been used for irrigated crops. If enough water is available, deep leaching alone is enough to leach out most of the salts and alkali. Even the soils that are lower lying and more strongly affected by salts and alkali can be reclaimed by deep leaching. The soils are relatively permeable, and enough gypsum is present in most places to reclaim the alkali soils.

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One problem is the limitation on water available for reclamation of soils and for irrigation. Most of these soils need some deep leaching to correct their salinity and alkalinity. Considerable water has been pumped, and the water table has subsided in some places. This lowering of the water table is likely to continue, as the annual pumpage appears to be greater than the recharge of water. The depth to the water table ranges from 5 to about 80 feet. The water is of good quality if the deeper strata are tapped.

Leveling is not a major problem if soil blowing is controlled. The vegetation is sparse and not difficult to remove. It can be incorporated into the soil as a mulch to help control wind erosion. Drainage is not a problem.

Careful management is required to prevent soil blowing, which is a serious problem even under irrigation. The soil should be irrigated shortly before cultivation. Windbreaks and stripcropping at right angles to the direction of the wind should be used. Mulches, subsurface cultivation, and other practices should also be used to reduce blowing of soil.

3. Dune land-Escalante soil association

The outstanding characteristic of this association is the dunelike topography. The eroded and hummocky Escalante soils occupy the spaces between the dunes. The association makes up less than 3 percent of the survey Area.

This association is surrounded by the Escalante-Beryl association and is nearly like it, except for topography. The dune materials appear to have been blown from the Escalante and Beryl soils. They are very strongly calcareous, moderately coarse textured, and light brown. They contain very little organic matter. The dunes range from about 5 to 30 feet in height. They are elongated from southwest to northeast and conform to the prevailing direction of the wind.

At least some of the dunes do not appear to have resulted from disturbance by cultivation. They may date from the time when the lake water in the basin was receding and the sandy shoreline deposits had not yet been stabilized by protective vegetation. Since that time, the dunes have probably been enlarged or modified during prolonged dry periods and high winds.

Most areas are at least partly stabilized by a very scattered growth of sagebrush and big rabbitbrush and some greasewood and shadscale. A few areas support almost no vegetation except squawbush. Most of this vegetation has little or no value for grazing. Its chief value is to stabilize the soil material against further erosion and keep it from blowing onto more valuable soils nearby (fig. 3).

These areas have little use, even for range. Some dunes and parts of dunes have been leveled, pump irrigated, and cropped. The leveled soils are similar to the soils of the Escalante-Beryl association in characteristics and in management requirements, but more care is needed during leveling and under cultivation to reduce blowing.

Figure 3.—**Squawbush growing on Dune land. Note the extensive root system.**

Soils of the Recent Alluvial Fans and Flood Plains

The recent alluvial fans and flood plains are nearly level to gently sloping areas along the intermittent drainageways that cross the older alluvial fans and terraces. They cover about 12 percent of the survey Area. The lower edge merges with the basin area. The cone-shaped recent alluvial fans rise gently toward the uplands. The flood plains are longer, narrower, and more irregular.

All of the soils in this part of the survey Area are considered in one association, the Tomas-Genola.

4. Tomas-Genola soil association

The soils in this association are the most productive in the Beryl-Enterprise Area. The slopes generally range from nearly level to very gently sloping, but in a few places on high alluvial fans next to the mountains, slopes are as steep as 12 percent. The elevations generally range from 5,200 to 5,500 feet. A few small areas are more than 5,500 feet high.

This association contains many soils, arranged in a complex pattern, but the main ones are only slightly different. The most common and most representative of these soils belong to the Tomas and Genola series. Other important soils are the dark-colored Mosida and Red Rock soils and the reddish-brown Modena and Redfield soils. The brownish, gravelly, and stony Newcastle soils are included, but they are too high in elevation to be used to any extent. The coarse textured Berent, the moderately fine textured Musinia and Tours, the fine textured Navajo, and small tracts of Beryl, Dixie, Escalante, Heist, Neola, Sevy, and Zane soils are also present.

The dominant soils in this association are pale brown and light brown. They are low to moderate in organic matter. Generally, they are medium textured. Variations are due to water sorting; the coarser textured materials were deposited nearest their source and the finer textured materials were carried the farthest. The Genola soils are coarser in texture than the Tomas soils. There has been some stratification and some overwash of one material over another, but generally the profiles are fairly uniform to considerable depths.

In a few places the soils contain considerable lime, but in most places they contain slight to moderate amounts. The Tomas soils are less calcareous than the Genola soils. Small areas of the Genola soils are slightly affected by alkali, but if water is available this problem can readily be corrected by deep leaching. The Navajo soils are moderately affected by alkali and are not suitable for reclamation.

The soils are well drained and well aerated. Gravel, stones, and other coarse fragments, as well as excess salts and alkali, generally are present only at higher elevations where development for agriculture is unlikely.

The vegetation is not abundant anywhere in the Beryl-Enterprise Area, but this association supports a heavier stand than other parts. Where they have not been overgrazed, the almost pure stands of winterfat on some areas of Tomas soils are the best range in the survey Area. The combination of sagebrush, galletagrass, and Indian ricegrass that covers the largest part of this association is of much lower quality and carrying capacity. Big rabbitbrush and a few cottonwood trees are present in some places at higher elevations and near watercourses.

Large tracts in this association have been cultivated under irrigation for many years. Most of the remainder is used for range. Near Enterprise a few areas are dry-farmed to grain; elsewhere, dryland cultivation has been abandoned.

Surface diversion irrigation is centered mainly on the alluvial fans along Shoal Creek and Pinto Creek, near Enterprise and Newcastle. Similar soils at lower elevations are pump irrigated.

These are the most productive soils in the Area. Many row crops, grains, forage crops, and pasture plants are well suited to them. The principal irrigated crops are alfalfa and barley. The acreage planted to potatoes fluctuates with market conditions.

Little fertilizer has been used on these soils. Phosphate would probably increase yields of legumes, and nitrogen and phosphate would improve the yields of other crops.

Most areas are free of salts and alkali, and those spots slightly affected by alkali can be reclaimed by deep leaching. The few spots that are moderately or strongly affected by salts or alkali are not used for irrigated crops.

Drainage is not a problem on most of these soils, even under intensive use, because they are permeable. Some care must be used in irrigating the silty Tomas soils and other fine-textured soils, because their rates of infiltration are slow.

The depth to the water table ranges from about 45 feet near the basin to more than 200 feet in the highest positions on the alluvial fans. The quality of the water is uniformly good.

Leveling for irrigation is not a major problem, because the slopes are fairly uniform and deep cuts can be made. The vegetation is not difficult to remove, and the plant material can be incorporated into the soil.

Wind erosion is most serious on the coarser textured soils, but it can be controlled by using windbreaks, mulches, stripcropping, and subsurface cultivation. The soils should be moistened before they are cultivated. Water erosion is not a serious problem, because most cultivation is on the more gently sloping areas. Where the slope is stronger, irrigation and cultivation should be done across the slope.

Soils of the Older Alluvial Fans and Terraces

The older alluvial fans and terraces are the gently sloping and very gently sloping, apron-shaped areas between the nearly level basin soils and the lower parts of the mountains. They cover about 40 percent of the Beryl-Enterprise Area. Elevations generally range from 5,200 to 5,500 feet, but in some places they reach 6,000 feet. These areas are crossed by more or less winding intermittent streams and drainageways.

Two soil series, the Dixie and the Sevy, dominate on these older alluvial fans and terraces. They differ chiefly in hardness or cementation of the very strongly calcareous lower subsoil. Domination of one or the other of these soil series is the principal basis for distinction between the two associations mapped on these old fans and terraces. The two associations are the Dixie-Neola and the Sevy-Neola.

5. Dixie-Neola soil association

The outstanding characteristics of the soils in this association are shallowness and a very strongly calcareous lower subsoil. In most places this subsoil is strongly cemented and caliche-like. About 35 percent of the survey Area is in this association. Most of the slopes are gentle or very gentle; they range up to about 7 percent. Elevations range from 5,200 to 5,500 feet but may reach 6,000 feet in a few places.

About half of this association is covered by the Dixie soils. Of the remainder, about one-fourth is covered by Neola soils, about one-fourth by Crestline soils, and about one-fourth by Timpahute soils. The Zane soils are important in some places. A few small areas of Tomas. Beryl, Escalante, and Berent soils, and some Riverwash and Terrace escarpments, are included.

The Dixie soils have a medium-textured surface layer. The amount of clay in the subsoil has been moderately increased over that in upper layers. Profile development has been fairly shallow. Lime has been removed from the surface soil and upper subsoil. The lower subsoil is a weakly to strongly developed caliche, and the material beneath it is in most places very gravelly, stony, or bouldery. The parent material is coarser where it is nearer to its original source, and it is finer where it has been carried farther from the mountains.

The Neola soils have a strongly cemented caliche subsoil. The soil material above it is strongly calcareous to the surface. It is relatively soft and pale in color, and it contains little organic matter.

The Crestline soils are derived from fairly uniform, moderately coarse, old deposits of alluvium. The horizons are weakly expressed, and no hardened caliche subsoil is present. The Timpahute soils are derived from similar materials, but they are more stony and bouldery. Their horizons are strongly expressed. Their subsoil is fine in texture. The caliche layer is prominent and uniformly hardened. The Crestline soils generally occur at lower elevations than the Dixie soils, and the Timpahute soils are at higher elevations. The Zane soils are of medium to moderately fine texture. They lie at lower elevations on somewhat older and relatively uniform alluvial fan materials.

A large part of the surface of this association has no vegetation. Sagebrush less than 3 feet high and scattered clumps of galletagrass are common. Yellowbrush (small rabbitbrush) also grows, principally on the Neola soils, but also in overgrazed places on other soils.

This association is used almost entirely for range, the purpose to which it is best suited. Forage production is low, and overgrazing has been a problem.

A few lower lying fields next to the more recent alluvial fan or basin soils have been irrigated. A few small areas near Enterprise receive more rainfall than the rest of this association, and they have been dry-farmed to small grain.

The chief management problem is improving the carrying capacity of the range. The sagebrush is of little value to sheep and of little or no value to cattle. The best possible range management practices, including proper stocking, salting, drift fencing, and watering, should be used.

6. Sevy-Neola soil association

The soils in this association have a very strongly calcareous but softly consolidated lower subsoil at shallow depths. The limy subsoil materials are more strongly cemented in the Neola soils than in the Sevy soils. This association covers only 5 percent of the Beryl-Enterprise Area. Most of the slopes are very gentle. Elevations range from about 5,200 to 5,400 feet.

The Sevy soils are a little more extensive in this association than the Neola soils. The Sevy and Neola soils differ distinctly, but in many places areas of one are mingled with areas of the other in a complex pattern. Small areas of Antelope Springs, Beryl, Escalante, Genola, and Timpahute soils are included.

The Sevy soils have a reddish-brown, noncalcareous, moderately fine textured surface soil and a reddish-brown, noncalcareous upper subsoil that contains more clay than the surface soil. Their lower subsoil is relatively soft, marly, and very strongly calcareous. In some places, hardened lenses and crusts are present in the upper part of the lower subsoil, but as a rule these are not continuous. The lower subsoil of the Sevy soils is generally permeable and can be penetrated by plant roots.

The Neola soils have a very pale brown, strongly calcareous surface soil overlying a strongly cemented caliche subsoil. The Neola subsoil in this association is not so strongly cemented as the subsoil in the Neola soils of the Dixie-Neola association.

The Sevy soils support a sparse vegetation consisting mostly of small clumps of sagebrush and galletagrass. Almost pure stands of small rabbitbrush grow on the Neola soils. Much of the surface is barren.

Range of low carrying capacity predominates on this association. The soils are not suited to dry-farming, because there is not enough rainfall. Little evidence remains of previous attempts.

Pump irrigation is expanding on the lower edges of this association, especially south of Garyville toward Enterprise and east toward Newcastle. Large tracts have been leveled and cropped. Alfalfa and small grains are the principal crops, and small amounts of potatoes, sugar beets, and carrots are grown. The legumes respond to fertilization with phosphorus, and the other crops respond to both nitrogen and phosphorus.

Little water erosion occurs on these very gentle slopes. Wind erosion is a problem when the Neola soils are irrigated, unless the soils are moistened before cultivation. Windbreaks, stripcropping at right angles to the wind direction, mulches, and other practices should be used to keep the soils from blowing.

Soils of the Uplands

The upland part of the Beryl-Enterprise Area consists of the stony, bouldery, and rocky lower parts of the mountains that surround the survey Area. About 10 percent of the Area consists of these upland soils. They were included only if they fell within the boundaries that were needed to take in all of the alluvial fans and terraces. Most of the areas are at elevations of more than 5,500 feet, but a few outcrops of bedrock are lower, and a small area is in the basin just west of Table Butte.

Nearly all of these soils are shallow or very shallow over bedrock. They were not separated into series but were mapped together as a miscellaneous land type, Rough broken and stony land. They are used only for range.

7. *Rough broken and stony land association*

This association is characterized by shallow, stony, rocky soils and strong slopes. Little true soil overlies the bedrock. This part of the Area was not examined in detail, as it is of little agricultural value. It was mapped as a miscellaneous land type.

Many kinds of bedrock are present, and the soils that developed from them vary considerably. Lava flows of rhyolite, latite, andesite, and some basalt have been deposited over beds of interbedded sandstone, shale, and limestone. The reddish sedimentary rocks crop out in only a few places, principally along the southern edge of the survey Area between Newcastle and Enterprise. The alluvial materials on the alluvial fans and basin areas below vary according to the kind and amount of sediment washed from the different kinds of rocks in the uplands.

The vegetation is meager in most places and is of little value even for range. Sagebrush and galletagrass predominate on the more gently sloping, lower lying soils. Where the elevation is higher, the slopes are steeper, the soils are more shallow, and the vegetation consists mostly of juniper and pinyon pine.

These soils are of value chiefly for watersheds, wildlife cover, and recreation.

Use, Management, and Productivity of the Soils

There are three different systems of management that can be used on the soils of this Area. One is the management system necessary to irrigate the soils and crop them intensively. Another is the management system for rangeland. A third is the management system used in dryland farming. Most of the soils are suitable for range use; some of them are suitable for irrigation farming; very few are suitable for dryland farming.

The first part of this section explains how the soils are placed in capability classes, subclasses, and units, according to their suitability for various uses and their need for different kinds of management.

The second part of this section explains the management system for irrigated soils, assigns the soils suitable for this use to the capability units, and gives estimates of yields that can be expected.

The third part of this section explains the system of range management, assigns soils to range sites, and provides estimated yields for unirrigated rangeland.

The management of dryland farming is not discussed separately, because it is not common and generally has not been successful. Dryland farming is practical only in one small area near Enterprise, which receives almost half again as much precipitation as the rest of the alluvial fan parts of the Area.

Capability Groups of Soils

Capability grouping is a system of classification used to show the relative suitability of soils for the usual crops and, in a very general way, for grazing, forestry, or wildlife. It is a practical grouping based on the needs and limitations of the soils, their response to management, and the risks caused by climate. In this report the soils have been grouped at three levels above the soil mapping unit. They are the capability unit, the subclass, and the class.

The capability unit, which can also be called a management group of soils, is the lowest level at which soil mapping units are grouped for this purpose. A capability unit is made up of soils similar in management needs, in risk of damage, and in general suitability for use.

The next broader grouping, the subclass, is used to indicate the dominant kind of limitation. The letter symbol "e" means that the main limiting factor is risk of erosion if the plant cover is not maintained. The symbol "w" means that excess water retards plant growth or interferes with cultivation. The symbol "s" means that the root zone is limited by such factors as shallowness, stoniness, low moisture-holding capacity, unusually low fertility, and salinity or alkalinity. The symbol "c" means that extreme temperatures, lack of moisture, or other factors of climate are the only major limitation on use of the soils.

The broadest grouping, the class, is identified by Roman numerals. All of the soils in one class have limitations or hazards of about the same degree, but of different kinds, as shown by the subclass. Any class except class I may have one or more subclasses.

Without drastic modification of the effects of climate, all of the soils of the Beryl-Enterprise Area would be suitable only for range and would be in subclass VIIc. The dryness of the climate is customarily counteracted by irrigating the soils. Most of the soils in this Area have been assigned to class VII, which indicates suitability for range when the soils are not irrigated. Those that can be irrigated have been assigned also to capability units in classes II, III, and IV.

In classes I, II, and III are soils that are suitable for annual or periodic cultivation of annual or short-lived crops. In the Beryl-Enterprise Area, the soils in these classes are the only ones even fairly well suited to irrigation. They are suitable for crops only when they are irrigated.

Class I soils have few limitations that restrict their use. There are no class I soils in this survey Area, even under irrigation.

Class II soils can be cultivated regularly, but they have some slight limitations on choice of crops or they require moderate use of conservation practices. Some need moderate care to prevent erosion. Others may be droughty, somewhat limited in depth, or affected by excess salts or alkali or both. In this Area, class II soils are well suited or moderately well suited to irrigation.

Class III soils have severe limitations that reduce the choice of plants, or require special conservation practices, or both. The class III soils in this Area are only fairly well suited to irrigation.

Class IV soils have very severe limitations and must be very carefully managed. The class IV soils in this Area are poorly suited to irrigation.

In classes V, VI, and VII are soils that normally should not be cultivated for annual or short-lived crops but can be used for range, woodland, or wildlife shelter.

Class V soils are not likely to erode, but they have other severe limitations on their use. None of the soils in the Beryl-Enterprise Area are in class V.

Class VI soils have severe limitations that make them unsuitable for cultivation. They can be used for range or pasture, and this range or pasture can be improved by reasonable care in management. Although most of the Beryl-Enterprise Area is used only for range, the moisture supply is so limited that it is generally difficult to improve the range much by special management; therefore, none of the soils are in class VI.

Class VII soils have very severe limitations that prevent their use for cultivated crops. They can be used for range, but it is difficult to apply some of the range improvement practices. Most of the soils in the Beryl-Enterprise Area are in this class, except when they are irrigated.

In class VIII are soils and miscellaneous land types that have almost no agricultural use. Some of them have value for watersheds, recreation areas, and wildlife shelter. Some parts of this survey Area are in this class.

The classes, subclasses, and units recognized in the Beryl-Enterprise Area are as follows:

Class II.—Soils that, under irrigation, have some limitations that reduce the choice of plants or require moderate conservation practices.

- Subclass IIe.—Soils that are subject to erosion when irrigated and tilled.
  - Unit IIe-1.—Deep, medium textured to moderately fine textured, moderately permeable, very gently sloping soils, moderately well suited to irrigation.
- Subclass IIs.—Soils in which the root zone is somewhat limited.
  - Unit IIs-1.—Deep, moderately fine textured, moderately slowly permeable, nearly level to gently sloping soils, moderately well suited to irrigation.
  - Unit IIs-2.—Deep, moderately coarse textured, moderately rapidly permeable, nearly level to very gently sloping soils, moderately well suited to irrigation.
  - Unit IIs-3.—Deep, medium-textured, moderately permeable, nearly level soils, slightly affected by salts or alkali or both; moderately well suited to irrigation after minor reclamation.
  - Unit IIs-4.—Deep, moderately coarse textured to medium textured, moderately permeable, nearly level soils, slightly affected by salts or alkali or both; moderately well suited to irrigation.
- Subclass IIc.—Soils on which the hazards of climate are the major limitation.
  - Unit IIc-1.—Deep, medium-textured, moderately permeable, nearly level soils, well suited to irrigation.

Class III.—Soils that, under irrigation, have severe limitations that reduce the choice of plants, require special conservation practices, or both.

- Subclass IIIs.—Soils in which the root zone is severely limited.
  - Unit IIIs-1.—Deep, coarse textured to moderately coarse textured, very rapidly to rapidly permeable, nearly level to very gently sloping soils, fairly well suited to irrigation.
  - Unit IIIs-2.—Shallow to deep, moderately coarse textured to medium textured, moderately to slowly permeable, very gently sloping soils, fairly well suited to irrigation.
  - Unit IIIs-3.—Deep, medium textured to moderately fine textured, slowly permeable, nearly level soils, slightly affected by alkali; fairly well suited to irrigation.
  - Unit IIIs-4.—Deep, moderately coarse textured, moderately permeable, eroded, nearly level to hummocky soils, slightly affected by salts or alkali or both; fairly well suited to irrigation.

Class IV.—Soils that, under irrigation, have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVs.—Soils in which the root zone is very severely limited.

Unit IVs-1.—Moderately deep, gravelly, medium-textured, moderately permeable, very gently sloping to sloping soils, poorly suited to irrigation.

Unit IVs-2.—Predominantly shallow, moderately coarse textured, very slowly permeable, very gently sloping soils, poorly suited to irrigation.

Unit IVs-3.—Deep, medium-textured, slowly permeable, nearly level soils, moderately affected by alkali; poorly suited to irrigation.

Unit IVs-4.—Deep, moderately coarse textured to medium textured, moderately permeable, nearly level to hummocky and duny soils, strongly affected by salts or alkali or both; poorly suited to irrigation.

Class VII.—Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to range or wildlife shelter.

Class VIII.—Miscellaneous land types that have limitations that prevent their use for crops or range.

Management of Irrigated Soils

General management

Although each capability unit of soils differs somewhat from the others, certain principles of management apply to all of the soils that are irrigated. Some practices that must be considered whenever soils are used under irrigation are crop rotation, maintenance of organic matter, tillage, leveling, addition of plant nutrients in commercial fertilizer and other amendments, and erosion control. Irrigation practices and the control of salinity and alkalinity are also very important in this Area, and they are discussed in separate sections.

Crop rotation.—Rotation of crops is necessary to maintain yields and improve the fertility of the soil. If potatoes are alternated with barley, both crops will return greater yields than either crop grown continuously. Continued planting of row crops, such as potatoes, lowers the content of plant nutrients and organic matter in the soil, gradually breaks down the soil structure, and encourages plant diseases and insect pests. When small grains are planted continuously, the general effects are the same, but it is longer before they are evident.

Growing grasses and legumes has a good effect on the soil. Organic matter is supplied by the abundant and extensive root system, the structure of the soil is improved, and the supply of certain nutrients, particularly nitrogen, is increased. Growing grasses and legumes for one or more years is the best way to counteract the soil-depleting effects of growing row crops and small grains. The soil improvement brought about by the grasses and legumes results in higher yields of the row crops and small grains that follow.

The most common rotation used in this Area consists of 2 years of a row crop, 1 year of small grain, and 4 years of a legume. The most common row crop is potatoes, but small acreages of carrots, sugar beets, and corn for silage are grown. Barley is the principal small grain, but some rye, oats, and winter wheat are also grown. Small grains frequently serve as companion crops for alfalfa seedings.

Alfalfa is the most important legume. It is well to supplement alfalfa seedings with a grass, such as smooth brome or orchardgrass. This provides a better hay mixture, and the finer fibered and more extensive root system of the grasses improves the soil structure.

The general rotation described is not followed invariably in the Area. It provides considerable flexibility without greatly affecting the productivity of the soil. This is desirable, as potatoes are the most important row crop and the acreage planted fluctuates widely from year to year, according to the price and market.

Maintenance of organic matter.—Maintaining or increasing the organic-matter content is probably the most important soil management problem in this Area. The organic-matter content is uniformly low. Most of these soils contain 1 percent, or less. The most favorable soils contain no more than 2.5 percent.

Organic matter is chiefly responsible for the larger and more stable forms of soil structure. It also provides good permeability and aeration of the soil. Organic matter contains appreciable amounts of nitrogen and other essential plant nutrients, such as phosphorus and sulfur. It is a source of energy for the micro-organisms that inhabit the soil and aids these organisms in making many important nutrients available to plants.

Organic matter can be added to the soil by plowing under plant residues or green manure, adding barnyard manure, or growing mixtures of grass and legumes. Plant residues, except those of plants like greasewood and shadscale, which accumulate salt, and those that harbor diseases or insects, should be returned to the soil.

Barnyard manure is especially valuable for adding organic matter to the soil. On decomposition, each ton furnishes about 10 pounds of nitrogen, 5 pounds of phosphorus, and 10 pounds of potash. It also improves the soil structure. For the maximum benefit from manure, large quantities of bedding should be used to absorb all the urine. The manure should be kept moist but not exposed to leaching, and it should be plowed under as soon as possible after spreading.

Grasses have an abundant and finely fibrous root system, well distributed through the upper part of the soil. The slow decay of the roots helps to improve soil structure and to bind the soil particles against erosion.

If legumes are properly inoculated with nitrogen-fixing bacteria, considerable nitrogen from the air will be added to the soil. Alfalfa and sweetclover may provide several hundred pounds of nitrogen per acre when plowed under.

Plowing under green-manure crops, adding large amounts of manure, and incorporating crop residues are all required to raise the organic-matter content.

Tillage.—Proper tillage is necessary to prepare a good seedbed, destroy the weeds that compete with the crops for water and nutrients, improve the structure of the soil, and help control soil erosion. Tillage will loosen the surface layers, at least temporarily. Some farmers practice subsurface chiseling to loosen the lower layers of the soil, especially for potatoes.

The soils in this Area are dense because they contain little organic matter and are not well aggregated. If the soils contained more organic matter, the beneficial effects of tillage would be greater and longer lasting.

Tillage that leaves a coarse and cloddy surface, the use of subsurface sweeps, and a stubble mulch on the surface will help to control wind erosion, especially on the coarser textured calcareous soils of the basin.

Leveling.—Some leveling is necessary on almost all of these soils to fit them for irrigation. How well the job is done determines how easily irrigation water can be distributed quickly and evenly to a uniform depth. Some farmers do a better job than others, and the difference is reflected in stand uniformity and crop yields.

After the initial leveling of a field, some floating is required every year to eliminate high spots, fill low spots where water stands, and obtain a uniform crop response without wasting water at the end of the row. Ordinarily, a number of years are required to secure a good leveling job and a fast, efficient system of distributing water.

Addition of plant nutrients.—Adding commercial fertilizers is the usual means of correcting nutrient deficiencies. The soils in this Area are generally deficient in nitrogen. All crops except legumes benefit from its addition. Available phosphorus is needed, especially on the strongly calcareous soils and at high levels of production. Potatoes respond to both nitrogen and phosphorus. Small amounts of nitrogen and little or no phosphorus are used on small grains. Very little fertilizer is used on alfalfa, but on the strongly calcareous soils this crop might respond to the addition of phosphorus.

The potassium supply seems to be adequate in all of the soils. The only places where the addition of potassium might be beneficial are on heavily cropped, coarse-textured soils. The soils have no known deficiencies of sulfur, calcium, iron, magnesium, copper, zinc, molybdenum, boron, or manganese. The supplies of some of these elements may be depleted in time, especially under heavy cropping on the coarser textured soils.

Calcium and magnesium are especially abundant in most of the local soils. In some soils calcium carbonate (lime) is so abundant that it interferes with the absorption of iron by some crops. In fruit trees, this causes chlorosis.

The soils in this Area do not need a complete fertilizer; that is, one that provides nitrogen, phosphorus, and potassium. The principal materials used for fertilizer in this Area are ammonium sulfate and ammonium nitrate for nitrogen, ammonium phosphate for both nitrogen and phosphorus, and superphosphate or treble superphosphate for phosphorus alone. Only the most water-soluble forms of phosphorus should be used, because all of the soils of the Area are neutral to very strongly alkaline. Little, if any, benefit is obtained from raw rock phosphate.

The only other chemical amendment used in the Area is calcium sulfate (gypsum), applied mainly for the purpose of reclaiming soils that are affected by alkali. Lime is not used, and none is needed.

Erosion control.—Wind erosion is difficult to control in this Area, especially on the coarser textured soils. During previous unsuccessful attempts to dry-farm, many of the soils eroded severely, and some dunes formed. Most of this erosion occurred in the basin area on the strongly calcareous and coarser textured soils of very low organic matter content.

Under irrigation, wind erosion is a minor hazard to soils. Careful management is always required. Moistening the soils just before and immediately after cultivation keeps them from being dry and powdery, and soil blowing is greatly reduced. Plowing under crop residues, keeping the surface cloddy, and using subsurface tillage all reduce the hazard of wind erosion. Windbreaks and stripcropping at right angles to the wind direction can be used. Stubble or crop residue left on the surface offers some protection against wind. Cropping plans that keep the soil covered during the windy seasons are helpful in control of erosion.

Water erosion is a relatively minor problem, because only the more nearly level soils are cultivated. Irrigation causes gullying in some places. Some waterways that carry flash runoff after sudden heavy rainstorms also are gullied.

Capability units of irrigated soils

CAPABILITY UNIT IIe-1

These are well-drained, deep soils. They are similar to the soils in capability unit IIc-1, but their average slope is very slightly stronger. The texture is medium, and it is relatively uniform through the profile. Both of these soils are moderately permeable and have a deep root zone.

The soils in this unit are—

Genola loam, 0 to 2 percent slopes.
Redfield loam, 0 to 2 percent slopes.

These soils are moderately well suited to irrigation. They are moderately to highly productive. Potatoes, barley, and alfalfa are the principal crops.

Requirements for fertilization and leveling are much the same as for the soils of capability unit IIc-1. The same irrigation practices are suitable, except that, for unit IIe-1, more careful attention to the length and direction of irrigation runs is needed to control runoff and erosion. In areas that have not been leveled, following the natural contour is advisable. Where leveling has eliminated the differences in slopes, irrigation practices can be generally the same as for capability unit IIc-1. Controlling erosion is not difficult.

CAPABILITY UNIT IIs-1

The soils in this group are well drained and deep. The texture is moderately fine and is fairly uniform. The permeability is moderately slow. The slopes are nearly level to very gently sloping. The Zane soil is a little more strongly sloping than the Musinia and Tours soils, and it has slightly more clay in its subsoil. The soils of this capability unit are free of salts and alkali.

The soils are—

Musinia silty clay loam, 0 to 1 percent slopes.
Tours silty clay loam, 0 to 1 percent slopes.
Zane clay loam, 0 to 2 percent slopes.

These soils are moderately well suited to irrigation. The principal crops are potatoes, barley, and alfalfa, generally grown in rotation. The soils are moderately to highly productive. Because of their moderately fine texture, they are less well suited to potatoes than the soils of capability unit IIc-1.

The management requirements are similar to those of the soils of unit IIc-1. Smaller heads, longer runs, and larger quantities of water can be used in irrigating the soils of this unit, because they have a higher moisture-holding capacity. These soils are more resistant to wind and water erosion than the medium-textured soils of unit IIc-1.

CAPABILITY UNIT IIs-2

These soils are well drained and deep. They are nearly level to very gently sloping. They were derived from alluvial deposits; some are recent and some are older. The profiles are moderately coarse textured and relatively uniform. Permeability is moderately rapid.

The Crestline soil has slightly more clay in the subsoil than in the surface soil. The Heist soil lacks this increase of clay in the subsoil and is calcareous throughout; otherwise, it is similar to the Crestline soil. These soils are free of salts and alkali.

The soils in this unit are—

Crestline fine sandy loam, 0 to 3 percent slopes.
Heist fine sandy loam, 0 to 3 percent slopes.
Modena fine sandy loam, 0 to 3 percent slopes.
Modena silt loam, overwashed, 0 to 1 percent slopes.
Mosida fine sandy loam, 0 to 1 percent slopes.

These soils are moderately well suited to irrigation. Potatoes, barley, and alfalfa are the principal crops. Potatoes are especially well suited. These soils are less productive than the soils of capability unit IIc-1.

Alfalfa generally does not need fertilization, but barley responds to nitrogen fertilizer, and potatoes need phosphorus in addition to nitrogen. Leveling is not a serious problem. Deep cuts have little effect on productivity.

These soils have a lower moisture holding capacity than the soils of capability unit IIc-1. They can be irrigated with smaller quantities of water, applied in larger heads and shorter runs.

Near Enterprise, some Modena fine sandy loam, 0 to 3 percent slopes, is used in a rotation consisting of winter wheat and summer fallow. Yields vary according to the rainfall, but they are generally low.

Wind erosion is a severe hazard to these soils whenever they are cultivated. Careful management is needed to prevent soil blowing. Water erosion is not a hazard if reasonable care is used. Some gullying occurs on the more strongly sloping areas of Modena fine sandy loam, 0 to 3 percent slopes.

CAPABILITY UNIT IIs-3

The Beryl soils, the most important soils in this unit, are deep, nearly level, well drained, and slightly affected by salts and alkali in the lower subsoil. They occur in the basin area; the Genola soil occupies small areas on recent alluvial fans.

The soils of this capability unit are medium in texture, strongly calcareous throughout, and moderately permeable.

The soils in this unit are—

Beryl very fine sandy loam, 0 to 1 percent slopes.
Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes.
Genola loam, slightly alkali affected, 0 to 1 percent slopes.

These soils are well suited to irrigation if minor reclamation practices are applied. The Beryl soils need deep leaching to remove the slight amounts of salts and alkali in the subsoil. After the initial reclamation, little more than periodic deep leaching is needed to keep the Beryl soils in good condition, because the gypsum naturally present in the profile aids in correcting the alkali condition. The Genola soil is slightly affected by alkali, principally under the greasewood plants. It can readily be reclaimed by deep leaching if enough irrigation water can be obtained.

The crops and management are the same for the soils of this unit as for those of unit IIc-1. Yields are less before the salts and alkali have been leached from the soils, but they are about the same afterward. Because of the coarser texture of the Beryl soils, larger amounts of fertilizer will probably be necessary to maintain the same yields. More phosphorus is needed on legumes because the soils are strongly calcareous.

Not much leveling is required, but it should be done carefully because the Beryl soils blow very readily.

CAPABILITY UNIT IIs-4

Except for the Heist soil, the soils in this unit have a weakly cemented caliche-like subsoil that is slightly affected by salts and alkali. The soils are otherwise deep, nearly level, and well drained. They are moderately coarse to medium in texture. Permeability is moderate. The soils are strongly calcareous, and they contain gypsum. The organic-matter content is low.

The soils in this unit are—

Escalante very fine sandy loam, 0 to 1 percent slopes.
Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes.
Escalante fine sandy loam, 0 to 1 percent slopes.
Escalante fine sandy loam, overwashed, 0 to 1 percent slopes.
Escalante silt loam, overwashed, 0 to 1 percent slopes.
Escalante-Heist fine sandy loams, 0 to 1 percent slopes.

These soils are moderately well suited to irrigation, and considerable areas near Garyville are pump irrigated. Alfalfa and barley are the principal crops, and potatoes are included in the rotation in some places. Alfalfa generally is not fertilized, but it would probably respond to phosphorus, because the soil is strongly calcareous. Potatoes respond to both nitrogen and phosphorus, and barley responds to nitrogen.

When these soils are irrigated, the caliche-like subsoil readily softens. Deep leaching is enough to reclaim the soil, and the natural content of gypsum is enough that little or no additional gypsum is necessary.

Management practices, especially leveling, should be done with care, because these strongly calcareous soils are easily eroded by wind.

CAPABILITY UNIT IIc-1

The soils in this unit are well drained, deep, and nearly level. The texture is medium, and the profiles are generally uniform. The soils are moderately permeable. They are free of salts and alkali.

The soils in this unit are—

Redfield silt loam, 0 to 1 percent slopes.
Red Rock silt loam, 0 to 1 percent slopes.
Tomas silt loam, 0 to 1 percent slopes.

Extensive areas of these soils, principally near Enterprise and Newcastle, are under surface diversion and pump irrigation.

These soils are well suited to irrigation. They are moderately to highly productive. Potatoes, barley, and alfalfa are the principal crops, and they are usually grown in rotation. Potatoes generally respond to nitrogen and phosphorus. Barley responds to nitrogen. Alfalfa generally grows well without supplemental fertilization.

Leveling is a rather minor problem. Deep cuts can be made, where necessary, with little effect on productivity. Under reasonably careful management, the water erosion problem is minor. Wind erosion, which is a hazard principally during planting time in spring, can be controlled readily.

CAPABILITY UNIT IIIs-1

These deep, nearly level to very gently sloping soils are well drained to somewhat excessively drained. The Berent soil is coarse textured and very rapidly permeable. The Crestline soil is moderately coarse textured in the upper horizons and is gravelly and very rapidly permeable at a moderate depth. The water-holding capacity of the soils in this unit is low.

The soils in this unit are—

Berent loamy fine sand, 0 to 2 percent slopes.
Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes.

These soils are fairly well suited to irrigation, but they are used mostly for range. Near Enterprise, some areas of Berent loamy fine sand, 0 to 2 percent slopes, are irrigated along with better soils in the Mosida and Red Rock series.

Alfalfa, barley, and potatoes are the principal crops; they are generally grown in rotation. The natural fertility of the soils is low. Potatoes respond to nitrogen and phosphorus; barley responds to nitrogen. Alfalfa generally is not fertilized. Under continuous sustained production, potatoes might also respond to potassium, and barley and alfalfa might respond to phosphorus.

Crops on these soils require a great deal of water. The water-holding capacity of the soils is low. Frequent but light irrigations, using short runs and large heads, are advisable. Under cultivation, the control of wind erosion is a major problem. Deep cuts can be made during leveling, with little permanent effect on the productivity of these soils.

CAPABILITY UNIT IIIs-2

These well-drained soils range from shallow to deep. They are on very gently sloping old alluvial fans. Their texture ranges from moderately coarse to medium, but there are moderate to strong concentrations of clay in the upper subsoil. Gravel and a few stones are present in some of these soils, but coarse fragments are not a special problem.

Strong concentrations of lime are present in the lower subsoil at shallow to moderate depth. This lime is in most places weakly to strongly cemented into a caliche hardpan. The soils are moderately to slowly permeable.

The soils in this unit are—

Dixie loam, 0 to 2 percent slopes.
Dixie gravelly loam, 0 to 3 percent slopes.
Sevy sandy clay loam, 0 to 2 percent slopes.
Timpahute sandy loam, 0 to 2 percent slopes.
Timpahute gravelly sandy loam, 0 to 3 percent slopes.

These soils are fairly well suited to irrigation. Their relatively shallow depth to hardened caliche limits depth of rooting and the moisture-holding capacity. The caliche subsoils do not soften readily under irrigation, except in the Sevy soil.

Most irrigated areas are on the lower margins of the older alluvial fans, near areas of other more productive irrigated soils. Irrigation water is pumped, and the water table is generally less than 100 feet below the surface.

Barley and alfalfa are the principal crops. Potatoes are grown in some places. Yields are fair. Barley generally requires nitrogen, and potatoes need both nitrogen and phosphorus. Alfalfa is not fertilized.

The hazard of erosion by water is moderate, especially if the soils are poorly managed. If they are leveled for irrigation, only shallow cuts are advisable, because the hardened caliche in the lower subsoil restricts the depth available for plant roots.

CAPABILITY UNIT IIIs-3

These are deep, nearly level, well-drained soils. The medium texture and moderately fine texture of the profile are relatively uniform. The soils are slightly affected by alkali, chiefly in the subsoil. The profile contains little or no gypsum. The soils are slowly permeable.

The soils in this unit are—

Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes.
Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes.
Bullion silty clay loam, 0 to 1 percent slopes.

The soils in this unit are fairly well suited to irrigation. Pump irrigation is used, mostly on marginal areas near Garyville. The principal crops are alfalfa and barley. The alfalfa is not fertilized, and it is doubtful that fertilizer would produce a response. Barley responds to nitrogen. Potatoes are only fairly well suited to these soils, and they need both nitrogen and phosphorus.

These soils are slightly affected by alkali in the subsoil, but they do not contain excess concentrations of salts. Additions of manure, deep leaching, and light treatments with gypsum would probably improve these soils considerably. The improvement would be slow and gradual because the permeability is slow and water infiltrates slowly.

The hazard of erosion is slight, and the soils can readily be managed if reasonable care is used. Most of the soils are more strongly affected by alkali in the lower part. Deep cuts can be made for leveling without changing the texture of the surface, but more gypsum will be required if the subsoil material affected by alkali is brought nearer the surface.

CAPABILITY UNIT IIIs-4

These soils are deep and well drained. They are nearly level, except that low hummocks of soil material have accumulated at the base of the shrubs in some places. The subsoil is a somewhat hardened caliche layer. In some areas the surface soil has been removed down to the hardened subsoil. These soils are moderately permeable. They are slightly affected by salts and alkali.

The soils in this unit are—

Escalante fine sandy loam, hummocky, 0 to 1 percent slopes.
Escalante fine sandy loam, eroded, 0 to 1 percent slopes.

These soils are fairly well suited to irrigation, but only a few areas near Garyville are under pump irrigation. Alfalfa and barley are the principal crops. Alfalfa generally is not fertilized, but it would probably respond to phosphorus, especially on the eroded places. Barley responds to nitrogen, particularly where the soil is eroded.

The hazard of wind erosion is severe, except where the hardened subsoil is already at the surface. In the hummocky areas, considerable drifting occurs whenever the soil is disturbed. The uneven surface makes leveling a problem. Careful management is needed to control soil blowing during and after leveling.

CAPABILITY UNIT IVs–1

This unit contains only one soil, Newcastle gravelly loam, 2 to 7 percent slopes. It is well drained, moderately deep, and gently sloping to sloping. The profile is gravelly and medium textured, but it is only moderately deep over material that becomes more gravelly and stony with depth. It is moderately permeable. This soil occurs on high recent alluvial fans or in drainageways in and near the mountains.

This soil is poorly suited to irrigation. The gravel content and the moderate depth to gravel and stones greatly reduce the moisture-holding capacity and the fertility. The high elevation, the slope, and the extremely high pumping lift are also unfavorable for pump irrigation. Little water is available for surface diversion.

A few small areas above Enterprise have been used for dryland wheat. Yields are low and variable because of the erratic rainfall.

A few areas that lie at lower elevations and next to more productive soils have limited possibilities for barley, alfalfa, and improved legume-grass pasture. Barley would benefit from fertilization with nitrogen, and pasture, from both nitrogen and phosphorus. Yields likely will be low, even if fertilizer is applied.

The hazard of erosion by water is moderate. If the soil is cultivated, care should be taken to control erosion.

If this soil is leveled for irrigation, only shallow cuts are advisable because the gravelly and stony substratum is so near the surface. Deep cuts are likely to expose materials that are not suitable for agricultural use.

CAPABILITY UNIT IVs–2

The Neola soils in this unit are shallow, well drained, and very gently sloping. They are strongly calcareous. The subsoils contain a very slowly permeable, strongly cemented caliche hardpan. Textures are moderately coarse.

The Sevy soil in this unit is deeper than the Neola soils, and its surface soil is noncalcareous. Its use is limited, however, by the characteristics of the complexly associated Neola soils.

The soils in this unit are—

- Neola sandy loam, 0 to 3 percent slopes.
- Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes.

These soils are poorly suited to irrigation. The shallowness over the caliche subsoil, the low content of organic matter, and the moderately coarse texture combine to limit the water-holding capacity and the fertility. Yields are moderately low. The caliche does not soften appreciably when the soils are irrigated.

A few areas on the lower margins of old alluvial fans and other areas among more productive soils are pump irrigated. Potatoes, barley, and alfalfa are the principal crops. Nitrogen and phosphorus are required for potatoes, and nitrogen for barley. Alfalfa generally is not fertilized, but it probably would respond to phosphorus, because the natural phosphorus may be unavailable in these strongly calcareous soils.

If these soils are not carefully managed, the hazard of water erosion is moderate and the hazard of wind erosion is severe. In leveling, cuts should be shallow because the hardened caliche is fairly close to the surface.

CAPABILITY UNIT IVs–3

The soils in this capability unit are similar to those in capability unit IIIs–3, except that they contain more alkali. They are deep, nearly level, medium textured, and slowly permeable.

The soils in this unit are—

- Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes.
- Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes.

These soils are poorly suited to irrigation. Small areas are pump irrigated, most of them along with better soils next to them. Alfalfa is the most suitable crop, and barley is less suitable. Potatoes are poorly suited. The soils are moderately affected by alkali, and this restricts plant growth. Barley needs nitrogen, and potatoes need both nitrogen and phosphorus, but the response to fertilizer is poor. Alfalfa is generally not fertilized.

These soils contain little or no salts, but they are moderately affected by alkali. The addition of considerable manure and gypsum and periodic deep leaching will be required to improve the soils. Improvement will be gradual because of slow infiltration and slow permeability.

Erosion is only a slight hazard and can be managed with reasonable care. Deep cuts generally are not required for leveling; they would not be advisable because the concentration of alkali increases with depth. The texture of the soils is not changed if deep cuts are made in leveling them.

CAPABILITY UNIT IVs–4

These soils are deep and well drained, but they are strongly affected by salts and alkali. Most areas are nearly level, except where wind action has eroded the surface soil and piled up hummocks and dunes. Textures are moderately coarse to medium. The soils are moderately permeable.

The soils in this unit are—

- Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes.
- Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes.
- Beryl soils-Dune land association.

These soils are poorly suited to irrigation. They are cultivated to barley and alfalfa in a few places. Yields are low and variable.

Periodic deep leaching would probably reduce the salt content enough that salt-tolerant crops could be grown. These soils already contain considerable gypsum, and adding gypsum in some places, plus applying manure and deep leaching, would probably correct the alkali condition of these soils in time.

The hazard of erosion is severe, and cultivation should be done very carefully. Most of the hummocks and dunes are the result of previous futile attempts to use these soils for dryfarming. Leveling cuts can be made readily without greatly altering the condition of these relatively uniform soils.

Yields on irrigated soils

The yield estimates in this report are based on observations made by the soil scientists who surveyed the Area, on information furnished by farmers in the Area and by the agricultural extension agent of Iron County, and on United States census data. If no information could be obtained for a particular soil, estimates were made on the basis of information pertaining to similar soils.

Table 2 gives the yields of the principal crops of the Area on irrigated soils under two levels of management. These yields, under both levels of management, are based on a generalized rotation consisting of 2 years of a row crop, 1 year of small grain, and 4 years of a legume. Potatoes are the principal row crop, barley the principal small grain, and alfalfa the principal legume. This basic rotation, or some variation of it, is followed in most of the Area.

The decision to grow potatoes depends on market conditions, and some other row crop may be substituted for potatoes. Sometimes a second crop of barley is grown as a companion crop for the new alfalfa seeding.

Alfalfa, which does well in this Area, is sometimes kept as long as it remains vigorous and productive. None of these variations in the basic rotation change the yield estimates much, as long as the other specified management practices are used.

TABLE 2.—*Average acre yields of principal crops on irrigated soils*

Yields in columns A are those to be expected over a period of years under prevailing management; those in columns B are those to be expected over a period of years under good management. Where no yield figure is given, the soil is generally considered unsuitable for that crop. See text for requirements for A and B management levels]

Map symbol	Mapping unit	Alfalfa A	Alfalfa B	Barley A	Barley B	Potatoes A	Potatoes B	Irrigated pasture
		Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days*[1]
Aa	Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes	3. 0	4. 0	35	55	100	100	125
Am	Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes	1. 5	2. 5	25	40	50	100	100
Ao	Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes	3. 5	4. 5	45	65	125	225	175
Ar	Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes	2. 0	3. 0	30	45	75	125	125
Be	Berent loamy fine sand, 0 to 2 percent slopes	1. 5	2. 5	25	40	100	200	175
Bf	Beryl very fine sandy loam, 0 to 1 percent slopes	3. 5	4. 5	35	55	150	275	175
Bo	Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes	4. 0	5. 0	45	65	175	300	200
Br	Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes	1. 0	2. 0	10	20	---	---	---
Bs	Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes	---	---	---	---	---	---	---
Bt	Beryl soils-Dune land association	---	---	---	---	---	---	---
Bu	Bullion silty clay loam, 0 to 1 percent slopes	2. 5	3. 5	30	45	75	150	125
Ce	Crestline fine sandy loam, 0 to 3 percent slopes	2. 5	3. 5	30	45	200	325	200
Cg	Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes	1. 5	2. 5	15	25	75	150	100
Da	Dixie loam, 0 to 2 percent slopes	1. 5	2. 5	20	35	75	150	150
Dg	Dixie gravelly loam, 0 to 3 percent slopes	---	---	---	---	---	---	---
Dk	Dixie stony loam, 2 to 5 percent slopes	---	---	---	---	---	---	---
Dt	Dixie very stony loam, 2 to 7 percent slopes	---	---	---	---	---	---	---
Du	Dune land	---	---	---	---	---	---	---
Ec	Escalante fine sandy loam, 0 to 1 percent slopes	3. 0	4. 0	25	45	125	250	150
Ee	Escalante fine sandy loam, eroded, 0 to 1 percent slopes	1. 5	3. 0	20	40	100	175	100
Eh	Escalante fine sandy loam, hummocky, 0 to 1 percent slopes	---	---	---	---	---	---	---
Eo	Escalante fine sandy loam, overwashed, 0 to 1 percent slopes	2. 5	4. 0	30	50	150	275	175
Er	Escalante very fine sandy loam, 0 to 1 percent slopes	3. 0	4. 0	30	50	150	275	175
Es	Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes	3. 5	4. 5	40	60	175	300	200
Et	Escalante silt loam, overwashed, 0 to 1 percent slopes	2. 0	3. 5	25	45	125	250	150
Ey	Escalante-Heist fine sandy loams, 0 to 1 percent slopes	3. 0	4. 0	25	45	125	250	150
Ge	Genola loam, 0 to 2 percent slopes	4. 0	5. 0	60	80	225	375	225
Gs	Genola loam, slightly alkali affected, 0 to 1 percent slopes	---	---	---	---	---	---	---
Hf	Heist fine sandy loam, 0 to 3 percent slopes	2. 5	3. 5	25	45	125	250	125
Mf	Modena fine sandy loam, 0 to 3 percent slopes	3. 0	4. 0	45	65	175	275	175
Mo	Modena silt loam, overwashed, 0 to 1 percent slopes	4. 0	5. 0	55	75	225	325	200
Ms	Mosida fine sandy loam, 0 to 1 percent slopes	4. 0	5. 0	50	70	225	350	225
Mt	Musinia silty clay loam, 0 to 1 percent slopes	4. 5	6. 0	70	90	225	350	250
Na	Navajo silty clay, moderately alkali affected, 0 to 1 percent slopes	---	---	---	---	---	---	---
Ne	Neola sandy loam, 0 to 3 percent slopes	1. 5	2. 5	15	25	75	150	100
Nh	Neola sandy loam, hummocky, 0 to 5 percent slopes	---	---	---	---	---	---	---

See footnote at end of table, p. 18.

TABLE 2.—*Average acre yields of principal crops on irrigated soils*—Continued

Map symbol	Mapping unit	Alfalfa		Barley		Potatoes		Irrigated pasture
		A	B	A	B	A	B	
		Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days*[1]
Nk	Neola stony sandy loam, 2 to 7 percent slopes							
Nm	Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes	2. 0	3. 0	25	40	100	200	150
Nr	Newcastle gravelly loam, 2 to 7 percent slopes							
Ny	Newcastle stony loam, 2 to 12 percent slopes							
Py	Playas							
Re	Redfield loam, 0 to 2 percent slopes	4. 0	5. 0	55	75	200	300	200
Rf	Redfield silt loam, 0 to 1 percent slopes	4. 0	5. 0	60	80	225	325	225
Rk	Red Rock silt loam, 0 to 1 percent slopes	4. 5	6. 0	70	90	250	400	250
Rw	Riverwash							
Ry	Rough broken and stony land							
Se	Sevy sandy clay loam, 0 to 2 percent slopes	2. 5	3. 5	35	55	125	225	175
Ta	Terrace escarpments							
Te	Timpahute sandy loam, 0 to 2 percent slopes	1. 5	2. 5	20	35	75	150	150
Tg	Timpahute gravelly sandy loam, 0 to 3 percent slopes							
Ts	Timpahute stony sandy loam, 2 to 5 percent slopes							
Tv	Timpahute very stony sandy loam, 2 to 7 percent slopes							
Pc	Tomas silt loam, 0 to 1 percent slopes	3. 5	4. 5	50	70	175	275	200
Ty	Tours silty clay loam, 0 to 1 percent slopes	3. 5	4. 5	50	70	150	250	225
Ua	Uvada loam, 0 to 2 percent slopes							
Ud	Uvada silt loam, 0 to 1 percent slopes							
Uo	Uvada silt loam, overwashed, 0 to 1 percent slopes							
Us	Uvada and Antelope Springs soils, 0 to 1 percent slopes							
Ut	Uvada and Antelope Springs soils, hummocky, 0 to 1 percent slopes							
Uv	Uvada, Antelope Springs, and Crestline soils, 0 to 1 percent slopes							
Ux	Uvada, Antelope Springs, and Heist soils, 0 to 1 percent slopes							
Uw	Uvada soils-Dune land association							
Za	Zane clay loam, 0 to 2 percent slopes	4. 0	5. 0	60	80	200	350	225

[1] Cow-acre-days is the number of days 1 acre will graze 1 cow, 1 steer, or 7 sheep without injury to the pasture.

Yields under the management most common in the Area are given in the columns headed A. Under common management, each acre of potatoes generally receives 32 pounds of nitrogen, 40 pounds of phosphate (P_2O_5), and 4.5 acre-feet of water per year. Barley receives 3 acre-feet of water per year, but no fertilizer. Alfalfa receives 4.5 acre-feet of water per year and no fertilizer.

A few farmers use more fertilizer, and the yields likely from this more intensive management are given in the columns headed B. Under this better management, each acre of potatoes generally receives 80 pounds of nitrogen, 40 pounds of phosphate, and 4.5 acre-feet of water per year. Barley receives 32 pounds of nitrogen per acre and 3 acre-feet of water each year. Alfalfa receives 4.5 acre-feet of water per year and no fertilizer. Ordinary barnyard manure can be substituted for commercial fertilizer at the rate of 10 pounds of nitrogen and 5 pounds of phosphate per ton.

Only one level of management is considered in estimating the productivity of irrigated pasture. At this level of management, a suitable mixture of grasses and legumes has been established, neither fertilizer nor lime has been added, and the pasture has not been overgrazed.

Range Management[3]

About 92.5 percent of the Beryl-Enterprise Area is in range. Many of the soils cannot be used for cultivated crops, but if grazing is properly managed they can produce forage for livestock year after year. High production of forage and most efficient use of soil and water are accomplished primarily by improvement of the vegetation. This is done by managing grazing to encourage and increase the best forage plants.

Principles of range management

The basic unit on which management and treatment of the range is determined is the range site. A range site is an area of range uniform enough in climate, soil, and topography to result in a particular climax vegetation. Climax vegetation is the combination of plants that grew on the site before the range was affected by grazing or cultivation. Generally, the climax vegetation is the most productive combination of range plants that a site can produce. If grazing is not too severe, the proportions of different plant species remain about the same. If grazing is too severe, the more palatable species (decreasers) are eliminated and their places are taken by less palatable species that were part of the original vegetation (increasers) or by other species that were not part of the climax vegetation but can now find room to grow (invaders).

Estimating range condition.—Range condition is determined by comparing the kind and amount of present vegetation with the climax vegetation for that range site. When 76 to 100 percent of the growing plants are those in the original climax vegetation, the range is in excellent condition. When 51 to 75 percent of the vegetation represents the climax vegetation, the range is in good

[3] Prepared by LAMAR R. MASON AND MARVIN E. OLSEN, with the assistance of WALDO FRANDSEN AND T. B. HUTCHINGS.

condition. When only 26 to 50 percent represents the climax vegetation, range condition is fair. A range in poor condition has 25 percent or less of the climax vegetation remaining. Ranges in good, fair, or poor condition contain fewer decreaser and more increaser and invader plants than were present in the climax vegetation on that site.

Livestock graze selectively, constantly seeking out the more palatable and nutritious plants. If grazing use is not carefully regulated, the better plants eventually are eliminated. It is important to know the key forage species that should be present on each range site when it is in good or excellent condition. Controlled grazing of these key species is basic to good range management. If too much top growth is removed, the condition of the range declines.

Ranchers who are cooperating with a soil conservation district can get assistance from range technicians to identify range sites and to determine range conditions on their ranches, and to help work out methods of grazing management to improve the range.

Control of grazing.—Experience has shown that when not more than half of the yearly volume of key forage plants are grazed, these better forage plants are able to maintain their growth and vigor. On slopes of 40 percent or less, the important species of range plants need about 50 percent of each year's growth of leaves to maintain themselves and produce maximum amounts of forage. On slopes of more than 40 percent, the proportion of top growth left should be increased 15 percent for each 10 percent of increase in slope. Areas having slopes of more than 70 percent are generally too steep to be grazed.

The forage that is left on the range has the following values—

1. It serves as a mulch that favors the intake and storage of water. As more water is held and stored in the soil, forage growth is improved.
2. A good top growth allows good root growth, and these roots can reach the deeper moisture.
3. Plant growth left on the surface covers the soil and protects it from erosion by wind or by water.
4. When the better forage grasses are allowed to retain their vigor, they can crowd out the inferior vegetation and improve the general condition of the range.
5. The top growth that remains enables plants to manufacture and store food for quick and vigorous growth after droughts and in the spring. This allows grazing earlier in spring.
6. Vegetation on the surface catches and holds snow where it falls, so that it soaks into the soil when it melts. Snow that is blown into drifts melts in fence rows and other places where it is of little benefit.
7. The forage saved on the range provides a feed reserve for dry periods that might otherwise force the sale of livestock at unfavorable prices.

Enough top growth must be left to produce seed stalks, and 20 to 30 percent of those stalks should remain to provide seed. Otherwise, the range cannot reseed itself naturally.

Rotation-deferred grazing.—Sound range management requires that the intensity of grazing use be adjusted according to the forage production from one season to another. The efficiency of range use can be increased 30 to 40 percent if a system of rotation-deferred grazing is followed. Under this plan of range management, the livestock graze on several different parts of the range for short periods. Generally, under this system, no area is grazed more than half of any growing season or at the same time in successive years. Not more than 50 to 60 percent of the growth should be grazed in any year for most rapid improvement or maintenance of the range.

Rotation-deferred grazing meets the growth requirements of the choice forage plants by resting the range at intervals during their growing season. This encourages their increase in the stand. Intervals can be arranged to allow a good seed crop of the preferred forage plants. After the seed is mature and the plants approach dormancy, the range can be grazed. Livestock scatter the ripened seed and trample it into the soil. Not more than 50 percent of the growth should be grazed in any year.

The growth period for the cool-season plants begins about March 15 and continues until June 15, when the plants become dormant for the hot summer period. When rains fall late in summer, these plants become green again and grow through the early part of fall. The warm-season plants, such as galletagrass, start growth about May 15 and continue until October 1, unless the summer is very dry. Most summers in this Area have enough rain for fair to good growth of these warm-season plants.

Before turning livestock onto the range in the spring, it is advisable to wait until the soil is dry and firm enough underfoot that the forage plants will not be damaged and the soil puddled by trampling. The new growth of grass should be about 4 to 7 inches high, depending on the species, before livestock are allowed to graze it.

A range that is closely grazed early in spring should be deferred at least the last half of the growing season in order to recover. A late-season recovery period permits seedlings and young plants to survive and develop.

If sheep graze throughout the winter and into the spring, special care should be used. Grazing a range during the early period of plant growth year after year does severe damage to the high-yielding forage plants. A system of rotation-deferred grazing that rests ⅓ to ⅔ of the winter range during the early growth period every year will aid the good forage plants to regain their health and vigor. This can be done by careful herding.

Winter range for cattle should be fenced into three or more pastures to protect part of the range area from grazing during the early period of plant growth. This improves the range and increases the forage yield.

Resting winter range through the spring and summer growing season allows the deferred range site to develop very good forage for the following winter. Range that is grazed during the critical periods late in spring or early in summer can be deferred throughout the entire growing season the following year.

An adequate supply of winter feed and an extra month's supply of reserve feed usually make it possible to wait until the range is ready to graze in the spring. Reserve pastures or other feed reserves are needed during droughts or other periods when forage production is low. In addition, it is often desirable to carry some readily salable animals, such as stocker steers. This allows the rancher to adjust the number of livestock to the available feed without sacrificing breeding animals.

For assistance in planning and applying rotation-deferred systems of grazing that will fit your particular ranch operation, range sites, and class of livestock, see your local soil conservation district representative.

Distribution of grazing.—To get better distribution of livestock on the range and uniform use of forage, the following practices are helpful.

Adequate and dependable supplies of water for stock should be located in each pasture. Many ranchers find it practical to haul water to tanks for stock. These water tanks can be moved when necessary to get better distribution of grazing. Moving the water tanks allows the trampled areas around the watering places to recover and produce forage again.

Placing salt at a distance from the watering places causes livestock, especially cattle, to scatter out better over the range. The salt can be moved at intervals into places where more grazing of the forage is desired.

Proper fencing prevents trespassing by livestock and controls their use of range forage. Fences to divide the range are necessary for a system of rotation-deferred grazing for cattle. Sheep can be controlled without fences by herding and the bedding-out system. Stock should be moved to different parts of the range as soon as the safe amount of grazing has been reached on the important forage plants.

Range seeding.—Range seeding is practical only on sites that have 10 inches or more of precipitation per year and where the stand of vegetation can be maintained by the expected management after it is established. Some sites, due to soil limitations or lack of moisture, cannot be successfully reseeded.

Range seeding is a method of increasing the forage resources of the range quickly. A good stand of planted grass can increase the carrying capacity of the range several times. Reseeding is especially needed on range sites where the vegetation is so depleted that it cannot recover within a reasonable time through management only. Some range sites can be plowed and reseeded to suitable grasses and browse plants to improve the forage value of the vegetation. Suitable species of native grasses, legumes, browse plants, or crested wheatgrass should be planted. Usually a combination of plants that have somewhat different habits and requirements will grow better than any one plant would grow alone. Reseeding to one grass and one browse or legume increases the opportunity for good range management.

After brush has been eliminated, the area should be plowed in June or July and settled over the summer. In the autumn, between September 1 and the first snowfall, the seed can be broadcast or drilled. Seeding is most effective when a favorable season of precipitation follows to help establish the stand. Soil blowing must be controlled to prevent destruction of seedlings as they emerge. The range should be protected from grazing long enough after reseeding to allow the new grass to establish itself, and then it should be managed carefully to maintain the stand.

Control of brush and weeds.—Removal of undesirable brush and weeds often speeds the improvement of those range sites that can be seeded successfully. Where such species as big sagebrush, yellowbrush, big rabbitbrush, broom snakeweed, tumbling Russian-thistle, and cheatgrass brome dominate, these undesirable plants should be controlled before the site is seeded. This should be done by plowing. The chances for establishing a good stand can be improved by summer fallowing the area for 1 or 2 years. Controlled burning of big sagebrush, followed by seeding, is sometimes successful.

On sites where the more valuable forage plants are still fairly abundant, control of big sagebrush, yellowbrush, big rabbitbrush, or broom snakeweed, followed by 2 or more years of grazing deferment, will improve the range. These species can be controlled by chemical spray, rotobeating, or railing. Railing is the least desirable method because the rate of kill is poor.

Range sites

The production of usable forage on each of the range sites varies each year. It depends on climatic variations, particularly variations in precipitation. In a drought year, yields on all sites are drastically reduced. Consequently, average forage production figures are not a reliable basis for stocking the range. Livestock men find that stocking on the basis of the current year's production is the safest policy.

Tables 3 through 10 give estimated yields for each of the range sites in the Area, in favorable and unfavorable years. Favorable years are those in which the precipitation is at or near the maximum and other growing conditions are favorable; in such years forage production will be near the maximum possible for the site in its present range condition. Unfavorable years are those in which precipitation is at or near the minimum and other growing conditions are unfavorable; in such years forage production will be near the minimum for the site in its present range condition.

After comparing current production with the extremes for the range site, stockmen will know what adjustments in stocking are needed to make proper use of the range. By adjusting the use of the range they can improve its condition and in time bring it to its maximum potential productivity.

Tables 3 through 10 also give suggestions for reseeding the range sites. Estimated yields on a successfully reseeded and well-managed range approximate the yields of the climax vegetation when the site is in good to excellent condition. The reader should understand that data from controlled experiments are insufficient to give quantitative predictions of forage yields after reseeding at this time.

SEMIDESERT LOAM RANGE SITE

These soils are deep and well drained. Their texture is medium to moderately fine, and it is relatively uniform. The available water holding capacity is moderate to high. A weak surface crust restricts infiltration of moisture in some places. The internal movement of water is medium to moderately slow. Where there is vegetation, the erosion hazard is slight. Localized erosion may result where runoff accumulates from flash storms or, occasionally, from rapid melting of snow if the plant cover is depleted.

These soils occur on nearly level to very gently sloping recent and slightly older alluvial fans and flood plains at elevations of 5,200 to 5,500 feet.

The soils in this range site are—

Genola loam, 0 to 2 percent slopes.
Genola loam, slightly alkali affected, 0 to 1 percent slopes.
Musinia silty clay loam, 0 to 1 percent slopes.
Redfield loam, 0 to 2 percent slopes.
Redfield silt loam, 0 to 1 percent slopes.
Red Rock silt loam, 0 to 1 percent slopes.
Tomas silt loam, 0 to 1 percent slopes.
Tours silty clay loam, 0 to 1 percent slopes.
Zane clay loam, 0 to 2 percent slopes.

The climax vegetation on this range site is 50 to 60 percent decreaser grasses, such as needle-and-thread (*Stipa comata*), bottlebrush squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*). It is usually no more than 25 percent decreaser browse plants, such as common winterfat (*Eurotia lanata*). Increaser grasses, such as western wheatgrass (*Agropyron smithii*), Sandberg bluegrass (*Poa secunda*), galletagrass (*Hilaria jamesii*), and blue grama (*Bouteloua gracilis*), comprise 15 to 20 percent of the climax vegetation; and the increaser forbs—scarlet globemallow (*Sphaeralcea coccinea*), buckwheat (*Eriogonum* spp.), phlox (*Phlox* spp.), wild onion (*Allium* spp.), foothill deathcamas (*Zygadenus paniculatus*), loco (*Astragalus* spp.), and painted-cup (*Castilleja* spp.)—total not more than 5 to 10 percent. Big sagebrush (*Artemisia tridentata*), and shadscale saltbush (*Atriplex confertifolia*), also increasers, make up 5 to 15 percent of the cover.

Common invaders are rubber rabbitbrush (*Chrysothamnus nauseosus*), tumbling Russian-thistle (*Salsola kalitenuifolia*), cheatgrass brome (*Bromus tectorum*), yellowbrush (*Chrysothamnus stenophyllis*), broom snakeweed (*Gutierrezia sarothrae*), pricklypear (*Opuntia* spp.), and annual weeds.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 3 gives estimated yields and management suggestions for this range site.

SEMIDESERT SANDY LOAM RANGE SITE

The soils in this range site are deep and well drained. The texture is moderately coarse and relatively uniform, though in some places the clay content of the subsoil is slightly greater. In some places the subsoil contains a little more lime than the surface soil. The available water holding capacity is moderate. In some places a very thin surface crust somewhat restricts infiltration of moisture. The internal movement of moisture is moderately rapid to medium.

The erosion hazard is slight if a cover of vegetation is maintained. Severe wind erosion may occur when the cover is depleted and the surface is exposed.

These are nearly level to gently undulating soils on the lower ends of old alluvial fans and on recent alluvial fans and flood plains. Elevations range from 5,200 to 6,000 feet.

The soils in this range site are—

Berent loamy fine sand, 0 to 2 percent slopes.
Crestline fine sandy loam, 0 to 3 percent slopes.
Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes.
Heist fine sandy loam, 0 to 3 percent slopes.
Modena fine sandy loam, 0 to 3 percent slopes.
Modena silt loam, overwashed, 0 to 1 percent slopes.
Mosida fine sandy loam, 0 to 1 percent slopes.

The climax vegetation on this site is 50 to 60 percent decreaser grasses, such as Indian ricegrass, western wheatgrass, needle-and-thread, and bottlebrush squirreltail. It may have 15 to 20 percent decreaser browse, such as common winterfat, bud sagebrush (*Artemisia spinescens*), and fourwing saltbush (*Atriplex canescens*).

Increaser grasses, such as sand dropseed (*Sporobolus cryptandrus*), galletagrass, blue grama, and Sandberg bluegrass, may make up 20 to 25 percent of the cover. Increaser forbs, such as scarlet globemallow, penstemon (*Penstemon* spp.), wild onion, loco, and Indian paintbrush (*Castilleja* spp.), are only 5 percent of the vegetation. About 5 to 10 percent is composed of increaser browse, such as big sagebrush, black sagebrush (*Artemisia nova*), and spiny hopsage (*Grayia spinosa*).

Common invaders are cheatgrass brome, big rabbitbrush, pricklypear, tumbling Russian-thistle, three-awn, yellowbrush, broom snakeweed, horsebrush (*Tetradymia* spp.), phlox, and annual weeds.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 4 gives estimated yields and management suggestions for this range site.

SEMIDESERT LIMY LOAM RANGE SITE

The soils of this site range from shallow to deep. They have moderately coarse to moderately fine textured surface soils overlying subsoils of sandy clay loam to sandy clay.

Lime is generally absent in the upper 15 inches, but at depths of between 15 and 36 inches most of the soils have a concentration of lime that is more or less cemented. The penetration of roots is restricted by this lime zone.

These soils have a crust and a fine gravelly to stony erosion pavement on the surface. The surface absorbs water even more slowly than the water can move within the soil. This is especially true where the range has been overgrazed. The moisture-holding capacity is medium to moderately low. Where the vegetation cover is maintained, the erosion hazard is slight.

These soils occur on nearly level to gently sloping old alluvial fans and terraces, which are gently dissected by intermittent drainageways. The direction of slope has no apparent effect on the vegetation on this site. Elevations range from 5,200 to 6,000 feet.

The soils in this range site are—

Dixie loam, 0 to 2 percent slopes.
Dixie gravelly loam, 0 to 3 percent slopes.
Dixie stony loam, 2 to 5 percent slopes.
Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes.
Sevy sandy clay loam, 0 to 2 percent slopes.
Timpahute sandy loam, 0 to 2 percent slopes.
Timpahute gravelly sandy loam, 0 to 3 percent slopes.
Timpahute stony sandy loam, 2 to 5 percent slopes.

The Neola sandy loam in the Neola sandy loam-Sevy sandy clay loam complex is in the Semidesert shallow hardpan range site, but the Sevy sandy clay loam is in this range site. The complex is listed under both sites because the two soils are not separated on the map.

TABLE 3.—*Yields, use, and management of Semidesert loam range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	450 to 300	325 to 175	200 to 100	110 to 10
	Unfavorable years.	325 to 175	200 to 100	110 to 50	60 to 1
Indications of range readiness		Indian ricegrass is 6 inches tall; bottlebrush squirreltail is in the boot stage; Sandberg bluegrass is in full bloom.			
Best grazing seasons		Spring and fall.			
Proper or safe use of key management species.		Indian ricegrass 50% Bottlebrush squirreltail 40% Common winterfat 50%		Indian ricegrass 50% Bottlebrush squirreltail 40% Common winterfat 50% Western wheatgrass 40% Galletagrass 30% Shadscale saltbush 30%	Indian ricegrass 40% Bottlebrush squirreltail 30% Common winterfat 40% Western wheatgrass 30% Galletagrass 20% Shadscale saltbush 20%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		Seed only if decreasers and better increasers make up less than 10% of the vegetation.	For winter pasture, seed Whitmar wheatgrass (7 lb. per acre) and Ladak alfalfa (1 to 2 lb. per acre). For spring and fall pasture, seed Siberian or crested wheatgrass (5 lb. per acre) and Ladak alfalfa (1 to 2 lb. per acre).
Development of water for livestock.		Use ponds; use wells with tanks; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			Fence seeded range to separate it from native range.
Control of undesirable plants		None needed		To control big sagebrush, yellowbrush, and broom snakeweed, use chemical spray, rotobeat, or rail.	To control sagebrush, yellowbrush, and broom snakeweed, plow before seeding.
Salting		Salt away from water in lightly grazed areas to get uniform grazing use.			

The climax vegetation is primarily grass. It includes a small percentage of browse plants and a very small percentage of forbs. It is 55 to 65 percent decreaser grasses, such as Indian ricegrass, needle-and-thread, bottlebrush squirreltail, and western wheatgrass. It may contain as much as 15 percent decreaser browse, such as common winterfat and fourwing saltbush.

Increaser grasses, such as galletagrass, blue grama, and Sandberg bluegrass make up 15 to 20 percent of the cover. As much as 5 percent may be increaser forbs, such as scarlet globemallow, loco, buckwheat, Indian paintbrush, and foothill deathcamas. Increaser browse, such as big sagebrush and black sagebrush, makes up 10 percent or less of the cover.

Common invaders of this range site are big rabbitbrush, cheatgrass brome, tumbling Russian-thistle, annual weeds, yellowbrush, broom snakeweed, phlox, and three-awn.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 5 gives estimated yields and management suggestions for this range site.

SEMIDESERT GRAVELLY LOAM RANGE SITE

The soils of this range site are gravelly and stony loams that contain coarser and more limy materials below a depth of 18 inches. In some places they are limy to the surface.

TABLE 4.—*Yields, use, and management of Semidesert sandy loam range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	400 to 200	225 to 125	150 to 75	100 to 10
	Unfavorable years.	250 to 125	150 to 75	80 to 40	50 to 5
Indications of range readiness		Indian ricegrass is 6 inches tall; western wheatgrass is 6 inches tall; Sandberg bluegrass is in full bloom; bottlebrush squirreltail is in the boot stage.			
Best grazing seasons		1. Spring and fall. 2. Winter.			
Proper or safe use of key management species.		Indian ricegrass 50% Bottlebrush squirreltail 40% Western wheatgrass 40%		Indian ricegrass 50% Bottlebrush squirreltail 40% Western wheatgrass 40% Galletagrass 30% Black sagebrush 20%	Indian ricegrass 40% Bottlebrush squirreltail 30% Western wheatgrass 30% Galletagrass 20% Black sagebrush 10%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		Seed only if decreasers and better increasers make up less than 10% to 20% of the vegetation.	For spring and fall pasture, seed Indian ricegrass (10 lb. per acre), or sand dropseed (2 lb. per acre), or Siberian or crested wheatgrass (5 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre). For winter pasture, seed Indian ricegrass (10 lb. per acre), or Whitmar wheatgrass (7 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre).
Development of water for livestock.		Use wells with tanks; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			Fence seeded range to separate it from native range.
Control of undesirable plants		None needed		To control big sagebrush, yellowbrush, and broom snakeweed, use chemical spray, rotobeat, burn, or rail.	To control sagebrush, yellowbrush, broom snakeweed, cheatgrass brome, and tumbling Russian-thistle, plow before seeding.
Salting		Salt away from water in lightly grazed areas to get uniform grazing use.			

The available water holding capacity is low because the profile contains so much coarse material. Internal movement of water is medium but becomes more rapid with depth. The depth of roots is not restricted, except by available moisture.

The gravelly surface pavement reduces the erosion hazard. If enough vegetation is present, erosion is slight. In some exposed spots, the surface has a very thin crust.

These gently sloping and slightly undulating soils are on recent alluvial fans and along drainageways that intersect the fans. Elevations range from 5,300 to 6,000 feet.

The soils in this range site are—

Newcastle gravelly loam, 2 to 7 percent slopes.
Newcastle stony loam, 2 to 12 percent slopes.

The climax vegetation is 50 to 60 percent decreaser grasses, such as Indian ricegrass, bottlebrush squirreltail, needle-and-thread, and western wheatgrass. From 10 to 15 percent is decreaser browse, such as common winterfat, bud sagebrush, and fourwing saltbush.

TABLE 5.—*Yields, use, and management of Semidesert limy loam range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	350 to 175	200 to 100	125 to 50	75 to 10
	Unfavorable years.	200 to 100	125 to 50	60 to 25	30 to 5
Indications of range readiness		Indian ricegrass is 6 inches tall; bottlebrush squirreltail is in the boot stage; western wheatgrass is 6 inches tall; Sandberg bluegrass is in full bloom.			
Best grazing seasons		1. Spring and fall. 2. Winter.			
Proper or safe use of key management species.		Indian ricegrass 50% Bottlebrush squirreltail 40% Western wheatgrass 40% Common winterfat 50%		Indian ricegrass 50% Bottlebrush squirreltail 40% Western wheatgrass 40% Common winterfat 50% Galletagrass 30% Black sagebrush 30%	Indian ricegrass 40% Bottlebrush squirreltail 30% Western wheatgrass 30% Common winterfat 40% Galletagrass 20% Black sagebrush 20%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		Seed only if decreasers and better increasers make up less than 10% to 20% of the vegetation.	For spring and fall pasture, seed Indian ricegrass (10 lb. per acre), or alkali sacaton (4 lb. per acre), or sand dropseed (2 lb. per acre), or Siberian wheatgrass (5 lb. per acre), or crested wheatgrass (5 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre). For winter pasture, seed Indian ricegrass (10 lb. per acre), or Whitmar wheatgrass (7 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre).
Development of water for livestock.		Use ponds; use wells with tanks; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			Fence seeded range to separate it from native range.
Control of undesirable plants		None needed		To control big sagebrush, yellowbrush, and broom snakeweed, use chemical spray, rotobeat, burn, or rail.	To control big sagebrush, yellowbrush, broom snakeweed, cheatgrass, and tumbling Russian-thistle, plow before seeding.
Salting		Salt away from water in lightly grazed areas to get uniform grazing use. Animals will not require much salt on this site.			

Increaser grasses, such as galletagrass, Sandberg bluegrass, blue grama, and sand dropseed, make up 15 to 25 percent of the cover. Such increaser forbs as scarlet globemallow, loco, euphorbia (*Euphorbia* spp.), phlox, Indian paintbrush, and foothill deathcamas are another 5 percent. From 5 to 20 percent is increaser browse, such as big sagebrush, spiny hopsage, black sagebrush, and yellowbrush.

Common invaders are rubber rabbitbrush, three-awn, broom snakeweed, annual weeds, pricklypear, and cheatgrass brome.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 6 gives estimated yields and management suggestions for this range site.

TABLE 6.—*Yields, use, and management of Semidesert gravelly loam range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced. (lb. per acre when air dry):	Favorable years.	325 to 200	225 to 100	125 to 40	50 to 10
	Unfavorable years.	150 to 100	110 to 50	65 to 25	30 to 5
Indications of range readiness		Needle-and-thread is 6 inches tall; bud sagebrush is in two-thirds to full leaf; Indian ricegrass is 6 inches tall; sand dropseed is in the boot stage.			
Best grazing seasons		1. Spring and fall. 2. Winter.			
Proper or safe use of key management species.		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40%		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40% Galletagrass 30% Black sagebrush 30%	Needle-and-thread 40% Indian ricegrass 40% Common winterfat 40% Bud sagebrush 30% Galletagrass 20% Black sagebrush 20%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		Seeding should be repeated until a favorable year allows the plants to establish themselves. Use the same species as those listed under Semidesert sandy loam range site.	
Development of water for livestock.		Use wells with tanks; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			
Control of undesirable plants		None needed		If decreasers and increasers make up 10% to 20% of the vegetation, then big sagebrush, rubber rabbitbrush, broom snakeweed, and yellowbrush can be successfully controlled by spraying, rotobeating, or railing.	
Salting		Animals generally do not require salt while grazing this site.			

SEMIDESERT STONY LOAM RANGE SITE

These very stony soils are generally shallow, but in a few places they are moderately deep. The surface soil has a moderately coarse to medium texture, and the upper subsoil is moderately fine to fine. The lower subsoil is a lime hardpan, weakly to strongly cemented.

The available moisture holding capacity is low because of the stoniness and the small quantity of soil material above the lime hardpan. Less of the moisture soaks in because of the surface crust. A surface pavement of stone and gravel helps reduce the hazard of erosion. If an adequate cover of vegetation is present, the erosion hazard is slight.

These soils lie on the higher parts of the gently sloping to sloping old alluvial fans and on their more steeply sloping escarpments. Slopes may range from 2 to 60 percent, but slopes of about 5 percent predominate. Elevations may be from 5,300 to 6,000 feet.

The soils in this range site are—

Dixie very stony loam, 2 to 7 percent slopes.
Terrace escarpments.
Timpahute very stony sandy loam, 2 to 7 percent slopes.

The climax vegetation consists of 35 to 45 percent decreaser grasses, such as Indian ricegrass, bottlebrush squirreltail, needle-and-thread, giant wildrye (*Elymus condensatus*), sedge (*Carex* spp.), and western wheatgrass. Such decreaser browse as common winterfat, fourwing saltbush, and bud sagebrush make up 10 to 15 percent.

Twenty percent or less of the cover consists of increaser grasses, such as Sandberg bluegrass, galletagrass, sand dropseed, and blue grama. Such increaser forbs as scarlet globemallow, loco, low larkspur (*Delphinium* spp.), foothill deathcamas, phlox, aster (*Aster* spp.), and Indian paintbrush make 5 to 10 percent. From 10 to 35 percent is increaser browse, such as black sagebrush, spiny hopsage, Mormon-tea, big sagebrush, and yellowbrush.

The most common invaders of this range site are tumbling Russian-thistle, annual weeds, cheatgrass brome, three-awn, broom snakeweed, rubber rabbitbrush, pricklypear, Utah juniper (*Juniperus utahensis*), and pinyon pine (*Pinus edulis*).

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 7 gives yield estimates and management suggestions for this range site.

SEMIDESERT SHALLOW HARDPAN RANGE SITE

The soils that characterize this site are light colored, moderately coarse textured, and strongly calcareous. They are underlain by a strongly cemented lime hardpan at a shallow depth.

The available water holding capacity is low. The internal movement of moisture is rapid above the hardpan, and it is very slow through it. The very thin crust on the surface may restrict the entrance of moisture into the soil. Erosion is less because of the gravel pavement on the surface. If adequate vegetation covers the soil, erosion is slight.

These soils occur on old alluvial fans at elevations of 5,200 to 6,000 feet. The surface is undulating to hummocky.

The soils in this range site are—

- Neola sandy loam, 0 to 3 percent slopes.
- Neola sandy loam, hummocky, 0 to 5 percent slopes.
- Neola stony sandy loam, 2 to 7 percent slopes.
- Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes.

Of the Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes, complex, the Neola sandy loam is in this range site and the Sevy sandy clay loam is in the Semidesert limy loam range site. The complex is listed under both range sites because it is not practical to separate the two soils on the map.

The climax vegetation is 40 to 50 percent decreaser grasses, such as Indian ricegrass, bottlebrush squirreltail, western wheatgrass, and needle-and-thread. From

TABLE 7.—*Yields, use, and management of Semidesert stony loam range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	200 to 100	125 to 50	75 to 25	40 to 5
	Unfavorable years.	125 to 50	75 to 25	30 to 10	20 to 1
Indications of range readiness		Needle-and-thread is 6 inches tall; bud sagebrush is in two-thirds to full leaf; Indian ricegrass is 6 inches tall; sand dropseed is in the boot stage.			
Best grazing seasons		1. Spring and fall. 2. Winter.			
Proper or safe use of key management species.		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40%		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40% Galletagrass 30% Black sagebrush 30%	Needle-and-thread 40% Indian ricegrass 40% Common winterfat 40% Bud sagebrush 30% Galletagrass 20% Black sagebrush 20%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		Because this range site is so stony, it is not feasible to seed it with presently known methods.			
Development of water for livestock.		Use wells with tanks; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			
Control of undesirable plants		None needed		If better decreasers and increasers make up 10% to 20% of the vegetation, they can be released by chemical sprays to control big sagebrush, rubber rabbitbrush, broom snakeweed, and yellowbrush. Pinyon pine and Utah juniper can be controlled by chaining or cabling with two large tractors.	
Salting		Animals generally do not require salt while grazing this site.			

10 to 15 percent is decreaser browse, such as common winterfat, bud sagebrush, and fourwing saltbush.

Increaser, grasses, such as galletagrass, blue grama, Sandberg bluegrass, and sand dropseed, make 15 to 20 percent of the cover. Such increaser forbs as phlox, buckwheat, Indian paintbrush, loco, and scarlet globemallow compose about 5 percent. From 10 to 30 percent is increaser browse, such as black sagebrush, yellowbrush, spiny hopsage, big sagebrush, and Mormon-tea.

Common invaders of this range site are pricklypear, tumbling Russian-thistle, cheatgrass brome, broom snakeweed, horsebrush, three-awn, and annual weeds.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 8 gives estimated yields and management suggestions for this range site.

TABLE 8.—*Yields, use, and management of Semidesert shallow hardpan range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	250 to 150	175 to 75	100 to 35	40 to 10
	Unfavorable years.	150 to 100	125 to 50	72 to 20	25 to 5
Indications of range readiness		Needle-and-thread is 6 inches tall; bud sagebrush is in three-quarter to full leaf; Indian ricegrass is 6 inches tall; sand dropseed is in the boot stage.			
Best grazing seasons		1. Winter. 2. Spring and fall.			
Proper or safe use of key management species.		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40%		Needle-and-thread 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40% Galletagrass 30% Sand dropseed 30% Black sagebrush 30%	Needle-and-thread 40% Indian ricegrass 40% Common winterfat 40% Bud sagebrush 30% Galletagrass 20% Sand dropseed 20% Black sagebrush 20%
Rotation-deferred grazing system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		Seed only if decreasers and increasers make up less than 10% to 20% of the vegetation. This is a hazardous site for seeding. It may have to be seeded several years before seeding is successful. For winter pasture on soils 18 inches in depth, seed Indian ricegrass (10 lb. per acre), or Whitmar wheatgrass (7 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre). For spring and fall pasture on soils 18 inches in depth, seed Indian ricegrass (10 lb. per acre), or Siberian wheatgrass (5 lb. per acre), or crested wheatgrass (5 lb. per acre), and Ladak alfalfa (1 to 2 lb. per acre). On soils 12 inches deep, Indian ricegrass (10 lb. per acre) is the best possibility. Plow and summer fallow 2 seasons before seeding.	
Development of water for livestock.		Use ponds; use wells with troughs; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle; fence seeded range to separate it from native range.			
Control of undesirable plants		None needed		If 10% to 20% of the vegetation consists of good decreasers or increasers, control big sagebrush, rubber rabbitbrush, broom snakeweed, and yellowbrush by chemical spraying or rotobeating.	
Salting		Animals generally do not require salt when grazing on this site.			

SEMIDESERT LIMY FLATS RANGE SITE

The characteristic soils of this range site are deep, light colored, and strongly calcareous. Their texture is moderately coarse to medium. The subsoil is weakly cemented by lime in most places. The lower subsoil is slightly affected by salts and alkali. Growth of roots is slightly restricted by the hardness of the subsoil. The available water holding capacity is moderate.

These soils are subject to severe wind erosion whenever they are disturbed. When erosion starts, all the soil material above the weakly cemented subsoil may be removed rapidly. The result is blowouts and hummocky and duny accumulations of soil material nearby. A good cover of vegetation is needed to prevent erosion.

These soils occur in the nearly level old lake basin, but some places are hummocky. The elevation ranges from 5,100 to 5,200 feet.

The soils in this range site are—

- Beryl very fine sandy loam, 0 to 1 percent slopes.
- Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes.
- Escalante very fine sandy loam, 0 to 1 percent slopes.
- Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes.
- Escalante fine sandy loam, 0 to 1 percent slopes.
- Escalante fine sandy loam, hummocky, 0 to 1 percent slopes.
- Escalante fine sandy loam, eroded, 0 to 1 percent slopes.
- Escalante fine sandy loam, overwashed, 0 to 1 percent slopes.
- Escalante silt loam, overwashed, 0 to 1 percent slopes.
- Escalante-Heist fine sandy loams, 0 to 1 percent slopes.

The decreaser grasses, such as giant wildrye, alkali bluegrass (*Poa juncifolia*), alkali sacaton (*Sporobolus airoides*), Indian ricegrass, needle-and-thread, western wheatgrass, and sand dropseed, make 40 to 50 percent of the climax vegetation on this site. Browse decreasers, such as common winterfat, bud sagebrush, and fourwing saltbush may be as much as 25 percent.

The cover may be 10 to 15 percent of increaser grasses, such as inland saltgrass (*Distichlis stricta*), bottlebrush squirreltail, galletagrass, and Sandberg bluegrass. Increaser forbs, such as scarlet globemallow, are only 2 percent. Browse increasers, such as shadscale saltbush, big sagebrush, rubber rabbitbrush, and black greasewood (*Sarcobatus vermiculatus*), are 10 to 25 percent.

Common invaders are halogeton (*Halogeton glomeratus*), tumbling Russian-thistle, foxtail barley (*Hordeum jubatum*), povertyweed (*Iva axillaris*), annual weeds, three-awn, horsebrush, and yellowbrush.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 9 gives estimated yields and management suggestions for this range site.

SEMIDESERT ALKALI FLATS RANGE SITE

The soils in this range site are relatively deep alluvial and lake-laid deposits that are moderately fine to medium in texture.

Most of these soils are strongly affected by salts, alkali, or both. They are high in lime. The water-holding capacity is moderate to high, but little moisture is available for plant use because the penetration of water and roots through the profile is severely restricted. The erosion hazard is generally slight, but in some places it is severe. A good cover of vegetation should be maintained at all times.

These soils occur in the nearly level old lake basin. Where the surface has been reworked by the wind, hummocks and low dunes are present. Elevations range from 5,000 to 5,200 feet.

The soils in this range site are—

- Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes.
- Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes.
- Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes.
- Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes.
- Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes.
- Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes.
- Beryl soils-Dune land association.
- Bullion silty clay loam, 0 to 1 percent slopes.
- Navajo silty clay, moderately alkali affected, 0 to 1 percent slopes.
- Uvada loam, 0 to 2 percent slopes.
- Uvada silt loam, overwashed, 0 to 1 percent slopes.
- Uvada silt loam, 0 to 1 percent slopes.
- Uvada and Antelope Springs soils, 0 to 1 percent slopes.
- Uvada and Antelope Springs soils, hummocky, 0 to 1 percent slopes.
- Uvada, Antelope Springs, and Heist soils, 0 to 1 percent slopes.
- Uvada, Antelope Springs, and Crestline soils, 0 to 1 percent slopes.
- Uvada soils-Dune land association.

The Heist soil and the Crestline soil, each of which is mapped in an undifferentiated group with Uvada and Antelope Springs soils, are in the Semidesert sandy loam range site. As it is not practical to separate them, and as each is only a small part of the group in which it is mapped, both are included in this range site.

The climax vegetation on this range site is 25 to 35 percent decreaser grasses, such as alkali sacaton, alkali bluegrass, Indian ricegrass, bottlebrush squirreltail, and giant wildrye. From 10 to 15 percent is decreaser shrubs, such as common winterfat, Gardners saltbush, and fourwing saltbush.

Less than 10 percent of the cover is increaser grass, mostly inland saltgrass. A trace of increaser forbs, such as scarlet globemallow, bassia (*Bassia hyssopifolia*), and pickleweed (*Allenrolfea occidentalis*), are present. Increaser shrubs are 40 to 55 percent of the cover; they include black greasewood, shadscale saltbush, gray molly (*Kochia vestita*), rubber rabbitbrush, big sagebrush, and yellowbrush.

This site is commonly invaded by halogeton, tumbling Russian-thistle, horsebrush, three-awn, foxtail barley, annual weeds, and povertyweed.

At the time this survey was made, all of the range was in fair to poor condition and the vegetation consisted largely of the invaders.

Table 10 gives estimated yields and management suggestions for this range site.

MISCELLANEOUS LAND TYPES

These miscellaneous land types have very little if any use for intensive agriculture or for range. All have some use as a home for wildlife, as recreation sites, or as watersheds. Some materials for construction can be obtained from Dune land and Rough broken and stony land. Some of the juniper trees on Rough broken and stony land can be used for fenceposts.

The miscellaneous land types that have little use for range are—

Dune land.
Playas.
Rough broken and stony land.

Salts and Alkali

Most soils of the arid and semiarid regions contain at least small quantities of soluble salts, alkali, or both. In some soils these constituents are highly concentrated and toxic to plants.

The soluble salts that accumulate in soils come from several sources. Most of them had their origin in the decomposition of soil minerals and rocks through weathering processes. In humid regions, the more soluble products of decomposition are usually removed from the rooting zone by percolating rainfall. In more arid regions, where the rainfall is low and evaporation is high, the highly soluble salts may remain in the rooting zone and become a problem. In addition, many low-lying areas receive salty runoff or seepage. The shallow percolation and surface evaporation of such water usually results in a further increase of soluble salts in or on the soils. In areas that have a high water table, water may rise in the soil by capillary action, bringing dissolved salts with it. Soluble salts are readily dissolved in water and may move in solution to any part of the soil profile.

When the proportion of salts of sodium in a soil is high in relation to that of the salts of calcium or magnesium, an exchange of the sodium for calcium or magnesium occurs on the surface of the clay particles. Soil clay that has a high percentage of sodium on the surface tends to swell and disperse. Pore space, permeability, and aeration are decreased. Such a soil is "puddled." The particles are packed so closely together that movement of water, air, and plant roots is restricted. A soil that has 15 percent or more of sodium on the surface of the clay is generally strongly or very strongly alkaline (reaction is pH 8.5 or more) and is called an *alkali* soil.

A soil that contains excess soluble salts but not alkali is called a *saline* soil. The effect of soluble salts de-

TABLE 9.—*Yields, use, and management of Semidesert limy flats range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	320 to 200	200 to 130	130 to 80	80 to 15
	Unfavorable years.	150 to 75	100 to 50	60 to 40	40 to 2
Indications of range readiness		Alkali sacaton is in the boot stage; bud sagebrush is in two-thirds to full leaf; Indian ricegrass is 6 inches tall; sand dropseed is in the boot stage.			
Best grazing season		Winter.			
Proper or safe use of key management species.		Alkali sacaton 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40%		Alkali sacaton 50% Indian ricegrass 50% Common winterfat 50% Bud sagebrush 40% Inland saltgrass 30% Shadscale saltbush 20%	Alkali sacaton 40% Indian ricegrass 40% Common winterfat 40% Bud sagebrush 30% Inland saltgrass 20% Shadscale saltbush 10%
Rotation-deferred system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		This is a hazardous site for seeding by present methods. Water conservation measures should be used when seeding trials are made. Seed Indian ricegrass (10 lb. per acre), or alkali sacaton (4 lb. per acre), or sand dropseed (2 lb. per acre).	
Development of water for livestock.		Use ponds; use wells with troughs; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			
Control of undesirable plants		None needed		None needed	None needed.
Salting		None needed.			

TABLE 10.—*Yields, use, and management of Semidesert alkali flats range site*

Range condition		Excellent	Good	Fair	Poor
Usable forage produced (lb. per acre when air dry):	Favorable years.	125 to 50	60 to 35	40 to 10	15 to 0
	Unfavorable years.	50 to 25	30 to 20	20 to 5	5 to 0
Indications of range readiness		Alkali sacaton is in the boot stage; bottlebrush squirreltail is in the boot stage; Indian ricegrass is 5 inches tall.			
Best grazing season		Winter.			
Proper or safe use of key management species.		Alkali sacaton 50% Indian ricegrass 50% Common winterfat 50% Fourwing saltbush 50%		Alkali sacaton 50% Indian ricegrass 50% Common winterfat 50% Fourwing saltbush 50% Inland saltgrass 20% Shadscale saltbush 20%	Alkali sacaton 40% Indian ricegrass 40% Common winterfat 40% Fourwing saltbush 40% Inland saltgrass 10% Shadscale saltbush 10%
Rotation-deferred system to be used.		Use system of 3 pastures or more, and defer each pasture at least every third year.		Use system of 4 pastures or more, and defer each pasture every other year.	
Range seeding		None needed		This is a hazardous site for seeding by present methods. Water conservation measures should be used when seeding trials are made. Seed alkali sacaton (4 lb. per acre).	
Development of water for livestock.		Use ponds; use wells with troughs; haul water.			
Fencing		Fence to control trespass; use cross fences to provide for rotation-deferred grazing of cattle.			
Control of undesirable plants		None needed		None needed	None needed.
Salting		None needed.			

pends on the amount and composition of those present. When the proportion of calcium and magnesium is high and that of sodium is low, the salts do not have a detrimental effect on the soil. For the most part, such a soil is fairly well aggregated, porous, and permeable. Large amounts of soluble salts, however, directly affect the growth of plants. Soluble salts have strong attraction for water, and this makes it more difficult for plants to absorb moisture. If the salt content becomes too high, water may even be withdrawn from the plant root, and the plant will wilt and probably die. Saline soils, therefore, need more water than nonsaline soils to return the same crop yield.

Plants affected by excess salts are usually stunted and have burned leaf tips. Crop quality is generally inferior to that on nonsaline soils. Strong concentrations of sodium also interfere with calcium absorption by plants. Some plants are more sensitive to salinity than others. Significant differences by variety and even by strain of plant have been observed.

If an excess of soluble salts and an excess of alkali occur together, the soil is *saline-alkali*. Concentrations of these can have extreme effects on plant growth, and the soil may be especially difficult or expensive to improve.

In mapping soluble salts, alkali, or both, considerable variation may be found within short distances. The four general classes for content of alkali or content of salts are the following:

Class 0: Soils free of excess salts or alkali. Practically no crops are inhibited by or show evidence of injury from excess of salts or alkali.

Class 1: Soils slightly affected by salts or alkali. The growth of sensitive crops is inhibited, but that of salt-tolerant crops may not be.

Class 2: Soils moderately affected by salts or alkali. Crop growth is inhibited, and no crop does well.

Class 3: Soils strongly affected by salts or alkali. Only a few highly tolerant kinds of plants survive.

Salinity classes are based on percentage of soluble salts, calculated on a basis of dry soil weight or on the electrical conductivity of the saturation soil extract. Alkalinity classes are based on the relative effect on plant growth.

Table 11 gives the approximate limits of various classes of salinity and alkalinity that were used in describing soils in the Beryl-Enterprise Area.

TABLE 11.—*Classes of salinity and alkalinity*

Class	Salinity		Alkalinity
	Soluble salts	Electrical conductivity of saturation extract at 25° C.	Relative effect on plant growth
	Percent	*Millimhos per centimeter*	
Free	0 to 0.15	0 to 4	Too small to be significant.
Slightly affected	0.15 to 0.35	4 to 8	Slight.
Moderately affected	0.35 to 0.65	8 to 15	Moderate.
Strongly affected	More than 0.65.	More than 15	Severe.

The problems of soluble salts and alkali are concentrated in the nearly level, lake basin part of the Beryl-Enterprise Area. The problem increases in severity from the higher lying outer basin rim toward the lower center part. On the outer rim, the chief problem is the presence of slight amounts of alkali or both salts and alkali in the subsoil of the Antelope Springs, Bullion, Beryl, and Escalante soils. Neither the Antelope Springs nor the Bullion soils contain gypsum, and their improvement would probably be hastened by adding gypsum or sulfur together with manure and by periodic deep leaching. Because these soils are slowly permeable and the alkali is in the subsoil, improvement would be gradual. In contrast to the slowly permeable Antelope Springs and Bullion soils, the moderately permeable Beryl and Escalante soils are readily improved by periodic deep leaching alone. Some gypsum that is present naturally in these soils assists in this improvement.

In intermediate positions in the basin area, the alkali content of the Antelope Springs series is moderate. Most of it is in the subsoil but some is closer to the surface. In about the same area, the Beryl soils are both strongly saline and strongly alkali. To improve the moderately affected Antelope Springs soils, large applications of gypsum or sulfur and manure will be required together with periodic deep leaching. Because of the slow permeability of these soils, considerable time will be needed for the chemical reaction. On the other hand, the Beryl soils, which are strongly saline and strongly alkali, should be much more quickly and easily improved. They are moderately permeable soils and contain considerable gypsum.

The strongest concentrations of salts and alkali are in the lowest parts of the basin, principally in the Antelope Springs and Uvada soils. These Antelope Springs soils are moderately to strongly saline and strongly alkali, and the Uvada soils are both strongly saline and strongly alkali. Very heavy applications of gypsum or sulfur and manure would be required over a prolonged period of time. However, these soils are slowly or very slowly permeable, and it is questionable if these amendments would be more than partly effective.

Estimates of the amounts of chemical amendments needed to improve saline, alkali, or saline-alkali soils can be seen in table 12. Table 13 shows, for a few soils located throughout the affected area, the relation of salts and alkali concentration to the principal kinds of vegetative cover. This table illustrates the magnitude of the problem of improving these soils. Fairly reliable improvement estimates should be possible, but any given area to be reclaimed should be tested before treatment. The permeability of the soil indicates how effective deep leaching is likely to be. If the permeability is very slow, improvement is improbable, or it will be extremely slow. If the permeability is satisfactory, periodic deep leaching alone can correct a problem of excess soluble salts.

TABLE 12.—*Amounts of gypsum and sulfur required to replace indicated amounts of exchangeable sodium* [1]

Exchangeable sodium	Gypsum ($CaSO_4 \cdot 2H_2O$)		Sulfur (S)	
meq. per 100 gm. of soil	*Tons per acre-foot* [2]	*Tons per acre-6 inches* [2]	*Tons per acre-foot* [2]	*Tons per acre-6 inches* [2]
1	1. 7	0. 9	0. 32	0. 16
2	3. 4	1. 7	. 64	. 32
3	5. 2	2. 6	. 96	. 48
4	6. 9	3. 4	1. 28	. 64
5	8. 6	4. 3	1. 60	. 80
6	10. 3	5. 2	1. 92	. 96
7	12. 0	6. 0	2. 24	1. 12
8	13. 7	6. 9	2. 56	1. 28
9	15. 5	7. 7	2. 88	1. 44
10	17. 2	8. 6	3. 20	1. 60

[1] Based on "Diagnosis and Improvement of Saline and Alkali Soils," U.S. Salinity Laboratory, Riverside, Calif. (*15*).

[2] Each acre-foot contains approximately 2,000 tons of soil, and each acre-6 inches contains approximately 1,000 tons of soil.

The foregoing process of salinity reduction can be upset, however, if dispersion of the soil occurs and the permeability is reduced. The clue to this possibility is given by the percentage of exchangeable sodium. The higher the percentage of exchangeable sodium and the finer the texture of the soil, the more likely it is that soil dispersion will occur. The addition of gypsum, or sulfur if lime is present, is the means whereby the amount of exchangeable sodium is reduced and its soil-dispering effects are minimized. Gypsum is slightly soluble, and upon solution it provides calcium to replace the exchangeable sodium. In soils that contain enough free lime, as all the problem soils in this area do, sulfur does the same thing as gypsum. It is converted to gypsum by a slower chemical process that depends on sulfur oxidation by microbes living in the soil.

Assuming complete replacement of the sodium on the clay by the calcium from gypsum, 1.7 tons of gypsum are required to replace each milliequivalent (meq.) of exchangeable sodium per acre-foot of soil. Complete replacement, however, is not necessary and may be impossible. Reducing the exchangeable sodium to a safe margin of about 10 percent of the cation exchange capacity should be sufficient in most soils. Thus, the gypsum requirements for an acre-foot of soil with a content of 4 milliequivalents of exchangeable sodium and 40

TABLE 13.—*Data from selected samples of saline and alkali soils* [1]

[Where no figure is given, information was not recorded]

Soil	Depth	Saturation	Reaction [2]		Cation exchange capacity	Exchangeable sodium		Gypsum [3]	Permeability [4]
			Saturated paste	1:5 suspension					
Antelope Springs silt loam (NE¼NW¼ sec. 29, T. 35 S., R. 15 W.):	*Inches*	*Percent*	*pH*	*pH*	*meq. per 100 gm.*	*meq. per 100 gm.*	*Percent*	*meq. per 100 gm.*	*Inches per hour*
(a) Bare soil between shrubs	0–2	25.3	8.1	9.1	21.6	0.92	4.2	0	0.02
	2–5	32.3	7.7	8.6	30.6	.69	2.3	0	.16
	5–10	51.2	7.8	8.6	35.2	.58	1.6	0	3.6
	10–14	49.5	7.8	8.6	28.7	.51	1.7	0	3.9
	14–28	52.0	8.0	8.7	15.9	.82	5.1	0	7.1
	28–33	45.2	8.0	8.8	11.5	1.18	10.2	0	5.9
	33–48	36.8	7.9	9.0	11.2	1.28	11.4	0	2.4
(b) Under greasewood plant 9 feet from sample (a)	0–2	38.0	8.7	10.1	22.4	8.15	36.3	0	.27
	2–6	27.4	9.1	10.3	25.1	12.19	48.6	0	--------
	6–13	51.0	9.0	10.3	31.8	17.07	53.7	0	[5] .002
	13–22	71.7	8.6	9.8	16.8	7.90	46.9	1.2	.03
	22–30	56.4	8.3	9.5	13.9	5.62	40.6	(6)	.12
	30–38	46.5	8.2	9.5	11.4	4.96	43.4	(6)	.30
	38–44	45.5	8.2	9.5	12.2	5.35	43.8	0	.23
	44–52	43.7	8.2	9.6	14.4	5.72	39.7	0	.26
Uvada loam (SE¼SW¼ sec. 9, T. 35 S., R. 15 W.):									
(a) Bare soil between shrubs	0–2	20.9	8.6	9.9	13.4	3.35	24.9	0	.04
	2–5	22.6	8.5	9.0	16.1	5.02	31.3	0	.04
	5–13	70.0	8.8	10.0	30.0	18.39	61.3	0	.002
	13–19	57.4	9.0	10.1	19.3	14.56	75.6	(6)	.004
	19–34	49.1	8.5	9.5	12.5	8.78	70.0	(6)	3.2
(b) Under greasewood plant 24 feet from sample (a)	0–1	47.3	8.7	9.9	14.5	5.28	36.4	0	2.4
	1–3	27.9	9.1	10.1	14.6	6.95	47.4	0	.27
	3–6	24.3	9.0	10.2	16.0	8.10	50.8	0	.01
	6–14	73.1	9.5	10.3	31.9	26.04	81.6	0.5	[5] .002
	14–23	79.8	9.5	10.2	25.7	19.06	74.0	(6)	[5] .003
	23+	48.8	8.4	9.4	11.55	9.55	82.6	(6)	1.1
Navajo silty clay (NE¼SW¼ sec. 12, T. 36 S., R. 16 W.):									
(a) Bare soil between shrubs	0–4	39.7	7.6	8.7	30.5	.53	1.7	0	1.2
	4–10	54.4	7.7	8.8	28.9	.74	2.5	0	.87
	10–30	42.2	7.8	8.7	30.0	2.76	9.2	0	.05
	30–48	45.6	8.0	9.1	27.8	7.33	26.4	0	[5] .008
(b) Under greasewood plant 3 feet from sample (a)	0–4	42.7	8.5	9.7	27.1	8.18	30.4	0	[5] .002
	4–10	49.5	8.6	9.7	19.2	10.08	34.6	0	[5] .001
	10–30	54.6	8.3	9.5	18.5	7.68	26.9	0	[5] .001
	30–48	49.4	7.7	8.2	28.7	5.26	18.3	4.9	.47
Beryl very fine sandy loam (SW¼SW¼ sec. 16, T. 34 S., R. 16 W.):									
(a) Bare soil between shrubs	0–3	31.2	8.1	8.7	21.6	7.64	35.5	17.7	.39
	3–20	34.9	8.2	9.2	23.2	8.64	37.2	.6	.28
	20–34	26.4	7.8	8.7	16.5	8.04	48.7	2.0	7.1
(b) Under greasewood plant 18 inches from sample (a)	0–3	30.4	9.2	10.1	17.6	8.17	46.4	.7	.28
	3–20	33.5	9.1	10.0	22.8	11.23	49.3	(6)	.16
	20–34	33.2	7.7	8.5	18.5	6.23	33.7	2.0	2.9
(c) Under big rabbitbrush plant 15 inches from sample (b)	0–3	35.5	7.8	8.6	20.6	5.55	27.0	6.8	1.7
	3–20	34.5	7.9	9.3	21.0	6.23	29.6	(6)	.13
	20–34	33.3	7.8	8.7	15.7	5.90	37.6	(6)	3.6
(d) Under shadscale plant 15 feet from sample (b)	0–3	33.2	7.9	8.7	15.4	4.03	26.2	3.9	2.8
	3–20	35.2	8.1	9.2	16.8	6.75	40.1	(6)	.16
	20–34	41.7	7.6	8.4	19.0	5.66	29.7	2.1	2.5

[1] Analyses by M. Fireman and L. W. Healton, U.S. Salinity Laboratory, Riverside, Calif.
[2] Determined by glass-electrode method.
[3] Determined by acetone method.
[4] Disturbed soil samples. The measurement was made after 6 inches of water had passed through soil.
[5] These samples were measured after 2 weeks, although 6 inches of water had not yet passed through the soil.
[6] Trace.

percent sodium saturation would be the replacement of 3 milliequivalents of sodium and a reduction to 10 percent exchangeable sodium. Table 12 shows that 5.2 tons of gypsum or 0.96 tons of sulfur would be required to replace 3 milliequivalents of exchangeable sodium. Similar estimates can be made for other layers in the soil to estimate the total amount of gypsum or sulfur needed to reclaim the profile to any desired depth.

Where gypsum is already present in the soil, less will need to be added. An estimate of this reduction in tons of gypsum per acre-foot of soil can be made by multiplying the milliequivalents of gypsum per 100 grams of soil by the factor 1.72.

Because of saline irrigation waters, high water table, slow permeability, or need to grow crops while improvement is underway, it may not be economically possible or desirable to maintain low salinity. In such cases, a certain amount of salinity is permissible if a proper selection of crops is made. The following tabulation will help in making such use and management decisions.

The crops within each group are listed in order of decreasing salt tolerance according to electrical conductivity (EC x 10^3) values. These values show the electrical conductivity of the saturation extract of the soil in millimhos per centimeter at 25° C. The conductivity values represent the salinity level at which a 50 percent decrease in yield can be expected, as compared to the yield on nonsaline soils under otherwise similar growing conditions. For example, moderately tolerant forage crops such as white sweetclover would have a salt tolerance nearer to conductivity value 12, but the salt tolerance of tall meadow oatgrass would be nearer to 4. In most instances, these data are based on field plot trials, in which crops were grown on soils that were artificially adjusted to various salinity levels.

- Field crops:
  - Good salt tolerance (EC x 10^3 = 16 to 10).
    - Barley for grain.
    - Sugar beets.
    - Milo.
    - Rape.
  - Moderate salt tolerance (EC x 10^3 = 10 to 6).
    - Rye for grain.
    - Wheat for grain.
    - Oats for grain.
    - Sorghum for grain.
    - Field corn.
  - Poor salt tolerance (EC x 10^3 = 4).
    - Field beans.
- Vegetable crops:
  - Good salt tolerance (EC x 10^3 = 12 to 10).
    - Beets.
    - Kale.
    - Asparagus.
    - Spinach.
  - Moderate salt tolerance (EC x 10^3 = 10 to 4).
    - Tomato.
    - Cabbage.
    - Lettuce.
    - Sweet corn.
    - Potatoes (White Rose).
    - Carrots.
    - Onions.
    - Peas.
    - Squash.
    - Cucumber.
  - Poor salt tolerance (EC x 10^3 = 4 to 3).
    - Radish.
    - Celery.
    - Green beans.
- Forage crops:
  - Good salt tolerance (EC x 10^3 = 18 to 12).
    - Alkali sacaton.
    - Saltgrass.
    - Canada wildrye.
    - Beardless wildrye.
    - Barley for hay.
    - Birdsfoot trefoil.
  - Moderate salt tolerance (EC x 10^3 = 12 to 4).
    - White sweetclover.
    - Yellow sweetclover.
    - Perennial wildrye.
    - Strawberry clover.
    - Sudangrass.
    - Hubam clover.
    - Alfalfa.
    - Tall fescue.
    - Rye for hay.
    - Wheat for hay.
    - Oats for hay.
    - Orchardgrass.
    - Blue grama.
    - Meadow fescue.
    - Reed canarygrass.
    - Big trefoil.
    - Smooth bromegrass.
    - Tall meadow oatgrass.
  - Poor salt tolerance (EC x 10^3 = 4 to 2).
    - White dutch clover.
    - Meadow foxtail.
    - Alsike clover.
    - Red clover.
    - Ladino clover.

Table 14 gives the chemical analyses of the saturation extracts obtained from the same soil samples. These data indicate that chloride (Cl), sulfate (SO_4) and bicarbonate (HCO_3) salts of sodium (Na) are probably the most important salts in the soils of the Area. In the Beryl soil, electrical conductivity and percentage salt values are high, but periodic deep leaching alone would greatly reduce them and make some cropping possible. On the other hand, conductivity and percentage salt values are relatively low, at least in the upper horizons, of the Antelope Springs and Uvada soils, and elimination of alkali (excess exchangeable sodium) is needed to improve the soil and increase crop yields.

Irrigation

Except for range and a limited dryland wheat area above Enterprise, all parts of the Beryl-Enterprise Area need irrigation for agriculture. The first irrigation consisted of storage and surface diversion from Shoal Creek near Enterprise and from Pinto Creek near Newcastle, about the turn of the century. These projects remained small for many years. The first irrigation well was drilled near Beryl in 1922. Pump irrigation was not successful, however, until the introduction of electric power and the more favorable economic conditions of World War II.

The fields near Enterprise are irrigated by water stored in two reservoirs on a branch of Shoal Creek in the mountains west of the survey limits. These reservoirs hold 10,250 acre-feet of water. The main recharge is from snowmelt. The amount is extremely variable from year to year. The reservoirs are seldom filled to capacity. Since 1935, the quantity of water actually distributed has varied from 1,750 acre-feet in 1946 to 6,250 acre-feet in 1937. In 10 of the years up to 1950,

TABLE 14.—*Chemical analyses of saturation extracts from saline and alkali soils* [1]

[Where no figure is given, information was not recorded]

Soil	Depth	EC [2]	Cations: Na	Cations: K	Cations: Ca	Cations: Mg	Anions: CO_3	Anions: HCO_3	Anions: Cl	Anions: SO_4	Anions: NO_3	Salt content [3]
	Inches	*mmhos per cm.*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*meq. per liter*	*Parts per million*	*Percent*
Antelope Springs silt loam (NE¼NW¼ sec. 29, T. 35 S., R. 15 W.):												
(a) Bare soil between shrubs	0–2	0. 96	6. 40	1. 90	1. 95	0. 80	0. 23	7. 57	1. 01	0. 94	0	0. 03
	2–5	. 37	1. 75	. 45	1. 37	. 44	0	3. 01	. 25	-------	0	. 01
	5–10	. 33	1. 50	. 31	1. 31	. 42	0	3. 01	0	-------	0	. 01
	10–14	. 35	1. 35	. 33	1. 85	. 64	0	3. 01	. 25	-------	0	. 01
	14–28	. 40	1. 65	. 15	1. 77	. 38	0	1. 93	. 25	-------	0	. 01
	28–33	. 57	3. 35	. 18	1. 47	. 38	0	2. 24	2. 29	-------	0	. 01
	33–48	. 76	5. 85	-------	1. 79	. 34	0	2. 85	3. 30	-------	0	. 02
(b) Under greasewood plant 9 feet from sample (a)	0–2	2. 62	31. 12	3. 90	. 86	. 89	0	28. 68	7. 11	-------	0	. 09
	2–6	3. 43	38. 75	-------	. 74	. 99	0	34. 54	1. 01	-------	0	. 07
	6–13	3. 24	36. 25	-------	. 69	. 88	1. 54	21. 27	4. 57	-------	0	. 13
	13–22	3. 41	33. 87	. 95	. 62	. 54	0	7. 39	13. 71	12. 9	0	. 17
	22–30	4. 12	40. 62	. 95	1. 41	. 72	0	4. 47	17. 27	17. 15	0	. 16
	30–38	3. 84	36. 62	1. 85	1. 49	. 66	0	3. 70	20. 83	12. 0	0	. 12
	38–44	3. 43	32. 50	. 20	1. 31	. 64	0	3. 70	19. 81	8. 23	5	. 10
	44–52	2. 50	23. 50	. 25	. 79	. 46	0	4. 47	14. 22	-------	0	. 07
Uvada loam (SE¼SW¼ sec. 9, T. 35 S., R. 15 W.):												
(a) Bare soil between shrubs	0–2	1. 06	10. 85	1. 00	1. 19	1. 25	0	10. 35	. 25	-------	0	. 02
	2–5	. 94	9. 85	-------	1. 49	1. 18	0	9. 27	. 25	-------	20	. 02
	5–13	1. 69	18. 20	-------	. 18	. 32	1. 22	11. 86	1. 52	-------	0	. 09
	13–19	9. 16	97. 5	2. 70	. 53	. 60	0	8. 94	62. 99	24. 3	0	. 38
	19–34	23. 98	264. 0	1. 56	3. 06	-------	0	4. 31	197. 61	61. 2	5	. 86
(b) Under greasewood plant 24 feet from sample (a)	0–1	3. 78	34. 37	4. 85	. 94	1. 25	0	32. 37	3. 04	5. 92	0	. 13
	1–3	2. 17	22. 50	-------	. 47	. 50	0	20. 97	1. 01	-------	0	. 04
	3–6	2. 11	23. 25	-------	. 07	. 36	2. 46	15. 72	1. 01	-------	0	. 04
	6–14	4. 04	43. 75	-------	. 18	. 32	3. 08	17. 11	1. 47	3. 89	0	. 21
	14–23	12. 45	140. 5	3. 55	. 16	. 36	2. 93	11. 55	85. 34	32. 9	3	. 75
	23+	26. 81	308. 0	1. 95	4. 52	4. 70	0	3. 70	225. 0	84. 0	0	1. 01
Navajo silty clay (NE¼SW¼ sec. 12, T. 36 S., R. 16 W.):												
(a) Bare soil between shrubs	0–4	. 33	1. 25	-------	1. 33	. 26	0	2. 47	. 50	-------	0	. 01
	4–10	. 33	1. 65	-------	1. 01	. 24	0	2. 54	. 25	-------	0	. 01
	10–30	. 30	1.-65	-------	. 84	. 26	0	2. 31	. 50	-------	0	. 01
	30–48	. 41	3. 60	-------	. 46	. 20	0	3. 39	. 50	-------	0	. 01
(b) Under greasewood plant 3 feet from sample (a)	0–4	2. 05	23. 00	1. 58	. 57	. 42	. 76	16. 57	. 50	-------	-------	. 07
	4–10	1. 08	11. 80	. 30	. 36	. 22	0	11. 71	. 50	2. 0	0	. 04
	10–30	1. 38	13. 35	-------	. 57	. 26	0	6. 02	3. 05	-------	0	. 05
	30–48	11. 62	92. 5	. 35	31. 75	21. 2	0	1. 77	63. 62	43. 3	0	. 47
Beryl very fine sandy loam (SW¼SW¼ sec. 16, T. 34 S., R. 16 W.):												
(a) Bare soil between shrubs	0–3	56. 9	617. 5	95. 2	44. 7	6. 8	0	3. 23	458. 2	272. 0	185	1. 55
	3–20	41. 3	437. 5	62. 8	31. 1	5. 2	0	2. 46	304. 8	202. 5	10	1. 21
	20–34	30. 7	276. 0	24. 6	40. 1	14. 6	0	2. 15	255. 0	106. 0	4	. 61
(b) Under greasewood plant 18 inches from sample (a)	0–3	31. 1	359. 0	45. 9	. 34	1. 1	0	38. 70	215. 4	130. 5	0	. 80
	3–20	35. 4	386. 0	46. 1	26. 75	16. 3	1. 23	14. 48	276; 3	114. 0	0	1. 03
	20–34	36. 5	372. 0	31. 25	1. 09	1. 0	0	2. 00	356. 1	100. 2	0	. 87
(c) Under big rabbitbrush plant 15 inches from sample (b)	0–3	69. 1	705. 0	126. 0	72. 3	33. 3	0	7. 24	753. 9	130. 5	0	2. 09
	3–20	26. 9	242. 0	45. 2	19. 85	8. 4	0	3. 08	306. 3	42. 7	0	. 71
	20–34	21. 05	168. 0	9. 85	34. 2	-------	0	1. 23	174. 7	53. 8	0	. 46
(d) Under shadscale plant 15 feet from sample (b)	0–3	25. 7	202. 0	58. 2	42. 1	8. 8	0	6. 47	190. 0	97. 4	0	. 67
	3–20	33. 6	291. 0	69. 2	17. 9	5. 0	0	3. 38	284. 0	88. 3	0	. 88
	20–34	29. 9	238. 0	26. 2	72. 4	37. 8	0	92	304. 3	54. 5	3	1. 01

[1] Analyses by M. Fireman and L. W. Healton, U.S. Salinity Laboratory, Riverside, Calif.

[2] Electrical conductivity of saturation extract in millimhos per centimeter at 25° C.

[3] Percentage of salt on a dry soil basis, calculated from cation content and saturation percentage.

the quantity distributed was between 4,500 and 5,700 acre-feet. The reservoir water is owned on a share basis. Water shares are sold and transferred separately from the land. Since 1944, wells have been used to supplement the water supply, particularly in dry years.

About 4,000 acres are partly or completely irrigated by water from Shoal Creek. The principal crops are potatoes, alfalfa, and barley. Row crops are furrow irrigated; other crops are irrigated by means of corrugations or strip borders. Distribution is by unlined ditches and laterals. Many headgates are of concrete, and others are of planks. Nearly all are well maintained. The Board of Control determines the amount of water and the time of delivery for each share in the system. The water is of good quality.

The fields near Newcastle are irrigated with Pinto Creek water stored in Grass Valley Reservoir. In most years, the supply is very small after June 1, and irrigation is limited chiefly to alfalfa and barley. About 640 acres are irrigated, principally by means of corrugations and strip borders. The water is of good quality.

Most irrigation water in the Area is now obtained from wells. Pump irrigation is centered chiefly near Garyville. Before 1940, abandoning of old wells very nearly kept pace with the drilling of new ones, and total pumpage probably did not exceed 4,000 acre-feet in any year (*11*). Inferior and faulty equipment, equipment failures at critical times, isolated living, and adverse economic conditions were largely responsible. During this time, most of the pumps were centrifugal and used kerosene and other low-grade fuels for power.

Beginning with World War II, major changes occurred in pump irrigation. Between 1940 and 1950, about 140 new irrigation wells were installed and 12 older ones were reactivated. During this decade, pump-irrigated land increased from less than 900 to more than 16,000 acres, and the annual pumpage increased from about 2,600 to more than 51,000 acre-feet.

In 1950, 150 of the 190 irrigation pumps in the Area were electrically driven turbine pumps delivering 400 to 2,500 gallons per minute, but chiefly 900 to 1,200 gallons per minute. They consumed more than 6 million kilowatt-hours of electrical energy at an average cost of slightly less than 1.7 cents per kilowatt-hour (*11*). The electric pumps are not equipped with meters to measure the actual quantity of water pumped. Pumpage estimates are based primarily on the energy used seasonally by each pump.

In 1950, the discharge of several representative wells was checked with a Hoff current meter. By comparison with weir measurements, this meter gives the best results when discharge is a smooth uniform flow through a full horizontal pipe. From discharge, pumping lift, and energy input measurements, tests made at twelve wells indicated it requires an average of 1.82 kilowatt-hours of electricity to raise an acre-foot of water one foot (*11*).

Except from some shallow wells, the water used for irrigation and domestic purposes in the Area is of good quality. Table 15 gives chemical analyses from a number of water sources in the Area, arranged approximately from north to south. These data indicate that the more highly mineralized waters are in the east-central part of the Area, in the lower basin. The best quality waters are in the areas recharged principally by Shoal Creek and Crestline Wash; the poorest are in the northern and eastern parts of the Area. In general, the better water comes from wells where the water table is more than 30 feet from the surface, and the least desirable waters, from wells where the water table is less than 15 feet below the surface. Throughout the Area, the most highly mineralized waters are obtained from wells less than 100 feet deep, or from wells that have been perforated to allow entry of water from shallow depths. Some fluctuation in water quality from season to season has been noted, particularly in the shallower wells. In wells that are more than 100 feet deep, the fluctuations in quality are slight and are probably the result of underground movements to replace the water pumped during the irrigation season.

Permits to drill irrigation wells must be obtained from the Utah State Engineer in Salt Lake City. At present, no additional permits are being granted until studies can be completed as to the changes in the water table resulting from present pumping practices.

As nearly as can be determined now, the recharge is completely dependent upon rainfall in the Area and the contributing drainages. No outside contributing subsurface area is known. The exact quantity of the original underground reservoir of water is unknown, but estimates place it at several million acre-feet. The upper surface of this subterranean water is nearest the surface in the lower basin part of the Area. It becomes steadily deeper to the south toward Newcastle and Enterprise and to the west toward Modena. At Websters Well, a flowing artesian well just west of Table Butte, the water table is about 4 feet from the surface. At Garyville the depth is about 45 feet. Pumping changed the position of the water table surface considerably between 1939 and 1949. The greatest changes have occurred near Garyville, the area of greatest concentration of irrigation wells. Throughout the pump-irrigated area the decline was more than 2 feet, and in the most heavily pumped area it was more than 8 feet.

The future of pump irrigation in the Area depends upon the solution of several problems. The Area is a closed basin. It discharges ground water by flow northeastward past Lund beneath the valley floor, and by evaporation and transpiration of plants where the water table is close enough to the surface. Under natural conditions, the exact annual recharge and discharge of water is unknown, but studies to date indicate they are about equal and approximately 10,000 acre-feet per year.

The movement of ground water northeastward past Lund is suggested by water table contours of approximately 3 feet per mile under the central part of the valley. Logs of wells near Lund indicate that most of the sediments are clays, however, and generally poor transmitters of water. Because of the low groundwater gradient and small proportion of permeable material, it has been estimated that underground discharge from the Beryl-Enterprise Area does not exceed several hundred acre-feet per year (*16*). Estimates made by White of losses from evaporation and plant transpiration from the ground water for the area near Beryl were about 5,000 acre-feet. Farther northeastward toward Lund, the water table is closer to the surface, and

TABLE 15.—*Chemical analyses of water in wells*

[Where no figure is given,

Source of water	Depth of well	Date of collection	Specific conductance	Sodium	Total dissolved solids	Silica (SiO_2)
Wells, by location and number:	*Feet*		*Millimhos per cm. at 25° C.*	*Percent*	*Parts per million*	*Parts per million*
NW¼NE¼NW¼ sec. 25, T. 33 S., R. 16 W., No. 1	50	June 16, 1950	1. 06	77	703	61
NW¼SW¼NW¼ sec. 29, T. 33 S., R. 16 W., No. 1	--------	June 16 1950	1. 06	17	661	57
SE¼SW¼NE¼ sec. 17, T. 34 S., R. 16 W., No. 1	20	June 16, 1950	1. 74	75	1, 140	81
SE¼SW¼NE¼ sec. 17, T. 34 S., R. 16 W., No. 2	65	June 16, 1950	. 50	34	344	68
SW¼SW¼SE¼ sec. 28, T. 34 S., R. 16 W., No. 1	--------	June 16, 1950	1. 00	18	591	70
SW¼SW¼SE¼ sec. 30, T. 34 S., R. 16 W., No. 1	250	Aug. 22, 1949	. 47	23	321	62
SW¼SW¼NW¼ sec. 31, T. 34 S., R. 16 W., No. 3	22	Aug. 20, 1949	1. 22	28	687	----------
SW¼SW¼SE¼ sec. 3, T. 35 S., R. 15 W., No. 2	350	Aug. 22, 1949	2. 33	35	1, 610	68
SW¼NE¼NW¼ sec. 10, T. 35 S., R. 15 W., No. 1	42	Aug. 22 1949	8. 21	42	5, 650	63
SW¼SE¼NW¼ sec. 10, T. 35 S., R. 15 W., No. 1	271	Apr. 25, 1950	1. 78	32	1, 150	62
SW¼SW¼SW¼ sec. 23, T. 35 S., R. 15 W., No. 1	100	Apr. 25, 1950	. 66	13	407	48
NW¼NW¼NW¼ sec. 7, T. 35 S., R. 16 W., No. 1	95	June 15, 1950	1. 55	13	933	63
SE¼SE¼SE¼ sec. 29, T. 35 S., R. 16 W., No. 1	25	Aug. 22, 1949	. 78	19	362	----------
SE¼SW¼SE¼ sec. 32, T. 35 S., R. 16 W., No. 1	452	Aug. 22, 1949	. 53	13	273	----------
SW¼SW¼SE¼ sec. 12, T. 35 S., R. 17 W., No. 1	200	June 15, 1950	. 72	20	446	66
SE¼SE¼NW¼ sec. 13, T. 35 S., R. 17 W., No. 1	75	June 15, 1950	1. 77	18	1, 060	63
SE¼SW¼SE¼ sec. 4, T. 36 S., R. 15 W., No. 1	235	Apr. 28, 1950	. 84	38	538	58
SW¼NE¼SE¼ sec. 9, T. 36 S., R. 15 W., No. 1	170	June 15, 1950	1. 32	20	827	39
NW¼ sec. 4, T. 36 S., R. 16 W., No. 3	144	June 15, 1950	. 43	18	276	48
NE¼ sec. 5, T. 36 S., R. 16 W., No. 9	200	June 15, 1950	. 99	10	566	45
SW¼SE¼SE¼ sec. 13, T. 36 S., R. 16 W., No. 1	207	May 10, 1950	. 62	15	382	33
SW¼SW¼SW¼ sec. 1, T. 37 S., R. 17 W., No. 1	438	June 13, 1950	. 50	20	316	47
Springs:						
Modena town supply [3]	--------	Oct. 3, 1939	----------	46	----------	79
Sand Spring	--------	Apr. 24, 1950	. 55	13	282	19
Newcastle town supply	--------	June 15, 1950	. 83	29	533	45
Enterprise town supply	--------	June 13, 1950	. 30	25	217	55

[1] Based on table in "27th Biennial Report of State Engineer, July 1948 to June 30, 1950" (*11*) by Joseph M. Tracy, State Engineer. Analysis by the U.S. Geological Survey unless otherwise indicated.

[2] According to standards proposed by J. P. Thorne and D. W. Thorne, "Irrigation Waters of Utah," Bulletin 346, Utah Agricultural Experiment Station and Soil Conservation Service, June 1951 (*9*). Class 1 water can be used safely on all soils. Class 2 water can cause salt problems where drainage is poor and leaching of residual salts from previous irrigations is not consistently practiced. Class 3 water can be used with crops having moderate to high salt tolerance on soils of moderate permeability and with irrigation practices that provide some leaching. Class 4 water can be used only on highly salt-tolerant crops growing on moderately permeable;

discharge of ground water by evaporation and plant transpiration is greater. The total discharge from these sources is thus believed to be about double White's estimates, or about 10,000 acre-feet per year.

Inasmuch as annual discharge very nearly equals recharge under natural conditions, pumpage to date has been taken chiefly from the original accumulated water storage in the valley fill. Not all of this pumpage has been net loss, however, for seepage losses have returned some pumped water to the underground reservoir. Although current pumping rates cannot be maintained indefinitely, there is no danger of an early or sudden exhaustion of ground water unless the pumping rate is increased greatly above that of 1950. Pumping at 1950 rates would require approximately 20 years to exhaust 1 million acre-feet of water, and there are probably several million acre-feet of water in the underground reservoir. At present, the water table in the pumping district is declining less than 2 feet per year. The increased pumping energy needed is the principal factor in the increasing cost. In time, this cost could be considerable unless electricity rates are reduced. In addition, entry of poorer quality water is also a possibility, especially from the shallower wells, if the water table continues to decline. There may also be some decreases in crop yields. On the other hand, the development of economical chemical processes to remove excess salts from water might make more instead of less water available and result in even higher yields.

Descriptions of the Soils

In this section, the soils and miscellaneous land types of the survey Area are described, and some characteristics that affect their use and management are summarized. The range site and capability unit of each soil when it is not irrigated are given. If the soil is irrigated or is suitable for irrigation, its capability unit under irrigation is given. More detailed information about the use, management, and productivity of the soils and land types in each capability unit or range site is given in the sections, Management of Irrigated Soils, and Range Management.

The location and distribution of the individual soils are shown on the detailed soil map in the back of this report. The approximate acreage and proportionate extent of each soil are given in table 16.

Antelope Springs series

The soils of the Antelope Springs series were derived from deep deposits of reddish-brown, medium textured *and springs in the Beryl-Enterprise Area* [1]

information was not recorded]

Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total hardness as $CaCO_3$	Class[2]
Parts per million	*Parts per million*	*Parts per million*	*Parts per million*	*Parts per million*	*Parts per million*	*Parts per million*	*Parts per million*	*Parts per million*	
38	7. 8	190	245	166	117	------------	2. 5	127	2B
132	28	43	205	133	160	------------	6. 9	444	2A
55	22	318	482	195	219	1. 9	9. 1	228	2B
42	15	40	166	57	39	1. 0	0	166	1A
118	23	39	159	66	194	------------	2. 6	389	2A
54	11	25	166	64	20	. 5	2. 7	180	1A
137	20	77	186	183	172	------------	6. 6	424	2A
183	92	206	208	628	318	. 3	11	835	3A
568	317	917	254	1, 750	1, 900	. 2	5. 2	252	3B
152	62	136	190	344	295	. 2	. 5	634	3A
75	24	20	175	79	73	------------	1. 5	286	1A
212	37	45	220	149	307	. 3	11	681	2A
83	16	29	200	41	88	------------	6. 4	273	2A
66	14	15	176	20	66	------------	5. 3	222	1A
84	17	31	160	57	110	------------	2. 2	280	1A
221	41	73	126	110	435	. 4	57	720	3A
81	16	77	310	69	68	------------	16	268	2A
166	30	62	340	60	144	. 1	158	538	2A
53	11	18	176	15	37	------------	6. 9	178	1A
132	25	22	197	55	177	. 2	13	432	2A
72	24	22	222	71	49	------------	1. 6	278	1A
64	12	24.	250	16	25	------------	4. 6	209	1A
53	5	60	------------	53	60	------------	([4])	133	------------
65	13	15	160	20	64	------------	6. 9	216	1A
83	31	61	388	54	65	. 2	2. 5	334	2A
33	9. 4	18	164	6. 6	12	. 6	1. 2	121	1A

well-drained soils under careful irrigation and soil management practices. Class 5 water is generally unsuited for use except under very special conditions.

Water in subclass A contains less than 4 percent exchangeable sodium at equilibrium, which should cause no difficulty from accumulation of sodium in irrigated soils. Water in subclass B contains between 4 and 8 percent exchangeable sodium at equilibrium. In poorly drained, fine-textured soils that do not contain gypsum or lime, when small quantities of water are applied each irrigation, sodium may accumulate, but usually not in quantities that will cause serious injury to crops.

[3] Analyses furnished by the State Chemist of Utah.

[4] Trace.

to moderately fine textured alluvium that overlie older basin sediments. The parent alluvium is derived chiefly from rhyolite, andesite, basalt, granite, sandstone, limestone, and other rocks. Thin deposits of new alluvium are occasionally added to these soils by runoff from higher areas. The watercourses are intermittent and very shallow. The vegetation is mainly greasewood and shadscale.

The Antelope Springs soils are deep, well drained, and nearly level. The surface soil is reddish brown, slightly hard, and granular. The subsoil is reddish brown and hard and has a subangular blocky structure. The substratum is pinkish white, hard, and generally massive. In a few areas, dark-colored horizons of an older buried soil are present in the subsoil and substratum. In some areas, a dark-colored overwash has been deposited on the surface.

These soils are calcareous to the surface. The highest areas are slightly affected by alkali, chiefly in the subsoil. The areas at intermediate elevations are moderately affected by alkali. The lowest areas are both strongly saline and strongly affected by alkali. There is very little or no gypsum in the profile.

In the Beryl-Enterprise Area, the Antelope Springs soils occupy considerable areas on the valley floor. They are associated principally with the Uvada soils.

Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes (Aa).—This soil occurs in the higher parts of the basin. It is associated principally with soils of the Beryl, Escalante, and Heist series. A representative profile in an area free of vegetation follows:

- 0 to 3 inches, silt loam crust; pink and soft when dry, brown and very friable when moist; moderately calcareous; moderately alkaline; platy structure, vesicular.
- 3 to 6 inches, silty clay loam; reddish brown and slightly hard when dry, dark reddish brown and friable when moist; moderately calcareous; moderately alkaline; granular structure.
- 6 to 13 inches, clay loam; reddish brown and hard when dry, darker reddish brown and firm when moist; very strongly calcareous; moderately alkaline; subangular blocky structure.
- 13 to 18 inches, clay; brown and hard when dry, brown and firm when moist; very strongly calcareous; moderately alkaline; massive to subangular blocky structure.
- 18 to 48 inches +, clay; pinkish white and hard when dry, light brown and firm when moist; very strongly calcareous; moderately alkaline; massive to subangular blocky structure.

Stratification of the subsoil and parent material varies. The texture of the subsoil and substratum ranges from silt loam to light clay. In some places the subsoil and substratum contain dark-colored horizons of material like that of buried Red Rock soils.

TABLE 16.—*Approximate acreage and proportionate extent of the soils mapped*

Map symbol	Soil	Area	Extent
		Acres	*Percent*
Aa	Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes	2, 583	0. 7
Ao	Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes	782	. 2
Am	Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes	8, 585	2. 2
Ar	Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes	1, 514	. 4
Be	Berent loamy fine sand, 0 to 2 percent slopes	2, 302	. 6
Bf	Beryl very fine sandy loam, 0 to 1 percent slopes	1, 076	. 3
Bo	Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes	1, 014	. 3
Br	Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes	18, 866	5. 0
Bs	Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes	321	. 1
Bt	Beryl soils-Dune land association	702	. 2
Bu	Bullion silty clay loam, 0 to 1 percent slopes	1, 158	. 3
Ce	Crestline fine sandy loam, 0 to 3 percent slopes	13, 579	3. 6
Cg	Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes	1, 226	. 3
Da	Dixie loam, 0 to 2 percent slopes	29, 209	7. 7
Dg	Dixie gravelly loam, 0 to 3 percent slopes	26, 602	7. 0
Dk	Dixie stony loam, 2 to 5 percent slopes	4, 660	1. 2
Dt	Dixie very stony loam, 2 to 7 percent slopes	1, 428	. 4
Du	Dune land	10, 064	2. 6
Er	Escalante very fine sandy loam, 0 to 1 percent slopes	3, 833	1. 0
Es	Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes	515	. 1
Ec	Escalante fine sandy loam, 0 to 1 percent slopes	11, 347	3. 0
Eh	Escalante fine sandy loam, hummocky, 0 to 1 percent slopes	9, 777	2. 6
Ee	Escalante fine sandy loam, eroded, 0 to 1 percent slopes	1, 647	. 4
Eo	Escalante fine sandy loam, overwashed, 0 to 1 percent slopes	130	(1)
Et	Escalante silt loam, overwashed, 0 to 1 percent slopes	2, 215	. 6
Ey	Escalante-Heist fine sandy loams, 0 to 1 percent slopes	775	. 2
Ge	Genola loam, 0 to 2 percent slopes	6, 293	1. 6
Gs	Genola loam, slightly alkali affected, 0 to 1 percent slopes	194	(1)
Hf	Heist fine sandy loam, 0 to 3 percent slopes	9, 273	2. 4
Mf	Modena fine sandy loam, 0 to 3 percent slopes	3, 356	. 9
Mo	Modena silt loam, overwashed, 0 to 1 percent slopes	614	0. 2
Ms	Mosida fine sandy loam, 0 to 1 percent slopes	4, 013	1. 0
Mt	Musinia silty clay loam, 0 to 1 percent slopes	291	. 1
Na	Navajo silty clay, moderately alkali affected, 0 to 1 percent slopes	287	. 1
Ne	Neola sandy loam, 0 to 3 percent slopes	27, 095	7. 1
Nh	Neola sandy loam, hummocky, 0 to 5 percent slopes	1, 029	. 3
Nk	Neola stony sandy loam, 2 to 7 percent slopes	3, 324	. 9
Nm	Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes	1, 168	. 3
Nr	Newcastle gravelly loam, 2 to 7 percent slopes	6, 295	1. 6
Ny	Newcastle stony loam, 2 to 12 percent slopes	3, 336	. 9
Py	Playas	943	. 2
Re	Redfield loam, 0 to 2 percent slopes	1, 362	. 4
Rf	Redfield silt loam, 0 to 1 percent slopes	1, 171	. 3
Rk	Red Rock silt loam, 0 to 1 percent slopes	4, 262	1. 1
Rw	Riverwash	814	. 2
Ry	Rough broken and stony land	44, 191	11. 6
Se	Sevy sandy clay loam, 0 to 2 percent slopes	9, 013	2. 4
Ta	Terrace escarpments	1, 518	. 4
Te	Timpahute sandy loam, 0 to 2 percent slopes	4, 862	1. 3
Tg	Timpahute gravelly sandy loam, 0 to 3 percent slopes	614	. 2
Ts	Timpahute stony sandy loam, 2 to 5 percent slopes	6, 354	1. 7
Tv	Timpahute very stony sandy loam, 2 to 7 percent slopes	5, 441	1. 4
Pc	Tomas silt loam, 0 to 1 percent slopes	11, 471	3. 0
Ty	Tours silty clay loam, 0 to 1 percent slopes	1, 090	. 3
Ua	Uvada loam, 0 to 2 percent slopes	7, 391	1. 9
Uo	Uvada silt loam, overwashed, 0 to 1 percent slopes	823	. 2
Ud	Uvada silt loam, 0 to 1 percent slopes	1, 362	. 4
Us	Uvada and Antelope Springs soils, 0 to 1 percent slopes	25, 019	6. 6
Ut	Uvada and Antelope Springs soils, hummocky, 0 to 1 percent slopes	2, 263	. 6
Ux	Uvada, Antelope Springs, and Heist soils, 0 to 1 percent slopes	5, 785	1. 5
Uv	Uvada, Antelope Springs, and Crestline soils, 0 to 1 percent slopes	11, 502	3. 0
Uw	Uvada soils-Dune land association	1, 745	. 5
Za	Zane clay loam, 0 to 2 percent slopes	9, 006	2. 4
	Total	380, 480	100. 0

[1] Less than 0.1 percent.

Natural drainage is good; internal drainage is slow, and runoff is very slow. The erosion hazard is slight. The available water holding capacity is high. Roots penetrate deeply. The organic-matter content and the natural fertility are low.

This soil is free of toxic concentrations of salts, but it is slightly affected by alkali. In barren areas the alkali occurs principally in the subsoil. Under greasewood and shadscale plants the alkali is distributed throughout the profile. Very little or no gypsum is present.

Use and management (Semidesert alkali flats range site, capability unit VIIc-8 unirrigated, IIIs-3 irrigated).—Most of this soil is in spring and fall range.

Limited areas, principally southeast of Garyville, which is at the junction of State Highways 56 and 18, have been cleared of shrubs and irrigated by pumps.

Alfalfa is the crop best suited to this soil. Small grains, especially barley, are moderately well suited. Potatoes are not well suited. The lack of organic matter and nitrogen has not appreciably affected the growth of alfalfa, but the alkali in the subsoil has. Small grains require supplemental nitrogen. Potatoes need both nitrogen and phosphorus.

Light applications of gypsum, applications of manure, and occasional deep leaching should materially improve this soil. Because of the slow rate of infiltration and slow internal drainage, improvement would be slow and gradual.

Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes (Ao).—This soil has an overwash of dark-colored silt loam that is like the material of the Red Rock soils. In most places the overwash is 5 to 8 inches thick, but in some places it is more than 10 inches thick.

Because the surface layer is subject to wind action, there is a moderate hazard of erosion. The natural fertility is moderate, as a result of the dark-colored surface deposit.

Most of this soil is southeast of Garyville. It lies a little higher than Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IIIs–3 irrigated).—Most of this soil is under pump irrigation. The overwash allows more rapid infiltration of water and provides a better environment for the germination of seeds. Applications of manure and periodic deep leaching will improve this soil and reduce the amount of alkali in the subsoil.

Yields of alfalfa, small grains, and potatoes are higher on this soil than on Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes. The management needs of the two soils are similar.

Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes (Am).—In this soil, the strongest concentrations of alkali are in the subsoil, but some alkali occurs in the surface soil (fig. 4).

This soil occurs at lower elevations and nearer to the center of the basin than Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes, and it includes fewer areas that have a buried soil.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IVs–3 irrigated).—Most of this soil is in spring and fall range.

Small areas are under pump irrigation and are farmed with adjacent soils. In crop suitability this soil is similar to Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes. It is also similar in fertilizer requirements but shows less response to fertilization.

Improving this soil would require large applications of manure, moderate applications of gypsum, and deep leaching. Improvement would be gradual because of the slow rate of infiltration and slow internal drainage.

Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes (Ar).—This soil has a layer of dark-colored overwash that resembles Red Rock silt loam. In some places the overwash is as much as 10 inches thick, but in most places it is less than 5 inches. The concentration of alkali is strongest in the subsoil, but there is some alkali in the surface soil. The erosion hazard is moderate.

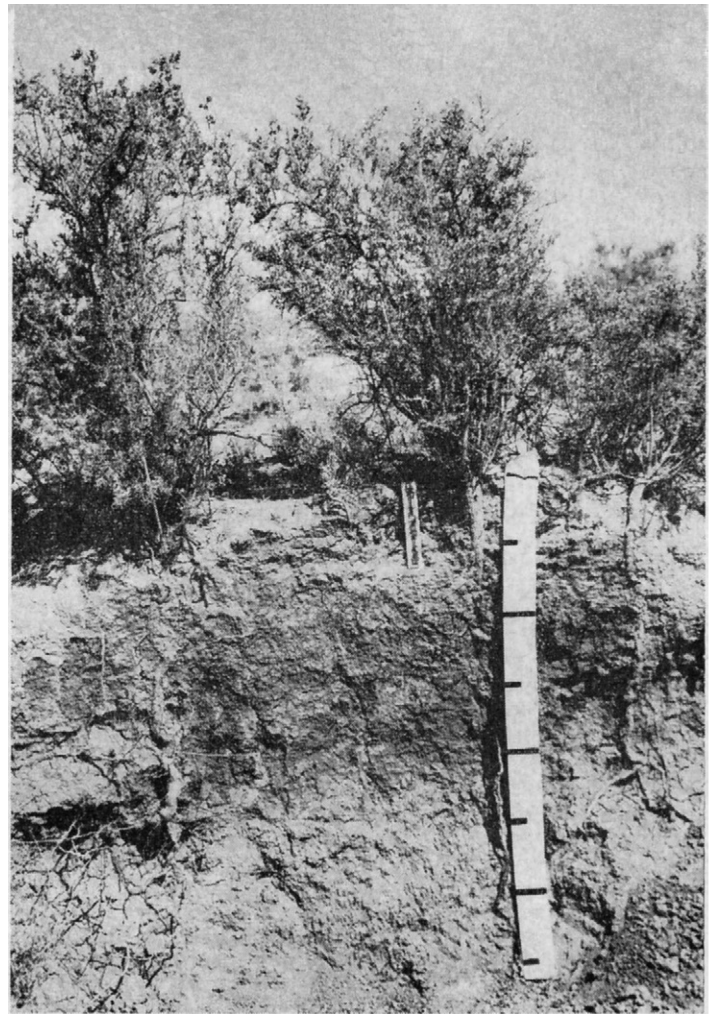


***Figure 4.*—Profile of Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes. Note the deep penetration of the root system of the greasewood shrubs. The profile contains more alkali directly beneath the greasewood plants than in the barren areas between them.**

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IVs–3 irrigated).—Most of this soil is in fall and spring range.

North and northwest of Newcastle are several areas that are on the fringes of pump irrigation.

This soil is similar to Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes, in crop suitability and in fertilizer requirements. Its response to fertilization is slightly better. The reclamation needs of the two soils are similar. The overwash on this soil improves its suitability for small grains.

Berent series

Berent soils formed in uniformly coarse-textured deposits on alluvial fans and flood plains. The parent material came chiefly from rhyolite but also from granite, andesite, basalt, and sandstone.

The surface of the Berent soils is somewhat undulating or gently sloping. It shows the effect of wind action. The vegetation on the somewhat older alluvial fans is mostly sagebrush, galletagrass, and, in places, some yellowbrush and three-awn grass. Along the stream courses on the more recent alluvial fans and flood plains, the vegetation is mainly rabbitbrush, sagebrush, and some willow and cottonwood trees.

The soils on the somewhat older alluvial fans are associated chiefly with soils of the Crestline series. The soils on recent alluvial fans and on flood plains are associated principally with the Red Rock and Mosida soils.

On the somewhat older alluvial fans, the soil is deep and somewhat excessively drained. The profile is free of salts and alkali, and most areas are noncalcareous to depths of more than 4 feet. The surface soil is light brown, soft, and massive. The subsoil is similar to the surface soil but slightly lighter in color. The substratum is pink, soft to slightly hard, and massive.

On the recent alluvial fans and flood plains, the soil is similar to that on the older alluvial fans, except for color. The surface soil is pale brown, the subsoil is very pale brown, and the substratum is brown. In some places the profile is stratified and includes lenses of finer textured material and also of gravelly material.

Berent loamy fine sand, 0 to 2 percent slopes (Be).—Except for the slightly darker color of the surface soil—a result of some accumulation of organic matter—and the removal of lime from the upper layers, the profile of this soil is nearly uniform. A representative profile, in an area free of vegetation on a somewhat older alluvial fan, follows:

0 to 6 inches, loamy fine sand; light brown and soft when dry, brown and very friable when moist; noncalcareous; neutral; massive.

6 to 36 inches, material that is similar to that in the surface soil but slightly lighter in color and mildly alkaline.

36 to 60 inches, loamy fine sand; pink and soft to slightly hard when dry, light brown and very friable when moist; weakly calcareous; moderately alkaline; massive.

The most common variations are in the depth to lime and in the amount of lime in the lower part. Typically, the lime content is low. In many places the soil contains little or no lime to a depth of more than 4 feet. In other places the lime is somewhat segregated and very weakly hardened or cemented, but such deposits are thin and discontinuous. Fine gravel is present throughout the profile, but the amount varies. The lower part of the profile contains more gravel than the upper horizons. In some places the substratum is gravelly.

On the more recent alluvial fans and flood plains the profile is similar to the one described but is moderately alkaline throughout. The surface soil is pale brown, the subsoil is very pale brown, and the substratum is brown. The soil is more stratified because of stream action. Thin lenses of coarse and moderately coarse materials are present, especially in the subsoil and substratum. Lenses or pockets of lime or gravelly material may be present at any depth in the profile. Some included areas have a moderately coarse textured subsoil.

The general drainage of this soil is somewhat excessive. Runoff is very slow, and internal drainage is very rapid. The available water holding capacity and natural fertility are low. Roots penetrate deeply. The erosion hazard is severe. This soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIIs–1 irrigated).—Most of this soil is used for fall and spring range.

Small areas on the higher, older alluvial fans have been cleared and pump irrigated. Considerable areas on the recent alluvial fans and flood plains along Shoal Creek near Enterprise are irrigated, both by surface diversion and by pump irrigation. The principal crops are alfalfa, barley, and potatoes. Yields are low unless the soil is well managed. Extra care must be used in management because of the severe wind-erosion hazard and low water-holding capacity. Phosphorus fertilizer is needed for legumes, and both nitrogen and phosphorus are needed for good yields of other crops. Potassium fertilizer may bring some response, especially under high levels of management.

Beryl series

The soils of the Beryl series were derived from pinkish, moderately coarse, old alluvial or lake sediments. These parent materials washed from rhyolite, andesite, basalt, sandstone, granite, limestone, and other rocks. The Beryl soils are extensive in the basin area; they are associated principally with the Escalante soils. The two kinds of soil are similar, but the subsoil of the Beryl soils is easier to penetrate.

Big rabbitbrush and sagebrush, with some greasewood, shadscale, and fourwing saltbush, are dominant on the less alkaline soils of this series. Shadscale, considerable greasewood, and scattered big rabbitbrush and sagebrush are on the strongly saline-alkali affected areas.

The Beryl soils are well drained, deep, and nearly level. They are light colored and strongly calcareous throughout. The surface soil is pink, soft, and massive to granular. The subsoil is pink, hard, and massive. The substratum is pink, slightly hard, and massive. In many areas the subsoil and the substratum are very weakly cemented. Thin, hardened lenses occur in the substratum. This material is strongly alkaline and appears to be hardened more by silica than by lime.

The higher areas are slightly saline-alkali affected, chiefly in the subsoil. The lower areas are strongly saline-alkali affected. Considerable gypsum is present in the profile.

These soils have a severe erosion hazard, especially in spring when strong southwesterly winds blow. Where dryland farming has been practiced, many areas now have a hummocky surface.

Beryl very fine sandy loam, 0 to 1 percent slopes (Bf).—This soil is slightly saline-alkali affected, chiefly in the subsoil. It occurs in the basin, a little above the Antelope Springs and Uvada soils and a little below the Escalante soils. A representative profile in an area free of vegetation follows:

0 to 1 inch, very fine sandy loam crust; pinkish white and soft when dry, light brown and very friable when moist; strongly calcareous; moderately alkaline; platy structure, vesicular.

1 to 16 inches, very fine sandy loam; pink and soft when dry, light brown and very friable when moist; strongly calcareous; moderately alkaline; massive to granular structure.

16 to 30 inches, fine sandy loam; pink and hard when dry, light brown and friable when moist; strongly calcareous; moderately alkaline; massive to very weakly cemented.
30 to 60 inches, fine sandy loam; pink and slightly hard when dry, light brown and very friable when moist; strongly calcareous; moderately alkaline; massive to very weakly cemented.

Hardened lenses and aggregates are present in the lower subsoil and in the substratum. Most of this material is strongly alkaline and only slightly calcareous. The cementing agent appears to be silica and not lime.

The natural drainage of this soil is good. Runoff is very slow, and internal drainage is medium. The available water holding capacity is moderate. Roots penetrate deeply. If this soil is not managed carefully, the erosion hazard is severe. The organic-matter content and the natural fertility are low. Considerable gypsum occurs in the profile.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–3 irrigated).—Most of this soil is used for spring and fall range.

Areas near Garyville have been cleared and pump irrigated. Alfalfa is the best crop, and it does well without additional fertilizer. Potatoes and small grains, principally barley, are moderately well suited. Potatoes need nitrogen and phosphorus, and barley needs nitrogen fertilizer. Small acreages of carrots and sugar beets have been grown with fair to good success.

The principal management problems are controlling wind erosion and increasing the content of organic matter. The soil should be moistened just before and immediately after cultivation to reduce the hazard of wind erosion. Adding manure, stubble mulching, or growing of green-manure crops will reduce the hazard of erosion by increasing the organic-matter content.

The slight amounts of salts and alkali in the subsoil are not a special problem. Periodic deep leaching should correct most of the salinity and alkalinity, because the soil contains gypsum.

Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes (Bo).—This soil has an overwashed layer of dark-colored silt loam like the material of the Red Rock soils. In most places the overwash is 4 to 6 inches thick, but in a few places it is only 1 to 2 inches thick, and in other places it is as thick as 10 inches. The erosion hazard is moderate.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–3 irrigated).—The use of this soil and its management problems are similar to those of Beryl very fine sandy loam, 0 to 1 percent slopes.

The dark-colored overwash is very important when this soil is irrigated. The overwash is high in organic matter and is the most fertile part of the soil. Prevailing tillage practices leave most of the overwash on the surface. The coarse clods that result appreciably reduce the hazard of wind erosion.

Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes (Br).—This soil is similar to Beryl very fine sandy loam, 0 to 1 percent slopes, except that it contains strong concentrations of salts and alkali. The amounts of salts and alkali vary from one place to another. In some places the concentration of soluble salts is only moderately strong, but in other places a soluble salt content of more than 2 percent has been measured. The pH of the soil is not excessively high, however, because the predominant salts are neutral in reaction.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IVs–4 irrigated).—This soil is predominantly in fall and spring range.

Small areas south of Beryl are under pump irrigation. The principal crops are alfalfa and barley. The barley needs nitrogen fertilizer. Yields are very erratic, and stands are uneven. Some formerly cultivated areas have been abandoned.

This soil can be reclaimed readily. The medium internal drainage, the moderate permeability, the moderately coarse substratum materials, and the presence of gypsum in the profile make the usual reclamation measures more effective. Heavy applications of manure and deep leaching would eliminate most of the excess soluble salts and greatly decrease the alkali problem. Little irrigation water is available, however, and it is more practical to use that water on more valuable soils nearby.

Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes (Bs).—The hummocky surface of this soil is the result of wind erosion, most of which took place during attempts to practice dryland farming. All dryland farming has been abandoned. Most of the hummocks are less than 5 feet high.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IVs–4 irrigated).—All of this soil is used for fall and spring range.

After the hummocks are leveled, reclamation is similar to that of Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes. It is not generally practical, however, to use the limited supply of irrigation water for this purpose, because there are better soils nearby.

Beryl soils-Dune land association (Bt).—This association consists of eroded areas of Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes, and areas of Dune land. The strong prevailing southwesterly winds have removed soil material from the Beryl soil during unsuccessful attempts at dryland cultivation. The material has been deposited in dunes, some of them more than 15 feet high, that are oriented from southwest to northeast.

The eroded Beryl soil is on the southwestern side of the Dune land. It is nearly level to somewhat hummocky. The sparse vegetation consists principally of greasewood, shadscale, and big rabbitbrush.

The slopes of the Dune land are short and variable. The soil material in the dunes is deep and excessively drained, low in fertility, and free of salts and alkali. Scattered big rabbitbrush and greasewood are the principal vegetation.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IVs–4 irrigated).—All of this association is used for fall and spring range.

It would be possible, though not economically practical, to reclaim the soils in this association. It would be necessary to level the dunes and then follow the procedure described for reclaiming Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes.

Bullion series

The parent materials of the Bullion soils came from rhyolite, andesite, sandstone, limestone, and reddish sedimentary rocks. These soils are more reddish in color than the associated Antelope Springs soils. In this Area, only one Bullion soil is mapped, principally in the basin area west and northwest of Newcastle. It is not extensive.

The soil is deep, well drained, and nearly level. The vegetation is mostly greasewood and shadscale.

The surface soil is red and slightly hard, and it has a granular to platy structure. The subsoil is reddish brown and hard, and it has a subangular blocky structure. The substratum is light reddish brown and hard, and its structure is subangular blocky to massive.

The soil is slightly affected by alkali, principally in the subsoil. It is strongly calcareous to the surface. Little or no gypsum is present in the profile.

Bullion silty clay loam, 0 to 1 percent slopes (Bu).—This soil is in nearly level basin areas, adjacent to Navajo, Sevy, and Escalante soils. It is finer in texture and redder in color throughout the profile than Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes, but it is otherwise similar. A representative profile in an area free of vegetation follows:

0 to 2 inches, silty clay loam crust; light reddish brown and slightly hard when dry, reddish brown and friable when moist; strongly calcareous; moderately alkaline; platy structure, vesicular.

2 to 7 inches, silty clay loam; red and slightly hard when dry, reddish brown and friable when moist; strongly calcareous; moderately alkaline; platy to granular structure.

7 to 16 inches, silty clay; reddish brown and very hard when dry, dark red and firm when moist; strongly calcareous; moderately alkaline; subangular blocky structure.

16 to 40 inches, heavy silty clay loam; reddish brown and hard when dry, dark reddish brown to dark red and firm when moist; very strongly calcareous; contains visible seams of lime; moderately alkaline; subangular blocky structure.

40 to 60 inches, silty clay loam; light reddish brown and hard when dry, red and firm to friable when moist; very strongly calcareous; moderately alkaline; massive to subangular blocky structure.

The subsoil and substratum may be slightly stratified. The textures vary from silt loam to light clay.

The natural drainage of this soil is good. Runoff is very slow, and internal drainage is slow. The hazard of erosion is slight. The available water holding capacity is high. Roots penetrate deeply. The organic-matter content and natural fertility are low.

This soil is free of toxic concentrations of salts. It is slightly affected by alkali. In bare areas the alkali is present principally in the subsoil. Under shrubs of greasewood or shadscale, the alkali is distributed throughout the profile. Little or no gypsum is present in the soil.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated, IIIs–3 irrigated).—Most of this soil is used for fall and spring range.

Small areas, principally west of Newcastle, have been cleared and pump irrigated. Alfalfa is the best crop; barley is moderately well suited; but potatoes are poorly suited.

The alkali in the subsoil slows the growth of the alfalfa, but the small amounts of nitrogen and organic matter do not have an appreciable effect. Small grains require supplemental nitrogen.

This soil could be considerably improved by applications of manure, light applications of gypsum, and deep leaching. The slow rate of infiltration, slow internal drainage, and moderately fine texture cause reclamation of the soil to be slow and improvement to be gradual.

Crestline series

The Crestline soils developed from gravelly and sandy alluvium that washed from rhyolite, andesite, basalt, sandstone, limestone, and other rocks. They occupy extensive areas on the lower margins of the older alluvial fans, where they are associated principally with soils of the Dixie and Neola series. In the basin, small areas of Crestline soils also occur at slightly higher elevations on isolated old bar or delta deposits that lie over gravel. These small areas are associated with Antelope Springs and Uvada soils. The dominant vegetation consists of sagebrush and galletagrass.

The soils are deep to moderately deep, well drained, and nearly level to gently sloping. The surface soil is light brown, slightly hard, and granular in structure. The subsoil is light brown, slightly hard, and subangular blocky in structure. The substratum is pink, slightly hard, and massive. The lime has been leached from the surface soil and upper subsoil. The entire profile is free of salts and alkali.

Crestline fine sandy loam, 0 to 3 percent slopes (Ce).—This soil occurs in fairly large areas on the lower margins of old alluvial fans and smaller elongated sand and gravel bars in the basin. A representative profile in an area free of vegetation follows:

0 to 1 inch, fine sandy loam crust; light brown and soft when dry, brown and very friable when moist; noncalcareous; neutral; platy structure, vesicular.

1 to 6 inches, fine sandy loam; light brown and slightly hard when dry, brown and very friable when moist; noncalcareous; mildly alkaline; granular structure.

6 to 12 inches, heavy fine sandy loam; light brown and slightly hard when dry, brown and friable when moist; noncalcareous; mildly alkaline; subangular blocky structure.

12 to 36 inches, gravelly sandy loam; pink and hard when dry, light brown and very friable when moist; strongly calcareous; moderately alkaline; massive; in some places very weakly cemented by lime.

36 to 60 inches, gravelly sandy loam; pink and slightly hard when dry, light brown and very friable when moist; strongly calcareous; moderately alkaline; massive.

Where this soil adjoins the Dixie soils, the subsoil contains more clay and has a stronger structure. In some places, thin, lime-cemented plates are present in the lower subsoil.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. If the soil is not well managed, the erosion hazard is severe. The available water holding capacity is moderate. Roots penetrate deeply. The organic-matter content and the natural fertility are low. The soil is free of toxic salts and alkali.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIs–2 irrigated).

—Most of this soil is in fall and spring range. For grazing cattle, the most important improvements would be to eliminate the sagebrush and to plant adapted grasses. Grasses are difficult to establish because of the erratic and low rainfall, but the carrying capacity of the range can be multiplied many times. For grazing sheep, complete elimination of sagebrush is not necessary.

Extensive areas of this soil north of Enterprise are under pump irrigation. Most irrigated areas have a pumping lift of less than 100 feet. Where the pumping lift is more than 100 feet, the soil is generally left in range. Alfalfa, barley, and potatoes are the principal crops under irrigation. Potatoes are particularly well suited to this soil. Alfalfa does moderately well without fertilization. Small grains require nitrogen, and potatoes need both nitrogen and phosphorus.

To reduce the hazard of erosion, the soil should be moistened just before cultivation and immediately afterward. Applying manure, stubble mulching, and planting green-manure crops will increase the content of organic matter and help to reduce erosion.

Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes (Cg).—This soil is like Crestline fine sandy loam, 0 to 3 percent slopes, except that it has a substratum of very gravelly sand that begins at an average depth of about 28 inches. The available water holding capacity is low, and root penetration is moderately deep. The gravel content of the profile varies from place to place, and the depth to the calcareous lower subsoil also varies. The depth to the gravelly substratum ranges from 20 to 36 inches.

This soil occurs on the slightly higher, nearly level, old delta deposits of sand and gravel south of Beryl in the upper basin area.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIIs–1 irrigated).—This soil is used mostly for fall and spring range. A few areas are pump irrigated. The management problems are similar to those of Crestline fine sandy loam, 0 to 3 percent slopes. Yields are somewhat less because the water-holding capacity is lower and the depth of rooting is more limited.

Dixie series

Soils of the Dixie series developed from very thick deposits of brownish, poorly assorted sandy sediments, gravel, and cobbles. This material came chiefly from rhyolite, andesite, and basalt, and partly from sandstone and quartzite. These soils occupy large areas on old alluvial fans (fig. 5). They are associated principally with Neola soils. The Dixie soils are typically higher on the fan than the Crestline soils and lower than the Timpahute soils.

The slopes range from very gently sloping and undulating to sloping. The soils range from very slightly gravelly to very stony. The steeper soils in this series have the more stony profiles. The dominant vegetation is sagebrush and galletagrass.

The Dixie soils are shallow to moderately deep over a hardened caliche horizon in the lower subsoil. They are well drained. The lime has been leached from the surface soil and upper subsoil. The surface soil is brown, soft, and granular in structure. The subsoil consists of a reddish-brown, slightly hard, noncalcareous, subangular blocky horizon of clay enrichment, over a weakly to strongly cemented caliche. The substratum is very pale brown, soft, and massive. The content of gravel and

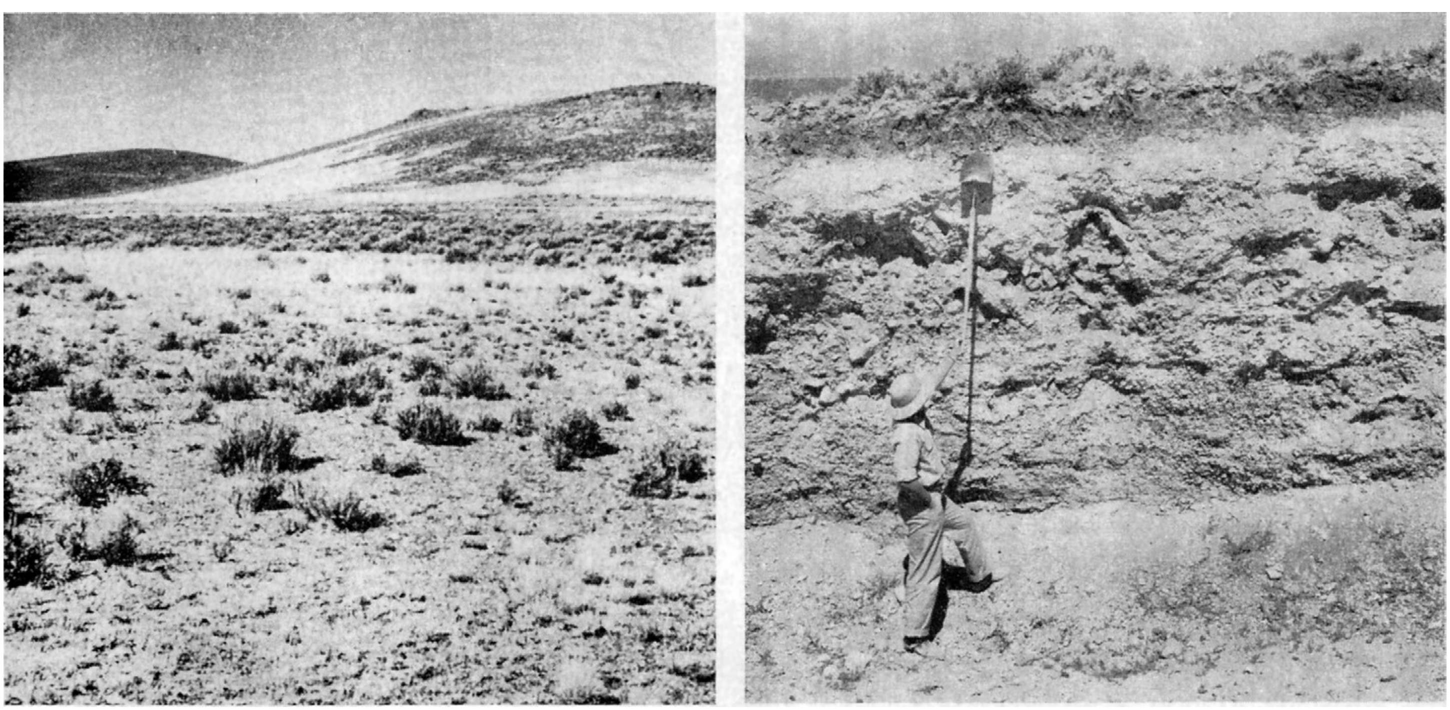


Figure 5.—**Landscape of sagebrush and galletagrass on Dixie gravelly loam, 0 to 3 percent slopes, with Rough broken and stony land in background. The profile of the same soil, taken a few feet away, shows the dark surface and upper subsoil horizons. The lower subsoil, beginning at the shovel point, is a strongly cemented caliche. The subsoil consists of sand, gravel, and cobblestones.**

stones increases with depth. The profile is free of salts and alkali.

Dixie loam, 0 to 2 percent slopes (Da).—This soil occupies gently sloping and undulating parts of old alluvial fans. It is a little higher on the fans than the Crestline soils and a little lower than Dixie gravelly loam, 0 to 3 percent slopes. A representative profile in an area barren of vegetation follows:

0 to 1 inch, loam crust; very pale brown and soft when dry, yellowish brown and very friable when moist; noncalcareous; mildly alkaline; platy structure, vesicular.
1 to 6 inches, loam; brown and soft when dry, dark brown and very friable when moist; noncalcareous; neutral; granular structure.
6 to 15 inches, clay loam; reddish brown and slightly hard when dry, slightly darker reddish brown and friable when moist; noncalcareous; mildly alkaline; subangular blocky structure.
15 to 36 inches, weakly to strongly cemented caliche; white when dry, very pale brown when moist.
36 to 60 inches, very gravelly sandy loam; very pale brown and soft when dry, yellowish brown and very friable when moist; strongly calcareous; moderately alkaline; massive.

In some places there is some gravel in the surface layer. The texture of the upper subsoil ranges from heavy loam to clay loam. The depth to the caliche and its degree of cementation vary.

The natural drainage is good. Runoff is very slow, and internal drainage is medium above the caliche and very slow through it. The erosion hazard is moderate. The available moisture holding capacity is low. Effective root penetration ranges from shallow to moderately deep. The organic-matter content and natural fertility are low. The soil is free of toxic salts and alkali.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated, IIIs–2 irrigated). —Fall and spring range is the principal use of this soil. The carrying capacity can be increased by eliminating sagebrush and by seeding palatable grasses.

A few areas with a pumping lift of 120 feet or less are under irrigation. Alfalfa, barley, and potatoes are suitable crops. Yields are low, chiefly because the soil is shallow above the caliche. Alfalfa requires little fertilizer. Barley requires nitrogen, and potatoes need both nitrogen and phosphorus.

Dixie gravelly loam, 0 to 3 percent slopes (Dg).—This soil is similar to Dixie loam, 0 to 2 percent slopes, except that the upper soil horizons are gravelly and the substratum is somewhat more stony and cobbly. Also, the position is higher and the average slope is slightly greater. The runoff is slow to very slow.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated, IIIs–2 irrigated). —All of this soil is used for fall and spring range. Elimination of sagebrush and seeding of adapted grasses would improve the range.

It is unlikely that this soil will be irrigated in the foreseeable future.

Dixie stony loam, 2 to 5 percent slopes (Dk).—This soil contains coarser material and larger stones than Dixie gravelly loam, 0 to 3 percent slopes. It lies higher on the old alluvial fans and nearer the mountains. The dominant slope is about 3 percent. Runoff is slow. The surface soil and subsoil are both stony.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated).—All of this soil is used for fall and spring range. The carrying capacity of this range is not so high as that of Dixie gravelly loam, 0 to 3 percent slopes, because of the stones on the surface and the slightly more rapid runoff. The carrying capacity can be improved by removing sagebrush and planting adapted grasses, but the stones make these management practices difficult.

This soil is not used for irrigated crops.

Dixie very stony loam, 2 to 7 percent slopes (Df).—This soil is similar to the other Dixie soils, except that it is very stony throughout. The stones range up to boulders in size. This soil is on the old alluvial fans and next to the mountains. The dominant slope is about 5 percent. Runoff is slow to medium.

Use and management (Semidesert stony loam range site, capability unit VIIc–5 unirrigated).—All of this soil is used for fall and spring range. The very stony surface and the runoff reduce the carrying capacity. Improving the range is almost impossible, because of the stones.

Dune land

Dune land (Du).—This miscellaneous land type consists of light-brown accumulations of loose, very strongly calcareous, moderately alkaline material. The dunes vary in size and shape but are predominantly from 5 to 30 feet high. Their longest axis is oriented from southwest to northeast.

These dunes are generally on the northeastern side of eroded Escalante soils in the basin area. The material appears to have been blown out of the Escalante soils by the prevailing southwesterly winds. Some of the dunes originated or enlarged during a former period of dryland cultivation, but most of them were in existence long before that time.

The vegetation is very sparse. It consists mainly of big rabbitbrush, a little sagebrush, and an occasional greasewood shrub. A few areas have some squawbush (fig. 6).

Figure 6.—**Squawbush growing on Dune land.**

Natural drainage is excessive. Internal drainage is very rapid, and little water runs off. The erosion hazard is severe. Nevertheless, the material is coarse enough to be fairly stable; it does not move readily. The available water holding capacity is low. Roots penetrate deeply. Natural fertility is low. This land contains no excess salts or alkali.

This miscellaneous land type is of little or no agricultural value. It provides very limited grazing. (Capability class VIII.)

Escalante series

The Escalante soils developed from moderately coarse textured old lake-laid sediments that washed chiefly from rhyolite and andesite but partly from sandstone, quartzite, and limestone. They are extensive in the basin area. They are associated principally with soils of the Beryl series.

The predominant vegetation is big rabbitbrush and sagebrush, along with scattered greasewood, shadscale, and fourwing saltbush.

These soils are well drained, deep, and nearly level. The surface soil is pink, soft, and massive to granular in structure. The subsoil is pinkish white, massive, and weakly cemented when dry but friable when moist. The substratum is pink, slightly hard, and massive. The weakly cemented caliche-like subsoil is the principal difference between the profile of the Escalante soils and that of the Beryl soils.

These soils are strongly to very strongly calcareous. They are slightly saline and slightly affected by alkali, principally in the subsoil. Variable amounts of gypsum are present in the profile.

The Escalante soils have a severe hazard of erosion when they are cultivated. The hazard is greatest in the spring when the prevailing southwesterly winds are strongest. The surface of many areas has been blown into hummocks.

Escalante very fine sandy loam, 0 to 1 percent slopes (Er).—This soil lies at elevations a little higher than the Beryl soils and a little lower than the Crestline, Sevy, and other soils on the old alluvial fans. A representative profile in an area barren of vegetation follows:

0 to 1 inch, very fine sandy loam crust; pink and soft when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; platy structure, vesicular.

1 to 12 inches, very fine sandy loam; pink and soft when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; massive to granular structure.

12 to 27 inches, fine sandy loam; pinkish white and hard when dry, pink and friable when moist; very strongly calcareous; moderately alkaline; massive; weakly cemented and caliche-like.

27 to 60 inches, sandy loam; pink and slightly hard when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; massive; contains some gravel.

The depth to the caliche-like subsoil ranges from 12 to 18 inches. The degree of cementation varies. In many places, thick beds of sand and gravel are present at depths below 40 inches. These materials are generally only slightly calcareous or in some places noncalcareous, but the reaction is moderately alkaline.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. The erosion hazard is severe. The available water holding capacity is moderate. Root penetration is deep. The organic-matter content and natural fertility are low.

This soil is slightly saline and slightly affected by alkali, principally in the subsoil. Variable amounts of gypsum are present in the profile.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—Most of this soil is used for spring and fall range.

Considerable areas near Garyville are pump irrigated. Alfalfa does well without additional fertilization, but phosphorus is helpful. Potatoes are moderately well suited to the soil, but they require both nitrogen and phosphorus fertilizers. Small grains, principally barley, are moderately well suited. They need nitrogen. Carrots and sugar beets have been grown in the past.

The control of wind erosion is a major management problem. If the soil is moistened shortly before it is cultivated and immediately afterwards, the hazard of wind erosion is greatly reduced. Erosion can also be reduced by increasing the content of organic matter. Adding manure, stubble mulching, or growing of green-manure crops will add organic matter to the soil.

The slight amounts of salts and alkali in the subsoil are not a serious problem. The saline-alkali condition is associated with the hardened caliche-like subsoil. When the subsoil is moistened with irrigation water, it softens and alkalinity of the subsoil decreases. Some gypsum is already present in the profile to help correct the alkali. Periodic deep leaching to depths of 5 feet or more ought to correct both the slight salinity and alkali and the problem of the hard caliche-like subsoil layer.

Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes (Es).—This soil is similar to Escalante very fine sandy loam, 0 to 1 percent slopes, except that it has an overwashed layer of dark-colored silt loam like the material of the Red Rock soils. In most places this overwash is 1 to 6 inches thick, but in some places it is as thick as 10 inches. The erosion hazard is moderate.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—This soil is used in much the same way as Escalante very fine sandy loam, 0 to 1 percent slopes, and it needs the same kind of management.

The dark-colored overwash layer contains more organic matter than the rest of the soil, and it is considerably more fertile. Where this overwash is thickest, it is very important in improving crop yields and in reducing wind erosion.

Escalante fine sandy loam, 0 to 1 percent slopes (Ec).—This soil is coarser textured throughout than Escalante very fine sandy loam, 0 to 1 percent slopes. The subsoil is sandy loam rather than fine sandy loam.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—Part of this soil is used for fall and spring range.

Some areas of this soil are under pump irrigation. Alfalfa, small grains, and potatoes are the principal crops. The chief management problem is the control of wind erosion. The slight amounts of salts and alkali in the subsoil are a minor problem, which can be corrected by periodic deep leaching.

Escalante fine sandy loam, hummocky, 0 to 1 percent slopes (Eh).—This soil is similar to Escalante fine sandy loam, 0 to 1 percent slopes. Hummocks of wind-blown soil material have accumulated around the base of shrubs. The hummocks are up to 5 feet in height.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIIs–4 irrigated).—The range areas of this soil are used and managed like Escalante fine sandy loam, 0 to 1 percent slopes.

If leveled and irrigated, this soil is the same as Escalante fine sandy loam, 0 to 1 percent slopes, in use suitability, management needs, and yields.

Escalante fine sandy loam, eroded, 0 to 1 percent slopes (Ee).—This soil is like Escalante fine sandy loam, 0 to 1 percent slopes, except that part or all of the surface layer has blown away. Some of the soil material has been deposited in small hummocks around the base of the scattered shrubs. The prevailing direction of wind movement is from southwest to northeast, and the areas are oriented in the same direction.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIIs–4 irrigated).—Most of this soil is used for spring and fall range.

In a few areas, principally near Garyville, this soil has been leveled and pump irrigated. When the caliche-like subsoil is exposed, it loosens somewhat. Irrigation water aids this loosening process. In some places, fill material from nearby dunes has been returned to the eroded area. In those areas where the subsoil has been loosened and some of the surface material has been returned, the use and management of the soil are similar to those of Escalante fine sandy loam, 0 to 1 percent slopes. Yields are somewhat lower. Small grains need nitrogen fertilizer. Alfalfa does not need nitrogen fertilizer if the seed has been properly inoculated with nitrogen-fixing bacteria. Alfalfa would probably grow better if phosphorus fertilizer were added.

Escalante fine sandy loam, overwashed, 0 to 1 percent slopes (Eo).—This soil is like Escalante fine sandy loam, 0 to 1 percent slopes, except that a layer of dark-colored silt loam like the material of the Red Rock soils has been washed onto the surface. In some places this overwash is as little as 1 inch in depth; in others it is as much as 10 inches. In most areas the overwash is less than 5 inches thick. The erosion hazard is moderate.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—This soil is used in much the same way as Escalante fine sandy loam, 0 to 1 percent slopes, and the management problems are similar. The dark-colored surface layer is the most fertile part of this soil because it contains a large amount of organic matter. Tillage that leaves this overwash in coarse clods on the surface reduces the hazard of wind erosion.

Escalante silt loam, overwashed, 0 to 1 percent slopes (Et).—This soil is similar to Escalante fine sandy loam, 0 to 1 percent slopes, except that it has a thick layer of brownish silt loam overwash that resembles the material of the Tomas soils. In most places this overwash is 3 to 10 inches thick, but in some places it is more than 10 inches thick.

Most of this soil occurs northwest of Garyville between areas of Tomas silt loam, 0 to 1 percent slopes, and Escalante fine sandy loam, 0 to 1 percent slopes. The Tomas soil material is shallow over material of Escalante fine sandy loam, but it is thick enough to cause the soil to be classified as silt loam instead of fine sandy loam.

The dominant vegetation on this soil is shadscale, some winterfat, and scattered sagebrush. The erosion hazard is moderate.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—Most of this soil is in fall and spring range.

Some of this soil is under pump irrigation. The same use and management are appropriate to this soil as to Escalante fine sandy loam, 0 to 1 percent slopes. The silty surface deposit reduces the erosion hazard and improves the natural fertility. The brownish overwash of Tomas soil material is lower in organic-matter content, lower in fertility, and less productive than the dark-colored overwash of Red Rock soil material that has been deposited on the Escalante fine sandy loam, overwashed, 0 to 1 percent slopes.

Escalante-Heist fine sandy loams, 0 to 1 percent slopes (Ey).—This complex consists of nearly equal acreages of Escalante fine sandy loam and Heist fine sandy loam. The Heist soil occurs on very slightly elevated mounds and gravelly channel deposits in areas of the Escalante soil. The Escalante soil is described under Escalante fine sandy loam, 0 to 1 percent slopes. The Heist soil is described under Heist fine sandy loam, 0 to 3 percent slopes.

Use and management (Semidesert limy flats range site, capability unit VIIc–7 unirrigated, IIs–4 irrigated).—A single large area of this complex occurs northwest of Garyville. Much of it is irrigated. The use and management problems are similar to those of Escalante fine sandy loam, 0 to 1 percent slopes.

When areas of this complex are leveled for irrigation, the Heist mounds are spread over the Escalante soil. The resulting soil is like Escalante fine sandy loam, 0 to 1 percent slopes, except that a little gravel has been added to the surface soil. The softening action of irrigation water on the caliche-like subsoil of the Escalante soil tends to make the two soils in this complex more nearly alike.

Genola series

The Genola soils developed in recent alluvial deposits that came principally from rhyolite, andesite, granite, and sandstone. They are associated chiefly with the Tomas soils. In most places the vegetation is sagebrush, along with some galletagrass and Indian ricegrass. A few areas are covered with greasewood instead of sagebrush.

These are deep, well-drained, strongly calcareous soils on nearly level to very gently sloping areas. The profile is medium in texture and brownish in color throughout. Variations in texture resulting from stratification are minor.

The surface soil is light brown, soft, and granular. The subsoil and the substratum are slightly lighter in color, slightly hard, and granular.

In most places these soils are free of salts and alkali. Directly beneath greasewood shrubs, the soils are slightly affected by alkali. They contain little or no gypsum.

Genola loam, 0 to 2 percent slopes (Ge).—This soil occupies a considerable area near Newcastle, along Pinto Creek. Smaller areas occur elsewhere, principally near Zane. A representative profile in a barren area follows:

0 to 2 inches, light loam crust; light brown and soft when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; platy structure, vesicular.

2 to 6 inches, light loam; light brown and soft when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; granular structure.

6 to 60 inches, light loam; slightly lighter colored than the layer above and slightly hard when dry, friable when moist; strongly calcareous; moderately alkaline; granular structure.

In some places the soil is somewhat stratified and contains lenses of moderately coarse to medium textured material. Some areas have a little gravel on the surface and in the profile.

The natural drainage is good. The runoff is very slow, and internal drainage is medium. The hazard of erosion is moderate. The soil has a moderate capacity for holding water available to plants. Roots penetrate deeply. The organic-matter content and the natural fertility are moderate. The profile is free of toxic concentrations of salts or alkali.

Use and management (Semidesert loam range site, capability unit VIIc–1 unirrigated, IIe–1 irrigated).—The principal use of this soil is for fall and spring range. The carrying capacity can be increased considerably by eliminating the sagebrush and planting adapted grasses.

Large areas near Newcastle are under irrigation. Water is pumped from wells or diverted from Pinto Creek. The quantity of water that can be diverted from the creek after June 1 is limited. The shortage of water at this season restricts crop yields.

Many crops are suited, but the principal ones grown are alfalfa, barley, and potatoes. Alfalfa does well without added fertilizer. Barley responds to nitrogen fertilizer, and potatoes to both nitrogen and phosphorus fertilizers.

Genola loam, slightly alkali affected, 0 to 1 percent slopes (Gs).—Only a few small areas of this soil are mapped in this survey, along intermittent streams that enter the valley from the mountains. The vegetation is chiefly greasewood, instead of the sagebrush that is common on Genola soils. Beneath the greasewood shrubs, the soil is slightly affected by alkali. In the barren areas between the shrubs, the profile is free of alkali and is similar to the profile of Genola loam, 0 to 2 percent slopes.

Use and management (Semidesert loam range site, capability unit VIIc–1 unirrigated, IIs–3 irrigated).—All of this soil is in fall and spring range. The range could be improved by removing the greasewood and planting adapted grasses. The greasewood should be removed from the area, not worked into the soil or burned on the site, for greasewood has an extremely high content of salts.

None of this soil is irrigated or cultivated. It could be reclaimed for such use if a water supply were available. There is not enough surface water for diversion irrigation, however, and the pumping lift is probably too great to be economical.

Heist series

The Heist soils developed in brownish, gravelly and sandy alluvium, which came chiefly from rhyolite, andesite, sandstone, quartzite, and some limestone. They occupy extensive areas, principally on the lower edges of the older alluvial fans and, in the basin area, on isolated bars that are slightly higher in elevation. The soils nearby belong to the Crestline, Escalante, Beryl, Antelope Springs, and Uvada series. The predominant vegetation is big rabbitbrush, sagebrush, and some yellowbrush.

These soils are deep and well drained. Slopes are nearly level to very gentle.

The soils are relatively uniform. The surface soil is light brown, soft, and massive to granular in structure. The subsoil is pink, hard, massive, and very weakly cemented. The substratum is light brown, loose, and single grained.

The Heist soils are calcareous to the surface, and they are free of salts and alkali. The amount of gypsum in the profile varies.

Heist fine sandy loam, 0 to 3 percent slopes (Hf).—This deep, calcareous, moderately coarse textured soil is widely distributed on the lower edges of the old alluvial fans or as bars slightly higher than the rest of the basin area. Most of the soil is nearly level to very gently sloping, but in a few areas the slopes are nearly 3 percent. A representative profile in an area free of vegetation follows:

0 to 12 inches, fine sandy loam; light brown and soft when dry, brown and very friable when moist; moderately calcareous; moderately alkaline; massive to granular structure; contains considerable fine gravel.

12 to 42 inches, sandy loam; pink and hard when dry, light brown and friable when moist; strongly calcareous, moderately alkaline; massive; very weakly cemented in places; contains considerable fine gravel.

42 to 60 inches, gravelly loamy sand; light brown and loose when dry, brown and loose when moist; moderately calcareous; moderately alkaline; single grained.

Thin, caliche-like layers weakly cemented by lime are discontinuous in the subsoil and substratum. These cemented layers usually soften when they are moistened. At least some gravel is present everywhere in the profile. Some included areas have a surface texture of loamy fine sand.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. The erosion hazard is severe. The available water holding capacity is moderate. Effective rooting is deep. The organic-matter content and the natural fertility are low.

This soil is free of toxic concentrations of salts and alkali. Gypsum occurs in varying amounts in the profile.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIs–2 irrigated).—This soil is used primarily for spring and fall range.

Some areas near Garyville have been pump irrigated. The principal crops are alfalfa, barley, and potatoes. Management needs are similar to those of Escalante fine sandy loam, 0 to 1 percent slopes.

Modena series

Soils of the Modena series were derived from alluvium that came from sandstone, rhyolite, and andesite. They occupy nearly level to gently sloping positions on recent alluvial fans. Most of the vegetation is sagebrush and galletagrass.

These soils are well drained and deep. The profile is somewhat stratified and moderately coarse in texture. The surface soil is light reddish brown, soft, and granular in structure. The subsoil and substratum are light reddish brown to yellowish red, slightly hard, and massive to granular in structure. The soil is calcareous to the surface, but it is free of salts and alkali.

Modena fine sandy loam, 0 to 3 percent slopes (Mf).—This moderately coarse textured soil occupies very gently sloping to gently sloping positions on recent alluvial fans, mostly southwest of Newcastle. Typically, it lies at lower elevations than the Newcastle soils and at higher elevations than Redfield loam. A representative profile in an area free of vegetation follows:

0 to 6 inches, fine sandy loam; light reddish brown and soft when dry, reddish brown and very friable when moist; moderately calcareous; moderately alkaline; granular structure. Some places have a platy and vesicular crust one-half inch thick on the surface; other places have no crust.

6 to 19 inches, fine sandy loam; light reddish brown and slightly hard when dry, reddish brown and friable when moist; strongly calcareous; moderately alkaline; massive to granular structure.

19 to 60 inches, fine sandy loam; yellowish red and slightly hard when dry, darker yellowish red and friable when moist; strongly calcareous; moderately alkaline; massive to granular structure.

Some gravel and a few stones may occur in the profile.

Natural drainage is good. Runoff is very slow to slow; internal drainage is medium. The erosion hazard is severe. The available water holding capacity is moderate. Root penetration is deep. The soil is low to moderate in organic matter and in natural fertility. It is free of toxic concentrations of salts or alkali.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIs–2 irrigated).—Nearly all of this soil is used for fall and spring range. The range could be improved considerably by eliminating the sagebrush and planting adapted grasses.

None of this soil is now irrigated, but some of it was previously watered by surface diversion from Pinto Creek. The irrigation was abandoned because of inadequate water supply and distance from the source.

When this soil is irrigated, it is suited to alfalfa, small grains, and potatoes. Alfalfa does well without added fertilizers. Small grains respond to nitrogen fertilizer, and potatoes respond to both nitrogen and phosphorus fertilizers. Irrigation should be done carefully, because the control of gully erosion on this soil is a problem.

A small area east of Enterprise is in dryland wheat. Yields vary extremely, but they are somewhat less than the yields on Redfield silt loam, 0 to 1 percent slopes.

Modena silt loam, overwashed, 0 to 1 percent slopes (Mo).—This soil is like Modena fine sandy loam, 0 to 3 percent slopes, except that an overwash of dark-colored silt loam like the material of the Red Rock soils has been deposited over its surface. The overwash is 4 to 8 inches thick in most places, but in a few areas it is as thick as 10 inches. The erosion hazard is moderate. The organic-matter content and the natural fertility are moderate.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIs–2 irrigated).—The use and management of this soil are much the same as for Modena fine sandy loam, 0 to 3 percent slopes. The dark-colored overwash slightly increases the water-holding capacity and natural fertility of this soil. It increases the yields somewhat.

Mosida series

The recent alluvium from which the Mosida soils developed was derived principally from rhyolite and andesite and partly from basalt, sandstone, granite, and limestone. The alluvium is dark in color and contains considerable organic matter because it washed from areas that receive more rainfall and support more vegetation than the soils at lower elevations. The vegetation is dominantly big sagebrush and rabbitbrush. It includes some Indian ricegrass and galletagrass.

The Mosida soils are deep, well drained, and nearly level. The texture is moderately coarse throughout the profile, and some mica is present. The surface soil is grayish brown, soft, and granular in structure. The subsoil and substratum are also grayish brown, or are a shade lighter in color. The subsoil and substratum are slightly hard and massive to granular in structure.

These soils are weakly to moderately calcareous. They are free of salts and alkali.

Mosida fine sandy loam, 0 to 1 percent slopes (Ms).—This soil is similar to Red Rock silt loam, 0 to 1 percent slopes, but it is coarser in texture throughout, is slightly lighter in color, and contains somewhat less organic matter. It occupies large areas along Shoal Creek near Enterprise and along Pinto Creek near Newcastle. It is associated with Red Rock silt loam, 0 to 1 percent slopes, but in most places it is at slightly higher elevations or where the stream water moved more rapidly and deposited coarser and more stratified materials. A representative profile in an area free of vegetation follows:

0 to 6 inches, fine sandy loam; grayish brown and soft when dry, very dark grayish brown and very friable when moist; noncalcareous; mildly alkaline; granular in structure.

6 to 60 inches, fine sandy loam; grayish brown and slightly hard when dry, dark grayish brown and friable when moist; weakly calcareous; moderately alkaline; massive to granular in structure.

This soil is considerably stratified in the subsoil and substratum. At depths of 3 feet or more, other soil materials occur in some places. The lime content varies from low to moderate.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. The erosion hazard is severe. The effective penetration of roots is deep. The available water holding capacity and the natural fertility are moderate. The soil is free of toxic salts and alkali.

Use and management (Semidesert sandy loam range site, capability unit VIIc–2 unirrigated, IIs–2 irrigated).

Some of this soil is still used for range. Most of it, however, is under either surface diversion or pump irrigation.

Alfalfa, barley, and potatoes are grown. Nitrogen fertilizer is needed for barley and potatoes, and phosphorus fertilizer is needed for potatoes. Irrigation water should be applied frequently and in small quantities. Careful management should be used for the control of wind erosion.

Musinia series

Soils of the Musinia series developed from recently deposited alluvium that washed from rhyolite, andesite, and some basalt, sandstone, granite, and limestone. They occupy nearly level positions on the recent alluvial fans. The vegetation is dominantly big sagebrush, and there is some Indian ricegrass and galletagrass.

These are deep, well-drained soils. The profile is dark colored throughout. The dark color of the sediments comes from organic matter that washed in from areas that are higher in elevation and that receive more rainfall and support more vegetation than the valley soils.

The texture of the Musinia soil is moderately fine throughout the profile. The surface soil is dark grayish brown to grayish brown, slightly hard, and granular in structure. The subsoil and substratum are grayish brown, hard, and massive to subangular blocky in structure.

There is some mica in the profile of these soils. The amount of lime they contain varies from low to moderate. The profile is free of salts and alkali.

Musinia silty clay loam, 0 to 1 percent slopes (Mt).—This soil is similar to Red Rock silt loam, 0 to 2 percent slopes, except that the Musinia soil has a silty clay loam texture throughout, and the Red Rock soil has a silt loam texture.

This is a minor soil. It occurs along the lower edge of deposits on the Shoal Creek alluvial fan. A representative profile in an area free of vegetation follows:

0 to 7 inches, silty clay loam; dark grayish brown to grayish brown and slightly hard when dry, very dark grayish brown and friable when moist; weakly calcareous; mildly alkaline; granular structure.

7 to 60 inches, silty clay loam; grayish brown and hard when dry, dark grayish brown and friable when moist; moderately calcareous; moderately alkaline; massive to subangular blocky structure.

In a few slightly depressed areas, the soil has strata of silty clay at the surface and in the profile, and there is some stratification with medium and moderately fine materials. In some places, other soil materials may be present at depths of more than 3 feet. The lime content ranges from slight to moderate.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. The available water holding capacity is high. Effective rooting is deep. The erosion hazard is slight. The organic-matter content and natural fertility are high. The soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert loam range site, capability unit VIIc–1 unirrigated, IIs–1 irrigated).—Some small areas are used for range. Most of the soil is pump irrigated. The principal crops are alfalfa, barley, and potatoes. The soil is not well suited to potatoes.

Larger but less frequent applications of water can be made in irrigating this soil, because of its high water-holding capacity. This soil is not so susceptible to blowing as some other soils.

Navajo series

The Navajo soils developed from recent alluvium that washed from sandstone, rhyolite, and andesite. Other soils nearby are of the Bullion, Tours, and Genola series. The vegetation is chiefly greasewood, shadscale, and fourwing saltbush.

These soils are moderately well drained and nearly level. The profile is fine textured and slightly stratified. The surface soil is reddish brown, slightly hard, and platy to granular in structure. The subsoil and substratum are reddish brown, hard, and massive to subangular blocky in structure.

These soils are strongly calcareous to the surface. The only soil of the Navajo series that was mapped in this area is moderately affected by alkali.

Navajo silty clay, moderately alkali affected, 0 to 1 percent slopes (Na).—This fine-textured soil occupies a small basinlike area west of Newcastle. Its reddish-brown color results from the reddish color of the sedimentary rocks southwest of Newcastle. A representative profile in a barren area follows:

0 to 1/4 inch, silty clay crust, reddish brown when dry, dark red when moist; platy structure, vesicular.

1/4 to 1 inch, silty clay; reddish brown and slightly hard when dry, dark red and friable when moist; strongly calcareous; mildly alkaline; granular in structure.

1 to 4 inches, silty clay; reddish brown and slightly hard when dry, dark red and friable when moist; strongly calcareous; mildly alkaline; platy structure.

4 to 60 inches, silty clay; reddish brown and hard when dry, darker reddish brown and firm when moist; strongly calcareous; moderately alkaline; massive to subangular blocky.

Under greasewood plants, the soil is strongly alkaline and the thin surface crust is absent.

The natural drainage is moderately good. Runoff and internal drainage are very slow. The available water holding capacity is low. The penetration of roots is shallow. The erosion hazard is slight. The organic-matter content and the natural fertility are low.

This soil is moderately affected by alkali, chiefly in the subsoil and substratum. There is no gypsum in the profile.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—All of this soil is used for spring and fall range. The possibilities for range improvement are limited.

Although Navajo soils are cultivated in other areas, none of this moderately alkali affected soil is irrigated or cultivated in this survey Area. Reclamation is not considered practical, as the soil is very slowly permeable, and even large amounts of gypsum would not counteract the alkali.

Neola series

The Neola soils developed in moderately coarse textured old alluvial deposits. This alluvium contains considerable gravel and stones, derived principally from rhyolite and partly from andesite. Neola soils occupy large areas on the old alluvial fans, where they are associated principally with the Dixie and Sevy soils. The dominant vegetation is yellowbrush. Indian ricegrass, galletagrass, and stunted sagebrush grow in some places.

These are shallow, well-drained soils. They range from very gently sloping to sloping. The surface soil is very pale brown, soft, and massive to granular in structure. The subsoil is a white, massive, strongly cemented caliche. The substratum is very pale brown, slightly hard, and massive.

The Neola soils are similar to the Escalante soils, with which they merge in several places, but the lime horizon of the Neola soils is thicker and more strongly cemented. The Neola soils are strongly calcareous to the surface. The profile is free of toxic salts and alkali.

Neola sandy loam, 0 to 3 percent slopes (Ne).—This soil occurs on very gently sloping to sloping old alluvial fans. Large areas are east of Modena and north of Zane. A representative profile in a barren area follows:

0 to 12 inches, sandy loam; very pale brown and soft when dry, light yellowish brown and very friable when moist; strongly calcareous; mildly alkaline; massive to granular in structure.

12 to 24 inches, caliche; white when dry, very pale brown when moist; very strongly calcareous; mildly alkaline; massive and strongly cemented.

24 to 60 inches, sandy loam; very pale brown and slightly hard when dry, light yellowish brown and very friable when moist; strongly calcareous; moderately alkaline; massive; contains some gravel and stones.

The thickness and cementation of the caliche subsoil varies. In some places it is several feet thick. It may include soft marly material. In some areas a few stones and pebbles are on the surface.

This soil has good natural drainage. Runoff is slow. Internal drainage is rapid until the water reaches the caliche layer, then it is very slow. The available water holding capacity is low. The erosion hazard is severe. Roots penetrate effectively only to shallow depths. The organic-matter content and natural fertility are low. The profile is free of toxic concentrations of salts and alkali.

Use and management (Semidesert shallow hardpan range site, capability unit VIIc–6 unirrigated, IVs–2 irrigated).—Most of this soil is in fall and spring range. The range could be improved somewhat by removing the brush and planting adapted grasses.

Little of this soil is irrigated, because the cemented caliche subsoil hinders drainage and because in most places the pumping lift is more than 120 feet. It is difficult to soften the caliche subsoil with irrigation water.

Some of the lower lying and very gently sloping areas at the edges of the old alluvial fans are under pump irrigation. The principal crops are alfalfa and barley. Potatoes and carrots are grown to some extent. This soil needs protection against wind erosion.

Neola sandy loam, hummocky, 0 to 5 percent slopes (Nh).—This soil is like Neola sandy loam, 0 to 3 percent slopes, except for hummocks up to 5 feet high. The soil occurs south and east of Zane. In this area, the edge of the old alluvial fan is abrupt, and it lies in a southwest-northeast direction parallel to the prevailing direction of the wind.

The surface soil has been extensively reworked by the wind. Big rabbitbrush is prominent in the vegetation. The effective rooting zone ranges from shallow to deep, depending on the position on a mound or between mounds.

Use and management (Semidesert shallow hardpan range site, capability unit VIIc–6 unirrigated).—All of this soil is in fall and spring range. Range improvement is difficult.

Neola stony sandy loam, 2 to 7 percent slopes (Nk).—This soil lies nearer to the mountains than Neola sandy loam, 0 to 3 percent slopes. It occurs high on the old alluvial fans and is associated principally with stony soils of the Dixie and Timpahute series. The dominant slope is about 5 percent. Stones are present all through the profile. The erosion hazard is moderate.

Use and management (Semidesert shallow hardpan range site, capability unit VIIc–6 unirrigated).—All of this soil is used for spring and fall range. The carrying capacity can be increased somewhat by removing brush and planting adapted grasses. These range improvement practices are very difficult to apply because of the stones on the surface.

Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes (Nm).—This complex consists of approximately equal parts of Neola sandy loam and Sevy sandy clay loam. It occurs southwest of Garyville.

Use and management (Complex of Semidesert shallow hardpan range site and Semidesert limy loam range site, capability units VIIc–6 and VIIc–3 unirrigated, IVs–2 irrigated).—Most of this complex is used for fall and spring range. The range can be improved by removing sagebrush and planting adapted grasses.

A number of areas are being developed for pump irrigation. Considerable leveling is required. Alfalfa, barley, and potatoes are the principal crops. The fertilizer and management requirements are similar to those for Neola sandy loam, 0 to 3 percent slopes, but the yields are higher.

Newcastle series

The Newcastle soils developed from brownish, medium-textured recent alluvium that came from rhyolite, andesite, basalt, and sandstone. The alluvium is gravelly to stony throughout. The soils occupy gently sloping to sloping positions high on the alluvial fans or in drainageways that are in or near the mountains. The vegetation is predominantly sagebrush and galletagrass.

These are well-drained soils. The surface soil is brown, soft, and granular in structure. The subsoil is brown, slightly hard, and granular. The substratum is light brown, slightly hard, and granular.

In some places the profile is calcareous to the surface, and in others as much as 18 inches of the upper soil contains no lime.

Newcastle gravelly loam, 2 to 7 percent slopes (Nr).—This soil occupies large areas on alluvial fans, especially near Newcastle and north of Beryl. A typical profile in an area free of vegetation follows:

0 to 8 inches, gravelly loam; brown and soft when dry, dark brown and very friable when moist; weakly calcareous; mildly alkaline; granular structure.

8 to 15 inches, gravelly loam; brown and slightly hard when dry, dark brown and friable when moist; weakly calcareous; mildly alkaline; granular structure.

15 to 60 inches, gravelly sandy loam; light brown and slightly hard when dry, brown and friable when moist; moderately calcareous; moderately alkaline; granular structure; content of gravel and stones increases with depth.

In some places this soil is noncalcareous to a depth of about 18 inches, and in others the soil is moderately calcareous to the surface. In some places stones are scattered on the surface and throughout the profile.

The natural drainage is good. Runoff is slow to medium, and internal drainage is medium. The erosion hazard is moderate. The available water holding capacity is low. The effective rooting zone is moderately deep. The organic-matter content and natural fertility are low. The soil is free of salts and alkali.

Use and management (Semidesert gravelly loam range site, capability unit VIIc–4 unirrigated, IVs–1 irrigated).—Almost all of this soil is used for fall and spring range. The range could be improved by eliminating the sagebrush and planting adapted grasses.

The possibility of irrigating this soil is slight, principally because of its high elevation, slope, and extremely high pumping lift. Little surface water is available for storage and diversion.

A few small areas above Enterprise have been used for dryland wheat.

Newcastle stony loam, 2 to 12 percent slopes (Ny).—This soil is like Newcastle gravelly loam, 2 to 7 percent slopes, except that it contains more coarse and stony materials throughout. Nearest the mountains on the highest alluvial fans, the materials may reach boulder size. Most of the slopes range between 3 and 7 percent, but in some places the slopes are as much as 12 percent.

Use and management (Semidesert gravelly loam range site, capability unit VIIc-4 unirrigated).—All of this soil is used for fall and spring range. Removing sagebrush and planting adapted grasses would improve the range, but these practices are difficult to apply because the soil is stony.

This soil cannot be irrigated, because of its slope, its stones, and its very high pumping lift.

Playas

Playas (Py).—This miscellaneous land type consists of nearly level basins of intermittent lakes that do not have surface outlets. The materials are light brown, stratified, platy, and medium to fine in texture. They are strongly to very strongly alkaline.

The natural drainage is very poor. Internal drainage is very slow, and water does not run off. At intervals, strongly saline and alkaline water drained from surrounding areas accumulates on the surface and disappears very slowly by evaporation or percolation. These evaporating waters frequently leave salt crusts and deposits.

There is practically no vegetation on these areas. They are of little or no use, except that when they are covered by water they are used by migratory wildlife (Capability class VIII).

Redfield series

Soils of the Redfield series developed on alluvial fans from recent alluvium derived from sandstone, rhyolite, and andesite.

The vegetation is predominantly sagebrush and galletagrass.

The soils are deep and well drained. They are nearly level to very gently sloping. The surface soil is light reddish brown to reddish brown, soft, and granular in structure. The subsoil and substratum are light reddish brown to yellowish red, slightly hard, and granular in structure. The texture is typically medium throughout the profile, but in some places the subsoil and substratum are somewhat stratified.

These soils are calcareous to the surface. The profile is free of salts and alkali.

Redfield loam, 0 to 2 percent slopes (Re).—This soil occurs on recent alluvial fans just below Modena fine sandy loam, 0 to 3 percent slopes, and the slopes are more gentle. A representative profile in an area free of vegetation follows:

0 to 6 inches, loam; light reddish brown to reddish brown and soft when dry, darker reddish brown and very friable when moist; moderately to strongly calcareous; moderately alkaline; granular structure.

6 to 19 inches, loam; light reddish brown to reddish brown and slightly hard when dry, darker reddish brown and friable when moist; strongly calcareous; moderately alkaline; granular structure.

19 to 60 inches, loam; yellowish red and slightly hard when dry, darker yellowish red and friable when moist; strongly calcareous; moderately alkaline; granular structure.

Some gravel may be present in the profile. In some places the lower subsoil and substratum are stratified.

The natural drainage is good. Runoff is very slow, and internal drainage is medium. The erosion hazard is moderate. The available water holding capacity is moderate. Roots penetrate deeply. The organic-matter content and natural fertility are low to moderate. The soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIe-1 irrigated).—Most of this soil is used for range, but a few areas are irrigated. Use and management problems under irrigation and in range are similar to those of Genola loam, 0 to 2 percent slopes.

Redfield silt loam, 0 to 1 percent slopes (Rf).—This soil contains slightly more organic matter and has a finer textured profile than Redfield loam, 0 to 2 percent slopes, but it is otherwise similar. It occupies nearly level recent alluvial fans along Cottonwood, Spring, and Shoal Creeks near Enterprise. The available water holding capacity is high. The natural fertility is moderate.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIc-1 irrigated).—Both pump and surface diversion irrigation are practical on this soil. Most of it is irrigated. Alfalfa, barley, and potatoes are the principal crops. Alfalfa does well without supplemental fertilization, but barley responds to nitrogen, and potatoes to both nitrogen and phosphorus.

A small area southeast of Enterprise is used for dryland wheat alternated with summer fallow. Yields average between 15 and 20 bushels per acre, but they vary considerably, depending on rainfall.

Small areas are used for fall and spring range. The range can be improved by eliminating sagebrush and planting adapted grasses.

Red Rock series

The Red Rock soils developed from recent alluvium that washed chiefly from rhyolite and andesite and partly from basalt, sandstone, granite, and limestone. The vegetation is dominantly big sagebrush and some Indian ricegrass and galletagrass.

These soils are deep, well drained, and nearly level. The surface soil is dark grayish brown to grayish brown, slightly hard, and granular in structure. The subsoil and substratum are similar, but they are somewhat stratified. The texture is usually medium throughout the profile. Some mica is present. The soil is free of salts and alkali. The relatively dark color of the entire profile is a result of the high content of organic matter in the sediments, which were derived from higher lying areas that receive more rainfall and support more vegetation than the soils in the valley.

Red Rock silt loam, 0 to 1 percent slopes (Rk).—This deep, dark-colored soil occupies a considerable area along Shoal Creek north and east of Enterprise and along Pinto Creek north of Newcastle. A representative profile in a barren area follows:

0 to 2 inches, silt loam crust; dark grayish brown to grayish brown and slightly hard when dry, very dark grayish brown and friable when moist; noncalcareous; mildly alkaline; platy structure, vesicular.

2 to 7 inches, silt loam; dark grayish brown to grayish brown and slightly hard when dry, very dark grayish brown and friable when moist; noncalcareous; mildly alkaline; granular structure.

7 to 60 inches, silt loam; grayish brown and slightly hard when dry, very dark grayish brown to dark grayish brown and friable when moist; weakly calcareous; moderately alkaline; in some places contains thin seams and flecks of visible lime at about 20 inches; massive to granular structure.

The subsoil and substratum in some places include stratified layers of medium to fine texture. In some places other soil materials occur at depths greater than 3 feet. The lime content ranges from slight to moderate.

This soil has good natural drainage. Runoff is very slow, and internal drainage is medium. The hazard of erosion is moderate. The available water holding capacity is high. The zone of effective rooting is deep. The organic-matter content and natural fertility are high. The soil is free of toxic concentrations of salts and alkali.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIc-1 irrigated).—Considerable areas of this soil are in fall and spring range. The carrying capacity can be increased by eliminating sagebrush and planting adapted grasses.

Large areas near Enterprise and Newcastle are under surface diversion and pump irrigation. The pumping lift, which is almost 100 feet in some places, is partly compensated for by the comparatively high yields and good response to management.

The principal crops are alfalfa, barley, and potatoes, but other crops can be grown. Alfalfa produces very well without additional fertilization, but barley requires nitrogen, and potatoes need both nitrogen and phosphorus for high yields. Management problems are minor.

Riverwash

Riverwash (Rw).—This miscellaneous land type consists of brownish, stratified materials of coarse to medium texture deposited by streams in nearly level to very gently sloping drainageways and on high alluvial fans. These materials contain various amounts of gravel and stones. Scattered sagebrush and big rabbitbrush are the principal vegetation.

The natural drainage is excessive. Runoff is very slow, and internal drainage is very rapid. The amount of overflow and deposition on these areas varies. The available water holding capacity is low. The erosion hazard is slight.

The effective rooting zone is shallow to very shallow. The materials contain very little organic matter, and the natural fertility is low. The materials are free of salts and alkali.

This miscellaneous land type has little agricultural value except for very limited grazing (Capability class VIII).

Rough broken and stony land

Rough broken and stony land (Ry).—This miscellaneous land type consists of rough, broken, and stony soil materials that are shallow to very shallow over bedrock. No attempt was made to differentiate the kinds of soil in this land type. The soil materials are coarse to medium in texture and brownish in color. The principal bedrock materials are rhyolitic, andesitic, and basaltic lava flows, reddish sandstones, and interbedded shale and limestone.

Most of this land type consists of the mountainous land that borders the survey Area on all except the northeastern margin. Outside the survey Area, these surrounding mountains rise more or less abruptly above the alluvial fan deposits to elevations of 7,000 feet or more.

The principal vegetation is scattered juniper. It also includes some pinyon pine, sagebrush, mountain-mahogany, and oak brush. Where the slopes are less abrupt, the vegetation is almost exclusively sagebrush and galletagrass.

Except for very limited use for grazing, this miscellaneous land type has no agricultural value (Capability class VIII).

Sevy series

The Sevy soils developed in alluvium that washed principally from rhyolite, andesite, basalt, and sandstone. They lie on old alluvial fans and are associated principally with the Neola soils. Sagebrush and galletagrass dominate the vegetation.

These well-drained soils are very gently sloping and undulating. The surface soil is reddish brown, slightly hard, and granular in structure. The subsoil consists of a reddish-brown, hard, subangular blocky horizon of clay accumulation over a pinkish, hard to weakly cemented horizon that is high in lime content. The substratum is pink, soft, and massive.

These soils are noncalcareous in the upper horizons. They have a conspicuous horizon of lime concentration in the lower subsoil. The profile is free of salts and alkali.

Sevy sandy clay loam, 0 to 2 percent slopes (Se).—This soil occupies very gently sloping and undulating old alluvial fans near Newcastle and north of Enterprise. A representative profile in an area free of vegetation follows:

0 to 1 inch, sandy loam crust; light brown and soft to slightly hard when dry, dark brown and very friable when moist; noncalcareous; neutral; platy structure, vesicular.

1 to 4 inches, sandy clay loam; reddish brown and slightly hard when dry, darker reddish brown and friable when moist; noncalcareous; neutral; granular structure.

4 to 13 inches, sandy clay loam; reddish brown and hard when dry, reddish brown and friable when moist; noncalcareous; neutral; subangular blocky structure.

13 to 16 inches, sandy clay loam; light brown and hard when dry, brown and friable when moist; moderately calcareous; moderately alkaline; subangular blocky structure.

16 to 34 inches, clay loam; pinkish white and hard to weakly cemented when dry, pink and friable when moist; very strongly calcareous; moderately alkaline; massive to subangular blocky structure.
34 to 60 inches, fine sandy loam; pink and soft when dry, brown and very friable when moist; strongly calcareous; moderately alkaline; massive.

The chief variations in the profile are in the depth to and degree of cementation of the very strongly calcareous lower subsoil. Through most of the mass, the limy material is friable and moderately penetrable. A thin, platy, indurated lime layer may be present, but it is not continuous. Figure 7 shows a profile of this soil that developed under sagebrush and galletagrass.

Figure 7.—**Profile of Sevy sandy clay loam, 0 to 2 percent slopes. The surface soil and upper subsoil are moderately well developed. The lower subsoil consists of a whitish, caliche-like concentration of lime. The alidade in the picture is 7½ inches long.**

This soil has good natural drainage. Runoff is very slow to slow, and internal drainage is medium. The erosion hazard is moderate. The available water holding capacity is high. Roots penetrate deeply. The organic-matter content and the natural fertility are low. The soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert limy loam range site, capability unit VIIc-3 unirrigated, IIIs-2 irrigated).—This soil is used mostly for fall and spring range. The range can be improved by eliminating the sagebrush and planting adapted grasses.

Some areas near Newcastle and north of Enterprise are under surface diversion or pump irrigation. The principal crops are alfalfa, barley, and potatoes. Alfalfa does comparatively well without additional fertilizer, but barley responds to nitrogen, and potatoes respond to both nitrogen and phosphorus.

Terrace escarpments

Terrace escarpments (Ta).—This miscellaneous land type consists of the abrupt, steeply sloping side walls of entrenched drainageways and the margins of higher lying old alluvial fans. The slopes range from 5 to 60 percent, but most of them are more than 20 percent.

The materials in this land type are the same kind of brownish, coarse-textured, gravelly and stony materials as those underlying the Dixie, Timpahute, and Neola soils. Nearly everywhere, these materials are strongly calcareous to the surface.

The natural drainage is excessive. Runoff is medium to very rapid, and internal drainage is rapid to very rapid. The erosion hazard is moderate. The available water holding capacity is low. Penetration of roots is shallow. The soil contains very little organic matter, and the natural fertility is low. The vegetation is a sparse cover of yellowbrush, sagebrush, and galletagrass.

Very limited grazing is the only use for these areas. (Semidesert stony loam range site, capability class VIII.)

Timpahute series

Soils of the Timpahute series developed from brownish, moderately coarse textured, gravelly, and cobbly old alluvium that came principally from rhyolite, andesite, basalt, and sandstone. They are on the highest parts of old alluvial fans, above the Dixie and Neola soils and just below Rough broken and stony land. The principal vegetation is sagebrush and galletagrass, but a few junipers grow at the higher elevations.

These well-drained soils are nearly level to sloping. The profile is strongly developed. A conspicuous subsoil horizon of clay concentration lies above a massive, strongly cemented caliche layer. The surface soil is very pale brown, soft, and granular. The upper subsoil is brown to dark brown, very hard, and prismatic and blocky in structure. The lower subsoil is a pinkish white, massive, strongly cemented caliche. The substratum is very pale brown, soft, and massive.

These soils are noncalcareous in the upper horizons. The profile is free of salts and alkali.

Timpahute sandy loam, 0 to 2 percent slopes (Te).—This soil occupies nearly level to gently sloping parts of the old alluvial fans, principally near Modena and Enterprise. A representative profile in an area free of vegetation follows:

0 to ½ inch, loose mulch that contains considerable gravel.
½ to 2 inches, sandy loam crust; light gray and soft when dry, light brownish gray and very friable when moist; noncalcareous; mildly alkaline; platy structure, vesicular.

2 to 6 inches, sandy loam; very pale brown and soft when dry, brown and very friable when moist; noncalcareous; mildly alkaline; granular structure.
6 to 15 inches, light sandy clay; brown to dark brown and very hard when dry, brown to dark brown and firm when moist; noncalcareous; neutral; prismatic and blocky structure.
15 to 24 inches, sandy clay loam; brown to light brown and very hard when dry, brown to light brown and firm when moist; weakly calcareous; moderately alkaline; subangular blocky structure.
24 to 52 inches, caliche; pinkish white when dry, pink when moist; very strongly calcareous; strongly alkaline; massive and strongly cemented.
52 to 60 inches, fine sandy loam; very pale brown and soft when dry, brown and very friable when moist; moderately calcareous; moderately alkaline; massive; number of pebbles and cobblestones increases with depth.

The depth to the caliche subsoil and its degree of cementation vary. Near Enterprise, this soil is more reddish brown, its surface soil is thinner, and its sandy clay subsoil is thicker and more blocky in structure than in typical areas of the Timpahute soil. In a few places, a very thin but not continuous light-gray horizon is present in the lower surface soil, just above the sandy clay of the upper subsoil.

The natural drainage is good. Runoff is very slow to slow. Internal drainage is slow to the caliche, then it is very slow. The erosion hazard is moderate. The available water holding capacity is moderate to low. The effective zone of rooting is shallow to moderately deep. The organic-matter content and natural fertility are low. The soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated, IIIs–2 irrigated).—Almost all of this soil is used for fall and spring range. The carrying capacity could be improved by removing sagebrush and planting adapted grasses.

A few areas near Enterprise are irrigated by surface diversion from Shoal and Spring Creeks. Alfalfa, barley, and potatoes are grown. Alfalfa is not fertilized. Barley responds to nitrogen fertilizer, and potatoes to both nitrogen and phosphorus fertilizers.

The use of a few areas near Enterprise alternates between dryland wheat and summer fallow. Yields vary considerably, depending on rainfall, but they probably average less than 15 bushels per acre.

Timpahute gravelly sandy loam, 0 to 3 percent slopes (Tg).—This soil is similar to Timpahute sandy loam, 0 to 2 percent slopes, except for gravel and a few stones on the surface and in the profile. Typically, it occurs above Timaphute sandy loam, 0 to 2 percent slopes. It has slightly stronger slopes, and it developed from coarser material.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated, IIIs–2 irrigated).—All of this soil is used for fall and spring range. Range improvement consists of the elimination of sagebrush and establishment of adapted grasses.

It is extremely unlikely that this soil will be brought under pump irrigation, principally because of its high elevation and the extreme depth to the water table.

Timpahute stony sandy loam, 2 to 5 percent slopes (Ts).—This soil is like Timpahute gravelly sandy loam, 0 to 3 percent slopes, except that it has stones on the surface and throughout the profile. This soil is at higher elevations, and the parent material is coarser in texture. The average slope is about 3 percent. Runoff is slow.

Use and management (Semidesert limy loam range site, capability unit VIIc–3 unirrigated).—All of this soil is used for fall and spring range. Removing sagebrush and planting adapted grasses would improve the carrying capacity, but these practices are difficult to apply because of the stones on the surface.

None of this soil is irrigated, and its stoniness and extreme depth to the water table make pump irrigation unlikely in the future.

Timpahute very stony sandy loam, 2 to 7 percent slopes (Tv).—This soil is very stony in the surface soil and subsoil but is otherwise similar to Timpahute stony sandy loam, 2 to 5 percent slopes. It lies on the highest parts of the alluvial fans, just below Rough broken and stony land and above the other Timpahute soils. It developed from material that was coarser than that from which the other Timpahute soils developed. The average slope is about 5 percent. Runoff is slow to medium.

Use and management (Semidesert stony loam range site, capability unit VIIc–5 unirrigated).—This soil is all in spring and fall range. Range improvement is very difficult because of the many stones on the surface.

Tomas series

The recent alluvium from which the Tomas soils developed was washed principally from rhyolite, andesite, and sandstone, and partly from basalt, granite, and limestone. These soils occupy recent alluvial fans, drainageways, and basins. The vegetation at the higher elevations consists principally of scattered sagebrush and some galletagrass, and at the lower elevations it consists mostly of winterfat.

These well-drained soils are deep and medium textured throughout the profile. The surface soil is pale brown, soft, and platy in structure. The subsoil and substratum are pale brown, soft to slightly hard, and massive to platy in structure.

The lime content of the profile is greater at the lower elevations. The soils are free of salts and alkali.

Tomas silt loam, 0 to 1 percent slopes (Pc).—This deep, medium-textured soil occupies large areas of nearly level recent deposits on alluvial fans, in drainageways, and in basins. A representative profile in a barren area follows:

0 to ½ inch, silt loam crust; platy structure, vesicular.
½ to 7 inches, silt loam; pale brown and soft when dry, brown and very friable when moist; noncalcareous to weakly calcareous; moderately alkaline; platy structure.
7 to 60 inches, silt loam; pale brown and slightly hard when dry, brown and friable when moist; weakly to strongly calcareous; moderately alkaline; massive.

The higher lying areas of this soil contain less lime than the lower lying areas. In some places a few pebbles are scattered on the surface. The depth of the silty alluvial deposit over old buried soil materials is more than 3 feet in most places.

This soil has good natural drainage. Runoff is very slow, and internal drainage is medium. The hazard of erosion is moderate. The available water holding capacity is high. Roots penetrate deeply. The organic-matter content and natural fertility are moderate. The soil is free of toxic concentrations of salts or alkali.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIc-1 irrigated).—Most of this soil is used for fall and spring range. The carrying capacity is relatively low where the vegetation is mostly sagebrush and galletagrass. It can be improved by removing the sagebrush and planting adapted grasses. The carrying capacity is relatively high where the vegetation is dominated by winterfat.

Considerable areas of this soil near Garyville are under pump irrigation. Alfalfa, barley, and potatoes are the principal crops. Some carrots and sugar beets have been grown. Alfalfa does quite well without supplemental fertilization. Barley should have nitrogen fertilizer, and potatoes need both nitrogen and phosphorus fertilizers.

Tours series

The alluvium from which the Tours soils developed came mostly from sandstone and partly from rhyolite and andesite. These soils lie on recent alluvial fans. The vegetation is dominantly sagebrush and galletagrass.

These soils are well drained, deep, and nearly level. The surface soil is reddish brown, hard, and granular in structure. The subsoil and substratum are reddish brown, hard, and massive. Textures are moderately fine throughout a typical profile, but the subsoil and substratum may be somewhat stratified and, therefore, variable in texture.

These soils are calcareous to the surface. The soil is free of salts and alkali.

Tours silty clay loam, 0 to 1 percent slopes (Ty).—Except for its finer texture throughout the profile, this soil is similar to Redfield silt loam, 0 to 1 percent slopes. It occurs at lower elevations on the alluvial fans near Enterprise. A representative profile in an area free of vegetation follows:

0 to 6 inches, silty clay loam; reddish brown and hard when dry, darker reddish brown and friable when moist; moderately to strongly calcareous; moderately alkaline; granular structure.

6 to 60 inches, silty clay loam; reddish brown and hard when dry, darker reddish brown and friable when moist; moderately to strongly calcareous; moderately alkaline; massive.

In some spots a few pebbles may be present in the profile. In some places stratified layers are present below a depth of 20 inches.

The natural drainage is good. Runoff is very slow, and internal drainage is slow. The erosion hazard is slight. The available water holding capacity is high. Roots penetrate deeply. The natural fertility is low. The soil is free of excess salts and alkali.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIs-1 irrigated).—This soil is used mostly for range. The carrying capacity can be improved by removing sagebrush and planting adapted grasses.

A few areas are irrigated and used for alfalfa, barley, and potatoes. Nitrogen fertilizer will increase barley yields, and potatoes will respond to nitrogen and phosphorus fertilizers. This soil has a high water-holding capacity which makes it possible to apply large amounts of irrigation water at fairly long intervals. Erosion is a minor problem.

Uvada series

Soils of the Uvada series developed in medium textured to moderately fine textured old alluvial or basin deposits that were derived chiefly from rhyolite, andesite, basalt, and sandstone. They occupy a large area, principally in the basin part of the survey Area, where they are associated mostly with the Antelope Springs soils. The dominant vegetation is greasewood and shadscale. There are some scattered sagebrush, big rabbitbrush, bud sage, and patches of black lichens.

These moderately well drained soils are nearly level to very gently sloping. The surface soil is pink, soft to slightly hard, and platy to granular in structure. The subsoil is strong brown, hard, and prismatic in structure. The substratum is pink, hard, and massive.

The Uvada soils are calcareous to the surface. The profile contains moderate to strong concentrations of soluble salts and strong concentrations of alkali. There is little or no gypsum in the profile.

Uvada loam, 0 to 2 percent slopes (Ua).—This is one of the most widely distributed soils in the basin part of the survey Area. A representative profile in an area free of vegetation follows:

0 to 1 inch, light loam crust; pinkish white and soft when dry, light brown and very friable when moist; moderately calcareous; moderately alkaline; platy structure, vesicular.

1 to 5 inches, light loam; pink and soft to slightly hard when dry, brown and very friable to friable when moist; moderately calcareous; moderately alkaline; platy to granular structure, vesicular.

5 to 10 inches, heavy silty clay loam; strong brown and hard when dry, dark brown and firm to friable when moist; strongly calcareous; strongly alkaline; prismatic structure.

10 to 18 inches, silty clay loam; light brown and hard when dry, brown and firm to friable when moist; strongly calcareous; strongly alkaline; subangular blocky structure.

18 to 60 inches, clay loam; pink and hard when dry, darker pink and friable when moist; very strongly calcareous; moderately alkaline; massive.

In some places the prismatic to subangular blocky structure of the subsoil is weakly expressed or nearly absent.

This is a moderately well drained soil. The runoff and internal drainage are very slow. The erosion hazard is severe. The available water holding capacity is low. Effective rooting is very shallow to shallow. The organic-matter content and natural fertility are low.

The soil is moderately to strongly saline, and it is strongly affected by alkali. The entire profile is affected, but the strongest concentrations are in the subsoil. Little or no gypsum is present.

Use and management (Semidesert alkali flats range site, capability unit VIIc-8 unirrigated).—Almost all of this soil is used for fall and spring range. Range improvement is difficult because of the strong concentrations of salts and alkali.

In the past, considerable areas were dry-farmed, but all attempts ended in failure. A few areas are now pump irrigated along with the better Escalante, Beryl, and Antelope Springs soils nearby. Crop response has been spotty and meager because this soil is not suitable for irrigation. Reclamation has been unsuccessful. Drastic and expensive measures are required to improve the soil, and the limited supplies of water available will produce greater returns on better soils nearby.

Uvada silt loam, overwashed, 0 to 1 percent slopes (Uo).—This soil is similar to Uvada loam, 0 to 2 percent slopes, except that it has been covered by a recent deposit of dark-colored silt loam like the material of the Red Rock soils. In most places this overwash is less than 5 inches thick, but in others it is as much as 8 to 10 inches thick.

The largest areas of this soil are north of Newcastle, where Pinto Creek ends. The erosion hazard is moderate. The vegetation contains considerable sagebrush.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—Most of this soil is in fall and spring range. The possibilities for range improvement are meager.

This soil is not considered generally suitable for irrigation; however, one area on the old Clark Ranch north of Newcastle is under pump irrigation. The principal crops are alfalfa, barley, and carrots. These crops appear to be growing almost entirely in the very shallow, dark-colored overwash layer. The carrots, especially, are very shallow rooted.

Uvada silt loam, 0 to 1 percent slopes (Ud).—This soil is similar to Uvada loam, 0 to 2 percent slopes, but it is of finer texture throughout. In addition, its subsoil is subangular blocky instead of prismatic in structure. This soil somewhat resembles soils of the Antelope Springs series, except that the profile development is more advanced.

This soil occurs north of Newcastle, near Antelope Road. The erosion hazard is slight.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—All of this soil is in spring and fall range. There is little possibility of range improvement. Pump irrigation is not practical.

Uvada and Antelope Springs soils, 0 to 1 percent slopes (Us).—These undifferentiated soils consist mainly of Uvada loam and Antelope Springs silt loam. Small areas of Crestline fine sandy loam, Heist fine sandy loam, Uvada silt loam, and Beryl very fine sandy loam are included. More than 70 percent of the area is Uvada loam. The soils were not separated, because most of them are so seriously affected by strong concentrations of alkali and by moderate to strong concentrations of salts that there is little possibility of improving them.

These soils are at the lower elevations in the basin part of the survey Area.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—Areas of these soils are entirely in fall and spring range. Little improvement is possible.

Uvada and Antelope Springs soils, hummocky, 0 to 1 percent slopes (Ut).—Except for the hummocky surface, these undifferentiated soils are similar to Uvada and Antelope Springs soils, 0 to 1 percent slopes. The hummocks, less than 5 feet in height, have accumulated around shrubs and in elongated ridges. Probably they are the result of wind erosion during previous unsuccessful attempts to dry-farm these soils.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—These soils are used for fall and spring grazing. There is little possibility of improving the range.

Uvada, Antelope Springs, and Heist soils, 0 to 1 percent slopes (Ux).—These undifferentiated soils consist of Uvada loam, Antelope Springs silt loam, and Heist fine sandy loam. The Uvada and Antelope Springs soils are moderately to strongly saline and strongly affected by alkali. The Heist soil is practically free of excess salts and alkali.

These soils are in the lower basin part of the survey Area. The Heist fine sandy loam is on slight elevations that probably represent old sandbars or deposits in the former lake.

The vegetation on the Uvada and Antelope Springs soils is shadscale and greasewood, but the Heist soil is covered principally with sagebrush and big rabbitbrush.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—These areas are all in spring and fall range. Little can be done to improve the range. The patches of Heist fine sandy loam would be suitable for irrigation, but they are much too small and too irregularly distributed. In addition, the necessary leveling would destroy the Heist soil without appreciably improving the soils around it.

Uvada, Antelope Springs, and Crestline soils, 0 to 1 percent slopes (Uv).—The soils in this undifferentiated group are Uvada loam, Antelope Springs silt loam, and Crestline fine sandy loam, gravelly substratum. The Uvada and Antelope Springs soils are moderately to strongly saline and strongly affected by alkali. The Crestline soil is almost free of salts and alkali.

These soils lie in the lower part of the basin area. The Crestline soil occupies slightly higher elevations on what were probably old gravelly sandbars in an old lake.

The Uvada and Antelope Springs soils are covered with shadscale and greasewood. The Crestline soil is dominated by sagebrush and has only a few scattered bushes of shadscale and greasewood.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—All areas of these soils are in fall and spring range. There is little possibility of improving the range.

A few of the larger areas of Crestline fine sandy loam, gravelly substratum, have been dry-farmed or pump irrigated in the past. The effects of wind erosion ended the dryland cultivation, and the irrigation has also been abandoned. The Crestline soil is not a good soil for irrigation because it is sandy and moderately deep over the gravelly substratum. The other soils are not suitable for irrigation. Leveling these soils for irrigation would destroy the favorable characteristics of the Crestline soil and expose its gravelly substratum without appreciably improving the Uvada and Antelope Springs soils.

Uvada soils-Dune land association (Uw).—This association consists of eroded areas of Uvada loam and Dune land. The Uvada loam is nearly level to slightly hummocky. The Dune land has a considerable range in slope.

The eroded areas of Uvada loam are on the southwestern side of each association, and the Dune land is on the northeastern side. The prevailing southwesterly winds appear to have blown soil material from the Uvada soils and piled it into Dune land. Scattered shadscale and greasewood shrubs are present on the Uvada soils, and scattered big rabbitbrush grows on the Dune land.

Use and management (Semidesert alkali flats range site, capability unit VIIc–8 unirrigated).—All of the association is in fall and spring range. There is very little possibility of range improvement or reclamation.

The damage from wind erosion was probably the result of attempts to dry-farm these areas. All such attempts ended in failure. Even if it had been possible to control the wind erosion under cultivation, the moderate to strong concentrations of salts and the strong concentrations of alkali would have prevented successful dryland farming.

Zane series

Zane soils developed in deep deposits of brownish, moderately coarse textured to medium textured, somewhat older alluvium that was derived chiefly from rhyolite, andesite, basalt, and sandstone. They occupy large areas on very gently sloping alluvial fans and are associated principally with Dixie and Neola soils. The profile is more strongly developed than the profiles of the Tomas and Genola soils, and the alluvial fans are somewhat older and more sloping.

In most places the principal vegetation is sagebrush and galletagrass. In a few places, especially where the Zane soils lie next to Tomas soils near Modena, the vegetation is almost pure winterfat.

These are deep, well-drained soils. The surface soil is reddish brown, slightly hard, and granular in structure. The subsoil is reddish brown, slightly hard, and prismatic and subangular blocky in structure. The substratum is light brown, slightly hard, and massive. The soils are free of salts and alkali. The lime has been leached out of the upper horizons.

Zane clay loam, 0 to 2 percent slopes (Za).—This soil occupies considerable areas on very gently sloping old alluvial fans. A representative profile in an area free of vegetation follows:

0 to 1 inch, clay loam crust; pinkish gray and slightly hard when dry, brown and friable when moist; noncalcareous; moderately alkaline; platy structure, vesicular.

1 to 8 inches, clay loam; reddish brown and slightly hard when dry, dark reddish brown and friable when moist; noncalcareous; mildly alkaline; granular structure.

8 to 13 inches, heavy clay loam; reddish brown and slightly hard when dry, dark reddish brown and friable when moist; noncalcareous; mildly alkaline; prismatic and subangular blocky structure.

13 to 20 inches, silt loam; brown and slightly hard when dry, dark brown and friable when moist; moderately calcareous; moderately alkaline; contains visible seams and flecks of lime; subangular blocky structure.

20 to 60 inches, fine sandy loam; light brown and slightly hard when dry, brown and friable when moist; moderately calcareous; mildly alkaline; massive.

The depth to which the soil is noncalcareous differs from one place to another. In many places the structure of the subsoil is very weakly developed. The materials of the substratum may differ from those described. In some places the material below a depth of 3 feet is like that from which the Dixie and other soils have formed.

The natural drainage is good. Runoff is very slow to slow, and internal drainage is medium. The erosion hazard is moderate. The available water holding capacity is high. The effective rooting zone is deep. The organic-matter content and natural fertility are low. The soil is free of toxic concentrations of salts and alkali.

Use and management (Semidesert loam range site, capability unit VIIc-1 unirrigated, IIs-1 irrigated).—Nearly all of this soil is used for fall and spring range. The carrying capacity of the areas covered with winterfat is higher than where the vegetation consists principally of sagebrush and galletagrass. The range can be improved considerably by eliminating the sagebrush and planting adapted grasses.

A few areas west of Zane are under pump irrigation. Alfalfa does well without added fertilizer. Barley responds to nitrogen, and potatoes will benefit from both nitrogen and phosphorus fertilizers. This is potentially one of the best soils in the area for irrigation. Development depends on the pumping lift, and only the lower lying areas are now irrigated.

Formation and Classification of Soils

Factors of Soil Formation

Soils are the products of the five main factors of soil formation: (1) Parent material, (2) climate, (3) living organisms (chiefly vegetation), (4) topography, and (5) time. Under the prevailing low average annual rainfall, sparse vegetative cover, and relatively gentle slopes, the soils of the Beryl-Enterprise Area strongly reflect the influence of parent material and time. Where the soils are essentially recent alluvial deposits, even the time factor is negligible. Such soils are little more than unmodified parent material. Their properties are essentially hereditary, and the profiles exhibit a minimum of soil development and horizon differentiation. Where the parent material has been longer in place, the influence of the other soil-forming factors is more apparent.

Parent materials.—Most of the soils in the Area are developing from water-transported and locally wind-reworked sediments derived from the surrounding mountains. Extensive areas of sediment were deposited as large, gently sloping, coalescing, and, in places, overlapping alluvial fans adjacent to the mountains. In the center of the Area at a considerable distance from the mountains, there is an extensive, nearly level, old lake basin. As is generally the case with water-transported material, the sediments are coarsest nearest their source in the mountains and finest the farthest removed.

Typically, the sediments are of mixed mineral composition. They were derived predominantly from extrusive igneous rock that unconformably overlies older Cretaceous and Tertiary sedimentary formations. The extrusive igneous rock is mostly rhyolite but includes some latite, andesite, basalt, and obsidian (*11*). The upper reaches of the Shoal Creek and Pinto Creek drainage areas extend into areas of intrusive granitic rock, and some of the dark-colored soils developing from recent alluvium carry visible mica flakes. The sedimentary rock is mostly reddish sandstone but includes some interbedded limestone and shale. Along the southeastern edge of the Area near Newcastle, a thick section of the sedimentary rock crops out, and the resulting alluvium and the soils derived from it are distinctly reddish in color. Elsewhere in the Area, the parent material is most strongly influenced by the extrusive igneous rock, and the sediments are predominantly brownish in color. Toward the center of the Area, proportionately more water-soluble material was deposited, and the soils are progressively more calcareous and more affected by soluble salts or alkali, or both. With increasing lime content, the sediments acquire a pinkish cast that masks their otherwise brownish color. The sediments are Quaternary and Recent in age. Their total depth is unknown. Wells south of Beryl have been drilled to depths of more than 450 feet without reaching bedrock, and the 746-foot railroad well at Lund, just east of the Area, is entirely in valley fill.

Climate.—The climate of the Area is semiarid-continental. It has a wide range in seasonal and daily temperatures, low humidity, much sunshine, a relatively short growing season, and little rainfall. The average annual rainfall varies from 8 to 9 inches for the basin area to between 10 and 12 inches for most of the alluvial fan area. In a small protected pocket near Enterprise, the rainfall is 15 inches, and the older soils in that vicinity are more reddish in color than elsewhere on the alluvial fans.

Only over long periods of time does climate have appreciable effects on the soils in this Area, and the effects are more prominent in the B and C_{ca} horizons than in the A horizon. Because of the low rainfall and the prevailing cool temperatures, the soil profiles are shallow, as compared with those in areas that have more rainfall and higher temperatures.

Vegetation.—Two plant associations dominate in the present vegetative cover of the Area: (1) The sagebrush-galletagrass association on the alluvial fans, and (2) the greasewood-shadscale association on the saline-alkali soils in the lower basin. In an intermediate position between these associations is a third association that is somewhat mixed or transitional. This third association—principally big rabbitbrush, together with some sagebrush, shadscale, and greasewood—occurs in the higher lying parts of the upper basin, where most of the soils are strongly calcareous. The vegetation in the Beryl-Enterprise Area is sparse, and much of the surface is bare. The total annual production of organic material is low.

From the standpoint of the organic-matter content of the A horizon, compared with that of the underlying horizons of the profile and that of soils in other areas, the effect of vegetation on the soils of this Area has been weak. The organic-matter content is uniformly low—usually less than 1 percent—except where the soils have been affected by dark-colored alluvial deposits from higher lying areas that receive more rainfall and support more vegetation.

The most striking effect of vegetation is that associated with the presence of greasewood and shadscale. These plants are salt accumulators, and they consistently increase the alkalinity and exchangeable sodium percentage in the soil immediately under the drip zone of each individual plant. Greasewood appears to have more effect than shadscale. Because of the variations in the composition, density, and age of the plant cover, the pattern of salt and alkali content is extremely complex.

Topography.—The slopes in the survey Area are gentle; the adjacent mountains were excluded. In the basin, the slope is negligible; it is generally area wide and can be measured in feet per mile. Within the basin are playas that are essentially level and have no external drainage. The alluvial fans have long gentle slopes. The gradient is low but sufficient to provide adequate surface drainage for the small amount of rain that falls in the Area.

Time.—The length of time a given parent material has been in place is related to horizon differentiation and stage of profile development. More time is required to produce modification of the parent material in this Area than in places that have more rainfall and more vegetation. Recent deposits of parent material show little modification, but older deposits reveal increasing horizon differentiation.

On the more strongly sloping, older alluvial fans that are free of excess lime, salts, and alkali, horizon differentiation follows the so-called "normal" sequence of development. This includes a decrease in the pH, the concentration of clay in the B_2 horizon, the concentration of lime in the C_{ca} horizon, and a profile generally free of excess salts and low in exchangeable sodium.

In the saline-alkali basin, this same pattern is generally evident, but excess salts and exchangeable sodium persist and the pH is much higher.

Where there are strongly calcareous deposits of relatively coarse and siliceous material low in weatherable minerals, the soils are calcareous to the surface, little clay appears to form or to concentrate, and the profile lacks a B_2 horizon of clay concentration. Such soils are intermediate between the so-called "normal" soils of the older terrace positions and the more strongly developed saline-alkali soils of the basin areas.

Classification of Soils

The general framework of classification in this section is the scheme outlined by Baldwin, Kellogg, and Thorp *(1)* in 1938 and modified by Thorp and Smith *(10)* in 1949. Recognition of the Calcisols as a great soil group was proposed by Harper *(6)* in 1957, and the restriction of the Sierozems to soils having some evidence of a textural-structural B horizon, also a modification of the 1938–49 concepts of this group, was presented in a paper by Ulrich *(12)* in 1956. The horizon designations and the descriptive terminology generally follow the Soil Survey Manual *(14)*. Table 17 gives the higher categories of classification and the approximate acreage and proportionate extent of the soil series in the Area.

TABLE 17.—*Classification of soils by orders and great soil groups; approximate acreage and proportionate extent*

AZONAL SOILS

Great soil group and series	Approximate area	Proportionate extent
	Acres	*Percent*
Alluvial soils	46,337	12.17
Berent	2,302	.60
Genola	6,487	1.70
Modena	3,970	1.04
Mosida	4,013	1.05
Musinia	291	.08
Navajo	287	.08
Newcastle	9,631	2.53
Redfield	2,533	.67
Red Rock	4,262	1.12
Tomas	11,471	3.01
Tours	1,090	.29

Table 17.—*Classificaton of soils by orders and great soil groups; approximate acreage and proportionate extent*—Con.

ZONAL SOILS

Great soil group and series	Approximate area	Proportionate extent
	Acres	*Percent*
Sierozems	114, 878	30. 20
Crestline [1]	17, 105	4. 50
Dixie [2]	61, 899	16. 27
Sevy [2]	9, 597	2. 52
Timpahute [3]	17, 271	4. 54
Zane [1]	9, 006	2. 37

INTRAZONAL SOILS

Great soil group and series	Approximate area	Proportionate extent
Calcisols	94, 329	24. 79
Beryl	21, 628	5. 68
Escalante	29, 852	7. 85
Heist	10, 817	2. 84
Neola	32, 032	8. 42
Solonetz soils	66, 182	17. 39
Antelope Springs [1]	34, 020	8. 94
Bullion [1]	1, 158	. 30
Uvada [2]	31, 004	8. 15
Miscellaneous land types	58, 754	15. 45
Total	380, 480	100. 00

[1] Minimal development.
[2] Medial development.
[3] Maximal development.

Alluvial soils

Alluvial soils consist of "the more recently deposited water-laid materials, which have been very little changed by the environment. Their characteristics are determined largely by the nature of the materials from which they have been derived and the manner in which these materials have been sorted and deposited. The climatic conditions, drainage, and vegetation vary widely" (*13*).

The earliest stage in the development of a soil profile from well-drained alluvial materials free of excess soluble salts, alkali, and alkaline earth carbonates can be illustrated by a profile of Redfield loam. This profile is located in an area free of vegetation 200 feet west of the southeast corner of sec. 23, T. 36 S., R. 16 W.

A_1 0 to 6 inches, loam; reddish brown (5YR 5/4) when dry, dark reddish brown (5YR 3/4 to 4/4) when moist; weak very fine granular structure; soft, very friable; moderately to strongly calcareous; pH 7.9; the uppermost half inch may be a very fine vesicular horizon and have a weak very thin platy structure.

C_{11} 6 to 15 inches, loam; reddish brown (5YR 5/4) when dry, reddish brown (5YR 4/4) when moist; very weak coarse granular structure crushing to medium and fine granules; slightly hard, friable; strongly calcareous; pH 7.9; contains many tubules and root channels, some up to 3 millimeters in diameter.

C_{12} 15 to 19 inches, similar to C_{11} horizon but containing visible thin lime seams and flecks; pH 7.9.

C_2 19 to 60 inches, loam; yellowish red (5YR 5/6) when dry, yellowish red (5YR 4/6) when moist; very weak coarse granular structure crushing to medium and fine granules; slightly hard, friable; strongly calcareous; pH 8.0.

The Redfield soils show a minimum of horizon differentiation. The reddish colors are quite uniform throughout the profile and are largely due to the presence of reddish Cretaceous and Tertiary sandstone in the parent material. Only a slight darkening of the A_1 horizon has resulted from the vegetation, and the platy and vesicular layer at the top of the A_1 horizon is very thin, only slightly developed, and discontinuous. Structural development is essentially very weak to almost massive. The pH is uniform. The slight lime concentration in the C_{12} is neither uniformly present nor visible, but its depth of occurrence is quite significant in terms of probable future horizon differentiation and profile development. Other soils developing from recent alluvial materials, as well as slightly more differentiated profiles in the Area, have thin lime seams and flecks at about the same depth. This indicates the approximate depth at which lime begins to accumulate in the soils of this Area, particularly those of intermediate textures.

In the survey Area there are 10 other soil series that are developing from recent alluvial material and that, in profile characteristics and degree of horizon differentiation, are similar to the Redfield series. The other 10 series are Berent, Genola, Modena, Mosida, Musinia, Navajo, Newcastle, Red Rock, Tomas, and Tours.

The Berent soils are brownish, coarse-textured soils derived from water-deposited and, in places, partly windreworked materials derived chiefly from rhyolitic sources. The Genola soils are brownish, medium-textured soils derived from mixed igneous and sedimentary material. The Modena soils are moderately coarse textured, reddish-brown soils derived from somewhat mixed but predominantly reddish sedimentary material. The Mosida soils are moderately coarse textured, dark-colored soils derived from mixed igneous and sedimentary material. The Musinia soils are dark-colored, moderately fine textured soils derived from mixed igneous and sedimentary material. The Newcastle soils are brownish, gravelly or stony, medium-textured soils that occupy more strongly sloping positions on alluvial fans and in drainageways and are derived from mixed igneous and sedimentary material. The Navajo soils are reddish-brown, fine-textured soils derived from somewhat mixed but predominantly reddish sedimentary sources. The Red Rock soils are dark-colored, medium-textured soils derived from mixed igneous and sedimentary material. The Tomas soils are brownish, very silty soils derived from mixed igneous and sedimentary material. The Tours soils are reddish-brown, moderately fine textured soils derived from somewhat mixed but predominantly reddish sedimentary sources.

Sierozems

If the parent material is not high in alkaline earth carbonates, soluble salts, or alkali, profile development appears to proceed in stages from Alluvial soils to Sierozems. Depending on the degree of horizon differentiation, three stages of profile development occur: Weak, or minimal; moderate, or medial; and strong, or maximal. These terms are relative and are based on changes in morphology, such as (a) textural, structural, and color modifications that distinguish the B horizon from the C horizon, (b) leaching of carbonates from the upper horizons of the soil profile, and the relative prominence of the C_{ca} horizon, (c) the degree of expression of the vesicular A_v horizon, and (d) differences in reaction between the A and B horizons and the C horizon (*12*).

Weak, or minimal.—This stage of horizon differentiation is illustrated by a profile of Zane clay loam taken in a barren area 700 feet west of the northeast corner of sec. 35, T. 33 S., R. 17 W.

A_v 0 to 1 inch, clay loam; pinkish gray (7.5YR 7/2) when dry, brown (7.5YR 5/4) when moist; very weak very thin platy structure and very fine vesicular porosity; slightly hard, friable; noncalcareous; pH 8.0.

A_1 1 to 8 inches, clay loam; reddish brown (5YR 5/4) when dry, dark reddish brown (5YR 3/4) when moist; moderate fine granular structure; slightly hard, friable; noncalcareous; pH 7.7.

B_2 8 to 13 inches, heavy clay loam; reddish brown (5YR 5/4) when dry, reddish brown (5YR 4/4 when moist; weak medium prismatic and weak very fine subangular blocky structure; slightly hard, friable; thin patchy clay films; noncalcareous; pH 7.6.

B_3 13 to 20 inches, silt loam; brown (7.5YR 5/4) when dry, dark brown (7.5YR 4/2 to 4/4) when moist; weak medium subangular blocky structure; slightly hard; friable; thin very patchy clay films; moderately calcareous, fine lime seams; pH 8.0.

C 20 to 60 inches +, fine sandy loam to light loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; massive; slightly hard, friable; moderately calcareous; pH 7.6.

Compared with the profile of Redfield loam, this profile has more horizon differentiation and development. The platy and vesicular A_v horizon is thicker, more strongly developed, leached of lime, and continuous. The A_1 horizon also shows color modification, stronger structural development, and a loss of free lime. A lime-free, weak textural-structural B_2 horizon is also present. The B_3 horizon shows somewhat less development, but it has weak structure, some increase in clay content, and fine lime seams in the lower part.

These soil properties indicate that the leaching of lime in the A_1 and B_2 horizons has taken place more or less concurrently with an increase in clay formation and concentration. The reddish color in these horizons can be attributed to an increase in content of free iron oxide and to accompanying formation of secondary clay from the primary minerals in the parent alluvium.

Some profiles of Zane clay loam are not so pronounced as the profile described above, but nearly all of this soil is characterized by the removal of lime from the A horizon, some increase in the clay content of the B horizon, and weak structure in the B horizon. The color differences are less pronounced in places, particularly where the parent material is like that of the Tomas soils; in such areas, the soil is more brownish throughout.

One other soil series in the Area shows horizon differentiation equivalent to that of the Zane soils. This is the Crestline series. The parent material of Crestline soils is moderately coarse textured to coarse textured and probably contains less of the weatherable primary minerals than the parent material of the Zane soils. For the most part, profile development consists of the leaching of lime from the A_1 horizon, a small increase in clay content and weak structural development in the B_2 horizon, and a weak lime concentration and, in places, very slight cementation below the B_2 horizon.

Moderate, or medial.—This stage in profile development is basically an intensification of the processes described for the weak, or minimal, stage. A profile of Sevy sandy clay loam taken in a barren area a quarter of a mile south of the west quarter corner of sec. 22, T. 36 S., R. 16 W., illustrates this stage.

A_v 0 to 1 inch, sandy clay loam; light brown (7.5YR 6/4) when dry, dark brown (7.5YR 4/2 when moist; weak very thin platy structure and very fine vesicular porosity; soft, very friable; noncalcareous; pH 7.3.

A_1 1 to 4 inches, sandy clay loam; reddish brown (5YR 5/3) when dry, reddish brown (5YR 4/3) when moist; moderate to strong very fine granular structure; slightly hard, friable; noncalcareous; pH 7.0.

B_2 4 to 13 inches, sandy clay loam; reddish brown (5YR 4/4) when dry or moist; moderate coarse subangular blocky structure; hard, friable; thin nearly continuous clay films; noncalcareous; pH 7.1.

B_3 13 to 16 inches, sandy clay loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; moderate to weak coarse subangular blocky structure; hard, friable; thin patchy clay films; strongly calcareous; pH 8.0.

C_{ca} 16 to 34 inches, clay loam; pinkish white (7.5YR 8/2) when dry, pink (7.5YR 7/4) when moist; weak medium subangular blocky structure to massive; hard to weakly cemented, friable; very strongly calcareous; pH 8.2.

C 34 to 60 inches +, fine sandy loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; massive; soft, very friable; strongly calcareous; pH 8.3.

Compared with the profile of the Zane soils, the Sevy profile shows intensification of the same process of lime removal and concentration, as well as differentiation by color, texture, and structure. Lime has concentrated in large quantities in the C_{ca} horizon and is hard to weakly cemented when dry. Lenses and dense incrustations of lime also occur, but the horizon is relatively soft and is not uniformly hardened into a massive caliche-like deposit. Mechanical analyses, with and without the presence of lime, indicate that much of the lime in the C_{ca} horizon is in the clay-size fraction. The A_1 and B_2 horizons are now neutral in reaction.

One other series, the Dixie, shows profile development equivalent to that of the Sevy soils. In the Dixie soils, however, the C_{ca} horizon is white (very pale brown, moist), weakly to strongly cemented caliche, and the A_1 and B_2 horizons are neutral to mildly alkaline.

Strong, or maximal.—This stage in profile development is a further intensification of the processes described above. A profile of Timpahute sandy loam in a barren area a quarter of a mile south of the northwest corner of sec. 6, T. 35 S., R. 18 W., illustrates this stage.

A_v 0 to 2 inches, sandy loam; light gray (10YR 7/2) when dry, light brownish gray (10YR 6/2) when moist; very weak very thick platy structure and very fine vesicular porosity; soft, very friable; noncalcareous; pH 7.5; the uppermost ¼ to ½ inch is a loose mulch containing numerous pebbles.

A_1 2 to 6 inches, sandy loam; very pale brown (10YR 7/3) when dry, brown (10YR 5/3) when moist; moderate very fine granular structure; soft, very friable; noncalcareous; pH 7.6.

B_2 6 to 15 inches, sandy clay; brown and dark brown (7.5YR 5/4 and 4/4) when dry or moist; strong medium to coarse prismatic and strong medium angular blocky structure; very hard, firm; thick continuous clay films; noncalcareous; pH 7.3.

B_3 15 to 24 inches, sandy clay loam; brown to dark brown (7.5YR 5/4 and 4/4) when dry or moist; weak coarse subangular blocky structure; very hard, firm; thin patchy clay films; weakly to strongly calcareous; pH 8.1.

C_{ca} 24 to 52 inches, strongly cemented caliche; pinkish white (7.5YR 8/2) when dry, pink (7.5YR 7/4) when moist; massive; very strongly calcareous; pH 8.6.

C 52 to 60 inches +, sandy loam; very pale brown (10YR 7/3) when dry, brown (7.5YR 5/3) when moist; massive; soft, very friable; moderately calcareous; pH 8.2; with increasing depth, becomes chiefly coarse sand, gravel, and cobblestones.

Compared with the Sevy and Dixie profiles, the Timpahute profile reveals a much thicker and more strongly cemented C_{ca} horizon and a greater concentration of clay in the B_2 horizon. Whitish sprinklings and a paper-thin, discontinuous A_2 horizon can be found, in a few places, just above the B_2 horizon. Some variations in the color and thickness of the horizons occur. Near Modena this soil is browner than the profile described, and near Enterprise it is more reddish. In addition, the soil near Enterprise has a thinner A_1 horizon and a thicker B_2 horizon than the soil near Modena. These variations indicate somewhat more clay formation and concentration in the soil near Enterprise, and may reflect the difference in rainfall. The annual rainfall is more than 15 inches a year at Enterprise and less than 11 inches at Modena.

Calcisols

If the parent material is high in alkaline earth carbonates, profile development takes another course. The formation and movement of clay are inhibited or retarded, and a subsoil horizon of lime rather than of clay enrichment is the conspicuous feature of the profile. These soils were not separated from the Sierozems and other associated great soil groups in the scheme of classification given in the 1938 Yearbook of Agriculture, Soils and Men (*1*), but, as they are usually calcareous to the surface and lack a textural and structural B_2 horizon above the C_{ca}, they are now recognized as a separate great soil group. The morphology and genesis of Calcisols has recently been discussed by Harper (*6*).

As with the Sierozems and other zonal soils that have a B_2 horizon of clay concentration, various stages of horizon differentiation are recognized. The relative increase in lime concentration in the C_{ca} horizon over that in the parent material and the relative thickness and hardness or cementation of the C_{ca} horizon can be used to distinguish weak (or minimal), moderate (or medial), and strong (or maximal) horizon differentiation. A profile of Escalante fine sandy loam, a medial Calcisol on the basis of the criteria mentioned above, illustrates this group of soils. This profile is located in a barren area at the northwest corner of sec. 2, T. 35 S., R. 16 W.

A_v 0 to 1 inch, fine sandy loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; very weak thin platy structure and very fine vesicular porosity; soft, very friable; strongly calcareous; pH 8.2.

A_1 1 to 12 inches, fine sandy loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; very weak very fine granular structure to massive; soft, very friable; strongly calcareous; pH 8.3.

C_{ca} 12 to 27 inches, fine sandy loam; pinkish white (7.5YR 8/2) when dry, pink (7.5YR 7/4) when moist; massive; weakly cemented and caliche-like; very strongly calcareous; pH 8.5.

C 27 to 39 inches, sandy loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; some gravel; massive; slightly hard, very friable; strongly calcareous; pH 8.3.

D 39 to 112 inches +, unrelated beds of sand and gravel of variable size and composition but all highly siliceous; single grained; very weakly calcareous to noncalcareous; moderately alkaline.

Except for the prominent concentration of lime in the C_{ca} horizon, the Escalante profile indicates little horizon differentiation. Although the C_{ca} horizon hardens appreciably on drying and appears to be like caliche, it moistens quite readily under irrigation. Strongly alkaline reactions and some soluble salts are typically associated with the C_{ca} horizon, but the reaction quickly drops to moderately alkaline upon deep moistening under irrigation. Unrelated gravelly beds occur in places at variable depths of more than 3 feet and usually of more than 5 feet. The very weakly calcareous to noncalcareous nature of these beds is extremely interesting in view of the high lime content of the materials above.

In addition to the Escalante series, three other soil series, Beryl, Heist, and Neola, have similar profile properties. On the basis of the relative thickness, hardness, and lime concentration of the C_{ca} horizon as compared to the C horizon, the Beryl and Heist soils may be considered weak, or minimal, and the Neola soils strong, or maximal, in degree of horizon differentiation and profile development.

The Beryl soils are close associates of the Escalante soils. They differ from the Escalante soils mainly in having only a weak C_{ca} horizon that is comparatively soft and penetrable rather than cemented. Typically, the Beryl soils are soft to hard throughout, but thin, weakly cemented lenses may occur deep in the profile. This material is usually strongly alkaline and in places appears to be cemented by silica rather than lime.

The Heist soils vary more in slope and topographic position than other soils in this group. They occur principally on the lower margins of the older alluvial fans, but also as slightly elevated, isolated ridges or bars in the basin area. Considerable gravel occurs in the profile locally, and at least a little gravel is present everywhere. The profile is much like that of the Beryl soils, except for the gravel and the absence of excess salts or alkali. Some weak cementation in the C_{ca} horizon occurs in places, generally at depths of more than 3 feet, but the cemented layer is thin, lenslike, and not continuous like the C_{ca} horizon in the Escalante soils. It also softens upon moistening.

The Neola soils are similar to the Escalante soils, but the lime zone is prominent, usually thicker, and strongly cemented; it appears to be a true caliche. In addition, the Neola soils are on old alluvial fans, are stony in some places, and extend up to the adjoining mountains, whereas the Escalante and Beryl soils occur only on the nearly level deposits in the basin.

The development of C_{ca} horizons in these soils is a matter about which there is considerable speculation and difference of opinion. In some places ground-water tables, present and past, appear to play a part, but it is questionable whether, in this Area, ground-water action was a factor, even though part of Lake Bonneville probably occupied the basin area. Escalante and Beryl soils occur on virtually the same type of parent material and at the same topographic level. The first has weakly cemented C_{ca} horizons; the second has a hard when dry, but friable when moist, C_{ca} horizon. If a water table were present, it should have been general and have affected both soils similarly. In places beds of noncalcareous to very weakly calcareous gravel occur beneath both Escalante and Beryl soils. Lime-charged water could not have risen any significant distance in such materials by capillary action, and the water table is now generally at depths of more than 10 feet in these soils. Even granting that the water table might have stood much closer to the surface at one time, a theory not readily provable, the thickest, most strongly cemented C_{ca} horizons, and the only ones that are true caliche horizons, are on the more strongly sloping old alluvial fans and not in the nearly level basin. On the alluvial fans, the depth to the C_{ca} horizon and its relation to other morphological horizons is essentially constant with reference to the surface of the soil, including the irregularities due to stream dissection. The present depth to water in most of these areas is more than 100 feet, and in many places on the highest fans it is more than 200 feet. It is questionable if high water tables ever played a significant role in the formation of these soils.

Solonetz soils

If the parent material is high in soluble salts that contain sodium, horizon differentiation and profile development in this Area proceed in stages from Alluvial soils to Solonetz soils. As defined in Soils and Men (*13*), Solonetz soils are "salty and alkali soils of the arid and semi-arid regions having a thin surface layer of light colored leached ashy material over a darker colored subsoil layer of tough material of columnar structure. The subsoil is generally light gray and highly calcareous." As in the Sierozems and Calcisols, several stages of development can be recognized, but only two stages—weak, or minimal, and moderate, or medial—occur in this Area.

Weak, or minimal.—A profile of Antelope Springs silt loam located at the north quarter corner of sec. 29, T. 35 S., R. 15 W. illustrates the initial effects of excess exchangeable sodium on soils of this Area. The following profile is located in a barren area between greasewood plants. Under greasewood and shadscale plants, the pH is considerably higher and the soil is more strongly affected by alkali.

A_v 0 to 3 inches, silt loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; moderate medium platy structure and very fine and fine vesicular porosity; soft, very friable; moderately calcareous; pH 8.3.

A_1 3 to 6 inches, silty clay loam; reddish brown (5YR 4/4) when dry, dark reddish brown (5YR 3/4) when moist; moderate very fine to fine granular structure; slightly hard, friable; moderately calcareous; pH 7.9.

B_2 6 to 13 inches, clay loam; reddish brown (5YR 5/4) when dry, reddish brown (5YR 4/4 when moist; weak medium subangular blocky structure; hard, firm; thin patchy clay films; very strongly calcareous; pH 7.9.

B_3 13 to 18 inches, light clay; brown (7.5YR 5/4) when dry or moist; massive to weak medium subangular blocky structure; hard, firm; few thin patchy clay films; very strongly calcareous; pH 8.0.

C 18 to 60 inches, clay; pinkish white (7.5YR 8/2) when dry, light brown (7.5YR 6/4) when moist; massive to very weak fine subangular blocky structure; hard, firm; very strongly calcareous; pH 7.9.

The Antelope Springs soil appears to be developing from more recent medium-textured alluvial deposits overlying older basin materials. Although this soil is influenced by exchangeable sodium, only weakly differentiated profiles are evident. The differentiation is mainly in the structure of the A_1 and B_2 horizons. There is some differentiation in color but little textural change between the A_1 and the B_2 horizons. In places, buried dark-colored soil materials of variable thicknesses occur in the B and C horizons of these soils. Under greasewood and shadscale plants, the A_v horizon is absent, the A_1 horizon contains more organic matter, the pH is higher, and the soil is more strongly affected throughout by exchangeable sodium.

Another series, the Bullion, has profile characteristics much like the Antelope Springs soils. Developing west of Newcastle and influenced by reddish Cretaceous and Tertiary sandstones, the Bullion soils are reddish colored throughout. Otherwise, the profile is similar to that of the Antelope Springs soils.

Moderate, or medial.—The most advanced stage of horizon differentiation under the influence of strong concentrations of soluble salts and excess exchangeable sodium in this Area is illustrated by a profile of Uvada loam located in a barren area at the east quarter corner of sec. 9, T. 35 S., R. 15 W.

A_{v1} 0 to 1 inch, loam; pinkish white (7.5YR 8/2) when dry, light brown (7.5YR 6/4) when moist; weak medium platy structure and very fine to coarse vesicular porosity; soft, very friable; moderately calcareous; pH 8.4.

A_{v2} 1 to 5 inches, loam; pink (7.5YR 7/4) when dry, brown (7.5YR 5/4) when moist; weak very thin platy structure and very fine vesicular porosity; soft to slightly hard, very friable to friable; moderately calcareous; pH 8.4.

B_2 5 to 10 inches, heavy silty clay loam; strong brown (7.5YR 5/6) when dry, dark brown (7.5YR 4/4) when moist; strong medium prismatic and fine and very fine subangular blocky structure; surfaces of prisms covered with thin nearly continuous clay films and stained with organic matter; hard, firm to friable; weakly calcareous and moderately alkaline on the outside of prisms but brownish to whitish and strongly calcareous and strongly alkaline on the inside; pH 8.5.

B_3 10 to 18 inches, heavy silty clay loam; light brown (7.5YR 6/4) when dry, brown (7.5YR 5/4) when moist; weak fine to medium subangular blocky structure; hard, firm to friable; thin patchy clay films; very strongly calcareous; pH 8.6.

C 18 to 60 inches, clay loam; pink (7.5YR 8/4) when dry, pink (7.5YR 7/4) when moist; massive; hard, friable; very strongly calcareous; pH 8.2.

Compared with the Antelope Springs profile, this profile exhibits pronounced horizon differentiation, but the morphology is not everywhere so well developed. Neither has it progressed so far as to develop the rounded columnar type of structure in the B_2 horizon, but a few whitish sprinklings are present, in places, just above the B_2 horizon. In many respects, the soil appears to be the consequenec of pronounced textural and structural differentiation in soils that are like a strongly saline-alkali Beryl very fine sandy loam.

Laboratory Data

Mechanical and chemical analyses of samples of representative soils of the Beryl-Enterprise Area are given in table 18. These samples were analyzed at the Soil Survey Laboratory at Riverside, Calif. The mechanical analyses were by the pipette method. The pH was determined by the glass electrode method. The $CaCO_3$ equivalent was determined by CO_2 evolution. The wet combustion method was used to measure the organic carbon. The total nitrogen was determined by the Kjeldahl procedure.

General Information About the Area

This section presents a little of the history of the Beryl-Enterprise Area and a general idea of the community as it was in 1950.

Organization and Population

The first recorded visit of a white man in this area was that of Father Escalante, who traveled through this region late in the fall of 1777 (*2*). His trail was probably followed by other early Spanish explorers, but the earliest exploration by a representative of this Government was in 1843–45, when Captain Fremont explored this region.

Iron County was established in 1850 as a part of the State of Deseret, the church state that preceded the Utah Territory. The first settlements in both Iron and Washington Counties soon followed. The Beryl-Enterprise Area was used as grazing land. It had no permanent settlements within its limits until December 1895, when the first people moved into Enterprise. These people came from the now nonexistent town of Hebron. Hebron had been settled in 1862, just west of the limits of this Area on Shoal Creek, but the venture had proved unsuccessful. In 1891 the present reservoir and ditches supplying water for Enterprise were surveyed. Work started on them on October 26, 1893. The settlers constructed the dam and ditches themselves. They had little money, and the construction covered a period of 16 years.

The town of Newcastle was settled in 1905 and 1906 by people who moved from Pinto, several miles to the south. There had been a cattle ranch at the present townsite for many years preceding this migration.

The Union Pacific Railroad was constructed through this Area in 1905, and all the towns along it were settled as construction progressed. An old stage road had preceded the railroad, and there was a stage station called Desert Springs near the present town of Modena.

After the discovery of subsurface water supplies by the railroad company and the dryland farmers between 1909 and 1919, the first irrigation well was put in operation near Beryl in 1922. Abandonment of irrigation wells very nearly kept pace with development until 1940, when the present settlement near Garyville became firmly established.

The early settlers were nearly all members of the Church of Jesus Christ of Latter-day Saints (Mormon). They were descended from northern European stock. Most of the present population of both Newcastle and Enterprise has descended from these pioneer families. The people in and near Garyville came from various places, some outside of Utah. Many of these people have settled in the Area only since World War II.

The 1950 census[4] gives the population of the Beryl-Enterprise Area as 1,448. Of this, 790 people live in Enterprise, the only incorporated community in the Area.

Transportation and Markets

The Area is so sparsely settled that there has been little need for an intricate pattern of improved roads. The Union Pacific Railroad, Salt Lake City to Los Angeles Division, traverses the Area from northeast to southwest along the northern side of the Area. There are ore-loading dumps, stock yards, loading chutes, and freight platforms at Modena and a small platform for handling freight at Beryl. There are no other freight facilities in the Area, but Lund, 2 miles east of the northeastern corner of this survey Area, has complete facilities.

State Highway No. 56 crosses the Area from Newcastle to Modena. This paved road connects the Area with Cedar City on the east and Panaca, Nev., on the west. It is a connecting link between U.S. Highway No. 91 in Utah and U.S. Highway No. 93 in Nevada. State Highway No. 18, connecting Enterprise with Saint George on the south and with State Highway No. 56 on the north at Garyville, is also paved. From Garyville, there is a graded gravel road from State Highway No. 56 to Lund by way of Beryl. Graded gravel roads also run from Modena to Beryl and from Newcastle to Enterprise. Antelope Road runs south of Table Butte. There are a number of graded and maintained dirt roads. A few minor roads run between ranches, but most of the other roads in the Area are tracks made by stockmen. Many of these tracks are impassable in wet weather, and some may be partly blocked by drifted sand. In 1945, the Area contained 56 farms that were 0.0 to 0.2 mile from an all-weather road, 3 farms that were 0.3 to 0.5 mile, 14 farms that were 1.0 to 1.9 miles, 39 farms that were 2.0 to 4.9 miles, and 25 farms that were more than 5 miles.

Small local markets, trading centers, and produce-shipping points are located at Enterprise, Modena, Beryl, and Garyville. Lund, just northeast of the Area, Cedar City, and Saint George are other outlets nearby. Cedar City and Saint George have the most complete local trading and shopping facilities. More distant markets to which produce is shipped and from which supplies and equipment are obtained are Los Angeles, Calif., and Salt Lake City.

Community Facilities

Almost the entire population of Newcastle and Enterprise belongs to the Church of Jesus Christ of Latter-day Saints (Mormon), and each town has a ward organization of this church. There are no other church facilities in the Area.

Grade schools are maintained at Enterprise, Modena, Newcastle, and Garyville. There is a high school in

[4] All census data used in this report are based on the figures for the Beryl, Lund, Modena, and Newcastle precincts in Iron County and the Enterprise precinct in Washington County.

TABLE 18.—*Mechanical and chemical*

[Where no figures are given,

Soil name and location	Depth	Size class and diameter of particles			
		Gravel [1] (more than 2 mm.)	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*
Antelope Springs silt loam (NE corner of NW¼, sec. 29, T. 35 S., R. 15 W.)	0–3	0	0. 6	1. 0	0. 9
	3–6	0	. 2	. 6	. 6
	6–13	0	. 9	4. 0	3. 6
	13–18	0	. 3	1. 5	1. 8
	18–48	0	. 2	1. 1	1. 2
Beryl very fine sandy loam (SW corner of sec. 16, T. 34 S., R. 16 W.)	0–3	--	3. 5	11. 1	7. 6
	3–20	--	4. 5	11. 6	8. 7
	20–34	--	16. 1	24. 6	13. 9
Bullion silty clay loam (SE¼NW¼ sec. 13, T. 36 S., R. 16 W.)	0–4	--	. 3	. 3	. 4
	4–10	--	. 1	. 3	. 6
Dixie gravelly loam (NE¼NE¼ sec. 2, T. 36 S., R. 17 W.)	0–1	20. 4	4. 1	5. 4	2. 7
	1–6	15. 5	5. 4	7. 1	3. 3
	6–15	4. 2	2. 4	5. 4	3. 0
	15–36	--	--	Weakly	to strongly
	36–72	60. 1	13. 7	12. 2	5. 3
Escalante fine sandy loam (NW corner of sec. 2, T. 35 S., R. 16 W.)	[3] 0–1	--	--	--	--
	1–12	0	5. 4	5. 0	6. 6
	12–27	6. 6	1. 6	4. 9	3. 9
	27–39	10. 9	5. 2	12. 0	8. 2
	39–112	--	--	Beds	of sand and
Modena fine sandy loam (SW¼SE¼ sec. 12, T. 37 S., R. 17 W.)	0–6	1. 0	1. 8	3. 6	4. 3
	6–30	. 4	1. 7	2. 1	2. 2
	30–54	0	. 4	. 8	. 8
Navajo silty clay (NE¼SW¼ sec. 12, T. 36 S., R. 16 W.)	0–4	--	. 7	. 7	. 4
	4–10	--	. 3	. 5	. 4
	10–30	--	--	--	--
	30–48	--	--	--	--
Neola sandy loam (NW corner of sec. 9, T. 33 S., R. 16 W.)	0–12	8. 6	7. 8	15. 7	11. 1
	12–24	24. 0	--	--	Strongly
	24–48	9. 7	8. 9	13. 3	12. 4
Tomas silt loam (NE¼NE¼ sec. 6, T. 34 S., R. 17 W.)	0–5	--	. 3	1. 2	1. 0
	5–15	--	. 2	. 6	. 5
Redfield loam (200 ft. from SE corner of sec. 23, T. 36 S., R. 16 W.)	0–6	5	. 1	3. 1	2. 9
	6–15	1	. 3	1. 5	2. 0
	15–19	3	2. 7	3. 9	3. 8
	19–60	10	4. 5	8. 5	8. 5
Red Rock silt loam (1,000 ft. E of NW corner of SW¼ sec. 9, T. 36 S., R. 16 W.)	0–2	0	. 3	. 6	. 7
	2–7	0	. 1	. 2	. 3
	7–48+	0	1. 0	2. 3	1. 6
Sevy sandy clay loam (¼ mile S of NW corner of SW¼ sec. 22, T. 36 S., R. 16 W.)	[3] 0–1	6. 8	--	--	--
	1–4	1. 7	4. 4	11. 7	8. 9
	4–13	1. 7	4. 5	7. 8	6. 2
	13–16	3. 4	3. 6	8. 2	7. 3
	16–34	4. 1	3. 2	6. 1	5. 0
	34–60	6. 5	8. 1	8. 2	5. 9
	[4] 13–16	--	3. 5	9. 1	8. 4
	[4] 16–34	--	3. 7	7. 5	7. 5
	[4] 34–60	--	5. 8	8. 7	6. 9
Timpahute sandy loam (¼ mile S of NW corner of sec. 6, T. 35 S., R. 18 W.)	0–2	2. 8	3. 4	14. 2	13. 0
	2–6	1. 1	2. 3	13. 8	16. 7
	6–15	3. 9	1. 4	8. 0	11. 0
	15–24	6. 7	4. 0	10. 2	12. 2
	24–52	--	--	--	Strongly
	52–60	1. 8	1. 0	3. 3	5. 3

See footnotes at end of table.

analyses of representative soils

data were not determined]

Size class and diameter of particles—Continued					Reaction					
Fine sand (0.25–0.1 mm.)	Very fine sand (0.1–0.05 mm.)	Silt (0.05–0.002 mm.)	Silt[2] (0.02–0.002 mm.)	Clay (less than 0.002 mm.)	Saturated paste	1:5 suspension	$CaCO_3$ equivalent	Organic carbon	Total nitrogen	Ratio of carbon to nitrogen
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*pH*	*pH*	*Percent*	*Percent*	*Percent*	
4. 7	10. 1	67. 3	40. 5	15. 4	8. 3	9. 0	5. 5	0. 60	0. 068	8. 8
2. 2	4. 7	59. 4	46. 0	32. 3	7. 9	8. 9	1. 8	. 43	. 051	7. 9
8. 0	9. 1	43. 0	29. 0	31. 4	7. 9	8. 7	21. 5	. 74	. 077	9. 6
7. 5	10. 1	35. 5	20. 4	43. 3	8. 0	8. 6	36. 2	. 59	----------	----------
4. 7	7. 5	36. 1	19. 7	49. 2	7. 9	9. 1	37. 8	. 36	----------	----------
10. 5	6. 4	37. 7	23. 6	23. 2	8. 1	8. 7	9. 2	. 90	----------	----------
15. 8	11. 2	29. 6	17. 7	18. 6	8. 2	9. 2	8. 5	. 49	----------	----------
16. 5	7. 3	12. 1	7. 4	9. 5	7. 8	8. 7	4. 7	. 17	----------	----------
2. 1	3. 4	60. 9	47. 4	32. 6	7. 9	9. 0	15. 8	. 56	----------	----------
3. 6	2. 7	48. 3	37. 9	44. 4	8. 0	8. 9	14. 2	. 50	----------	----------
5. 8	14. 2	58. 8	28. 1	9. 0	7. 7	8. 4	0	. 50	----------	----------
6. 0	11. 9	39. 8	22. 0	26. 5	7. 2	7. 8	0	. 43	----------	----------
6. 3	12. 7	39. 4	20. 0	30. 8	7. 4	7. 9	<. 5	. 54	----------	----------
cemented caliche		----------	----------	----------	8. 1	8. 9	41. 9	. 28	----------	----------
7. 2	9. 8	37. 6	21. 3	14. 2	7. 9	8. 3	12. 8	. 20	----------	----------
----------	----------	----------	----------	----------	8. 2	9. 2	9. 5	1. 04	. 123	8. 5
13. 6	16. 7	41. 7	36. 0	11. 0	8. 3	9. 5	10. 8	. 71	. 078	9. 1
10. 2	22. 7	46. 7	24. 2	10. 0	8. 5	9. 8	22. 9	. 37	. 035	10. 6
13. 8	18. 7	37. 6	12. 7	4. 5	8. 3	9. 7	2. 0	. 13	----------	----------
gravel, unrelated to horizons above			----------	----------	----------	----------	----------	----------	----------	----------
27. 0	22. 6	30. 1	11. 0	10. 6	7. 7	8. 9	5. 3	. 71	----------	----------
13. 8	16. 5	42. 5	22. 8	21. 2	7. 9	9. 1	6. 0	. 63	----------	----------
4. 6	12. 5	50. 2	31. 6	30. 7	7. 7	8. 8	7. 3	. 65	----------	----------
1. 8	3. 7	47. 6	38. 0	45. 1	7. 6	8. 7	7. 5	. 32	----------	----------
1. 6	2. 2	46. 5	37. 3	48. 5	7. 7	8. 8	8. 0	. 31	----------	----------
----------	----------	----------	----------	----------	7. 8	8. 7	----------	----------	----------	----------
----------	----------	----------	----------	----------	8. 0	9. 1	----------	----------	----------	----------
19. 0	10. 4	23. 9	11. 7	12. 1	7. 8	9. 1	8. 0	. 40	----------	----------
cemented caliche		----------	----------	----------	7. 7	8. 5	35. 5	. 50	----------	----------
25. 0	13. 5	19. 5	8. 1	7. 4	8. 0	9. 1	15. 0	. 21	----------	----------
3. 3	3. 0	71. 5	50. 6	19. 7	7. 7	8. 6	. 1	. 59	----------	----------
2. 5	4. 9	74. 1	53. 8	17. 2	7. 8	8. 7	1. 4	. 64	----------	----------
13. 3	17. 3	43. 5	22. 7	19. 8	7. 9	9. 0	10. 3	. 47	. 051	9. 2
9. 2	17. 8	50. 2	23. 9	19. 0	7. 9	8. 9	16. 6	. 37	. 041	9. 0
15. 3	17. 1	40. 7	18. 6	16. 5	7. 9	9. 0	11. 2	. 27	----------	----------
20. 2	14. 1	30. 2	15. 3	14. 0	8. 0	8. 8	8. 3	. 22	----------	----------
6. 0	11. 7	54. 5	42. 4	26. 2	7. 4	8. 3	0	1. 20	----------	----------
1. 2	2. 3	54. 1	51. 1	41. 8	7. 6	8. 4	0	1. 10	----------	----------
2. 9	3. 4	60. 4	54. 0	28. 4	8. 4	9. 4	. 9	. 77	----------	----------
----------	----------	----------	----------	----------	7. 3	8. 2	0	. 28	. 029	9. 7
18. 8	11. 2	23. 0	11. 9	22. 0	7. 0	8. 0	0	. 39	. 047	8. 3
15. 4	15. 4	22. 8	7. 3	27. 9	7. 1	7. 8	0	. 28	. 044	6. 4
17. 6	13. 6	23. 1	9. 9	26. 6	8. 0	8. 9	5. 5	. 36	----------	----------
11. 7	10. 4	28. 2	15. 1	35. 4	8. 2	9. 1	27. 5	. 42	----------	----------
17. 9	16. 3	32. 2	13. 1	11. 4	8. 3	9. 2	12. 0	. 22	----------	----------
17. 6	15. 2	23. 6	6. 9	22. 6	----------	----------	----------	----------	----------	----------
17. 7	14. 8	27. 1	10. 4	21. 7	----------	----------	----------	----------	----------	----------
22. 3	21. 3	33. 4	10. 5	1. 6	----------	----------	----------	----------	----------	----------
21. 3	9. 0	33. 9	17. 8	5. 2	7. 5	7. 6	0	. 25	. 029	8. 6
25. 5	7. 7	24. 7	16. 3	9. 3	7. 6	7. 8	0	. 35	. 050	7. 0
19. 8	7. 0	10. 4	5. 0	42. 4	7. 3	8. 3	0	. 52	. 063	8. 3
23. 2	9. 0	13. 2	7. 0	28. 2	8. 1	9. 3	2. 0	. 38	----------	----------
cemented caliche		----------	----------	----------	8. 6	9. 2	20. 7	. 41	----------	----------
26. 8	21. 5	34. 3	13. 5	7. 8	8. 2	9. 0	3. 6	. 09	----------	----------

TABLE 18.—*Mechanical and chemical*

[Where no figures are given,

Soil name and location	Depth	Size class and diameter of particles			
		Gravel [1] (more than 2 mm.)	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)
	Inches	*Percent*	*Percent*	*Percent*	*Percent*
Uvada loam (South quarter corner of sec. 9, T. 35 S., R. 15 W.)	0–1	0. 1	0. 8	1. 8	2. 0
	1–5	0	. 1	1. 0	1. 6
	5–10	0	. 1	. 3	. 5
	10–18	0	. 1	. 7	. 7
	18–48	0	1. 0	4. 6	4. 4
Heist fine sandy loam (SE corner of sec. 32, T. 33 S., R. 17 W.)	0–12				
	12–42				
	42–60				
Newcastle stony loam (SE¼SE¼ sec. 19, T. 36 S., R. 15 W.)	0–8				
	8–15				
	15–48				
Zane clay loam (700 ft. W of NE corner of sec. 35, T. 33 S., R. 17 W.)	0–1				
	1–8				
	8–13				
	13–20				
	20–40				

[1] Excluded in calculating percentages of other size classes.

[2] International classification. All other particle-size classes are according to the U.S. Department of Agriculture classification.

analyses of representative soils—Continued

data were not determined]

Size class and diameter of particles—Continued					Reaction		$CaCO_3$ equivalent	Organic carbon	Total nitrogen	Ratio of carbon to nitrogen
Fine sand (0.25–0.1 mm.)	Very fine sand (0.1–0.05 mm.)	Silt (0.05–0.002 mm.)	Silt [2] (0.02–0.002 mm.)	Clay (less than 0.002 mm.)	Saturated paste	1:5 suspension				
Percent	*Percent*	*Percent*	*Percent*	*Percent*	*pH*	*pH*	*Percent*	*Percent*	*Percent*	
4. 1	31. 8	53. 8	27. 1	5. 7	8. 4	9. 2	3. 4	0. 69	0. 068	10. 1
12. 6	18. 6	55. 2	32. 4	10. 9	8. 4	9. 3	3. 4	. 41	. 053	7. 7
4. 1	6. 4	48. 8	35. 2	39. 8	8. 5	9. 5	9. 5	. 56	--------	--------
2. 7	7. 5	50. 0	32. 8	38. 3	8. 6	9. 5	14. 3	. 38	--------	--------
9. 7	9. 2	32. 2	28. 9	38. 9	8. 2	8. 8	28. 4	. 24	--------	--------
--------	--------	--------	--------	--------	7. 9	9. 0	2. 8	. 36	--------	--------
--------	--------	--------	--------	--------	8. 1	9. 1	12. 4	. 25	--------	--------
--------	--------	--------	--------	--------	8. 1	9. 3	4. 7	. 22	--------	--------
--------	--------	--------	--------	--------	7. 8	8. 5	<. 5	. 88	--------	--------
--------	--------	--------	--------	--------	7. 8	8. 6	<. 5	. 64	--------	--------
--------	--------	--------	--------	--------	7. 9	8. 9	2. 7	. 26	--------	--------
--------	--------	--------	--------	--------	8. 0	--------	<. 5	. 71	--------	--------
--------	--------	--------	--------	--------	7. 7	--------	<. 5	. 39	--------	--------
--------	--------	--------	--------	--------	7. 6	--------	<. 5	. 41	--------	--------
--------	--------	--------	--------	--------	8. 0	--------	2. 8	. 41	--------	--------
--------	--------	--------	--------	--------	7. 6	--------	1. 5	. 34	--------	--------

[3] First two horizons mixed in equal parts and subsample taken for particle-size distribution.

[4] Same as respective horizons above, but treated with HCl to remove excess carbonates before mechanical analyses.

Enterprise. High school students are transported from Modena to Enterprise and from Newcastle to Cedar City.

Electric power is generally available throughout the Area. Enterprise has running water. Telephone service is available at Beryl, Enterprise, Modena, Newcastle, Garyville, and many of the farms and ranches. Mail service is available in the principal communities, chiefly by private postal boxes for both town and rural inhabitants. A motion picture theatre is located in Enterprise.

The farms are all well improved and well fenced. Good fences of close-meshed wire are necessary to prevent crop damage by rabbits. The irrigated fields are well equipped with laterals and head ditches and are fitted and leveled for strip, border, or furrow irrigation.

Industries

There are no industries within the Area. Some men in Modena are employed seasonally in the mines near Pioche, Nev. The iron mines east of the Area near Cedar City also afford limited opportunities for seasonal labor. The Union Pacific Railroad offers steady employment for a few men as section hands, and occasionally some extra labor. Probably not more than 50 men residing in the Area are employed in these industries.

Water Supplies

Enterprise is supplied by a municipal water system from springs just south of the town. This water is of good quality and adequate for the needs of the town. Newcastle takes water from Pinto Creek for both irrigation and domestic use, and a few residents have individual wells. All other towns and ranches are supplied by wells.

Water supplies for range livestock are generally scattered and inadequate. There are two springs in the hills just east of the Area in T. 35 S., R. 14 W.; the Webster artesian well near the northeastern corner of T. 34 S., R. 15 W.; the springs in Mountain Meadow Creek, Mountain Springs Wash, Nigger Liza Wash, and Stateline Wash; and several small springs along the base of the northern hills. Throughout most of the Area, the stock must depend on wells or small manmade ponds. During winter and spring, water stands in many playas and small ponds throughout the Area.

The Enterprise Reservoirs are on the Shoal Creek drainage west of the Area, and the Grass Valley Reservoir is on Pinto Creek south of the Area. These reservoirs also have some recreational value, mainly for fishing. There are no perennial or year-round streams in the Area.

Agriculture

Although there are many indications of early Indian civilization in the Beryl-Enterprise Area, there is no evidence of agricultural activities by these people.

The first permanent white residents in this region settled along the perennial streams outside the survey Area. Settlers came to Pinto Creek in 1855, and to Shoal Creek and Mountain Meadow Creek in 1862. The pioneer settlers used the Beryl-Enterprise Area for grazing. No attempts were made to raise crops in the Area until the Enterprise Canal was finished near the turn of the century. Two reservoirs in the Shoal Creek drainage basin were built. The first was begun in 1893; the second was built later. The Grass Valley Reservoir, along Pinto Creek about 16 miles south of Newcastle, was built about 1910. The reservoir failed to hold water, however, because of highly permeable underlying bedrock. The extensive irrigation plans were abandoned, except for a small area around Newcastle.

Along with these pioneer irrigation projects for storage and surface diversion, many attempts were made between 1909 and 1919 to dry-farm throughout the Area. Except for a very small area near Enterprise, all these attempts ended in failure.

Wells dug or drilled by the railroad and by farmers proved that good quality water could be obtained at relatively shallow depths in many places. Pump irrigation was begun near Beryl in 1922 and on the old Clark Ranch north of Newcastle in 1926. Progress was slow and not very successful for many years. Poor equipment, equipment failures at critical times, isolated living conditions, distance from market, and depressed economic conditions in the 1930's were chiefly responsible. By 1937, a total of 80 irrigation wells had been drilled, but only 22 were being used. Up until World War II, abandoning of old wells very nearly kept pace with drilling of new wells, and total pumpage probably did not exceed 4,000 acre-feet in any year (*11*).

Major changes in the Area began during World War II. From 1940 to 1950, about 140 new irrigation wells were drilled and 12 inactive or intermittently operated ones returned to service. During this time, the pump-irrigated area increased from less than 900 to more than 16,000 acres and the annual pumpage from about 2,600 to 51,000 acre-feet. Most of these new wells were on higher land, where the water table is more than 30 feet below the surface and the pumping lift is from 40 to 150 feet. Electric lines serve most of the irrigation pumps.

Farms of the Area

In 1945, there were 143 farms in the Area, averaging 458 acres in size. Of the 380,480 acres in the Beryl-Enterprise Area, 64,511 acres were in farms. The rest of the Area was chiefly in private and public domain range.

Figure 8 shows the approximate land use in this Area in 1952. For this generalized map, land use was mapped to the nearest 40-acre tract.

Only 27,680 acres, or 7.3 percent of the land in the Beryl-Enterprise Area, was irrigated in 1952, and all except 1,440 acres of this was cultivated. Very little of the land was dry-farmed—only 1,040 acres, or 0.2 of 1 percent. The remaining 92.5 percent in dryland range covered 351,760 acres.

The acreage of irrigated land changes from one year to another, depending on the availability of water. For a long time, a small but stable acreage was surface irrigated from Shoal and Pinto Creeks near Enterprise and Newcastle. Before 1940, the acreage irrigated by pumps was small and changed frequently. Between 1940 and

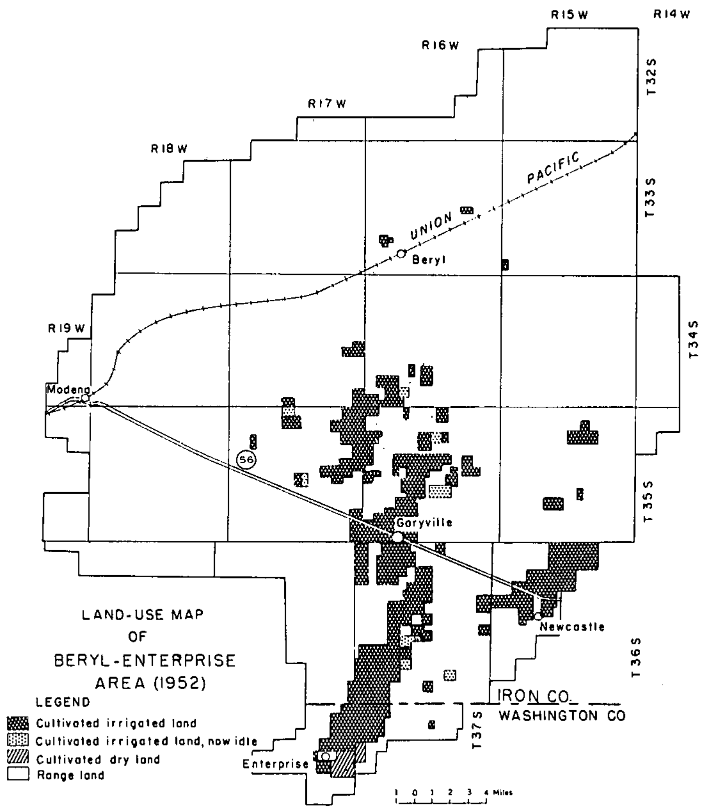


Figure 8.—**Land use in the Beryl-Enterprise Area in 1952.**

1950, pump irrigation expanded rapidly. Although no additional well permits are being granted at present, some new land is still being brought under irrigation under permits previously granted but not developed.

The cultivated land is all under private ownership, and most of the range land is also. The State and Federal governments own the remainder of the range. Most of the Federal range land is administered by the Bureau of Land Management. Small areas of forest and range around the survey margins are under the Forest Service.

Most farmers in the Area own their farms. In 1945, there were 130 farms operated by full owners, 4 by part owners, 8 by tenants, and 1 by a manager. On the rented farms, the agreements vary, but usually the owner furnishes the seed, fertilizer, and water and receives half of the crop.

Most of the farm labor is supplied by the farm family. Some help is hired during potato harvest. Most of the hired help is paid by the bushels of potatoes handled.

Farm Improvements

Complete data on farm improvements are not available, but the farms of the Area are more or less completely mechanized. In 1945, there were 60 tractors, 69 automobiles, and 115 motortrucks reported on the farms in this Area.

Most farms also have plows, cultivators, seed and fertilizer drills, and potato diggers. Small-grain combines and hay balers are owned or are available on a custom or exchange basis throughout the Area.

Other farm improvements vary with the locality. Near Garyville, most farmers live on their holdings, and many new and substantial homes have been erected. Homes near Enterprise and Newcastle are generally smaller, and the investment in barns and sheds is very small.

The leveling of land near Garyville has been extensive, and most of the improvements are expensive. Drilling of wells and purchase and installation of pumps have also been expensive on many farms, especially since 1945. The total capital investment in most pump-irrigated farms has been very high.

Crops

The choice of crops for this Area is limited by the soil, the climate, the elevation, and the economic problems.

Most of the irrigated farms near Enterprise are small. Potatoes, alfalfa, and barley are the principal crops. Dairying is important. Cultivation is intensive. One large farm produces certified seed potatoes.

Several farms on the alluvial fans above Enterprise grow dryland wheat and raise large numbers of turkeys. Most of the wheat is fed locally to the turkeys.

The farms near Newcastle are similar to those near Enterprise, except that in some places the shortage of irrigation water from Pinto Creek limits the crops to alfalfa and supplemental feed for livestock. Where the development of pump irrigation has increased the supply of available water, the agriculture is more diversified.

Most of the farms near Garyville depend entirely on pump irrigation. They vary in size, but most are small. They are intensively cultivated to alfalfa, barley, potatoes, and small acreages of carrots and sugar beets.

Several large ranches raise only sheep and cattle. A few ranches produce supplemental irrigated feed for livestock. Many livestock enterprises in the Beryl-Enterprise Area have grazing rights in the nearby Dixie National Forest and on the public domain part of the range.

Potatoes.—The most important row crop is potatoes. The acreage fluctuates widely from one year to another, mainly because of price and market changes. In 1944, farmers reported 9,455 acres of potatoes, but in 1939, they reported only 332 acres.

Potatoes receive the most intensive management of any crop in this Area. They are planted from the middle of May to the middle of June, and they are harvested from September 20 through October. The crop is usually preirrigated, and the soil is kept moist until about September 1. In some places sprinkler irrigation is used. Under sprinkler irrigation there is less damage from root rot and tuber rot, especially in Russet potatoes. The crop responds to nitrogen and phosphorus on nearly all soils, especially at the higher levels of production.

White Rose and Russet are the principal varieties of potatoes grown. At least one large farm grows certified seed potatoes exclusively. Harvesting is done with mechanical potato diggers.

Alfalfa.—Alfalfa is the most important hay crop in the Area. In many years it occupies the largest acreage of any of the crops grown. In 1944, it covered 2,545 acres of cropland, and in 1939, 1,889 acres.

Alfalfa is usually planted with a small-grain companion crop in the spring. If it is planted alone, it may be started at any time up until September. Three cuttings are usually made during the season. Most of it is cut and baled in the field. Some aftermath grazing is possible after the last cutting.

On almost all soils, alfalfa does well without supplemental fertilizer. On the strongly calcareous soils in the basin, the crop would probably respond to phosphorus in fertilizer.

The principal varieties of alfalfa grown in the Area are Ranger, Chilean, and Utah Common.

Other hay.—Only a few acres of hay other than alfalfa is grown. In 1944, farmers reported growing 111 acres of clover and timothy. Other hay crops were not reported in 1944; but in 1939, 44 acres of small grains were cut for hay, and 94 acres of other tame hay were cut. Wild hay was cut from 149 acres.

Small grains.—Barley is the principal small grain. Some dryland winter wheat and small amounts of oats and rye are also grown. In 1944, there were 1,291 acres of barley in the Area, 29 acres of oats, and 83 acres of rye. Only 12 acres of spring wheat, but 468 acres of winter wheat, were grown.

Barley is sown from the middle of March to the end of May. It is generally harvested by combine in August. It has been planted as late as June 15 and produced a crop in October. The crop is usually pre-irrigated so that moisture will be near the surface. Barley is not always fertilized, although it will respond to nitrogen on almost all of the soils of the Area. Sometimes the straw is baled for livestock bedding. Barley straw is also sometimes used, along with cull potatoes and other supplements, to feed livestock. Trebi is the principal variety of barley, and Velvon, Gem, Winter Club, and Ball varieties are also planted.

The management of rye, oats, and winter wheat is very similar to that of barley. On the dryland farms near Enterprise, winter wheat is grown every other year, and the land is fallowed in the alternate years. Turkey Red is the principal variety.

Fruits and vegetables.—The short frost-free season and the late, cold spring limit the production of orchard and vegetable crops to the more hardy and quick-maturing varieties. Even of these, many cannot be grown in the basin part of the Area. Fruits and vegetables are produced only for home use. There are no orchards in the Area, but a few trees are grown near the mountains. They produce little. The fruit trees in the Area in 1944 consisted of 366 apple, 13 apricot, 9 peach, 17 pear, 20 cherry, and 6 plum trees.

Other crops.—The acreage of corn, sugar beets, and carrots varies from year to year, depending on economic considerations, but it is generally very small.

In 1939, farmers reported 267 acres of corn, but in 1944, only 23 acres. The corn may be harvested for grain or silage, or it may be hogged off or used for fodder.

Sugar beets are planted in the latter part of April and carrots in the first part of May. Both crops require intensive management and heavy fertilization with nitrogen and phosphorus. Only a few acres are grown. Both sugar beets and carrots are usually harvested in October.

Rotations and Fertilizers

Rotations are not rigidly followed in this Area, but the usual practice is to grow alfalfa 4 or 5 years, then potatoes for 2 years, and finally barley or other small grain for 1 or 2 years. The second small-grain crop is usually a companion crop for the new stand of alfalfa.

Lime (calcium carbonate) is neither used nor needed in the Area. Small amounts of gypsum (calcium sulfate) are used for reclamation of alkali soils. More gypsum would probably be used if more water were available for irrigation.

Commercial fertilizers, principally nitrogen and phosphorus, are coming into increasing use. According to the Iron County Agricultural Agent, 585 tons of nitrogenous fertilizer, principally ammonium sulfate and ammonium nitrate, were used in 1950. The principal phosphatic fertilizers were superphosphate and treble superphosphate, of which 446 tons were used in 1950. Ammonium phosphate is the principal fertilizer that supplies both nitrogen and phosphorus in this Area, and 290 tons were used in 1950. Potash was applied to some fields and not to others.

Permanent Pasture

Dryland range of native grass, shrubs, or both occupies about 92.5 percent of the Beryl-Enterprise Area. Most of this land is privately owned or in the public domain under the Bureau of Land Management, United States Department of the Interior. Some is owned by the State or is part of the Dixie National Forest. The carrying capacity of the range is generally low.

In addition to the native range, small areas of permanent irrigated pasture have been established. Various grasses and legumes are grown, principally smooth bromegrass, orchardgrass, tall meadow oatgrass, ryegrass, intermediate wheatgrass, ladino clover, alfalfa, red clover, and sweet clover. The carrying capacity of the irrigated pastures is moderate to very high.

Livestock

Livestock are important in the local economy. Most of them are sent by rail to markets in Los Angeles, Calif., or in Salt Lake City.

Raising of sheep is a major enterprise. Several large sheep ranches are in this Area. There are probably more than 15,000 sheep and lambs on the local farms. In addition to the locally owned sheep, thousands of sheep traverse the Area each spring and again the following fall, on the annual migration between desert winter range in Nevada and summer range in the Dixie National Forest east of Cedar City. Many bands of these sheep remain on the range in the Beryl-Enterprise Area for a month or more. Most of the sheep are cross-breeds of fairly good quality and produce rather fine wool.

Cattle raising is another important enterprise in this Area. In 1945, there were 4,537 head reported on farms. Most of the range cattle are Herefords. Milk cows, principally Jerseys, are kept on many farms, principally near Newcastle and Enterprise. Most of the cattle are of fair to good quality.

Turkey growing is a fairly new enterprise that brings in considerable income to farmers near Enterprise. The census reported that 41,920 turkeys were raised in 1944. Chickens are raised mostly for home use.

Horses, ponies, and mules are steadily decreasing in importance. Most of the 400 horses, colts, and ponies reported in 1945 are kept for riding stock. Only 6 mules remained in the Area.

Only 446 hogs and pigs were reported in 1945. Most of them were kept for local use.

Literature Cited

(1) BALDWIN, M., KELLOGG, C. E., AND THORP, J.
1938. SOIL CLASSIFICATION. In Soils and Men, U.S. Dept. Agr. Yearbook. pp. 979–1001.

(2) BANCROFT, H. H.
1889. HISTORY OF UTAH 1540–1886. Bancroft's Works, v. 26. 808 pp., illus. San Francisco.

(3) DENNIS, P. E.
1944. SHORELINES OF THE ESCALANTE BAY OF LAKE BONNEVILLE. Proc. Utah Acad. Sci., Arts, and Letters, v. 19 and 20: 121–124.

(4) FENNEMAN, N. M.
1931. PHYSIOGRAPHY OF WESTERN UNITED STATES. 534 pp., illus. New York and London.

(5) GILBERT, G. K.
1890. LAKE BONNEVILLE. U.S. Geol. Surv. Monograph 1, 438 pp., illus., maps.

(6) HARPER, W. G.
1957. MORPHOLOGY AND GENESIS OF CALCISOLS. Soil Sci. Soc. Amer. Proc. 21(4): 420–424, illus. July-August 1957.

(7) LAMBERT, C. B.
1940. THE DISTRIBUTION OF PLANT TYPES IN THE ESCALANTE DESERT OF UTAH WITH RELATION TO SOIL CONDITIONS. Unpublished thesis, Brigham Young Univ. 71 pp., maps. Provo.

(8) SHANTZ, H. L., AND PIEMEISEL, R. L.
1940. TYPES OF VEGETATION IN ESCALANTE VALLEY, UTAH, AS INDICATORS OF SOIL CONDITIONS. U.S. Dept. Agr. Tech. Bul. 713, 46 pp., illus., map.

(9) THORNE, J. P., AND THORNE, D. W.
1951. IRRIGATION WATERS OF UTAH. Utah Agr. Expt. Sta. Bul. 346, 64 pp., illus.

(10) THORP, J., AND SMITH, GUY D.
1949. HIGHER CATEGORIES OF SOIL CLASSIFICATION: ORDER, SUBORDER, AND GREAT SOIL GROUPS. Soil Sci. 67(2): 117–126.

(11) TRACY, J. M.
1950. TWENTY-SEVENTH BIENNIAL REPORT OF THE STATE ENGINEER TO THE GOVERNOR OF UTAH. 210 pp., illus., map.

(12) ULRICH, R.
1956. SOILS OF THE BERYL-ENTERPRISE AREA, UTAH: THEIR ORIGIN, PROPERTIES, AND CLASSIFICATION. Soil Sci. Soc. Amer. Proc. 20(4): 570–574. October 1956.

(13) UNITED STATES DEPARTMENT OF AGRICULTURE
1938. SOILS AND MEN. U.S. Dept. Agr. Yearbook 1938. 1232 pp., illus.

(14) ———
1951. SOIL SURVEY MANUAL. U.S. Dept. Agr. Handbook No. 18, 503 pp., illus.

(15) ———
1954. DIAGNOSIS AND IMPROVEMENT OF SALINE AND ALKALI SOILS. U.S. Dept. Agr. Handbook No. 60, 160 pp., illus.

(16) WHITE, W. N.
1932. A METHOD OF ESTIMATING GROUND-WATER SUPPLIES BASED ON DISCHARGE BY PLANTS AND EVAPORATION FROM SOIL. U.S. Geol. Surv. Water Supply Paper 659, 105 pp., illus.

Glossary

A horizon.—The surface horizon of a mineral soil, which has maximum biological activity, eluviation (removal of materials dissolved or suspended in water), or both.

Aggregate, soil.—A single mass or cluster consisting of many primary soil particles held together in a form such as a clod, prism, crumb, or granule.

Alkali soil.—A soil that has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or higher), or both, that the growth of most crop plants is reduced.

Alkaline soil.—A soil that has a pH value greater than 7.0.

Alluvial fan.—Alluvium deposited in a fan-shaped deposit at the base of a mountain.

Alluvial soil.—Soil formed from alluvium and showing little or no modification of the original materials by soil-forming processes.

Alluvium.—Material, such as gravel, sand, silt, or clay, deposited by a stream.

Association, soil.—Two or more soils geographically associated in a regular but not complex manner.

Available water holding capacity.—The total quantity of water that will not drain away but can be taken up by plant roots within the rooting zone or to a depth of 5 feet if no root-inhibiting factor is present. The rating for soils affected by salts or alkali is made as it would be if neither salts nor alkali were present, or as it would be if the soil were reclaimed. The ratings are (1) *low*, less than 4 surface inches; (2) *moderate*, 4 to 9 surface inches; and (3) *high*, more than 9 surface inches. Soils of low capacity require frequent but light irrigations, using a large irrigation head and short runs. Soils of high capacity can be irrigated less frequently with large quantities of water, using a smaller head and longer runs.

Azonal soil.—A group of soils that have no well-developed profile characteristics, because of lack of time for development or because of type of parent material or relief that prevents the development of strong profile characteristics.

B horizon.—A soil horizon, usually beneath an A horizon or surface soil, in which clay, iron, or aluminum have accumulated, or which has developed a blocky or prismatic structure, or which has some combination of these features.

Basin irrigation.—A method of irrigation in which water is applied to a level area that is surrounded by a low earth ridge to confine the water.

Blowout.—An area from which soil material has been removed by wind. Such an area appears as a nearly barren, shallow depression with flat or irregular floor consisting of a resistant layer, an accumulation of pebbles, or wet soil lying just above a water table.

Border irrigation.—A method of irrigation in which the lateral surface flow of water is controlled with small earth ridges called border dikes.

C horizon.—The unconsolidated material in the lower part of the soil profile that is like the material from which all or part of the upper horizons have developed.

Calcareous soil.—A soil that contains calcium carbonate or lime.

Calcisol.—An intrazonal group of soils that have a weakly developed A horizon underlain by a horizon of lime accumulation; usually developed on highly calcareous parent material in an arid climate.

Caliche.—A more or less cemented deposit of calicum carbonate or of mixed calcium and magnesium carbonates, characteristic of soils of warm or hot desert and semiarid regions.

Cemented (soil material).—A brittle, hardened consistence caused by a cementing substance such as lime, silica, iron, or alumina. Some cementing agents resist moistening but soften under prolonged wetting. Some soil layers cemented with lime soften readily when wet. Other cementing agents are still hard or brittle when wet, because the moistening produces little or no change. A *weakly cemented* mass is brittle and hard, but can be broken in the hands. A *strongly cemented* mass is brittle; it is too hard to be broken in the hand but can easily be broken with a hammer. An *indurated* mass is very strongly cemented and brittle, does not soften under prolonged wetting, and requires a sharp blow with a hammer to break it.

Chemical analysis.—The determination of the chemical properties of a material and the kinds and quantities of the various elements it contains.

Clay.—The mineral soil particles that are less than 0.002 millimeter in diameter across their greatest dimension.

Claypan.—A compact horizon, or layer, rich in clay and separated more or less abruptly from the overlying horizon.

Companion crop.—A crop grown with another crop, usually a small grain grown with alfalfa, clover, or other forage crop.

Complex.—A mapping unit composed of two or more soils that are mingled in such an intricate pattern or in such small individual areas that they cannot be shown separately on a map of the scale used.

Consistence.—The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence when air dry are *loose, soft, slightly hard, hard, very hard,* and *extremely hard.* Terms used to describe consistence when moist are *loose, very friable, friable, firm, very firm,* and *extremely firm.* These terms are defined as follows:

Loose.—Noncoherent; will not hold together in a mass.

Soft.—When dry, very weakly coherent and fragile; breaks to powder or individual grains under very slight pressure.

Hard.—When dry, moderately resistant to pressure; can barely be broken between thumb and forefinger.

Friable.—When moist, crushes easily under moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Continental climate.—A general term for the climate typical of great land masses, where wide ranges in temperature and other weather conditions occur because the area is not greatly influenced by nearness to the oceans. Much of the United States has a continental climate.

Contour farming.—Following the contours of the land in all field operations, such as plowing, planting, or cultivating.

Corrugation irrigation.—A method of irrigating close-growing crops by the use of small, closely spaced ditches.

Cover crops.—Close-growing crops grown primarily to improve the soil and protect it between periods of regular crop production.

Deferred grazing.—Postponing grazing for a prescribed period to improve the vigor of the forage stand or to allow seed production.

Depth of root penetration.—Effective depth to which plant roots can readily penetrate before being inhibited by a hardened lime layer, gravel, stones, or bedrock. Chemical restrictions such as salts and alkali, which are subject to change, are not considered. The depth classes are (1) *very shallow,* 0 to 10 inches; (2) *shallow,* 10 to 20 inches; (3) *moderately deep,* 20 to 36 inches; and (4) *deep,* 36 to 60 inches or more.

Drainage, soil.—The relative rapidity and extent of removal of water from on and within the soil under natural conditions. Terms commonly used to describe drainage are:

Very poorly drained.—Water is removed so slowly that the soil remains wet most of the time, and water ponds on the surface frequently.

Poorly drained.—Water is removed so slowly that the soil is wet for a large part of the time.

Somewhat poorly drained.—Water is removed from the soil so slowly that it is wet for significant periods but not all of the time.

Moderately well drained.—Water is removed from the soil somewhat slowly, so that the profile is wet for a small but significant part of the time.

Well drained.—Water is removed from the soil readily but not rapidly.

Somewhat excessively drained.—Water is removed from the soil rapidly.

Excessively drained.—Water is removed from the soil very rapidly.

Dry-farming.—Producing crops that require some tillage in a semiarid region without irrigation. The system usually requires periods of fallow between crops, and during these periods water from precipitation is absorbed and retained.

Erosion.—The wearing away of the surface of the soil by running water, wind, or other geological agencies.

Erosion hazard.—Relative susceptibility to wind or water erosion. Relative terms are *slight, moderate,* and *severe.*

Fallow.—Leaving cropland idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. The soil is tilled but not planted for at least one growing season, to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility.—The quality that enables a soil to provide the proper elements and compounds, in the proper quantities and in the proper balance, for the growth of specified plants when other factors such as light, temperature, and the physical condition of the soil are favorable. In this Area, soils rated *high* generally contain more than 2 percent organic matter; soils rated *moderate* contain 1 to 2 percent organic matter; and soils rated *low* contain less than 1 percent organic matter.

Floating.—Dragging a flat, heavy weight over the soil to compact and smooth the surface after leveling for irrigation.

Flood plain.—The nearly flat land next to a stream subject to overflow.

Forage.—Unharvested plant material that can be used as feed by domestic animals. It may be grazed or cut for hay.

Furrow irrigation.—A method of using furrows to apply irrigation water to crops planted in rows.

Great soil group.—Any one of several broad groups of soils that have fundamental characteristics in common. Examples are Calcisols, Sierozems, Solonetz soils, and Alluvial soils.

Green-manure crop.—Any crop grown and plowed under to improve the soil by the addition of organic matter.

Head.—Difference in elevation of water; therefore, pressure at point of discharge.

Horizon, soil.—A layer of soil, approximately parallel to the soil surface, that has relatively well defined characteristics produced as a result of soil-forming processes.

Igneous rock.—A rock produced by the cooling of melted mineral material either below the surface (intrusive rocks) or at the surface (extrusive rocks) of the earth.

Internal drainage.—The rate of downward movement of moisture through the soil. Relative terms are *very rapid, rapid, medium, slow, very slow,* and *none.*

Intrazonal soil.—Any of the great soil groups having rather well developed soil characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the effect of the climate and vegetation.

Lateral.—A branch ditch extending from a main drainage ditch or irrigation canal.

Leaching.—The removal of materials in solution by the passage of water through soil.

Leveling (of land).—The reshaping or modification of the land surface to a planned grade to provide a more suitable surface for the efficient application of irrigation water and to provide proper surface drainage.

Lime.—Strictly, calcium oxide (CaO), but, as the term is commonly used, also calcium carbonate ($CaCO_3$) and calcium hydroxide [$Ca(OH)_2$]. Agricultural lime refers to any of these compounds, with or without magnesia (MgO) or magnesium carbonate ($MgCO_3$).

Mapping unit.—A soil, land type, or combination of soils that is given a separate name and symbol in the mapping. A mapping unit, as outlined on the soil map, may include up to 15 percent of soils or land types that do not fit the general description of the mapping unit.

Massive.—Characterized by large uniform masses of cohesive soil, sometimes with poorly defined and irregular breakage.

Mechanical analysis.—The determination of the percentage of soil particles of various sizes, such as gravel, sand, silt, and clay.

Miscellaneous land type.—An area having little or no true soil, such as Riverwash and Playas.

Mottling, soil.—Contrasting color patches that vary in number and size. Descriptive terms are as follows: Contrast—*faint, distinct,* and *prominent;* abundance—*few, common,* and *many;* and size—*fine* (less than 5 millimeters in diameter along the greatest dimension), *medium* (ranging from 5 to 15 millimeters), and *coarse* (more than 15 millimeters in diameter).

Nutrients, plant.—The elements that may be taken in by a plant essential to its growth and used by it in construction of its food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, molybdenum, and perhaps others obtained from the soil; and carbon, hydrogen, and oxygen obtained mainly from air and water.

Parent material.—The unconsolidated mass of material from which the soil profile develops.

Particle.—An individual grain of soil, regardless of shape, within a definite size group; as a clay, silt, or sand particle.

Percent slope.—The gradient of any particular slope expressed as the difference in elevation in feet between two points 100 feet apart horizontally.

Permeability.—That quality of the soil that enables it to transmit water or air. Terms used to describe permeability are *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

pH.—A term to indicate weak acidity and alkalinity as in soils. Technically, pH is the common logarithm of the reciprocal of the hydrogen-ion concentration of a solution. A pH of 7.0 indicates precise neutrality; larger numbers up to 14.0, alkalinity; and smaller numbers down to 0.0, acidity.

Phase, soil.—A subdivision of a soil type based on differences in slope, extent of erosion, stoniness, salt and alkali content, or other characteristics of practical significance.

Physiographic province.—One of the major geographic divisions of the continent.

Productivity.—The ability of a soil to produce a specified plant or sequence of plants under a specified system of management.

Profile, soil.—A vertical section of the soil through all its horizons and extending into the parent material.

Railing.—Dragging heavy rails across rangeland to destroy the brush.

Range.—Land that produces primarily native forage plants suitable for grazing by livestock.

Reaction, soil.—The degree of acidity or alkalinity of a soil mass, expressed either in pH values or in word, as follows:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5–5.0
Strongly acid	5.1–5.5
Medium acid	5.6–6.0
Slightly acid	6.1–6.5
Neutral	6.6–7.3
Mildly alkaline	7.4–7.8
Moderately alkaline	7.9–8.4
Strongly alkaline	8.5–9.0
Very strongly alkaline	9.1 and higher.

Reclamation of soils.—In this Area, the removal of salts and alkali from the soil profile in order to make it suitable for crops.

Rotation grazing.—Grazing the forage in two or more areas in regular order, with definite recovery periods between grazing periods.

Runoff.—The rate at which water flows away over the surface of the soil. Relative terms are *very rapid, rapid, medium, slow, very slow,* and *ponded.*

Saline soil.—A soil containing soluble salts in quantities that impair its productivity for plants but not containing an excess of exchangeable sodium.

Saline-alkali soil.—A soil having a combination of a harmful quantity of salts and either a high degree of alkalinity or a large amount of exchangeable sodium, or both, so distributed in the soil profile that the growth of most crop plants is less than normal.

Sand.—Small rock or mineral fragments that range in diameter between 0.05 and 2.0 millimeters.

Sedimentary rock.—A rock composed of particles deposited from suspension or solution in water.

Semiarid climate.—A climate that is intermediate between that of the subhumid areas and the true deserts.

Series, soil.—A group of soils that have horizons similar, except for the texture of the surface soil, as to differentiating characteristics and arrangement in the soil profile, and developed from the same kind of parent material.

Sierozem.—A zonal group of soils that have light-colored surface horizons that grade through somewhat brighter colored material with prismatic or blocky structure into accumulated calcium carbonate, developed under mixed shrub vegetation in a temperate to cool, arid climate.

Silt.—Small mineral soil grains that range between 0.05 and 0.002 millimeter in diameter.

Single grain.—Structureless, each soil particle by itself, as in sand.

Soil separates.—The individual size groups of soil particles, as sand, silt, and clay.

Solonetz.—An intrazonal group of soils that have a surface horizon of varying degrees of friability, underlain by a prismatic to columnar subsoil that contains more clay; usually strongly alkaline and more or less strongly affected by salts, alkali, or both; developed under saltgrass or alkali-tolerant shrubs.

Solum.—The upper part of the soil profile, above the parent material; the part of the profile that has been noticeably affected by the soil-forming processes. The solum of mature soils consists of the A and B horizons.

Stripcropping.—A practice of seeding dense-growing crops in strips alternated with strips of clean-tilled crops or summer fallow across the line of slope, approximately on the contour, or at a right angle to the prevailing winds.

Structure, soil.—The arrangement of the primary soil particles into lumps, granules, or other aggregates. Structure is described by grade—*weak, moderate,* or *strong,* that is, the distinctness and durability of the aggregates; by the size of the aggregates—*very fine, fine, medium, coarse,* or *very coarse;* and by their shape—*platy, prismatic, columnar, blocky, granular,* or *crumb.* A soil is described as structureless if there are no observable aggregates. Structureless soils may be *massive* if coherent or *single grain* if noncoherent.

Blocky, angular.—Aggregates are shaped like blocks; they may have flat or rounded surfaces that join at sharp angles.

Blocky, subangular.—Aggregates have some rounded and some flat surfaces; upper sides are rounded.

Columnar.—Aggregates are prismatic and are rounded at the top.

Crumb.—Aggregates are generally soft, small, porous, and irregular, but they tend toward a spherical shape.

Granular.—Aggregates are roughly spherical and small. They may be either hard or soft but are generally more firm and less porous than crumb structure and are without the distinct faces of blocky structure.

Platy.—Aggregates are flaky or platelike.

Prismatic.—Aggregates have flat vertical surfaces, and their height is greater than their width.

Subsoil.—That part of the soil profile commonly below plow depth and above the parent material.

Subsoiling.—Tilling the subsoil or the soil horizon below the normal plow depth to break a plowsole, hardpan, or claypan that impedes internal soil drainage and penetration by roots. When done with a chisel attachment, it is usually called chiseling.

Substratum.—The soil material below the surface soil and the subsoil; the C or D horizon.

Subsurface tillage.—Tillage with a sweeplike plow or blade that does not turn over the surface cover or incorporate it into the lower part of the surface soil.

Summer fallow.—Tillage of uncropped land during the summer in order to control weeds and thus store soil moisture and build up nitrates. It is used primarily in semiarid regions where the annual rainfall is not enough to produce a crop each year.

Surface soil.—The upper part of the soil that is commonly stirred by tillage implements, or an equivalent depth (5 to 8 inches) in unplowed soils.

Terrace (geological).—The level or gently undulating land lying along a stream valley, intermediate in elevation between the flood plain and the upland. Terraces are remnants of an earlier flood plain of the stream.

Texture.—The relative amounts of the various size classes of soil particles, such as sand, silt, and clay.

Topography.—The elevations or inequalities of the land surface, the slope gradient, and the pattern of these.

Type, soil.—A subdivision of a soil series based on texture of the surface soil.

Undifferentiated group.—Two or more soils mapped as one unit although not regularly or complexly associated geographically.

Vesicular.—Filled with tiny air pockets and resembling a sponge or honeycomb in appearance.

Water table.—The upper surface of the ground water.

Zonal soil.—Any of the great soil groups having well-developed soil characteristics that reflect the influence of climate and living organisms, chiefly vegetation.

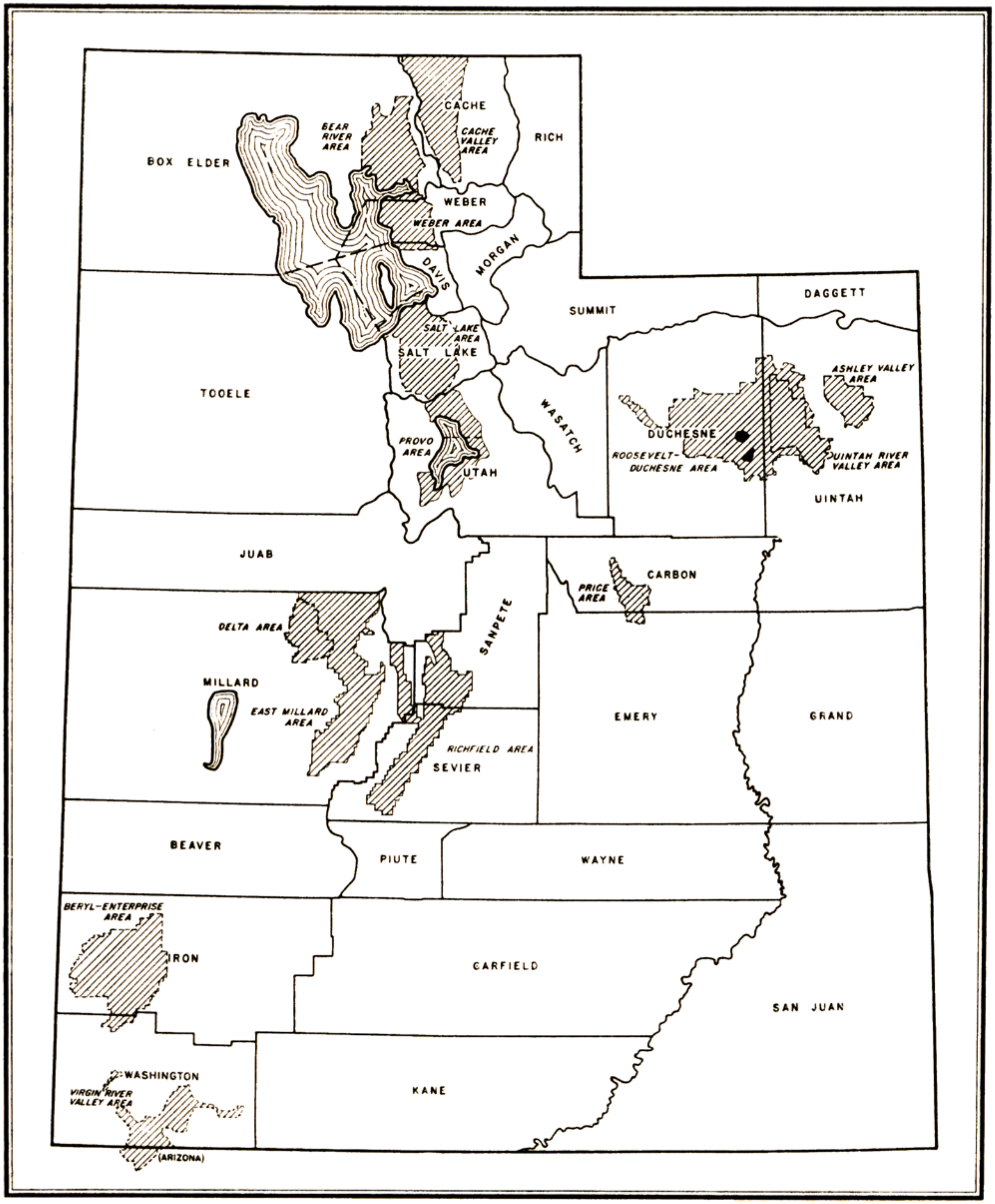
GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[See table 2, p. 17, for estimated yields from each soil under irrigation. See tables 3 to 10, pp. 22—30, for estimated yields of forage from each range site. See table 16, p. 38, for approximate acreage and proportionate extent of each soil]

Map symbol	Mapping unit	Page	Capability unit	Page	Range site	Page
Aa	Antelope Springs silt loam, slightly alkali affected, 0 to 1 percent slopes.	37	IIIs–3	15	Semidesert alkali flats	28
Am	Antelope Springs silt loam, moderately alkali affected, 0 to 1 percent slopes.	39	IVs–3	16	Semidesert alkali flats	28
Ao	Antelope Springs silt loam, overwashed, slightly alkali affected, 0 to 1 percent slopes.	39	IIIs–3	15	Semidesert alkali flats	28
Ar	Antelope Springs silt loam, overwashed, moderately alkali affected, 0 to 1 percent slopes.	39	IVs–3	16	Semidesert alkali flats	28
Be	Berent loamy fine sand, 0 to 2 percent slopes	40	IIIs–1	15	Semidesert sandy loam	21
Bf	Beryl very fine sandy loam, 0 to 1 percent slopes	40	IIs–3	14	Semidesert limy flats	28
Bo	Beryl very fine sandy loam, overwashed, 0 to 1 percent slopes.	41	IIs–3	14	Semidesert limy flats	28
Br	Beryl very fine sandy loam, strongly saline-alkali affected, 0 to 1 percent slopes.	41	IVs–4	16	Semidesert alkali flats	28
Bs	Beryl very fine sandy loam, strongly saline-alkali affected, hummocky, 0 to 1 percent slopes.	41	IVs–4	16	Semidesert alkali flats	28
Bt	Beryl soils-Dune land association	41	IVs–4	16	Semidesert alkali flats	28
Bu	Bullion silty clay loam, 0 to 1 percent slopes	42	IIIs–3	15	Semidesert alkali flats	28
Ce	Crestline fine sandy loam, 0 to 3 percent slopes	42	IIs–2	14	Semidesert sandy loam	21
Cg	Crestline fine sandy loam, gravelly substratum, 0 to 1 percent slopes.	43	IIIs–1	15	Semidesert sandy loam	21
Da	Dixie loam, 0 to 2 percent slopes	44	IIIs–2	15	Semidesert limy loam	21
Dg	Dixie gravelly loam, 0 to 3 percent slopes	44	IIIs–2	15	Semidesert limy loam	21
Dk	Dixie stony loam, 2 to 5 percent slopes	44	--------		Semidesert limy loam	21
Dt	Dixie very stony loam, 2 to 7 percent slopes	44	--------		Semidesert stony loam	25
Du	Dune land	44	VIII		--------	
Ec	Escalante fine sandy loam, 0 to 1 percent slopes	45	IIs–4	14	Semidesert limy flats	28
Ee	Escalante fine sandy loam, eroded, 0 to 1 percent slopes	46	IIIs–4	15	Semidesert limy flats	28
Eh	Escalante fine sandy loam, hummocky, 0 to 1 percent slopes	45	IIIs–4	15	Semidesert limy flats	28
Eo	Escalante fine sandy loam, overwashed, 0 to 1 percent slopes	46	IIs–4	14	Semidesert limy flats	28
Er	Escalante very fine sandy loam, 0 to 1 percent slopes	45	IIs–4	14	Semidesert limy flats	28
Es	Escalante very fine sandy loam, overwashed, 0 to 1 percent slopes.	45	IIs–4	14	Semidesert limy flats	28
Et	Escalante silt loam, overwashed, 0 to 1 percent slopes	46	IIs–4	14	Semidesert limy flats	28
Ey	Escalante-Heist fine sandy loams, 0 to 1 percent slopes	46	IIs–4	14	Semidesert limy flats	28
Ge	Genola loam, 0 to 2 percent slopes	46	IIe–1	13	Semidesert loam	20
Gs	Genola loam, slightly alkali affected, 0 to 1 percent slopes	47	IIs–3	14	Semidesert loam	20
Hf	Heist fine sandy loam, 0 to 3 percent slopes	47	IIs–2	14	Semidesert sandy loam	21
Mf	Modena fine sandy loam, 0 to 3 percent slopes	48	IIs–2	14	Semidesert sandy loam	21
Mo	Modena silt loam, overwashed, 0 to 1 percent slopes	48	IIs–2	14	Semidesert sandy loam	21
Ms	Mosida fine sandy loam, 0 to 1 percent slopes	49	IIs–2	14	Semidesert sandy loam	21
Mt	Musinia silty clay loam, 0 to 1 percent slopes	49	IIs–1	13	Semidesert loam	20
Na	Navajo silty clay, moderately alkali affected, 0 to 1 percent slopes.	49	--------		Semidesert alkali flats	28
Ne	Neola sandy loam, 0 to 3 percent slopes	49	IVs–2	16	Semidesert shallow hardpan	26
Nh	Neola sandy loam, hummocky, 0 to 5 percent slopes	50	--------		Semidesert shallow hardpan	26
Nk	Neola stony sandy loam, 2 to 7 percent slopes	50	--------		Semidesert shallow hardpan	26
Nm	Neola sandy loam-Sevy sandy clay loam, 0 to 2 percent slopes.	50	IVs–2	16	{Semidesert limy loam {Semidesert shallow hardpan	21 26
Nr	Newcastle gravelly loam, 2 to 7 percent slopes	50	IVs–1	16	Semidesert gravelly loam	22
Ny	Newcastle stony loam, 2 to 12 percent slopes	51	--------		Semidesert gravelly loam	22
Pc	Tomas silt loam, 0 to 1 percent slopes	54	IIc–1	14	Semidesert loam	20
Py	Playas	51	VIII		--------	20
Re	Redfield loam, 0 to 2 percent slopes	51	IIe–1	13	Semidesert loam	20
Rf	Redfield silt loam, 0 to 1 percent slopes	51	IIc–1	14	Semidesert loam	20
Rk	Red Rock silt loam, 0 to 1 percent slopes	52	IIc–1	14	Semidesert loam	20
Rw	Riverwash	52	VIII		--------	
Ry	Rough broken and stony land	52	VIII		--------	
Se	Sevy sandy clay loam, 0 to 2 percent slopes	52	IIIs–2	15	Semidesert limy loam	21
Ta	Terrace escarpments	53	--------		Semidesert stony loam	25
Te	Timpahute sandy loam, 0 to 2 percent slopes	53	IIIs–2	15	Semidesert limy loam	21
Tg	Timpahute gravelly sandy loam, 0 to 3 percent slopes	54	IIIs–2	15	Semidesert limy loam	21
Ts	Timpahute stony sandy loam, 2 to 5 percent slopes	54	--------		Semidesert limy loam	21

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES—Continued

Map symbol	Mapping unit	Page	Capability unit	Page	Range site	Page
Tv	Timpahute very stony sandy loam, 2 to 7 percent slopes	54	--------		Semidesert stony loam	25
Ty	Tours silty clay loam, 0 to 1 percent slopes	55	IIs-1	13	Semidesert loam	20
Ua	Uvada loam, 0 to 2 percent slopes	55	--------		Semidesert alkali flats	28
Ud	Uvada silt loam, 0 to 1 percent slopes	56	--------		Semidesert alkali flats	28
Uo	Uvada silt loam, overwashed, 0 to 1 percent slopes	56	--------		Semidesert alkali flats	28
Us	Uvada and Antelope Springs soils, 0 to 1 percent slopes	56	--------		Semidesert alkali flats	28
Ut	Uvada and Antelope Springs soils, hummocky, 0 to 1 percent slopes.	56	--------		Semidesert alkali flats	28
Uv	Uvada, Antelope Springs, and Crestline soils, 0 to 1 percent slopes.	56	--------		Semidesert alkali flats	28
Ux	Uvada, Antelope Springs, and Heist soils, 0 to 1 percent slopes.	56	--------		Semidesert alkali flats	28
Uw	Uvada soils-Dune land association	56	--------		Semidesert alkali flats	28
Za	Zane clay loam, 0 to 2 percent slopes	57	IIs-1	13	Semidesert loam	20



Areas surveyed in Utah shown by shading.

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