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ECOLOGICAL ASSESSMENT OF THE MCKENZIE PROPERTY BOULDER, COLORADO WITH EMPHASIS ON THE RAPTOR AND BLACK-TAILED PRAIRIE DOG COMMUNITIES

Prepared for:

City of Boulder
Real Estate Services/Open Space
1777 Broadway
Boulder, Colorado 80306

Prepared by:

Richard W. Thompson
Western Ecosystems, Inc.
1292 Ceres Drive
Lafayette, Colorado 80026

June 26, 1984

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INTRODUCTION

Boulder Real Estate Services/Open Space anticipates returning Field 5 of the McKenzie property, a former hayfield, to agricultural use to resolve current wind and water erosion problems. Agricultural use was abandoned on this field prior to purchase by Boulder Open Space in 1974. Since abandonment, black-tailed prairie dogs have colonized this field and contribute to the local raptor prey base. Boulder Open Space has requested an assessment of Field 5 and an adjacent field that is to be enhanced for wildlife (Field 4), to anticipate and evalutate the ecological effects of reducing the prairie dog population and returning the abandoned field to agricultural production. Field 6, adjacent to Fields 5 and 4, is included in this assessment because it supports a portion of the prairie dog colony and because of the City's proposed prairie dog management practices for this field.

This report documents the existing environment and the proposed alterations and analyzes the effects of the proposed alteration on the existing environment. The analysis is based on data obtained from City and County Open Space personnel, the U.S.D.A. Soil Conservation Service (SCS), local residents, and three surveys of the area (17 and 30 May and 17 June 1984). Common and scientific names of plants and animals used in text are listed in Appendix A.

EXISTING ENVIRONMENT

Location

The McKenzie property is located in northeast Boulder, Colorado and totals 150 acres in Sections 16 and 21 (T1N, R70W) (Fig. 1). The tract is bounded on the west by Burlington Northern Railroad tracks and Highway 119, on the north by Jay Road, and on the south by Independence Road.

Land Use

Land uses on and immediately around the property are irrigated agricultural fields used for haying and cattle grazing, residential, transportation corridors, recreation, and wildlife land.

This parcel was purchased by the City of Boulder from the McKenzies in 1974 and is now part of the Open Space System. John McKenzie is the leasee and maintains most of the property for agricultural purposes.

Physiography

Field #5 is an abandoned irrigated hayfield covering 26 acres (Fig. 1). The field was planted to grass - hayland in the early to mid-1950's and was hayed and periodically grazed by cattle until 1972 or 1973 when agricultural use was terminated. The field is relatively flat but slopes to the north, east, and south from a wedge-shaped piece of higher ground in the west and center portions of the field. Wind and water have eroded most topsoil off the wedge-shaped area, exposing subsoil pebbbles and cobble. This area is dominated by small bindweed. The northern, northeastern, and southern portions of the field support a mesic vegetative community dominated by sedges. These areas were in two to four inches of water during a 30 May site visit. Persisting between the high and low ground is the hayland grass communtiy. A row of middle-aged Plains cottonwood borders the northern edge of the field adjacent to Jay Road.

Field 4 covers 11 acres and borders Field 5 on the west (Fig. 1). The central portion of this field is an alkaline basin (3.3 acres), the northeast corner of which contains shallow water during wet Springs (April - May). This basin contained a small amount of water for only several weeks in 1984. Vegetation in the basin is entirely sedges. Current use of this field is designated as wildlife land.

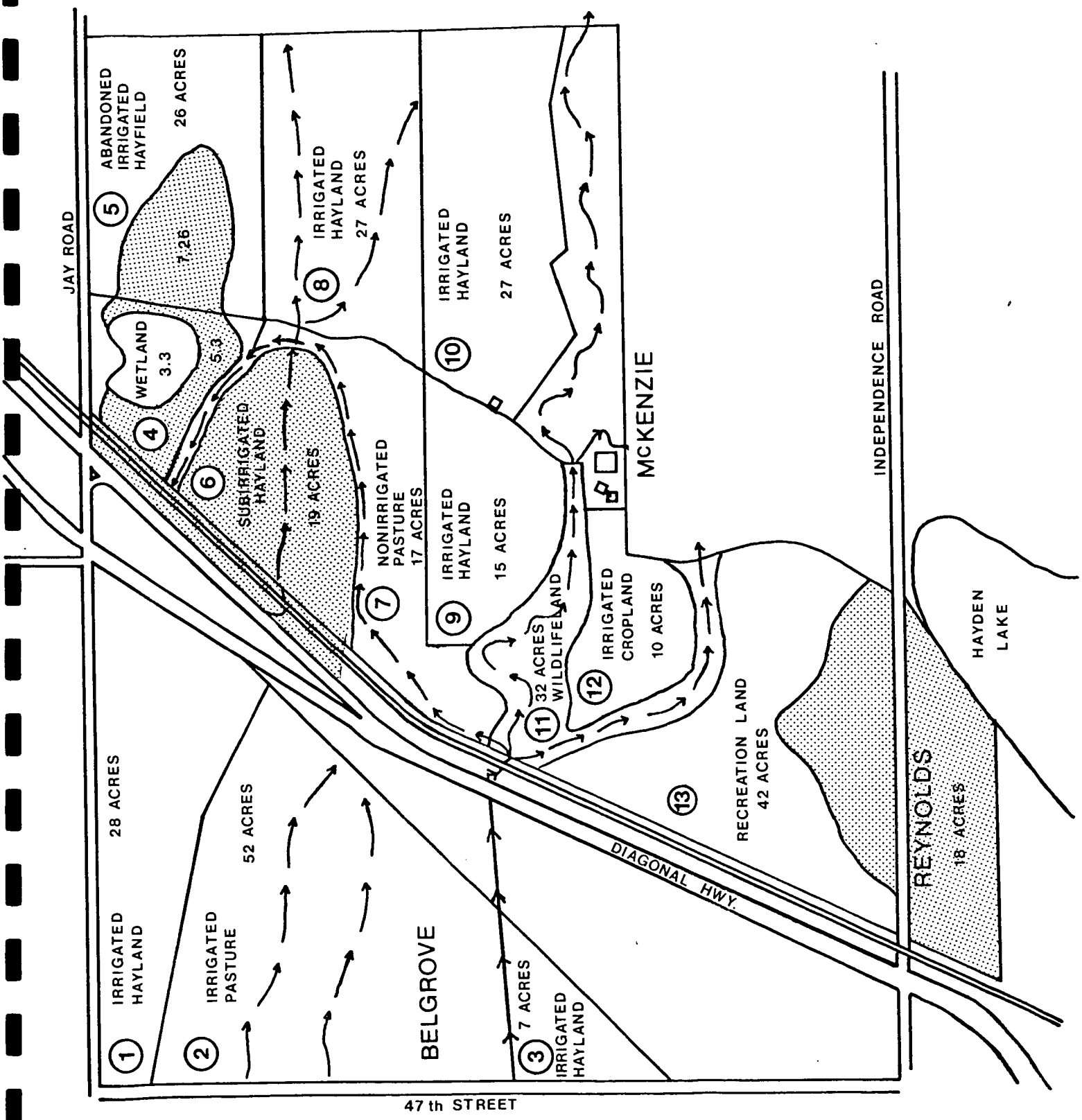


Figure 1. Early June, 1984 distribution of prairie dogs (shaded) and agricultural fields on and adjacent to the McKenzie property, Boulder, Colorado.

Field 6 is 19 acres of subirrigated hayland recently (early May, 1984) tilled and planted to a nurse crop (see Appendix B for SCS recommendations on this and other fields on the property). This field is surrounded on three sides by an irrigation ditch locally supporting young to mature cottonwoods and willows.

Other fields less relevant to this analysis are briefly described and illustrated in Figure 1.

Prairie Dogs

Prairie dogs have been in Fields 4, 5, and 6 for the last 15 years originally colonizing (or recolonizing) the area from the Burlington Northern Railroad tracks to the west (Chris Wilson, City of Boulder Open Space, pers. comm.). Prairie dog numbers have fluctuated widely over the years in concert with other towns in the area. The McKenzie population crashed in 1983; however, the cause and remaining base population was not identified. As of 1983, 172 prairie dog colonies existed in Boulder County (Rich Koopman, Boulder County Open Space, pers. comm.).

During late June, 1984, prairie dogs occupied 34.86 acres of Open Space on the north end of the McKenzie property, three acres of Burlington Northern Railroad right-of-way, 14.9 acres of Open Space on the south end of the McKenzie Property (Field 13), and 18 acres of the adjacent Reynolds property.

The prairie dogs in fields 4,5,and 6 and those along the railroad tracks represent one colony subdivided into two "wards" (King 1955), or subcolonies, by the irrigation ditch surrounding Field 6. Residents of Field 6 may frequently see or hear residents of Fields 4 and 5 (and vice versa), but communications between these wards are rare (Hoogland 1981).

In Field 5, prairie dogs are restricted to the 7.3 acres of "high" ground in the west and central portions of the field because of the high water table, particularly in spring. All holes located outside this area were flooded during a 30 May site visit. These flooded holes are used later in the year by adults and dispersing juveniles after the water table drops.

Prairie dogs inhabit the 5.3 acres of higher ground in field 4 and are restricted from the 3.3 acre ephemeral wetland in the northeast corner of the field until after the water table drops. Initial productivity in 1984 at this and other local colonies appears to be excellent. The number of six to eight week old young per litter ranged between four and six.

Prairie dogs also inhabit 14.9 acres on the south end of McKenzie Field 13 and 18 acres on the adjacent Reynolds property (Fig. 1). Another sizable town within the Open Space system is located 0.5 miles east of Field 5 on the Andrus property. While these towns are not directly associated with Fields 4 and 5, they are likely within the same home range of the large raptors which prey on prairie dogs in the fields proposed for development and enhancement. Prairie dogs are available as raptor prey from March to July and, intermittently during favorable weather, from September to February; they estivate in July and August.

Raptors

Nine species of raptors have been observed on or around fields 4, 5, and 6; however, because of different sizes, abundances, and/or activity patterns, some are more important as prairie dog predators than others.

Red-tailed hawks are the most common raptor in the area capable of taking prairie dogs. Although red-tails may prey on prairie dogs, they are thought to be relatively unimportant prairie dog predators compared to golden eagles and ferruginous hawks, possibly because of their small size (Bent 1937, Longhurst 1944, King 1955, Campbell and Clark 1981). This predator/prey size assessment also applies to Rough-legged hawks, Swainson's hawks (Koford 1958), Northern harriers (Koford 1958, Tyler 1968), prairie falcons (Koford 1958, Tyler 1968), and American kestrels (Tyler 1968) which seasonally inhabit the area.

Golden eagles and ferruginous hawks are considered important prairie dog predators (Koford 1958, Tyler 1968, Campbell and Clark 1981); however, because of their low abundance in the area, the relatively small size of the prairie dog colony, and the high level and type of vehicular activity bordering these fields, this area cannot be considered an important hunting area for either of these species.

Great horned owls, which are largely nocturnal, are probably insignificant predators of diurnal prairie dogs. Burrowing owls do not inhabit these fields.

Inexperienced, juvenile prairie dogs are undoubtedly taken by red-tails and other smaller raptors (primarily prairie falcons) and red-tailed hawks, ferruginous hawks, rough-legged hawks, and prairie falcons may seasonally prey on adults; however, the mice, voles, ground squirrels, and rabbits inhabiting these fields probably contribute more to the raptor prey base than do the prairie dogs. In 1984 there were no active nests of large, diurnal raptors on the McKenzie property.

Other Wildlife Groups

No trapping has been conducted to assess to small mammal community, however, it is probably similar to other "go-back" agricultural fields in the area. Approximately 90-95% of individuals present are probably deer mice. Other species may include prairie voles, northern pocket gophers, western harvest mice, thirteen-lined ground squirrels, and desert cottontails. Species of possible occurance include the masked shrew, meadow vole and hispid pocket mouse.

A number of shore birds including killdeer, sandpipers, and occasionally, American avocets, White-faced ibis, and black-necked stilts, use the ephemeral wetland in the northeast corner of Field 4 during wet Springs. No breeding bird studies have been conducted on the area; however, based on preliminary results of an ongoing Boulder Open Space bird study, such subirrigated and nonirrigated agricultural fields are some of the least productive habitats in the area. Species common on these fields include western meadowlarks, Brewer's blackbirds, European starlings, killdeer, vesper sparrows, red-winged blackbirds and barn swallows.

Striped skunk, raccoon, and red fox are the common predators in the area. Badgers probably do not occur in these fields although they are found in the area.

PROPOSED ALTERATION

The City of Boulder proposes to redevelop and manage Field 5 as an irrigated hayfield. The field will be leveled by moving soil from the higher central area to lower areas along the north, east, and south sides of the field. Specific guidelines for this manipulation, seed mixtures, and proposed management recommendations are provided in a 1984 Soil Conservation Service (SCS) report presented in Appendix B. Prairie dogs which persist in this field will be poisioned if they reach levels detrimental to the haycrop. (Chris Wilson, City of Boulder Open Space, pers. comm.).

Field 4 will be enhanced for wildlife by dredging the present wetland basin to create a pond, establishing windbreaks along the field's western border, and establishing riparian vegetation around the pond's periphery. Prairie dogs will be allowed to maintain an equilibrium with the post-modification habitat. SCS wildlife enhancement and management recommendations for this field are presented in Appendix B.

Field 6 will be seeded and managed as an alfalfa field. Prairie dogs persisting in this field will be poisioned if they attain levels detrimental to the alfalfa. A windbreak, continuous with that of Field 4 will be established along the field's western end to reduce soil erosion, control snow deposition, conserve moisture, and enhance aesthetics (SCS 1984, Appendix B).

Prairie dogs inhabiting Field 13, the adjacent Reynolds property, and other local colonies are not scheduled for poisioning.

EFFECTS OF THE PROPOSED ALTERATION ON THE EXISTING ENVIRONMENT

Implementing the proposed action on Field 5 will effect the loss of approximately 60-80 adult and juvenile prairie dogs and approximately 8 acres of the present colony. Although recolonization will occur, a high level of recolonization will initiate poisioning by City personnel. Composition of the field's small mammal community may change in species richness and the number of individuals composing each species, however, the deer mouse should continue to represent approximately 90% of the individuals present. The potential prey base available for raptors will initially drop to almost zero, as the field is torn up and leveled, then increase to a level below that which now exists. Mowed, irrigated hayfields are relatively depauperate of small mammals. Raptors which now hunt this field may continue to do so, however there will be better hunting areas nearby. Kestrels should continue hunting this field at previous levels. If the field is irrigated, breeding bird use of this field should increase.

Dredging the present wetland in Field 4 to establish a pond will not benefit the wildlife community. A drainage area of approximately 60 acres is required for each acre-foot of water stored in a pond in the Boulder area (SCS 1973). Although the proposed pond would have a storage capacity of less than one acre-foot, the entire drainage basin for this field is only 11 acres including the 3.3 acre wetland. The amount of water gained by sloping this field to concentrate runnoff in the pond would not significantly extend the amount of standing water or the amount of time standing water is available. Furthermore, it may take over 10 years to reestablish the type of wetland now present.

Trees and shrubs composing the windbreak and riparian vegetation will benefit the wildlife community; however, it is unlikely establishment will be successful if supplementary watering is not used. Breeding birds will be the major beneficiary of this vegetative enhancement.

If the pond is established, approximately 4.5 acres of summer prairie dog habitat will be lost to the pond and the riparian vegetation which develops around it. Construction impacts will initially reduce small mammal numbers, however, richness may increase over present levels because of greater habitat complexity. Changes in raptor use of this field should not be noticeable.

Abundance of breeding birds and small mammals will increase as the alfalfa develops in Field 6. Prairie dogs will be allowed to exist at a low level, however, they will be poisioned when they reach levels detrimental to the crop. Raptor use of this field should not change significantly.

Overall, 78% of this 37.86 acre prairie dog colony will be eliminated or reduced to lower densities leaving 8.3 acres of the colony (5.3 acres on Field 4 and 3 acres on the Burlington Northern right-of-way) undisturbed. Although this is a significant reduction in colony size, the remaining population is a viable one since these three fields were originally colonized by animals inhabiting the railroad right-of-way.

Because raptor use of prairie dogs on these three fields appears to be low, because other prairie dog colonies exist nearby, and because sufficient area remains for the prairie dogs on Field 4, along the railroad tracks, and marginally in Fields 5 and 6, the proposed actions should not locally effect any significant ecological consequences. It is difficult to assess, however, at what point the cummulative losses of hunting areas, perhaps in concert with other synergists, will initiate a reduction in an area's raptor population.

LITERATURE CITED

Bent, A.C. 1937. Life histories of North American birds of prey. Dover Publ., New York. 409 pp.

Campbell, T.M. and T.W. Clark. 1981. Colony characteristics and vertebrate associates of white-tailed and black-tailed prairie dogs in Wyoming. Amer. Midl. Nat. 105: 269-276.

Hoogland, J.L. 1981. The evolution of coloniality in white-tailed and black-tailed prairie dogs (Sciuridae: Cynomys leucurus and C. ludovicianus). Ecology 62: 252-272.

King, J.A. 1955. Social behavior, social organization and population dynamics in a prairie dog town in the Black Hills of South Dakota. Contrib. Lab. Vert. Biol. Univ. Mich. No. 67. 123 pp.

Koford, C.B. 1958. Prairie dogs, white faces, and blue grama. Wildl. Mono. No. 3. 78 pp.

Longhurst, W. 1944. Observations on the ecology of the Gunnison prairie dog in Colorado. J. Mammal. 25: 4-36.

Soil Conservation Service. 1973. Building a pond. U.S.D.A. Farmers' Bull. No. 2256. 13pp.

Tyler, J.D. 1968. Distribution and vertebrate associates of the black-tailed prairie dog in Oklahoma. Ph.D. Thesis, Univ. of Oklahoma, Norman. 85 pp.

APPENDIX A. LIST OF COMMON AND SCIENTIFIC NAMES USED IN TEXT

COMMON NAME	SCIENTIFIC NAME
PLANTS	
Small Bindweed	*Convolvulus arvensis*
Sedge	*Carex* spp.
Plains Cottonwood	*Populus sargentii*
Willow	*Salix* spp.
Alfalfa	*Medicago sativa*
ANIMALS	
MAMMALS	
Masked Shrew	*Sorex cinereus*
Desert Cottontail	*Sylvilagus audubonii*
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*
Black-tailed Prairie Dog	*Cyomys ludovicianus*
Northern Pocket Gopher	*Thomomys talpoides*
Hispid Pocket Mouse	*Perognathus hispidus*
Western Harvest Mouse	*Reithrodontomys megalotus*
Deer Mouse	*Peromyscus maniculatus*
Northern Grasshopper Mouse	*Onychomys leucogaster*
Meadow Vole	*Microtus pennsylvanicus*
Prairie Vole	*M. ochrogaster*
Red Fox	*Vulpes vulpes*
Raccoon	*Procyon lotor*
Badger	*Taxidea taxus*
Striped Skunk	*Mephitus mephitus*

BIRDS

Northern Harrier	Circus cyanus
Rough-legged Hawk	Buteo logopus
Ferruginous Hawk	B. regalis
Red-tailed Hawk	B. jamaicensis
Swainson's Hawk	B. swainsoni
Golden Eagle	Aquila crysaetos
Prairie Falcon	Falco mexicanus
American Kestrel	F. sparverius
White-faced Ibis	Plegadis chihi
American Avocet	Recurvirostra americana
Black-necked Stilt	Himantopus mexicanus
Killdeer	Charadrius vociferus
Great Horned Owl	Bubo virginuanus
Burrowing Owl	Athene cunnicularia
Barn Swallow	Hirundo rustica
European Starling	Sturnus vulgaris
Western Meadowlark	Sturnella neglecta
Red-winged Blackbird	Agelaius phoeniceus
Brewer's Blackbird	Euphagus cyanocephalus
Vesper Sparrow	Pooecetes gramineus

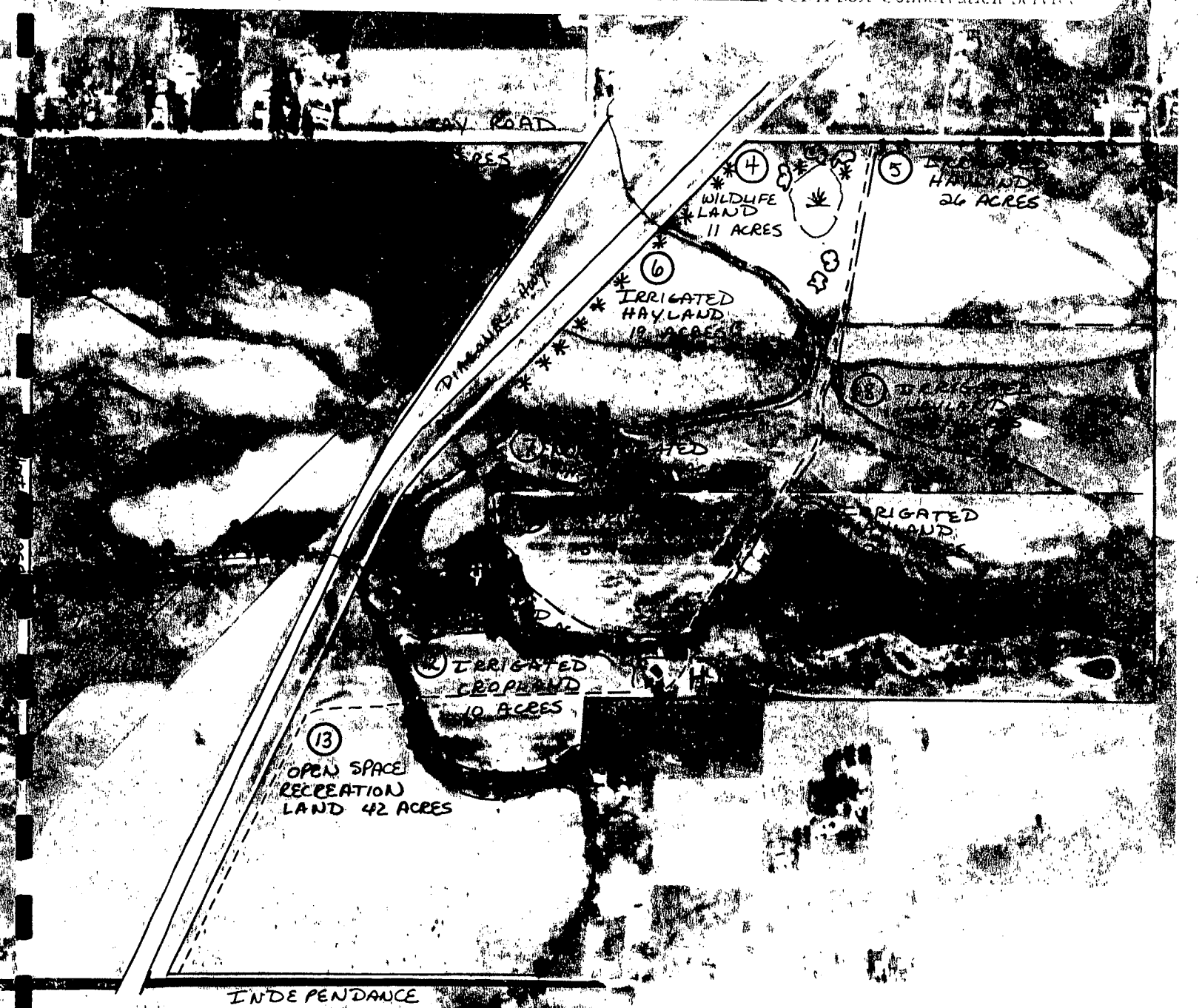
APPENDIX B. FEBRUARY, 1984 SOIL CONSERVATION SERVICE REPORT ON THE MCKENZIE PROPERTY.

SCS-CONS-16
OCTOBER 1974

SOIL CONSERVATION SERVICE

CONSERVATION PLAN MAP

Owner John McKenzie/City of Boulder Operator John McKenzie
County Boulder State Colorado Date 2-84
Approximate acres 317 Approximate scale 1" = 660'
Cooperating with Boulder Valley Conservation District
Plan identification Photo number
Assisted by Dawn Genes USDA Soil Conservation Service



STANDARD MAP SYMBOLS

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
COLORADO

Roads
- Good motor
- Poor motor or private
- Trail

Railroads

Buildings

School

Church

Gravel pit, open mine, or quarry

Farm, ranch, or other operations boundary

Field or land use boundary

Land capability, range, or woodland site boundary

Range condition boundary

Range condition — EC, GC, FC, PC

Farmstead

Field number — (2)

Field acreage — 320 Ac

Special purpose plantings (label)

Tent site

Trailer site — TR

Picnic shelter

Small recreation area (label as to type) — TENNIS

Rock outcrop

Gravel

Chert fragments

Clay spot

Bedrock escarpment

Gumbo or scabby spot

Sand spot

Gully

Made land

Blowout

Lake or Pond
- Permanent Water — POND
- Intermittent Water

Wet spot or Pot Hole

Marsh area or Spot Spring

Dam and reservoir

Stock pond, tank or charco

Spring development

Spring and trough

Trough

Well (label) — WELL

Windmill

Fence — -x-x-
side of ditch, etc.

Shelterbelt

Stream bank protection

Dike or levee

Pipeline

Flume or syphon

Canal (label) — CANAL / CANAL

Irrigation ditch

Pickup ditch — -P-P-

Diversion — -D-D-

Drainage Ditch (open drain)

Closed or tile drain

Terrace

Vegetative waterway

Division box or turnout

Diversion or spreader dam

Check dam or gully plug

Drop structure

USDA-SCS PORTLAND, OREG. 1968 M-4206

SCS-CONS-15
OCTOBER 1974

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

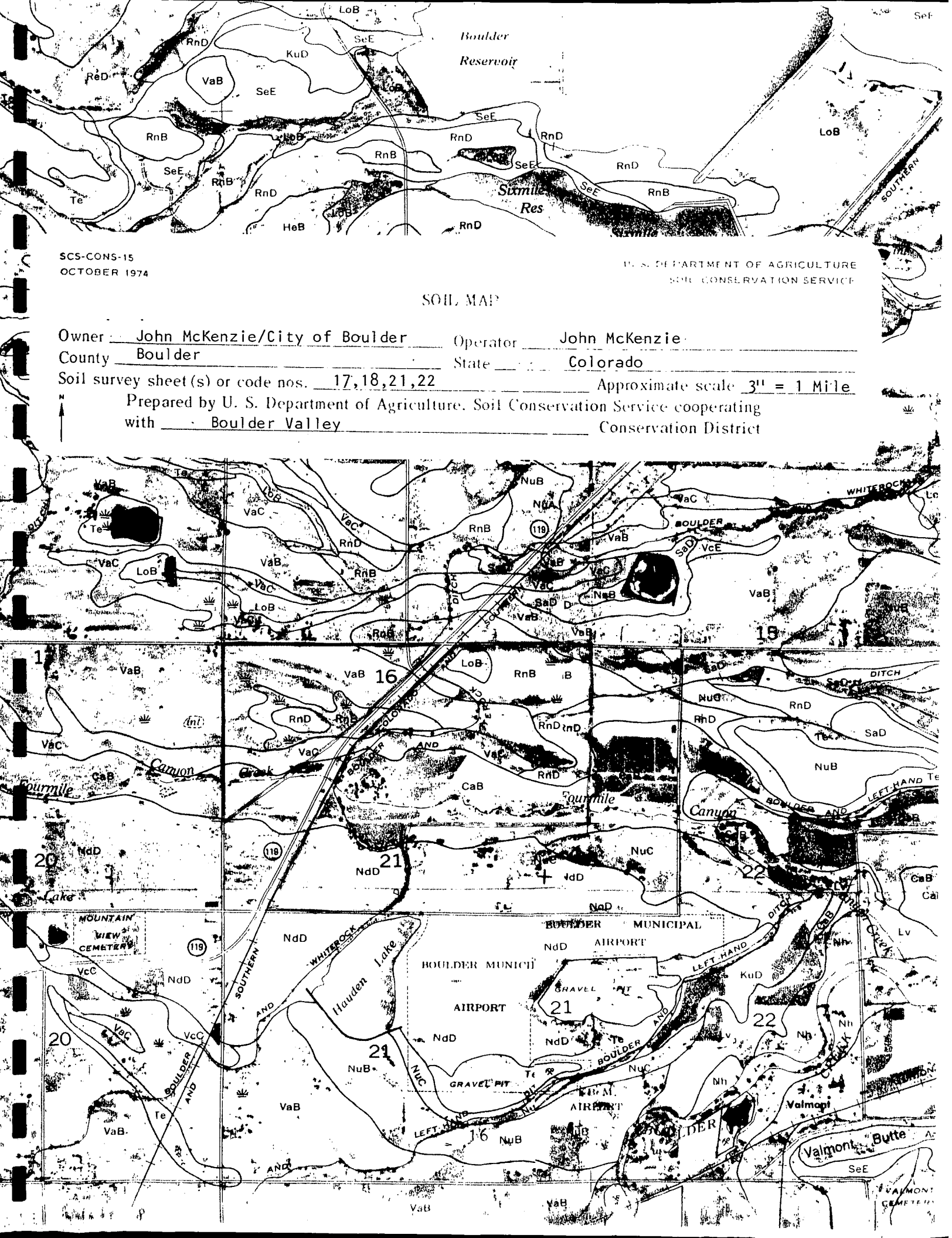
SOIL MAP

Owner John McKenzie/City of Boulder Operator John McKenzie

County Boulder State Colorado

Soil survey sheet(s) or code nos. 17,18,21,22 Approximate scale 3" = 1 Mile

Prepared by U. S. Department of Agriculture, Soil Conservation Service cooperating with Boulder Valley Conservation District



In a representative profile the surface layer is grayish-brown stony sandy loam about 10 inches thick. The underlying layer, about 5 inches thick, is light brownish-gray very stony sandy loam that overlies sandstone. Soil reaction is neutral.

Baller soils have rapid permeability. Available water capacity for the profile is low. Roots can penetrate to a depth of between 10 and 20 inches.

These soils are used for range and homesites.

Representative profile of Baller stony sandy loam, 9 to 35 percent slopes, located 1,400 feet south and 500 feet west of the northeast corner of sec. 6, T. 2 N., R. 70 W.:

A1—0 to 10 inches, grayish-brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 50 percent stones and cobbles; neutral; clear, smooth boundary.

C—10 to 15 inches, light brownish-gray (10YR 6/2) very stony sandy loam, dark grayish brown (10YR 5/2) when moist; massive; slightly hard, very friable; 60 percent stones and cobbles; neutral; gradual, wavy boundary.

R—15 inches, hard sandstone.

The A horizon ranges from 6 to 16 inches in thickness. Sandstone bedrock is at a depth of 10 to 20 inches. The average rock fragment content of the soil ranges from about 50 to 60 percent and is dominantly of stone size (more than 10 inches in diameter).

Baller stony sandy loam, 9 to 35 percent slopes (BoF).—This soil is on the east slopes of ridges in the western part of the Area. In most places it is in areas more than 100 acres in size. Large amounts of stone are on the surface and throughout the profile.

Included with this soil in mapping are small areas near the bottoms of slopes that have a sandy loam surface layer and a sandy clay loam subsoil. Near drainageways are areas that are deeper to bedrock. Also included, mostly near ridgetops, are small areas of Rock outcrop. The included soils and Rock outcrop make up about 20 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is high.

All of the acreage of this soil is in native grass. In some places there are scattered stands of ponderosa pine. (Capability unit VIIs–1, nonirrigated; tree suitability group 6)

Calkins Series

The Calkins series is made up of deep, somewhat poorly drained soils. They formed in loamy alluvium on low terraces and bottom lands. Slopes are 0 to 3 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly meadow grasses. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer, about 40 inches thick, is grayish-brown sandy loam. Underlying this to a depth of 60 inches or more is light brownish-gray coarse sandy loam that contains many brown mottles. Soil reaction is neutral.

Calkins soils have moderate to rapid permeability. Available water capacity for the profile is moderate to high. Roots can penetrate to a depth of 60 inches or more, and the seasonal high water table is at a depth of 3 feet or less.

These soils are used for irrigated crops and for pasture.

Representative profile of Calkins sandy loam, 0 to 1 percent slopes, located 400 feet east and 100 feet north of the southwest corner of sec. 16, T. 2 N., R. 69 W.:

Ap—0 to 14 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, medium, granular; hard, friable; neutral; clear, smooth boundary.

A1—14 to 40 inches, grayish-brown (10YR 5/2) sandy loam with common, medium, distinct, brown (7.5YR 5/4) mottles, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure that parts to fine granular; slightly hard, very friable; neutral; gradual, wavy boundary.

C—40 to 60 inches, light brownish-gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; many, fine, brown (7.5YR 4/4) mottles; massive; slightly hard, very friable; neutral.

The A horizon ranges from 24 to 40 inches in thickness and from fine sandy loam to sandy loam in texture. In some places these soils are calcareous below a depth of 40 inches.

Calkins sandy loam, 0 to 1 percent slopes (CaA).—This soil is on stream terraces and bottoms in the eastern part of Area. In most places it occurs as areas more than 30 acres in size. The profile of this soil is the one described as representative for the Calkins series.

Included with this soil in mapping are small areas that have a sandy clay loam texture throughout the profile, and a few small areas that are limy. Also included are small areas of McClave clay loam. These inclusions together make up about 10 percent of the acreage of this soil.

Runoff is slow on this soil. The erosion hazard is slight.

All of the acreage of this soil is used for irrigated crops. (Capability unit IIw–2, irrigated; tree suitability group 5)

Calkins sandy loam, 1 to 3 percent slopes (CaB).—This soil is on stream terraces and bottoms in the eastern part of the Area. In most places it occurs as long, narrow areas more than 20 acres in size.

Included with this soil in mapping are small areas of Calkins sandy loam, 0 to 1 percent slopes, and McClave clay loam. These included soils make up about 15 percent of each mapped area.

Runoff is slow on this soil. The erosion hazard is moderate.

All of the acreage of this soil is used for irrigated crops. (Capability unit IIw–2, irrigated; tree suitability group 5)

Colby Series

The Colby series is made up of deep, well-drained soils. These soils formed on upland slopes in loamy, uniform wind-deposited material. Slopes are 1 to 9 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly short grasses. Annual precipitation is 14 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is brown silty clay loam about 12 inches thick. Underlying this is pale-brown and light yellowish-brown silty clay loam and clay loam about 48 inches thick. Soil reaction is moderately alkaline. This soil is strongly calcareous through-

thick. Below this, at a depth of 30 inches, is shale. In the surface layer and subsoil, soil reaction is slightly acid, and in the underlying material, it is moderately alkaline.

Kutch soils have slow permeability. Available water capacity for the profile is moderate. Roots can penetrate to a depth of 20 to 40 inches.

These soils are used for irrigated and dryland crops and for pasture.

Representative profile of Kutch clay loam, 3 to 9 percent slopes, located 2,340 feet east and 400 feet north of the southwest corner of sec. 11, T. 1 S., R 70 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure that parts to moderate, medium, granular; very hard, firm; slightly acid; clear, smooth boundary.

B2t—7 to 22 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) when moist; moderate, coarse, subangular blocky structure that parts to moderate, medium, angular blocky; extremely hard, firm; thin patchy clay films on aggregate faces; slightly acid; clear, smooth boundary.

C1ca—22 to 30 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) when moist; massive; extremely hard, very firm; calcareous; common, fine to coarse, prominent, white (10YR 8/2) soft masses of lime; moderately alkaline; gradual, smooth boundary.

C2—30 inches, gray calcareous shale.

The Ap horizon ranges from 6 to 12 inches in thickness and from clay loam to light clay in texture. The structure of the B2 horizon ranges from weak prismatic to moderate, coarse and medium, subangular blocky and blocky. Depth to shale ranges from 20 to 40 inches.

Kutch clay loam, 3 to 9 percent slopes (KuD).—This soil is on the uplands, mainly in the south-central part of the Area. In most places it is in areas more than 20 acres in size. In some places scattered gravel and cobblestones are on the surface.

Included with this soil in mapping are small areas of Nunn clay loam, 5 to 9 percent slopes; Samsil clay, 3 to 12 percent slopes; Renohill silty clay loam, 3 to 9 percent slopes; and Shingle loam. These included soils make up about 15 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is high.

All of the acreage of this soil is used for irrigated and dryland crops and for native pasture. (Capability units IVe–1, irrigated, and VIe–1, nonirrigated; tree suitability group 3)

Laporte Series

The Laporte series is made up of shallow, well-drained soils. These soils formed on upland ridges in loamy residuum derived from limestone and limy shale. Slopes are 5 to 20 percent. Elevations are 5,200 to 5,800. The native vegetation is mainly short and mid grasses. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is strongly calcareous, grayish-brown very fine sandy loam about 8 inches thick. The underlying material is strongly calcareous, pale-brown loam, about 5 inches thick, that overlies limestone. Soil reaction is moderately alkaline.

Laporte soils have moderate permeability. Available water capacity for the profile is low. Roots can penetrate to a depth of between 10 to 20 inches.

These soils are used mainly for pasture or range, but in some areas the underlying limestone is used for the manufacture of cement.

Representative profile of Laporte very fine sandy loam, 5 to 20 percent slopes, located 1,820 feet west and 1,320 feet north of the southeast corner of sec. 16, T. 3 N., R. 70 W.:

A1—0 to 8 inches, grayish-brown (10YR 5/2) very fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure that parts to weak, fine, granular; soft, very friable; strongly calcareous; moderately alkaline; clear, wavy boundary.

C—8 to 13 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; soft, friable; strongly calcareous; moderately alkaline; clear, wavy boundary.

R—13 to 20 inches, gray limestone.

The A horizon ranges from 6 to 10 inches in thickness and from very fine sandy loam to loam in texture. Depths to limestone ranges from 10 to 20 inches. These soils are typically calcareous, but in some places are leached in the upper few inches. From 0 to 15 percent of the soil material is limestone chips.

Laporte very fine sandy loam, 5 to 20 percent slopes (LaE).—This soil is on tops and sides of ridges in the northwestern part of the Area. In most places it occurs as long, narrow areas more than 15 acres in size.

Included with this soil in mapping are some small areas of Manvel loam and near ridgetops, areas of Rock outcrop only a few feet wide. Also included is a Laporte-like soil that has limestone at depths below 20 to 40 inches. These included soils and Rock outcrop make up about 15 percent of each mapped area.

Runoff is medium to rapid on this soil. The erosion hazard is high. Available water capacity is low because of the depth to limestone.

This soil is too shallow to be cultivated. Almost all of the acreage is in range or pasture. (Capability unit VIe–3, nonirrigated; tree suitability group 6)

Longmont Series

The Longmont series is made up of deep, poorly drained, salty and alkaline soils. These soils formed on terraces and upland swales in clayey alluvium derived from shale. Slopes are 0 to 3 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly alkali sacaton and inland saltgrass. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is calcareous, light brownish-gray and light olive-brown clay about 21 inches thick. The underlying material is calcareous, light olive-brown and pale-olive clay to a depth of 60 inches or more. This material is mottled and has gypsum segregations. Soil reaction in the surface layer is strongly alkaline, and in the underlying material it is moderately alkaline.

Longmont soils have slow permeability. Available water capacity for the profile is high. Roots can penetrate to a depth of 60 inches or more and the seasonal high water table is between a depth of 2 and 4 feet.

These soils are used for pasture, homesites, and industrial sites.

Representative profile of Longmont clay, 0 to 3 percent slopes, located 500 feet north and 100 feet west of the south quarter of sec. 13, T. 2 N., R. 70 W.:

A11—0 to 5 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure; hard, firm; calcareous; strongly alkaline; clear, smooth boundary.

A12—5 to 21 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) when moist; weak, coarse, subangular blocky structure; extremely hard, very firm; calcareous; strongly alkaline; diffuse boundary.

C1csca—21 to 31 inches, light olive-brown (2.5Y 5/3) clay with many, medium, distinct yellowish-brown (10YR 5/4) mottles, dark grayish brown (2.5Y 4/3) when moist; massive; extremely hard, very firm; calcareous; common, fine to medium clusters of gypsum crystals and few, fine to medium, hard lime concretions; strongly alkaline; gradual, diffuse boundary.

C2cscag—31 to 60 inches, pale-olive (5Y 6/3) clay with common, medium, distinct olive (5Y 4/3) mottles, olive (5Y 5/3) when moist; massive; extremely hard, very firm; calcareous; common, fine to medium clusters of gypsum crystals and few to common, fine and medium, hard lime concretions; moderately alkaline.

The A1 horizon ranges from 12 to 24 inches in thickness and from clay loam to clay or silty clay in texture. The C horizon ranges from heavy clay loam to clay in texture. In most places shale is at a depth of more than 60 inches, but in a few areas it is between depths of 40 and 60 inches.

Longmont clay, 0 to 3 percent slopes (loB).—This soil is in the eastern part of the Area. A few soil areas are somewhat concave. In most places this soil is in irregular areas more than 20 acres in size.

Included with this soil in mapping is a Longmont-like soil that has shale at a depth of less than 40 inches. Also included are small areas of Colby silty clay loam, wet, 0 to 3 percent slopes; and small areas of Heldt clay, 0 to 3 percent slopes. These included soils make up about 10 percent of each mapped area.

In most places runoff is slow, but some concave areas are ponded. The erosion hazard is slight. Drainage and removal of salt and alkali are difficult because this soil is slowly permeable.

Almost all of the acreage of this soil is in pasture, except for some areas that are urbanized. Efforts to establish better stands of grass have been partly successful. (Capability unit VIw–1, nonirrigated; tree suitability group 6)

Loveland Series

The Loveland series is made up of deep, somewhat poorly drained soils. These soils formed on terraces and bottom lands in loamy alluvium that overlies gravelly and sandy materials. Slopes are 0 to 1 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly bluegrass and blue grama. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is calcareous, dark grayish-brown light clay loam about 20 inches thick. It is mottled in the lower part. The underlying material, about 10 inches thick, is strongly calcareous, grayish-brown light clay loam that is mottled. Underlying this to a depth of 60 inches or more is mottled, light brownish-gray gravelly sand. In the surface layer and underlying material soil reaction is moderately alkaline, and in the substratum it is mildly alkaline. In most areas, gypsum crystals and soft lime segregations are present in some layers.

Loveland soils have moderate permeability. Available water capacity for the profile is moderate to high, depending upon the depth to very gravelly sand. Roots can penetrate to a depth of 60 inches or more, and the seasonal high water table is at a depth of 2 to 4 feet.

These soils are used for pasture and crops. In some areas they are a source of gravel for construction.

Representative profile of Loveland clay loam, 0 to 1 percent slopes, in an area of Loveland soils located 70 feet east and 2,310 feet south of the northwest corner of sec. 11, T. 2 N., R. 69 W.:

A11—0 to 11 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) when moist; moderate, fine and medium, granular structure; soft, very friable; calcareous; moderately alkaline; clear, smooth boundary.

A12—11 to 20 inches, dark grayish-brown (10YR 4/2) light clay loam with common, medium, distinct yellowish-brown (10YR 5/4) mottles, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; hard, firm; calcareous; moderately alkaline; abrupt, smooth boundary.

C1csca—20 to 30 inches, grayish-brown (10YR 5/2) light clay loam with common, medium, distinct, yellowish-brown (10YR 5/4 and 6/6) mottles, dark grayish brown (10YR 4/2) when moist; massive; hard, friable; strongly calcareous; few to common, fine to medium clusters of gypsum crystals, and common, medium and coarse, soft white lime segregations; moderately alkaline; clear, wavy boundary.

IIC2—30 to 60 inches, light brownish-gray (10YR 6/2) very gravelly sand with many, medium, distinct, strong-brown (7.5YR 5/6) mottles, grayish brown (10YR 5/2) when moist; single grained; loose when dry and moist; mildly alkaline.

The A horizon ranges from 18 to 23 inches in thickness and from sandy clay loam to clay loam in texture. The C horizon ranges from loam to clay loam or sandy clay loam in texture. Depth to underlying sand or gravel ranges from 20 to 40 inches.

Loveland soils (0 to 1 percent slopes) (lv).—These soils are on stream terraces and bottoms in the eastern part of the Area. In most places they are in irregular areas more than 20 acres in size.

The profile of these soils is similar to the one described as representative for the series, but the texture of the surface layer ranges from sandy clay loam to clay loam.

Included with these soils in mapping is a Loveland-like soil that has a lighter colored surface layer. Also included are gravel bars less than 1 acre in size, small areas of McClave clay loam, and areas of Niwot soils. These included soils and gravel bars make up about 15 percent of each mapped area.

Runoff is slow on these soils. The erosion hazard is slight.

All of the acreage of these soils is used for irrigated crops or pasture. (Capability unit IIIw–1, irrigated; tree suitability group 5)

Made Land

Made land (Ma) is on nearly level areas along St. Vrain Creek near the eastern edge of the Area. This land is

9[illegible] feet south and 60 feet west of the center of sec. 11, T. 2 N., R. 69 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark brown (10YR 2/2) when moist; strong, medium, granular structure; soft, very friable; neutral; clear, smooth boundary.

A12—7 to 19 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard, firm; neutral; gradual, wavy boundary.

A13g—19 to 40 inches, grayish-brown (10YR 5/2) light clay loam with many fine, distinct, brown (7.5YR 5/4) mottles; very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; hard, firm; neutral; gradual, wavy boundary.

C1g—40 to 60 inches, brown (10YR 5/3) light clay loam with many, large, distinct, brown (7.5YR 5/4) mottles; brown (10YR 4/3) when moist; massive, slightly hard, very friable; neutral.

The A horizon ranges from 25 to 40 inches in thickness. Mottles are present in the lower part of the A horizon. The C horizon is typically a light clay loam or loam, but in places it is sandy loam. Some areas are underlain by sand and gravel at a depth of more than 40 inches.

McClave clay loam (0 to 1 percent slopes) (Mm).—This soil is on stream terraces and bottoms in the eastern part of the Area. In most places it occurs as areas more than 20 acres in size.

Included with this soil in mapping are small areas of Calkins sandy loam, 0 to 1 percent slopes, and Loveland soils. Also included is a McClave-like soil that has a heavy clay loam surface layer less than 24 inches thick. In places, the surface layer is light colored, the subsoil is a heavy loam, and lime occurs throughout the profile. Included soils make up about 15 percent of each mapped area.

Runoff is slow on this soil. The erosion hazard is slight.

All of the acreage of this soil is used for irrigated crops. Some areas are used to produce vegetables. Some of those areas that have a water table between depths of 2 and 3 feet are used for irrigated pasture. (Capability unit IIw–1, irrigated; tree suitability group 5)

Nederland Series

The Nederland series is made up of deep, well-drained soils that formed on old high terraces and alluvial fans. The soils developed in loamy alluvium that contains many cobblestones and other stones. Slopes are 1 to 12 percent. Elevations are 5,500 to 6,500 feet. The native vegetation is mainly tall grasses and mid grasses. Annual precipitation is 15 to 20 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is brown very cobbly sandy loam about 4 inches thick. The subsoil, about 16 inches thick, is brown and reddish-brown, heavy coarse sandy loam and very cobbly sandy clay loam. Underlying these materials to a depth of 60 inches or more is reddish-brown very cobbly coarse sandy loam. Soil reaction is neutral.

Nederland soils have moderate permeability. Available water capacity for the profile is moderate. Roots can penetrate to a depth of 60 inches or more.

These soils are used mostly for range, but some areas near the larger towns are used for homesites.

Representative profile of Nederland very cobbly sandy loam, 1 to 12 percent slopes, located 950 feet north of center of sec. 28, T. 1 S., R. 70 W.:

A1—0 to 4 inches, brown (7.5YR 5/2) very cobbly sandy loam, dark brown (7.5YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 50 percent gravel and cobblestones; neutral; clear, smooth boundary.

B1t—4 to 7 inches, brown (7.5YR 5/3) very cobbly heavy coarse sandy loam, dark brown (7.5YR 3/3) when moist; weak, medium, subangular blocky structure that parts to moderate, fine, granular; hard, friable; few thin clay films on the faces of peds and as coatings on gravel and cobblestones; 50 percent gravel and cobbles; neutral; clear, smooth boundary.

B2t—7 to 15 inches, reddish-brown (5YR 5/3) very cobbly sandy clay loam, dark reddish brown (5YR 3/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; extremely hard, friable; many thin clay films on faces of peds, as coatings on sand and gravel fragments, and as bridges between sand grains; 50 percent gravel and cobblestones; neutral; gradual, wavy boundary.

B3t—15 to 20 inches, reddish-brown (2.5YR 5/4) very cobbly light sandy clay loam, reddish brown (2.5YR 4/4) when moist; weak, medium, subangular blocky structure; extremely hard, very friable; few thin clay films on the vertical faces of peds, as coatings on sand grains, and as bridges between sand grains; 60 percent cobblestones and gravel; neutral; gradual, wavy boundary.

C—20 to 60 inches, reddish-brown (2.5YR 5/4) very cobbly coarse sandy loam, reddish brown (2.5YR 4/4) when moist; massive; extremely hard, very friable; 60 percent cobbles and gravel; neutral.

The A horizon ranges from 3 to 6 inches in thickness. Content of rock fragments in the A and B horizons ranges from 50 to 70 percent. The C horizon ranges from light sandy clay loam to sandy loam in texture. Content of coarse fragments in the C horizon is more than 50 percent.

Nederland very cobbly sandy loam, 1 to 12 percent slopes (NdD).—This soil is on outwash fans and on the uplands in the central part of the Area. In most places it occurs as areas more than 50 acres in size. These areas have many stones and cobblestones on the surface.

Included with this soil in mapping are some soils that lack a sandy clay loam subsoil and that are very stony and cobbly sandy loam throughout the profile. Also included, near the eastern edge of outwash fans, are some small areas of Valmont cobbly clay loam, 1 to 5 percent slopes. The included soils make up about 20 percent of each mapped area.

Runoff is slow to medium on this soil. The erosion hazard is slight.

Most of the acreage of this soil is used for range or pasture. Many areas near Boulder are used as homesites. (Capability unit VIIs-1, nonirrigated; tree suitability group 6)

Niwot Series

The Niwot series is made up of deep, somewhat poorly drained soils that are shallow over gravelly sand. These soils formed on low terraces and bottom lands in loamy alluvium superimposed over sand and gravel. Slopes are 0 to 1 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly bromegrass and water-tolerant grasses. Annual precipitation is 12 to 18 inches. Mean

R—32 to 60 inches, reddish-brown (2.5YR 5/4) noncalcareous Lyons sandstone with flagstone cleavage.

The A1 horizon ranges from 0 to 4 inches in thickness, and the A2 horizon ranges from 7 to 18 inches in thickness. The A horizon ranges from loamy fine sand to heavy loamy sand in texture. The B2t horizon ranges from 14 to 24 inches in thickness and from heavy clay loam to clay in texture. Amount of stones ranges from 35 to 80 percent throughout the profile.

Pinata-Rock outcrop complex, 5 to 55 percent slopes (PrF).—This complex is on upland ridges in the northwestern part of the Area. It is about 45 percent Pinata very stony loamy fine sand and about 35 percent Rock outcrop. The Pinata soil is throughout the area but mainly has the smoother slopes. Rock outcrop is scattered throughout the area, but mainly has the steeper slopes.

Mapped with this complex along drainageways are small areas of a Pinata-like soil that overlies sandstone at a depth of more than 40 inches. Near ridgetops are some soils that overlie sandstone at a depth of less than 20 inches. A few areas of Colluvial land are also included. These included soils and Colluvial land make up about 20 percent of each mapped area.

Runoff is medium to rapid on areas of this complex. The erosion hazard is high.

Most of the acreage of this complex is used for forestry and limited grazing of livestock. A major use in recent years is for quarrying of building stone. (Capability unit VIIe-1, nonirrigated; tree suitability group 6)

Renohill Series

The Renohill series is made up of moderately deep, well-drained soils. These soils formed on upland hills and ridges in loamy parent material weathered from shale and sandstone. Slopes are 1 to 9 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly

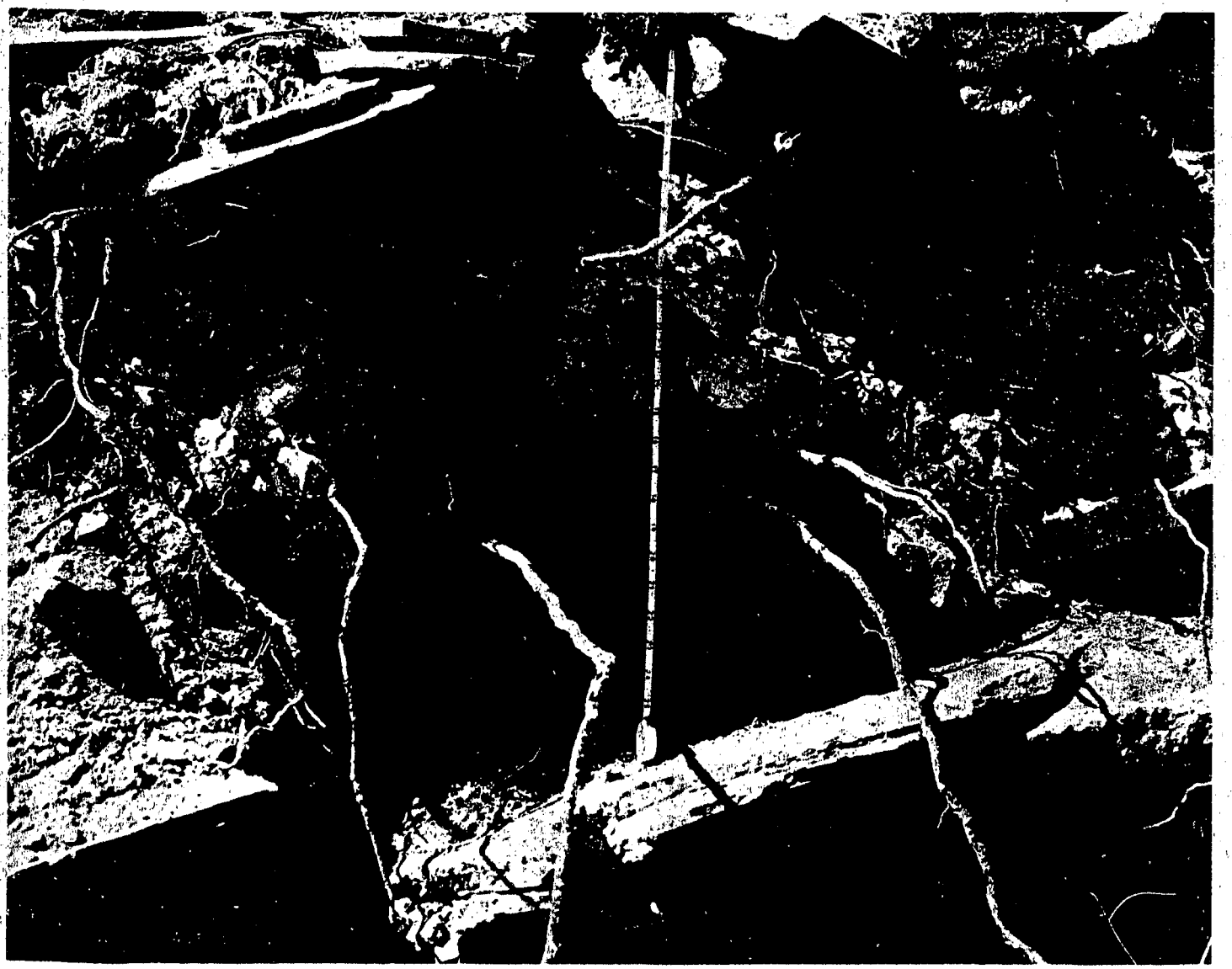


Figure 3.—Profile of Pinata very stony loamy fine sand in an area of Pinata-Rock outcrop complex, 5 to 55 percent slopes.

short and mid grasses. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer is slightly calcareous, light olive-brown silty clay loam about 7 inches thick. The subsoil, about 23 inches thick, is light olive-brown and light yellowish-brown silty clay and silty clay loam that is slightly calcareous in the upper part and strongly calcareous in the lower part. Calcareous weathered shale underlies the subsoil. In the surface layer and the upper part of the subsoil, soil reaction is mildly alkaline, and in the lower part of the subsoil, it is moderately alkaline.

Renohill soils have slow permeability. Available water capacity for the profile is moderate. Roots can penetrate to a depth between 20 and 40 inches.

These soils are used for irrigated and dryland crops and for pasture.

Representative profile of Renohill silty clay loam, 3 to 9 percent slopes, located 50 feet north and 1,240 feet east of the southwest corner of sec. 3, T. 3 N., R. 69 W.:

Ap—0 to 7 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; moderate, medium, subangular blocky structure; soft, friable; slightly calcareous; mildly alkaline; clear, smooth boundary.

B21t—7 to 12 inches, light olive-brown (2.5Y 5/4) silty clay, olive brown (2.5YR 4/4) when moist; moderate, medium, prismatic structure that parts to moderate and strong, angular blocky; very firm, very hard; nearly continuous clay films on ped faces; slightly calcareous; mildly alkaline; clear, smooth boundary.

B22t—12 to 20 inches, light olive-brown (2.5Y 5/4) silty clay loam, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure that parts to moderate, medium and fine, angular blocky; very hard, very firm; nearly continuous clay films on ped faces; strongly calcareous; moderately alkaline; gradual, wavy boundary.

B3tca—20 to 30 inches, light yellowish-brown (2.5Y 6/4) silty clay loam, light olive brown (2.5Y 5/4) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; very hard, firm; thin, patchy clay films on ped faces; strongly calcareous; moderately alkaline.

C—30 to 60 inches +, weathered calcareous shale.

The A horizon ranges from 6 to 12 inches in thickness and from loam to silty clay loam in texture. The B horizon ranges from silty clay loam to clay or silty clay in texture. Depth to underlying shale or sandstone ranges from 10 to 40 inches. The shallow depth to bedrock of Renohill loam is not typical of the Renohill series, but use and management of this shallow soil is similar to that for other Renohill soils having comparable slopes.

Renohill loam, 3 to 9 percent slopes (ReD).—This soil is on the uplands, mainly in the west-central part of the Area. In most places it is in irregular areas larger than 100 acres.

This soil has a profile similar to the one described as representative for the series, but the surface layer is a loam that is 3 to 5 inches thick. Hard sandstone is at a depth between 10 and 20 inches. This depth is somewhat shallower than is normal for Renohill soils as they occur in other areas. Because of its limited acreage and similar nonirrigated use and management, this soil has been named Renohill.

Included with this soil in mapping are a few areas of Rock outcrop. Also included are small areas of Samsil soils and Shingle soils that in most places are on the steeper west slopes. These included soils make about 20 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is high.

This soil is unsuited to cultivation. Most of the acreage is in native range. In recent years some areas have been used as sites for small industry. (Capability unit VIe–3, nonirrigated; tree suitability group 6)

Renohill silty clay loam, 1 to 3 percent slopes (RnB).—This soil is mainly in the northeastern part of the Area. In most places it is in long, relatively narrow areas more than 15 acres in size.

The profile of this soil is like the one described as representative for the series, but the surface layer is about 9 inches of silty clay loam. The subsoil is about 23 inches thick and is a silty clay throughout.

Included with this soil in mapping are small areas of Gaynor silty clay loam, 1 to 3 percent slopes; Samsil clay, 3 to 12 percent slopes; and Heldt clay, 0 to 3 percent slopes. These inclusions make up about 15 percent of each mapped area.

Runoff is medium on this soil. The erosion hazard is moderate.

Almost all of the acreage of this soil is cultivated and is used for irrigated crops and pasture. The rest is used for dryland crops. A few small areas are used as pasture. (Capability units IVs–1, irrigated, and IVe–4, nonirrigated; tree suitability group 3)

Renohill silty clay loam, 3 to 9 percent slopes (RnD).—This soil is on the uplands, mainly in the northeastern part of the Area. In most places it is in long, relatively narrow areas more than 15 acres in size. In a few places this soil has scattered narrow areas more than 15 acres in size. In a few places this soil has scattered gravel and cobbles on the surface. This soil has the profile described as typical for the series.

Included with this soil in mapping are small areas of Gaynor silty clay loam, 3 to 9 pecent slopes; Samsil clay, 3 to 12 percent slopes; and Renohill silty clay loam, 1 to 3 percent slopes. These included soils make up about 15 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is high.

All of the acreage of this soil is used for irrigated and dryland crops and for pasture. (Capability units IVe–1, irrigated, and VIe–1, nonirrigated; tree suitability group 3)

Rock Outcrop

Rock outcrop (Ro) consists mainly of steep slopes and cliffs in the western part of the Area. A few small areas of Rock outcrop are in the eastern part.

These barren areas are predominantly exposed bedrock that consists of mixed materials, including granite, sandstone, shale, and limestone.

Included in mapping are areas of a shallow soil that has less slope and is in areas of mixed colluvium near the bottom of slopes.

Rock outcrop is used mainly for watershed and wildlife habitat. Many areas are also used for such recreational purposes as climbing and hiking. (Capability unit VIIIs–1 nonirrigated; not placed in a tree suitability group)

soils and 35 percent Gaynor soils. The complex is on the uplands, mainly in the northeastern part of the Area. Most areas are more than 20 acres in size and are irregular in shape. Shingle soils are near ridgetops and on steeper slopes. In most places Gaynor soils are near the base of slopes.

Included with this complex in mapping are areas of Renohill silty clay loam, 3 to 9 percent slopes; Colby silty clay loam, 5 to 9 percent slopes; and Samsil clay, 3 to 12 percent slopes. These included soils make up about 15 percent of each mapped area.

Runoff is rapid on this complex. The erosion hazard is high.

This complex is best suited to pasture. Because the soils are shallow over bedrock, they are used for dryland crops and pasture. (Capability unit VIe–3, nonirrigated; tree suitability group 6)

Sixmile Series

The Sixmile series is made up of moderately deep, well-drained soils. These soils formed on upland ridges and side slopes in calcareous loamy residuum weathered from shale. Slopes are 10 to 50 percent. Elevations are 5,800 to 6,600 feet. The native vegetation is mainly mid grasses. Annual precipitation is 14 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 120 to 140 days.

In a representative profile the surface layer, about 4 inches thick, is strongly calcareous, reddish-brown stony loam. The underlying material is gray and reddish-gray light clay loam about 26 inches thick. Underlying this is weathered shale. Soil reaction is moderately alkaline.

Sixmile soils have moderate permeability. Available water capacity for the profile is moderate to high. Roots can penetrate to a depth between 20 and 40 inches.

These soils are used for grazing.

Representative profile of Sixmile stony loam, 10 to 50 percent slopes, located 650 feet west and 1,000 feet north of the southeast corner of sec. 8, T. 3 N., R. 70 W.:

A1—0 to 4 inches, dark reddish-gray (5YR 4/2) stony loam, dark reddish brown (5YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; many stones and boulders; strongly calcareous; moderately alkaline; gradual, wavy boundary.

C1—4 to 20 inches, gray (5YR 6/1) light clay loam, dark gray (5YR 4/1) when moist; massive; hard, very friable; strongly calcareous; moderately alkaline; gradual, wavy boundary.

C2—20 to 30 inches, reddish-gray (10YR 5/1) light clay loam, dark reddish gray (10YR 4/1) when moist; massive; hard, very friable; strongly calcareous; moderately alkaline; gradual, wavy boundary.

C3—30 to 60 inches, reddish-gray (10YR 5/1) partially disintegrated shale.

The A horizon ranges from 3 to 6 inches in thickness and from loam to light clay loam in texture. The C horizon ranges from loam to clay loam in texture. Depth to bedrock ranges from 20 to 40 inches.

Sixmile stony loam, 10 to 50 percent slopes (SmF).—This soil is on the uplands on the western side of steep ridges in the western part of the Area. In most places it is in areas more than 100 acres in size.

Included with this soil in mapping are narrow bands of Rock outcrop and rock escarpments. Rock outcrop is throughout the area, and in most places the escarpments are on ridgetops. Also included near the base of slopes are small areas of Colluvial land. Included Rock outcrop, rock escarpment, and Colluvial land make up about 20 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is high.

All of the acreage of this soil is in native range. (Capability unit VIIs–1, nonirrigated; tree suitability group 6)

Terrace Escarpments

Terrace escarpments (Te) are on side slopes of old outwash fans and terraces in the central part of the Area (fig. 4). Soil areas are long and narrow.

These areas consist of undifferentiated shallow soils that have many cobbles and stones on the surface. In many places there is merely a thin layer of cobbles over sandstone or shale.

Included in mapping are some deeper soils near the bottom of slopes.

Runoff is rapid, and the erosion hazard is high. Terrace escarpments take in water slowly, but in places intake of water is influenced by the amount of stones and cobblestones on the surface. Only limited moisture is available for plants because these undifferentiated soils are shallow.

Terrace escarpments is not suited to cultivation. It is used for native range. (Capability unit VIIs–1, nonirrigated; tree suitability group 6)

Valmont Series

The Valmont series is made up of deep, well-drained soils. These soils formed on old high terraces and benches in gravelly and cobbly loamy alluvium. Slopes are 1 to 25 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly tall and mid grasses. Annual precipitation is 12 to 18 inches. Mean annual air temperature is 48° to 52° F., and the frost-free season is about 140 to 155 days.

In a representative profile the surface layer, about 4 inches thick, is a grayish-brown light clay loam that contains varying amounts of cobbles and gravel. The upper part of the subsoil is brown clay loam about 3 inches thick. The middle part is brown light clay about 13 inches thick. The lower part is calcareous, light-brown gravelly clay loam about 4 inches thick. The underlying material is calcareous, pinkish-white and light-brown very gravelly loam. In the surface layer, soil reaction is neutral, but with increasing depth it becomes moderately alkaline.

Valmont soils have moderately slow permeability. Available water capacity for the profile is moderate. Roots can penetrate to a depth of 60 inches or more.

These soils are used for irrigated and dryland crops and for pasture.

Representative profile of Valmont clay loam, 3 to 5 percent slopes, located 800 feet east of the northwest corner of sec. 7, T. 3 N., R. 69 W.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, fine, granular structure; soft, very friable; 5 percent gravel; neutral; clear, smooth boundary.

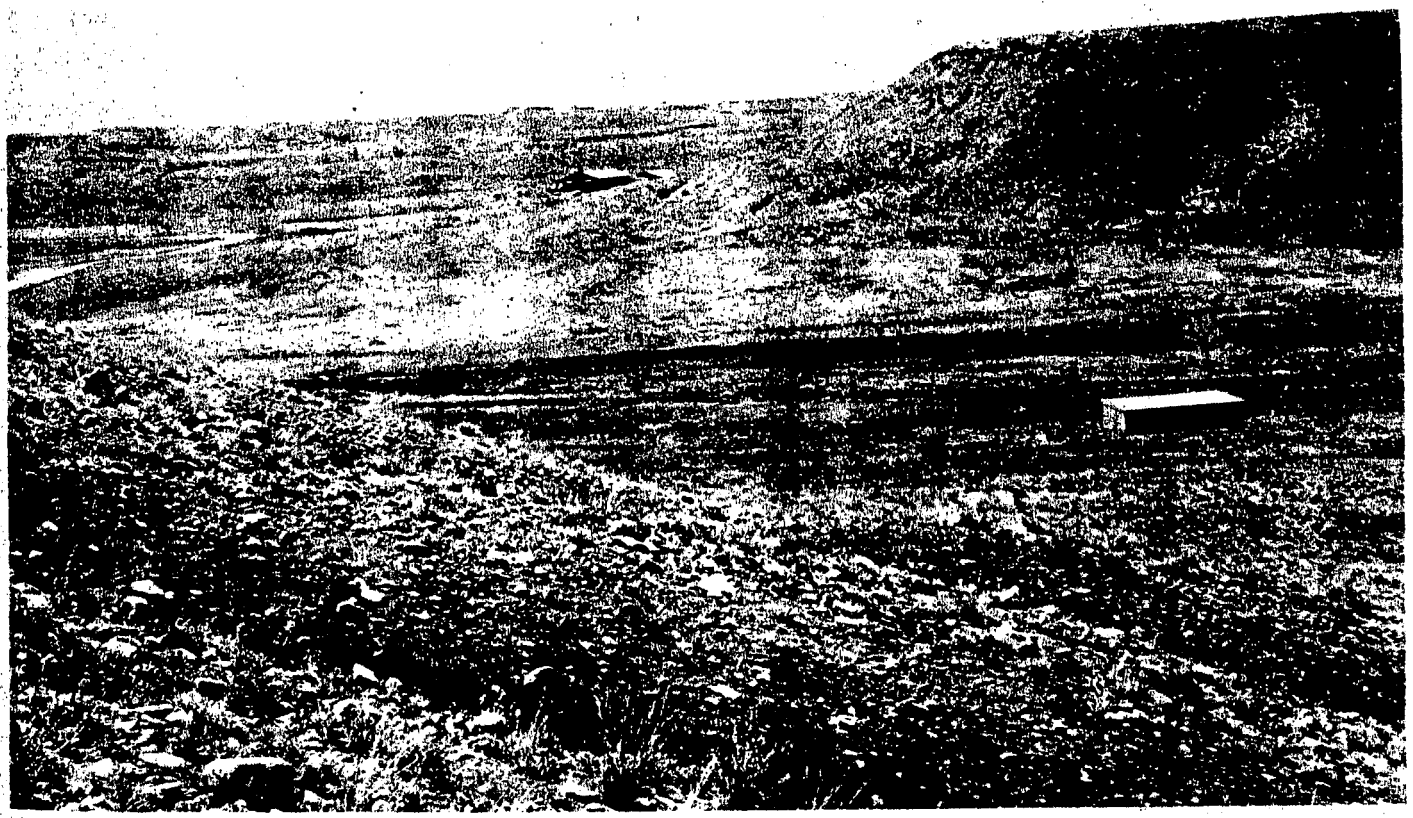


Figure 4.—Outwash fans and terraces with Terrace escarpments in the foreground and in the sloping areas.

B1t—4 to 7 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; hard, friable; few thin clay films on vertical faces of some aggregates; 10 percent gravel; neutral; clear, smooth boundary.

B2t—7 to 20 inches, brown (10YR 5/3) light clay, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure that parts to moderate, medium, angular blocky; extremely hard, firm; thin continuous clay films on faces of aggregates; 10 percent gravel; mildly alkaline; clear, wavy boundary.

B3ca—20 to 24 inches, light-brown (7.5YR 6/3) gravelly clay loam, brown (7.5YR 5/3) when moist; weak, medium, prismatic structure that parts to moderate, medium, subangular blocky; very hard, firm; common, thin clay films on faces of aggregates; 15 percent gravel; calcareous, with few to common, fine to medium, white (10YR 8/2) lime seams and streaks; moderately alkaline; gradual, wavy boundary.

IIC1a—24 to 35 inches, pinkish-white (7.5YR 8/2) very gravelly loam, pink (7.5YR 8/4) when moist; massive; very hard, very friable; 50 percent gravel and cobblestones; calcareous with many fine and few medium, white (10YR 8/2), soft segregations of lime; moderately alkaline; gradual, wavy boundary.

IIC2ca—35 to 60 inches, light-brown (7.5YR 6/3) very gravelly loam, brown (7.5YR 5/3) moist; massive; hard, very friable; 50 to 75 percent gravel and cobblestones calcareous with many, fine and medium, white (10YR 8/2) soft segregations and hard coatings of lime on under sides of rock fragments; moderately alkaline.

The A1 horizon ranges from 4 to 12 inches in thickness and from loam to clay loam in texture. Texture of the B2t horizon ranges from a heavy clay loam to clay that may be gravelly or cobbly. Depth to calcareous material ranges from 8 to 20 inches. Depth to underlying cobblestones and gravel ranges from 20 to 40 inches. Content of cobblestones and gravel in the A and B horizons normally ranges from 5 to 30 percent, but it may be as high as 50 percent in the surface layer of cobbly phases. In the C horizon, the content of cobblestones and gravel ranges from 50 to 70 percent.

Valmont clay loam, 1 to 3 percent slopes (VaB).—This soil is on terraces and fans mainly in the central part of the Area. In most places it occurs as areas more than 40 acres in size.

The profile of this soil is much like the one described as representative for the series, but the surface layer is about 9 inches of clay loam. The subsoil is about 6 inches of clay that grades into limy clay loam about 14 inches thick.

Included with this soil in mapping are a few areas that have a seasonal high water table. Also included are small areas of Valmont cobbly clay loam, 1 to 5 percent slopes; and Nunn clay loam, 1 to 3 percent slopes. These included soils make up about 15 percent of each mapped area.

Runoff is medium on this soil. The erosion hazard is moderate. Fertlity is medium.

Most of the acreage of this soil is used for irrigated and dryland crops and for pasture. (Capability units

IIIe–3, irrigated, and IIIs–1, nonirrigated; tree suitability group 3)

Valmont clay loam, 3 to 5 percent slopes (VaC).—This soil is on terraces and fans, mainly in the west-central part of the Area. In most places it is in long, narrow areas more than 20 acres in size. This soil has the profile described as representative for the series.

Included with this soil in mapping are small areas of Valmont clay loam, 1 to 3 percent slopes; Nunn clay loam, 3 to 5 percent slopes; and Valmont cobbly clay loam, 1 to 5 percent slopes. These included soils make up about 15 percent of each mapped area.

Runoff is rapid on this soil. The erosion hazard is moderate.

All of the acreage of this soil is used for irrigated and dryland crops and for pasture. (Capability units IIIe–2, irrigated, and IIIe–7, nonirrigated; tree suitability group 3)

Valmont cobbly clay loam, 1 to 5 percent slopes (VcC).—This soil is on high terraces and outwash fans in the west-central part of the Area. In most places it is in areas more than 20 acres in size.

The profile of this soil is much like the one described as representative for the series, but the surface layer is about 8 inches of cobbly clay loam. The subsoil is about 14 inches of cobbly clay loam or cobbly clay (fig. 5).

Included with this soil in mapping is a Valmont-like soil that is redder than this soil, that has less than 10 percent gravel and cobblestones, and that contains some depressions supporting no vegetation and having a crusted surface layer. Also included are small areas of Valmont clay loam, 3 to 5 percent slopes. These included soils make up about 15 percent of each mapped area.

Runoff is medium on this soil. The erosion hazard is slight to moderate.

This soil is not well suited to cultivation and the harvesting of crops because it has too many cobblestones and too much gravel on its surface. It is, however, a good grass-producing soil. Most of the acreage is used for native range. A few small areas are used for irrigated pasture. (Capability units Vs–1, irrigated, and VIIs–1, nonirrigated; tree suitability group 6)

Valmont cobbly clay loam, 5 to 25 percent slopes (VcE).—This soil is on the side slopes of high terraces or outwash fans, mainly in the south-central part of the Area. In most places it is in long, narrow areas more than 20 acres in size.

The profile of this soil is much like the one described as representative for the series, but the surface layer is about 6 inches of cobbly clay loam. The subsoil is about 12 inches of cobbly clay or clay loam. There are varying amounts of gravel and cobblestones throughout the profile.

Included with this soil in mapping are a few small areas of a Valmont-like soil that has a layer of gravel at a depth of more than 40 inches. A few minor areas have shale or sandstone underlying the very gravelly layers within a depth of 40 inches from the surface. Also included are some small areas of Valmont cobbly clay loam, 1 to 5 percent slopes. Included soils make up about 20 percent of each mapped area.

Runoff is medium to rapid on this soil. The erosion hazard is moderate to high.

Figure 5.—**Profile of Valmont cobbly clay loam, 1 to 5 percent slopes.**

All of the acreage of this soil is used for native range. (Capability unit VIIs–1, nonirrigated; tree suitability group 6)

Weld Series

The Weld series is made up of deep, well-drained soils. These soils formed on smooth uplands, mainly in loamy wind-laid parent material. Slopes are 0 to 5 percent. Elevations are 4,900 to 5,500 feet. The native vegetation is mainly short grasses. Annual precipitation is 12 to

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RECORD OF COOPERATOR'S DECISIONS AND PROGRESS IN APPLICATION

FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
1	28 Ac.	'84		PASTURE AND HAYLAND
2	52 Ac.	'84		PASTURE AND HAYLAND MANAGEMENT
3	7 Ac.	'84		
5	26 Ac.	'85		Properly manage pasture and hayland to prolong the life of desirable forage species, maintain or improve the quantity and quality of forage, provide soil protection, and reduce water loss.
6	19 Ac.	'85		
7	17 Ac.	'84		Fertilize according to soil test results or at a rate of 30 pounds available nitrogen, 10 pounds phosphorous, and 50 pounds potassium per ton of forage produced. See attached soil chart for expected yields.
8	27 Ac.	'84		
9	15 Ac.	'84		Apply 1/3 of the recommended fertilizer rate at the beginning of the growing season. Apply 1/3 after the first cutting and 1/3 after the second cutting (or approximately 6 weeks apart).
10	27 Ac.	'84		
				Observe the recommended minimum cutting height of 4 inches for quality hay production. Mow mid and tall grasses at boot stage.
				The last cutting should be timed to allow for a two to four week regrowth the period before the average first killing frost.
				Field number 2 is currently being grazed as one unit. This field should be divided into two or three units of equal size and grazing rotated among the units. Livestock should be moved as one herd to allow for a forage recovery period of up to 30 days. Grazing each unit for 15 days would allow a rest period of 30 days in the previously grazed unit.
				Do not graze below the recommended minimum height of four inches.
				Mow pastures periodically to prevent spot grazing and to control weeds.
				Fields may be winter grazed to remove old residue and offer limited forage. Do not graze down to root crown to prevent damage to the plant

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FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
7	17 Ac.	'84		Practice mechanical or chemical weed control if weeds are significantly inhibiting the growth of desirable forage species.
5	26 Ac.	'84		PASTURE AND HAYLAND PLANTING Establish long term stands of adapted species to produce high quality forage and reduce water loss. Erosion by wind and water on these fields, especially field #7 is severe. A grass seeding should be done to prevent further deterioration of the resource base. Prepare a seedbed by tilling the ground to a depth of four to six inches. The soil must be smoothed and firmed. Seed at a depth of 1/4 to 1/2 inch. Seedlings must be properly fertilized and on an annual basis as needed. Weed control is necessary to allow seedling to become established. Seed to a mixture of: Species — PLS* LBs/Ac. Smooth Brome — 3.9 Orchardgrass — 1.6 Intermediate wheatgrass — 4.5 10.0 Because of a critically high weed population in these fields, a small grain crop should be planted the first year, followed by the grass seeding the second year. Chemical weed control is necessary during this preparitory phase to increase the success of the grass seeding. Seed the desired small grain at a rate of 60 lbs/ac between March 15 and April 15. Seed to a depth of one to two inches. Seed the wet area of field #8 to a wat tolerant grass such as Tall Wheatgrass, Switchgrass, or Alkali Sacaton.

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FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
All fields				**IRRIGATION WATER MANAGEMENT** Determine the rate, amount, and timing of irrigations to efficiently utilize available water, produce the desired crop, and reduce soil and nutrient losses. Use stress tests, soil moisture tests, or evaporation rate to know when irrigation is required. Cool season grasses show moisture stress with a dull green color, then wilting. The critical moisture period is early spring and early fall.
7	1000 ft.	'84		**FIELD WINDBREAK** Plant a strip of trees or shrubs adjacent to the field to reduce soil blowing, control snow deposition, conserve moisture, protect crops, livestock, and wildlife, and to increase the natural beauty of the area. Disc a narrow strip for site preparation. Plant one or two rows of trees or shrubs. If two rows are used, space rows 20 feet apart. The spacing between trees or shrubs in the row will be as follows: Low shrubs ... 4-6 feet Tall shrubs 8-12 feet Trees 12-16 feet The following trees and shrubs are suitable for this site: Ponderosa pine Austrian pine Rocky Mountain juniper Concolor fir Colorado blue spruce Siberian elm Green ash Honeylocust Hackberry Caragana Chokecherry American plum Honeysuckle Lilac Spirea Skunkbush sumac Russian olive

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FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
				The roots of the planting stock must be kept moist after receiving. Provide planting holes deep enough so that roots are not curled or crowded. Plant seedling at a depth where the root collar is at ground level. Compact the soil around the roots to eliminate air pockets. Growth of vegetation around trees should be controlled to discourage rodents. This may be done by a light discing or by mowing periodically during the growing season. Delay the first mowing until July 1 to avoid destruction of nesting pheasants. Provide supplemental water as necessary. Protect the windbreak from fire and from grazing by both domestic and wild animals for the life of the planting. If chemical weed control is needed, use only approved products such as TNB-A, TMTD, or ZAC. Use caution and READ ALL LABELS FIRST. CROPLAND CONSERVATION CROPPING SYSTEM: Rotate row crops or small grains with grasses or legumes to reduce soil erosion, maintain the condition of the soil, and to control weeds, insects, and diseases. Use crop residues on the soil surface during the critical erosion period to protect the soil from blowing. Leave at least 1000 lbs. of small grain residue or 1750 lbs. of row crop residue on the ground to prevent wind erosion. Follow irrigation water management guidelines as under PASTURE AND HAYLAND.
12	10 Ac.	'84		

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FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
4	14 Ac.	'84		WILDLIFELAND WILDLIFE UPLAND HABITAT MANAGEMENT: Manage wildlife habitat by creating, retaining or improving the area for desired kinds of wildlife. Preserve vegetation that is valuable to wildlife for food and cover. Brush control activities should not be conducted unless it is necessary to develop or improve the habitat for wildlife. Protect the area from fire and grazing. All activities except noxious weed control will be suspended from April 1 to June 30 to avoid disturbance of game bird nesting activities. Provide food, cover, and water within close proximity to each other. Plant trees and shrubs in accordance with recommendations under FIELD WINDBREAK. Plant golden willow or cottonwood trees in the low-lying area of field #4 to provide wildlife cover and enhance the aesthetics of the area.
11	32 Ac.	'84		
13	42 Ac.	'84		RECREATIONLAND RECREATION AREA IMPROVEMENT: Establish grasses, shrubs, or trees or selectively reduce stand density to improve an area for recreation, increase the attractiveness and usefulness of the area, and protect soil and plant resources. Maintain grass area by periodically mowing to reduce stand height and make area more accessible for recreational use. Selectively thin volunteer tree stand at south edge of field. Remove defective, damaged, or infested trees and all dead trees and shrubs. Cut trees to provide optimum shade, density, and free movement. Leave trees and shrubs in

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FIELD NO.	PLANNED AMOUNT	PLANNED YEAR	APPLIED MONTH AND YEAR	LAND USE AND TREATMENT
				irregularly spaced clumps where possible. Cut all marked trees to a stump height not to exceed three inches on the high side, and all brush and shrubs at the ground line. Control weeds by mechanical or chemical methods to prevent the spread of weed seed and to improve the quality of the area.

COOPERATOR: John McKenzie

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