S O I L S I N V E N T O R Y

of

GILBERT CREEK COMMUNITY ALLOTMENT

and

ISAAC ALLOTMENT

within

C. M. RUSSELL - NATIONAL WILDLIFE RANGE, MONTANA

by

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Introduction

This soil survey was made to obtain basic information that will help in developing management plans for a portion of the Charles M. Russell National Wildlife Range. Fieldwork was initiated on August 30, 1966, by Lyle D. Linnell, Soil Scientist, DSC, and Robert E. Adams, Range Conservationist, BLM, Miles City District Office. Ernest K. Hogan, Soil Scientist, Soil Conservation Service, Lewistown, Montana, provided valuable assistance and acquainted Messrs. Linnell and Adams with principal soil series in the survey area. The survey, conducted by Messrs. Linnell and Adams during parts of the months of September and October, was completed the first week of November, 1966. It required a total of 2½ man-months to complete the fieldwork.

It should be pointed out that no field review or correlation was made of the surveyed area other than correlation of field mapping between Messrs. Linnell and Adams during the survey. The survey, therefore, may not have any standing as far as the National Cooperative Soil Survey is concerned.

Soil series adaptation in the survey followed, as closely as possible, the established series of the Soil Conservation Service of the U.S. Department of Agriculture which has the primary responsibility for soil surveys in the United States. There are, however, some soils mapped which did not seem to fit any established or tentative series that the survey party had soils descriptions of; so, tentative series names were given these soils.

Location

The Gilbert Creek Community and Isaac grazing allotments are located partially within the Charles M. Russell National Wildlife Range, in the northeast part of Garfield County, Montana, in Tps. 22 and 23 N., Rs. 39 and 40 E. These allotments comprise some 35,000 acres, with the northern boundary being the Fort Peck Reservoir.

The area is situated some 35 to 40 miles northeast of Jordan, Montana. It is devoted to wildlife and livestock use.

History

The Fort Peck Game Range was established December 11, 1936, by Executive Order No. 7509. Administration was to be jointly shared by the Secretaries of Agriculture and Interior. The Bureau of Biological Survey, Department of Agriculture, and the Grazing Service, Department of the Interior, were the agencies of the two departments responsible for jurisdiction of the game range. Administrative agencies are now under the Department of the Interior, and they are Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, and Bureau of Land Management. The game range was created so,

" . . . That the natural forage resources therein shall be first utilized for the purpose of sustaining in a healthy condition a maximum of four hundred thousand (400,000) sharptail grouse, and one thousand five hundred (1,500) antelope, the primary species, and such nonpredatory secondary species in such numbers as may be necessary to maintain a balanced wildlife population, but in no case

shall the consumption of forage by the combined population of the wildlife species be allowed to increase the burden of the range dedicated to the primary species: Provided further, That all the forage resources within this range or preserve shall be available, except as herein otherwise provided with respect to wildlife, for domestic livestock under rules and regulations promulgated by the Secretary of the Interior under the authority of the aforesaid act of June 28, 1934, as amended: . . ."

The Fort Peck Game Range was redesignated as the Charles M. Russell National Wildlife Range by Public Land Order No. 1548311, Montana, dated February 25, 1963.

Climate

The Gilbert Creek Community and Isaac grazing allotments are within an area generally described as having a continental climate, with cold winters, warm summers, and highly variable seasonal precipitation. About 66 percent of the annual precipitation falls during the growing season of May through September, with May, June, and July usually providing the highest rainfall. The average annual precipitation (Jordan, Montana) is 11.62 inches with 7.62 inches falling during the months of May through September. The average January temperature (Jordan, Montana) is 14.8° F., and the average July temperature is 72.4° F. with a maximum of 112° F. and a minimum of -58° F. The average last killing frost (Jordan, Montana) in

the spring is May 19 and the first killing frost in the fall is September 21, with an average growing season of 125 days.

Physiography and Geology

The Gilbert Creek Community and Isaac grazing allotments are situated on an upland plain that is deeply trenched with numerous coulees draining in a northerly direction into the Fort Peck Reservoir. Elevations range from approximately 2,200 to 2,700 feet above sea level. The relief of the area is common to the Missouri breaks section, and it was influenced to some degree by glaciation. The area lies at the end of the continental glaciation. According to most geologic literature, glaciers did not advance south of the Missouri River; however, the Geologic Map of Montana indicates that the border of the continental ice sheet extended over the subject area. This may have been intended only to relate evidence of glaciation by the presence of erratic boulders or remants of glacial till deposited south of the river by the receding ice.

The gullies of the drainages are actively moving back into the narrow ridges, tabular divides, and footslopes. The sides of drainages are steep to very steep with narrow intervening valley bottoms. The maximum local relief is approximately 500 feet. Southerly exposures are more droughty and contain grass-shrub vegetative type, whereas the northerly exposures have tree-shrub cover. The slopes of both exposures are steep to strongly sloping and dissected by deeply cut drains and gullies.

The eastern portion of Montana had its beginning with the complicated schists and gneisses of the basal or Pre-Cambrian complex. This area is depicted by geologic deposits of great thicknesses during inundation by inland seas, followed by an intense type of mountain creation. Long periods of erosion followed, leveling the Pre-Cambrian mountains to nearly a plain. Presence of igneous rock indicates the complex intrusions and possible extrusions in remote times. Classification of the geological periods are: Pre-Cambrian, Paleozoic, Mesozoic, and Cenozoic Eras. Present formations found in eastern Montana are attributed to contributions from each of the geologic eras. Sediment thicknesses from these eras range from a few to tens of feet. Thus, in eastern Montana and more specifically on the Gilbert Creek Community and Isaac grazing allotments, the Bearpaw shale, Fox Hills sandstone, and the Hell Creek formation are present in ascending order.

Ice movement over large land areas such as the northern United States and Canada is known as continental glaciation. Glaciation is the alteration of the land surface by glacier ice passing over it. The action of glaciation--erosion, transport, and deposition--produces phenomenal changes in land textures. In the northern United States, the ice sheet moved southward over the surface accumulating soil and rock material as it advanced. The accumulated material was deposited on the land surface as the ice sheet melted. The deposition is called glacial drift or glacial moraine. Deposition consists

of fine material of local origin and granitic boulders from the Flaxville benches. The area surveyed was very little, if any, affected by glaciation other than remnants on the higher ridges; but to the north, the glacial till or drift forms broad flat plains.

Four major advances of continental glaciation are known from oldest to youngest as Nebraskan, Kansan, Illinoian, and Wisconsin. The names were derived from the State, where the deposits are well displayed.

Interglacial stages occurred between each of the ice advances when the ice presumably melted northward and may have melted completely between advances. The same region was reinvaded by the Wisconsin ice sheet and obscured most effects of the earlier advances; however, it may not have extended as far south as the previous advances.

During glaciation times, rivers were dammed creating lakes. Many lakes occurred along the Missouri River. These lakes had an effect on the formations and depositions of the area.

Glacial ice sheets in Montana must have been 1,500 to 2,000 feet thick due to the evidence of glacial material present 1,500 feet above the plains on the slopes of isolated plains mountains.

The drainage system of the Missouri Plateau was greatly affected by glaciation. As the ice sheet spread southward into Montana, it carried with it soil and rock material in its path. The valleys

of the north-flowing streams were thus filled and the water could no longer flow northward nor could it flow westward; so, it flowed in an easterly direction near the edge of the ice sheet. Old stream channels were filled with sand and gravel transported by the glacial ice from Canada. The ancient stream pattern of the Missouri River which flowed by Big Sandy, Havre, and Malta became extinct. The eastward-flowing stream cut a new channel which formed a new drainage pattern, and the Missouri River flowing along its present course came into existence.

The effect of glaciation on topography is undoubtedly leveling the surface by abrading hills and filling up valleys. In some instances, valleys were deepened; but, a great deal of relief was due directly to glacial deposition and thus reducing relief.

The soil materials remaining from the glacier activity are largely outwash materials of silty clay loam and gravel on a limited extent in the area surveyed.

Factors of Soil Formation

Soils are developed by the interaction of soil-developing processes on material deposited during geologic time. Characterization of any soil is determined by, (1) the type of parent material, (2) the climate under which the soil developed, (3) the plant and animal life in and on the soil, (4) the topography or lay of the land, and (5) the length of time the factors of soil formation have acted on the soil.

Climate and vegetation with animal life are active factors in soil development. These factors act on parent material that has accumulated through the weathering of rocks and slowly changes this material over a long period of time into a natural body of soil with genetically related layers or horizons. Topography or relief influences the effect of climate and vegetation on soil development. The type of parent material affects the kind of soil profile that will develop and, in some instances, determines it altogether. Time, as previously stated, is essential to convert the parent material into a soil profile. Depending on the other factors, it may take long periods of time or relatively short periods; but a period of time is always required for soil horizon differentiation. Distinct soil horizons are developed over long periods of time.

The factors of soil formation are so closely interrelated that no one factor can explain all the differences in soil. All the factors act together but at different rates in soil development.

Parent Material

The soil parent materials of the Gilbert Creek Community and Isaac grazing allotments are derived primarily from two geologic formations--Fox Hills sandstone and Hell Creek with some from the Bearpaw shale formation and glacial till. The glacial till is an accumulation of soil and geologic material resulting from glaciation. The above geologic formations consist of marine shales, sandstones, and sandy and clayey shales of varying thicknesses. Soil parent materials may be

calcareous or noncalcareous with the finer textured materials being better supplied with mineral nutrients that are required for plant growth. Textures of these soil parent materials vary from loamy sand to clay with all variations of textures possible in between these extremes.

Climate

The climate of this area is continental with cold winters, warm summers, and a variable amount of annual precipitation. Although winter temperatures are cold, they are not oppressive due to the low humidity and the occasional warm Chinook winds. Precipitation with living organisms, acting in conjunction with temperature and relief, develops soil essentially from the upper 3 feet of the parent material. These factors act slowly over a long period of time in developing genetically related soil horizons. Organic matter added to the soil by the incorporation of decomposed vegetation and the translocation of $CaCO_3$, $CaSO_4$, and other salts in the soil are the earliest changes that take place in soil development. The nearly level to gently sloping upland soils express these changes to a marked degree. These soils contain horizons of accumulated $CaCO_3$ at varying depths ranging from 4 to 14 inches with other salts at 16 to 28 inches. The average depth of moisture penetration is reflected by the depth to the horizon of $CaCO_3$ accumulation. Relief or lay of the land modifies the effect of climate on the kind of soil profile that develops. Soils on steep slopes, narrow ridges, or rounded hilltops have little

or no soil development. Soils in these situations reflect the loss of precipitation from runoff and loss of small amounts of soil throughout their history of development. The opposite is true in concave positions where a greater amount and depth of organic matter accumulation reflects a better developed soil, due primarily to an increase of moisture by run-in-water.

Vegetation and Living Organisms

Living organisms are active forces in soil development. The continental climate--cool, temperate, semiarid--supports a short and midgrass vegetation over most of the area. Junipers with some Ponderosa pine are growing on the north and northeast facing slopes. The moderately fine and fine textured soils have a grassland aspect. Soils formed under grasslands accumulate large amounts of organic matter through decomposition of leaves, stems and roots of grasses by bacteria, and other micro-organisms. Plant-root growth in soil helps to create an open and porous condition for better air and water relationships. Earthworms and burrowing animals, living in a soil enriched with organic matter, rework and mix the soil. Under favorable climatic conditions, bacteria and other micro-organisms decompose the organic material to organic matter. Freezing and thawing of the soil in conjunction with animal and insect activity therein assists plant residues to maintain the soil in good physical condition through good soil structure and a high percentage of pore space.

Relief and Drainage

The effectiveness of climate and vegetation on soil development are modified by the relief as; it influences exposure to sun and wind, drainage of water over and in the soil, the rate of erosion, and the kinds and numbers of plant and animal life on and in the soil. The relief of the Gilbert Creek Community and Isaac grazing allotments varies from nearly level and gently sloping uplands and butte type geologic material to very steep and broken topography along deeply incised drainages.

Soils on the narrow upland ridges and nearly level slopes and benches display a much higher degree of soil development than the steeper more sloping areas by the added accumulation of organic matter and greater depth to lime. The better soil moisture relationship of these soils by additional moisture accumulation increases plant growth and, therefore, increases biological activity in decomposing plant remains.

Runoff waters emerging from the practically barren, soft, shaley geologic materials are heavily laden with sediments that are either deposited on the low lying areas adjacent to or in the Fort Peck Reservoir. Gully erosion is very evident in the soft geologic material of the Missouri River breaks adjacent to the reservoir. The majority of the two grazing allotments lie within the breaks area. Relief and drainage of the area have a marked influence on the degree of soil development by the effect of climate and living organisms acting on the soil parent material.

Time

Soil development occurs from parent material only after a long period of time has evolved. The length of time essential for soil development depends primarily on the other factors of soil formation. A mature soil develops in less time in a humid, warm region with luxuriant vegetation than in a dry or cold region with scant vegetation. Under similar conditions, soils develop quicker from coarse textured parent material than from fine textured material.

The age of soils in the surveyed area varies considerably. Soils on the relatively level upland ridges and benches have a much better developed soil profile indicating a more mature soil than the soils on the steeply sloping landscapes where geologic erosion has practically kept pace with soil development. Therefore, the soils on the steeper areas have only a thin surface horizon with little accumulated organic matter and are, therefore, in a youthful state of development. Flood plains of the drainageways are continually receiving alluvial deposition by run-in-water. The soils in this type of situation have not been in place long enough to develop any genetically related horizons.

The length of time that climate and living organisms have been active on the soil material in an area determines the kind of soil found in a given position on the landscape. The age of a soil is reflected by the depth and degree of differentiation between horizons. A soil is mature when the soil particles become finer and more clayey in nature and the A and B horizons become thicker; also, all the more

soluble minerals are leached from the A and B horizons. All soluble salts are leached or removed from the upper 1 to 3 feet of the soil, and clay has been formed or accumulated by translocation in the B horizon of Brown soils.

Classification of Soils

Soils are placed in narrowly defined classes for the organization and application of knowledge about their behavior within management units or areas. They are placed in broad classes or categories for study and comparison of larger areas. In the comprehensive system of soil classification, soils are categorized. There are six categories, as follows: order, suborder, great soil group, family, series, and type.

In the highest category, the soils are grouped into three orders; whereas in the lowest category, thousands of soil types are recognized. The suborder and family categories have not been fully developed and therefore have been used very little.

In the highest category of the soil classification system are the zonal, intrazonal, and azonal orders. Soils in the zonal order contain well-expressed, genetically related horizons that reflect the predominant influence of climate and living organisms in their formation. Soils in the intrazonal order have genetically related horizons that reflect the dominant influence of relief, parent material, or time over the effect of climate and plant and animal life in their development. The azonal order comprises soils that lack genetically

related horizons due to youthfulness, resistant parent material, or steepness of topography.

Classification of the soil series into the higher categories that were present on the surveyed area are listed below. Soils containing the same horizon sequence and characteristics are grouped into the same soil series and given a place name. Textural differences of the surface layer, slope, amount of erosion and depth of profile are distinguishing characteristics in soil types or phases. Similar soil series are grouped into the same great soil group.

Great Soil Groups in the Survey Area

Classification of the great soil groups into orders is the highest level of grouping in the classification scheme. The classification of the soil in the surveyed area by order, great soil group, and series is outlined below:

Zonal Order

Brown Soils

Assinniboine
Ryegate

Chestnut Soils

Fort Peck
Regent

Intrazonal Order

Solonetz Soils

Winnett
Bald

Azonal Order

Alluvial Soils

Havre
Lohmiller

Lithosols

Midway
Tullock

Regosols

Glendive

Brown soils have a brown A horizon of moderate thickness and a lighter colored B or C horizon. These soils commonly have an accumulation of lime at a depth of 1 to 3 feet.

Chestnut soils have a dark-brown surface horizon that grades to lighter colored sub-horizons. They have accumulated lime at a depth of 1 to 4 feet. Chestnut soils in the surveyed area have a darker colored surface layer than the Brown soils.

Solonetz soils have a friable surface horizon of variable thickness with a dark, hard, soil material of columnar structure. These soils are commonly highly alkaline. The Solonetz soils of this area have a thin A1 horizon or none. Many bare areas (Bald soils) have a thin A2 horizon exposed or a vesicular surface crust. The textural B horizon is darker colored than the A horizon and is assumed to be strongly alkaline.

Alluvial soils consist of water-transported and, in many cases, recently deposited material. They are characterized by weak

modification or no modification of the original material by soil-forming processes.

Lithosols are a group of soils that have no clearly expressed soil horizons. Essentially, they consist of a fresh or imperfect mass of weathered rock fragments. These soils occur usually on steep slopes and they are shallow.

Regosols are a group of soils that lack definite genetic horizons and are developing in deep, unconsolidated, or soft materials.

Erosion Classification

Under this criterion, accelerated erosion effects are rated as currently mainfested by active soil removal and deposition. Degree of erosion is estimated in relation to the land surface. Normal or geologic erosion influences soil development. Therefore, when aggradation exceeds degradation, soil development occurs; on the other hand, when degradation keeps pace with or exceeds aggradation, little or no soil develops. Aggradation occurs on the more level areas; and, as the slope gradient increases, less aggradation occurs and less soil development results until a point is reached where aggradation and degradation are at or near equilibrium and little or no soil development occurs. When degradation exceeds aggradation, geologic erosion is taking place.

Erosion classification is made in relation to soil layers designated by distinctive names. "Existing surface soil" refers to the upper mineral soil layer (about 6 inches in thickness, often

varying from 5 to 8 inches) before adverse influences caused accelerated erosion. It normally includes all of the A horizon and often a portion of the B horizon of the soil. "Subsoil" refers to the B horizon of well-developed soils or to an analogous part below the surface soil in which roots normally grow.

Erosion class ratings are made for both water and wind erosion. (See Erosion Classification Map, p. 65, and Table 1, p. 18) Sheet and gully erosion are considered together in making the water erosion ratings since they are not entirely distinct processes on most rangelands but occur coincidentally to some degree. A description of each of the five classes of water and four classes of wind erosion follows:

Water Erosion:

1. Negligible: No or little apparent evidence of active erosion. Not more than 10 percent of the surface soil removed, and no active gullying. Any evident soil movement is largerly on localized areas.

2. Slight: A small amount of active erosion is evident. From 10 to 25 percent of the surface soil has been removed, or in places comparable alluvial deposition may have occurred. An occasional active gully, usually small, may be present at intervals of over 100 feet. Most of the gullying, however, is of the rill (incipient) type. This degree of erosion has had little influence on the productive capabilities of the mapping unit.

3. Moderate: Considerable sheet erosion has removed 25 to 75 percent of the surface soil. Alluvial deposits occur in places,

TABLE 1

THE SOILS AND THEIR HYDROLOGIC SOIL GROUP, EROSION CLASSIFICATION, AND EROSION HAZARD INDEX ON THE STUDY AREA

Map Symbol	Soil or Land Type	Hydrologic Soil Group	Erosion Classification		Erosion Hazard Index	
			Water	Wind	Water	Wind
A	Assiniboine sandy loam	B	1	1	Slight	High
F	Fort Peck silt loam	B	1	1	Moderate	Moderate
Fc	Fort Peck silt loam	B	2	1	High	Moderate
G	Glendive loamy sand	A	1	2	Slight	High
GS	Glendive-Shale flow	A-D	2	2	Moderate	High
GT	Glendive-Tullock complex	A	1	2	Slight	High
HL	Havre-Lohmiller complex	B-C	2	1	High	Moderate
R	Ryegate sandy loam	B	1	1	Slight	High
RDL	Rough dissected land	B	4	2	High	Moderate
Re	Regent silty clay loam	C	2	1	Moderate	Moderate
SB	Shale Badlands	D	5	2	High	Slight
SM	Shale-Midway complex	D	4	2	High	Moderate
T	Tullock loamy sand	A	1	2	Slight	High
TR	Tullock Rock outcrop	A	2	3	Moderate	High
TS	Tullock-Shale complex	A-D	4	2	High	Moderate
TSc	Tullock-Shale complex	A-D	3	2	Moderate	Moderate
WB	Winnett-Bald complex	C-D	2	2	High	Moderate

including some washing of material on slopes against the upper side of plants and other obstacles. A certain amount of pedestalling of perennials has occurred. An occasional active deep gully and shallow gullies of closer frequency, although usually more than 100 feet apart, may be encountered. Rills may be quite abundant, although gullying of any kind may be restricted to less than 75 percent of the total area. With this degree of erosion, the productivity may have been somewhat impared.

4. Severe: A large amount of active erosion is evident. Seventy-five percent or more of the surface soil has been removed. Frequently, a part of the subsoil has been displaced. Alluvial deposits may be common, and heavy pedestalling of plants with some root exposure will occur at least on parts of the mapping unit. Typically, frequent shallow and some deep gullies less than 100 feet apart will be active with the main drainage channels cutting deeply. Rills may be numerous on some parts of the mapping unit. The inherent productivity of the unit has been extensively reduced by a continual loss of soil.

5. Extreme: Geologic erosion means that degradation has exceeded aggradation during past geologic time; and, therefore, very little if any soil development has occurred. Alluvium is irregularly deposited in many places. Active deep and shallow gullies are usually frequent (less than 100 feet apart), and rills are numerous.

Wind Erosion:

1. Negligible: No or little evidence of active soil movement by wind. Not more than 10 percent of the surface soil has been removed, and this is usually on localized areas.

2. Slight: A small amount of active soil movement is apparent. From 10 to 25 percent of the surface soil has generally been transported; and, in places, shallow accumulations occur sometimes as small hummocks around plants. The initial stages of an erosion pavement may appear as a slight concentration of pebbles and cobblestones at the surface. Mapping unit productivity is little affected by this degree of erosion.

3. Moderate: Considerable blowing has removed from 25 to 75 percent of the surface soil. Some plant pedestalling usually occurs with such soil removal. Where drift accumulations develop, small hummocks are often numerous. On gravelly and cobbly soils, an erosion pavement appears where soil is blown from the area. The production capability of the unit has been adversely affected to some extent by the surface soil removal.

4. Severe: Extensive soil movement has resulted in 75 percent or more of the surface soil being displaced on most of the unit. In addition, a part of the subsoil may also have been removed on portions of the area. Pedestalled plants are common; and, on many, the roots have been partially exposed. This amount of movement provides heavy accumulations of soil in places. These often occur

as hummocks and dunes, but may be deposited more smoothly over the surface. Pronounced erosion pavements are created on some areas by wind removal of this extent. In most cases, the productive capacity has been seriously reduced.

Vegetation

The vegetation of the survey area is closely related to the soil types. However, there are important exceptions, particularly among the soils having little or no soil profile development--the young soils--and even among the better developed soils. In addition, the picture is further confused as a result of the influence of a multiplicity of environmental factors, which includes management. Many species will be found growing over a wide range of environmental conditions in varying degrees of abundance. Other plants are more limited in their distribution.

It is for these reasons that one cannot make a reliable soil map by studying only the vegetation. Many may be tempted to do this because plants are far easier to observe than the underlying soil. It is rather a combination of studying the vegetation and the soil types that a soil survey which will have predictive value can be made.

Vegetation of Survey Area

Most of the plants found in the area can be found on practically all the various mapping units. There are some plants, however, which seem to prefer certain soils above others. For example,

silver sagebrush, Artemisia cana, is generally found growing on the deep loam, sandy loam, and loamy sand soils. However, there are areas of these soils with little or no silver sage, the reason--possibly management or some other environmental factor. From a limited examination of the soil, no differences could be detected between areas.

The following outline presents a few assumptions about some of the features of the soil as well as other factors.

1. Artemisia cana, silver sagebrush

    a. Texture - loam, sandy loam, loamy sands

    b. Depth - no restrictive layers--root penetration to 25 inches or more.

    c. Moisture - moderately high to low

    d. Soils - Assinniboine, Glendive, Ryegate, Havre

2. Artemisia tridentata, big sagebrush

    a. Texture - heavy loams, clay loams, silty clay loams, silty clay

    b. Depth - variable

    c. Moisture - variable, high to very low

    d. Soils - Midway, Winnett, Bald, Lohmiller, Regent, Shale

3. Rhus trilobata, skunkbrush

    a. Texture - sands, loamy sands

    b. Depth - shallow over sandstone

    c. Moisture - low

    d. Soils - Tullock

4. Juniperus scopulorum, Rocky Mountain juniper

   a. Texture - sands, loamy sand

   b. Depth - shallow

   c. Moisture - low

   d. Soils - Tullock

5. Agropyron smithii, western wheatgrass

   a. Texture - heavy loam, clay loam to silty clay

   b. Depth - variable

   c. Moisture - moderately high

   d. Soil - Lohmiller, Midway, Fort Peck, Winnett, Bald, Regent.

6. Carex filifolia, threadleaf sedge

   a. Texture - loamy sand, sandy loam

   b. Depth - deep to any restrictive layer

   c. Moisture - low

   d. Soil - Tullock, Glendive

7. Bouteloua gracilis, blue grama

   a. Texture - sandy loam to clay

   b. Depth - variable

   c. Moisture - variable

   d. Soil - found on all mapping units in the area; blue grama, however, had greatest density on Fort Peck, Regent and Winnett soils.

8. Stipa comata, needle and thread grass

a. Texture - predominantly silt loams to loamy sands

b. Depth - no restrictive layer to 28 inches or more

c. Moisture - moderately high to low

d. Soil - Assinniboine, Ryegate, Glendive

9. Atriplex confertifolia, shadscale

Sarcobatus vermiculatus, greasewood

a. Texture - clays and sandy clays

b. Depth - moderately shallow

c. Moisture - low

d. Soil - raw shale and shale alluvium from nearby shale buttes

10. Calamovilfa longifolia, prairie sandreed

a. Texture - loamy sand, sands

b. Depth - deep to any restrictive layer

c. Moisture - moderate

d. Soil - Glendive and Tullock, areas of accumulated pockets and drifts of deep loamy sands

11. Andropogon scoparius, little bluestem

a. Texture - loamy sand with sandstone rock fragments

b. Depth - shallow

c. Moisture - low

d. Soil - Tullock, shallow side slopes

Soil Series and Mapping Units

A soil series is a group of soil individuals having soil horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. Soil texture of the surface soil will vary within the series.

The soil series, itself, is seldom used as a mapping unit. There usually is not enough homogeneity in such features as slope, stoniness, and amount of erosion; and rarely does it occur in areas large enough to be mapped out. The series name, used as part of a mapping unit name, is the key to the majority of the soils found in the area. The series brings units of mapping together in an organized manner to help us remember soil properties and the relationships among soils.

Soil individuals are real things, but series are conceptual. A series cannot be seen or touched, although the soil individuals that we identify as parts of a series may be seen and touched.

Soil series are differentiated mainly on the basis of observable significant variations in the morphological properties of the soil profile. Such properties include the kind, thickness and arrangement of horizons, their color, texture, structure and other properties. A different series may be recognized if there is a significant difference in any one of these properties in any one

horizon. Usually, however, these properties are genetically related and seldom does one property change without others changing.

Relief is one important genetic factor partly responsible for the characteristics of the profile; and, since shape is a property of the soil body, each soil series has a defined range in slope. Some soil series have a wide range in slope, in others it is quite narrow.

Hard and fast rules covering the acceptable variation in properties within the range of a soil series may be difficult to make. No two profiles are identical; some variation in every property must be allowed. Otherwise, every soil profile would be a separate series.

Judgement plays an important part in weighing the magnitude of differences in properties that are observed, measured, or inferred and in testing the probable significance of those differences to soil genesis and soil behavior.

Soil series names are used in various ways and may result in some confusion. The tullock series, for example, may be spoken of as a taxonomic class that includes all the soil individuals within the defined limits of Tullock. Another way the series name is used is when we examine a soil profile and say, "this is Tullock," meaning that the properties we fine in that particular soil profile are those we ascribe to Tullock. Tullock may also be used as a

name for an area shown on a soil map if the Tullock series can be identified in 85 percent or more of the area. The other 15 percent or less of the mapping unit is inclusions of other soil series. Tullock may also appear in other mapping units with different series names as an inclusion.

Tullock may be included in a mapping unit with one or more other taxonomic units in a complex mapping unit, for example, Glendive-Tullock complex. Soils in a complex may be similar or contrasting. They do occur, however, in a more or less regular pattern and are so closely associated geographically that they cannot be separated by boundaries at the scale of mapping being used.

These various uses of the series name Tullock are all proper.

Mapping Unit Descriptions 1/

Assinniboine Sandy Loam, 3 to 8 Percent Slopes (A)

This mapping unit occupies gently sloping to undulating and rolling high plateaus rising abruptly above the adjacent land. The Assinniboine soils found in this mapping unit are moderately developed with a grayish-brown sandy loam to loam A1 horizon, prismatic B horizon, with segregated lime in the C. horizon. The soils are well drained with slow runoff and moderate permeability.

Typical view of the topographical features associated with the Assinniboine sandy loam soil. Note vegetative cover of grasses and shrubs.

1/ Soil series descriptions pertaining to each mapping unit are described in the appendix.

The unit is 80 percent Assinniboine with Ryegate, Glendive, and Tullock soils all making up about 20 percent of the unit. The inclusive soils are usually near the plateau edges; although, occasionally, small ridges of Tullock and Glendive of less than 5 acres in size will be interspersed within the interior of the unit.

Buttes of clay shale and sandstone rising from 50 to 200 feet above the surrounding plateau will occur. These buttes are often capped with hard, more weather resistant sandstone than the clayey shale immediately below. The base of the buttes is often soft sandstone with a coating of clay from the above layer of clay shale.

Erosion Classification	Erosion Hazard[2/]
Water - Negligible	Water - Slight
Wind - Negligible	Wind - High

Fort Peck Silt Loam, 3 to 7 Percent Slopes (F)

The Fort Peck mapping unit is found on relatively level benches to gently sloping uplands. It occurs usually in areas that are influenced by or developing from shale or outwash silts and clays. The Fort Peck soils found in this unit are moderately developed with a soft, weak, granular A1 horizon, a hard, weak to moderate prismatic B2 horizon that grades gradually to a Cca horizon containing

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2/ For a detailed explanation of the Erosion Classification and Erosion Hazard see pages 16 and 52.

splotches and streaks of $CaCO_3$ throughout. Shale or outwash materials are encountered at approximately 30 inches.

Only a limited acreage of this unit has been mapped in the area surveyed. It is associated with the Tullock-Shale complex (TS), Glendive-Tullock complex (GT), Glendive loamy sand (G), and Winnett-Bald complex (WB) mapping units. The typical profile description appearing in the Appendix represents this soil. Permeability of the subsoil is moderate to moderately slow.

Erosion Classification	Erosion Hazard
Water - Negligible	Water - Moderate
Wind- Negligible	Wind - Moderate

Typical view of nearly level to gently sloping (3 to 7 percent) bench type topography characteristic of the Fort Peck silt loam soil.

Fort Peck Silt Loam, 8 to 12 Percent Slopes (Fc)

This mapping unit consists of Fort Peck silt loam on moderately to strongly sloping benches and uplands. The unit is similar to Fort Peck silt loam, 3 to 7 percent slopes, except the slopes are steeper. The soil types in this unit are within the range of characteristics for the respective series.

Erosion Classification	Erosion Hazard
Water - Slight	Water - High
Wind - Negligible	Wind - Moderate

Typical view of Fort Peck silt loam, 8 to 12 percent slopes.

Glendive Loamy Sand, 5 to 12 Percent Slopes (G)

This mapping unit is generally found in an upland position, usually above the Tullock Rock outcrop (TR) mapping unit. Glendive will occur on convex ridges and hummocks. There will be occasional inclusions of Tullock Rock outcrop on top of the sharper ridges. Between the ridges there are areas with less than one acre of Assinniboine soils. The Glendive soils occupy 80 to 90 percent of the unit with Tullock comprising 10 to 15 percent and from 0 to 5 percent Assinniboine.

Erosion Classification	Erosion Hazard
Water - Negligible	Water - Slight
Wind - Slight	Wind - High

Typical view of the Glendive loamy sand mapping unit occurring on 5 to 12 percent slopes.

Glendive-Shale Flow, 5 to 12 Percent Slopes (GS)

This mapping unit is similar to the Glendive loamy sand unit described above, except there are small clay shale buttes within the unit with stratified clay flows from the buttes being deposited between the ridges of Glendive. At the scale of mapping being used, the Glendive and shale flow cannot be separated. Other inclusions include areas of Winnett-Bald between the Glendive ridges. The Glendive soils make up from 65 to 80 percent of the unit, with shale buttes and clay flow making up 10 to 20 percent and Winnett-Bald 5 to 10 percent.

Erosion Classification	Erosion Hazard
Water:	Water:
Glendive - Negligible Shale Flow - Extreme	Glendive - Slight Shale Flow - High
Wind - Slight	Wind:
	Glendive - High Shale Flow - Moderate

Glendive-Tullock Complex, 7 to 25 Percent Slopes (GT)

This complex mapping unit is usually found downslope from the Tullock Rock outcrop (TR) mapping unit, although it may occasionally occur above. Glendive and Tullock are so closely intermingled that it is difficult to separate them on a map of the scale being used.

The Tullock soils are found on the tops of the sharp hummocky ridges, usually with visible sandstone outcrop present. Glendive loamy sand soils are those moved downslope from the Tullock and are deep with no visible structure.

Composition of this mapping unit is Glendive, 45 to 55 percent and Tullock 40 to 50 percent. There are inclusions in this unit of shale or clay spots found below shale buttes.

Erosion Classification	Erosion Hazard
Water - Negligible	Water - Slight
Wind - Slight	Wind - High

The Glendive-Tullock mapping unit is the ridge in the background with sandstone outcropping visible.

Havre-Lohmiller, Slopes 2 to 4 Percent (HL)

The Havre and Lohmiller soils in this complex have profiles as described in the Appendix. These two soils are so closely intermingled that they cannot be separated on a map of the scale used;

therefore, they are mapped together as a single unit. This mapping unit, often 400 to 1,000 feet wide, occurs along the major stream bottoms subject to flooding. Havre and Lohmiller soils have developed from the deposition of sandy and clayey mixtures of local alluvium. Both soils are greatly stratified and have lenses of silty, loamy, and sandy materials. Lohmiller is dominantly clayey with layers of silty clay, silty clay loam and clay loam materials. Havre is medium to coarse textured but is dominantly made up of loamy sand, sandy loam, very fine sand, and silt loam materials. Composition of this unit is Havre soils 50 to 60 percent and Lohmiller soils 40 to 50 percent.

Erosion Classification	Erosion Hazard
Water - Slight	Water - High
Wind - Negligible	Wind - Moderate

Regent Silty Clay Loam, 3 to 8 Percent Slopes (Re)

Regent mapping unit is of a minor extent in the survey area. It occupies nearly level to gently sloping uplands in association with the Tullock-Shale complex (TS), Tullock-Shale complex (TSc), Glendive-Tullock complex (GT) and Winnett-Bald complex (WB) mapping units.

The Regent soils of this mapping unit are moderately well developed in residuum from clayey to silty shales. The surface horizon or A1 has a slightly hard granular structure; a B1 or BA horizon of hard, fine, subangular, blocky structure or strong granular, a very hard, moderate to strong, prismatic and strong subangular blocky B2; with

the lower part of the B horizon containing white streaks and spots of lime and other accumulated salts. The B horizon gradually merges with the parent soil material of partially weathered silty and clayey shales at approximately 3 feet below the surface.

The subsoil has moderately slow to slow internal drainage or permeability to air and water. The soil has good surface drainage with slow to medium runoff.

Erosion Classification	Erosion Hazard
Water - Slight	Water - Moderate
Wind - Negligible	Wind - Moderate

Rough Dissected Land (RDL)

This miscellaneous land type mapping unit occurs primarily as colluvial-alluvial areas in association with the Shale Badlands (SB) miscellaneous land type, Tullock Rock outcrop (TR) and Tullock-shale (TS) mapping units. The area mapped is extensively dissected with practically vertical walled rather shallow drainages. The gradient of the land type, itself, is generally not overly excessive; however, all slopes are included in this unit. The parent material of the developing soils varies greatly, depending on the type of geologic material. There are also small inconsistent areas of Assiniboine, Glendive, Ryegate, Regent, and Tullock soils along with the Shale Badlands miscellaneous land type in this mapping unit. The unit, as a whole, is well vegetated, with the sediment yield emerging therefrom being essentially derived from the adjacent badlands

topography and transported by the well-defined gully system of this unit. The gullies are erosive; but here, again, the erosiveness depends on the type of geologic material present.

Erosion Classification	Erosion Hazard
Water - Severe	Water - High
Wind - Slight	Wind - Moderate

The Rough dissected land is the area in the bottom of valley below the Shale Badlands.

Ryegate Sandy Loam, 3 to 8 Percent Slopes (R)

The Ryegate mapping unit usually occurs on gently rolling uplands in areas similar to the Assinniboine unit, except the ridges are shorter and topography is more rolling. The parent materials consist of coarse loamy or sandy materials derived from sandstone. The Ryegate soils in this mapping unit are moderately developed with moderately dark-colored solums containing soft granular A horizons, hard prismatic B2 horizons with a darker color in the upper part, a Cca horizon and sandstone bedrock between 20 and 35 inches.

Runoff is minor due to the sandy texture and good vegetative cover. Permeability of the subsoil to air and water is moderate to moderately rapid.

This mapping unit is found only to a moderate extent on the survey area. A typical profile description for the Ryegate soil, the major soil in this unit, may be found in the Appendix.

Erosion Classification	Erosion Hazard
Water - Negligible	Water - Slight
Wind - Negligible	Wind - High

Shale Badlands (SB)

This miscellaneous mapping unit is found where soft bedrock of shale and sandstone are widely exposed. It occurs in steep, water-cut drainages and as buttes of shale and sandstone on relatively level upland with alluvial-colluvial fans eminating therefrom. The buttes of this land type are monumental and form a very distinctive

landscape. Runoff is very rapid, and permeability is very slow. Geologic erosion is active, and very little soil development has occurred. On the fringe of and/or within this land type are solodized-Solonetz and clayey areas and small areas of Glendive loamy sand soils. Vegetation is limited to the bottom of drains, smooth narrow benchlike areas, or slopes that are conducive to soil development. The steep topography and the lack of vegetative cover over the greater portion of the mapping unit makes it essentially unsuitable for livestock grazing. Badlands are primarily valuable for wildlife and watershed use.

The distinction between the Shale Badlands mapping unit and the Shale-Midway complex (SM), Tullock-Rock outcrop (TR) and Tullock-Shale complex (TS) is general. The difference is based primarily on degree of slope, soil development, amount of stream dissection and presence of barren bedrock or rock outcrop.

Erosion Classification	Erosion Hazard
Water - Extreme	Water - High
Wind - Slight	Wind - Moderate

Typical view of the steeply sloping Shale Badlands miscellaneous mapping unit.

Shale-Midway, 15 to 45 Percent Slopes (SM)

This complex unit consists of a deeply dissected landscape of Midway clay loam and shale outcrop. The unit occurs on an area sloping up from Fort Peck Reservoir but below the Tullock Rock outcrop (TR) mapping unit. Midway occurs on the top of small rounded ridges and dissected fans and benches. The shale exposures occur on the steep gully sides, ridge points, and steep headwalls.

The Midway soil of this mapping unit has a grayish-brown clay loam A horizon, light brownish-gray silty clay loam massive AC

horizon, silty clay C horizon of partially weathered clayey and silty shale, with a R horizon of unweathered platy, gray shale at 10 to 16 inches deep. Composition of the various soils in the unit includes: Midway, 30 to 40 percent; and shale, 50 to 70 percent. There are also inclusions in the unit of Tullock and Glendive, making up 10 to 15 percent of the composition. These two soils have apparently moved downslope from the Tullock-Rock outcrop above.

Erosion Classification	Erosion Hazard
Water	Water - High
Shale - Extreme Midway - Severe	
Wind - Slight	Wind - Moderate

Tullock Loamy Sand, 10 to 25 Percent Slopes (T)

The Tullock mapping unit occurs on gently to moderately sloping uplands and benches. The slopes are smooth with good grass cover. Rock outcropping is confined to knobs and ridges and is of minor extent on this mapping unit. The Tullock soils comprise light-colored loamy sand, shallow or very shallow soils. These soils are developing in materials weathering in place from weakly consolidated sandstones or sandy shales. The soil profile consists of a loamy sand surface and subsoil, grading to weakly consolidated or fractured sandstone at 15 to 20 inches below the surface.

This mapping unit is associated mainly with the Tullock Rock outcrop (TR), Glendive loamy sand (G), Glendive-Tullock complex (GT),

and Tullock-Shale complex (TS) units but may be associated with any of the mapping units in the survey area. Permeability of the subsoil is rapid and surface runoff is slow to very slow. The soil is well drained.

Erosion Classification	Erosion Hazard
Water - Negligible	Water - Slight
Wind - Slight	Wind - High

Tullock Rock Outcrop, 25 to 75 Percent Slopes (TR)

This mapping unit occurs usually at the break of upland benches or ridges, where steep to very steep, rough and broken topography is encountered, and in deeply incised drainages. Rock outcrops and loose rocks occupy 10 to 25 percent of the surface with south-facing slopes containing more exposed rock than north-facing slopes. Scattered juniper trees with a few Ponderosa pine are characteristic of this mapping unit. North-facing slopes are often covered with dense stands of junipers.

Erosion Classification	Erosion Hazard
Water - Slight	Water - Moderate
Wind - Moderate	Wind - High

Typical view of the Tullock Rock outcrop mapping unit that occurs on 25 to 75 percent slopes.

Tullock-Shale Complex, 25 to 75 Percent Slopes (TS)

The Tullock-Shale complex, as mapped on the survey area, usually occurs in association with the Tullock Rock outcrop (TR) and Shale-Midway complex (SM) mapping units and Shale Badlands (SB). It consists mainly of steep to very steep, rough and broken topography--usually occurring in deeply incised drainages. The Tullock and Shale are too closely intermingled or intricately associated to separate on the soil map with the scale used in mapping. The Tullock portion of this mapping unit is a composite of the Tullock Rock outcrop (TR)

and Tullock (T) mapping units as described above. The Shale constituent is essentially composed of raw exposed slopes and ridges of shale with some shale buttes and alluvial-colluvial shale fans associated therewith. This mapping unit is also used on upland areas where shale buttes are strewn with remnants of Tullock; raw shale fans and outflows are prevalent. The Tullock occupies 50 to 65 percent of the mapping unit, while the shale comprises 35 to 45 percent.

Associated with this mapping unit are small areas of Midway and Glendive soils which are too small and occur in such nonconforming patterns that they cannot be mapped separately with the scale of mapping being used. These two soils occupy less than 5 percent of the Tullock-Shale complex mapping unit.

In most areas mapped as Tullock-Shale complex, the Tullock occurs almost exclusively above the shale; however, in some instances the reverse may occur depending on the geologic formations.

Erosion Classification	Erosion Hazard
Water	Water
Tullock - Slight Shale - Extreme	Tullock - Slight Shale - High
Wind - Slight	Wind
	Tullock - High Shale - Moderate

Typical view of the Tullock-Shale complex mapping unit which occurs on 25 to 75 percent slopes.

Tullock-Shale Complex, 10 to 25 Percent Slopes (TSc)

This mapping unit was used where erosion has not exposed the geologic material to any great degree, and a vegetative cover has been established. It occurs characteristically as an upland topographical site with relatively smooth slopes of 10 to 25 percent gradient and is associated with, but usually at a higher level than, the companion mapping unit of Tullock-Shale complex (TS). The Tullock usually occurs as a veneer over shale knobs and slopes with shattered sandstone rock occurring at the peak of most of the knobs.

The Tullock comprises 50 to 65 percent of the mapping unit, with the shale occupying 30 to 45 percent. There are small un[illegible]on-forming areas of Midway and Glendive soils within the mapping unit. These soils comprise less than 5 percent of the mapping unit.

Erosion Classification	Erosion Hazard
Water	Water
Tullock - Negligible Shale - Moderate	Tullock - Slight Shale - Moderate
Wind - Slight	Wind
	Tullock - High Shale - Moderate

Winnett-Bald Complex, 2 to 8 Percent Slopes (WB)

This mapping unit contains Winnett and Bald solodized-Solonetz soils that are so closely intermingled that it is not possible to separate them on a map of the scale used; therefore, they are mapped together as a soil complex. This complex occupies nearly level to gently sloping topography and occurs usually on uplands with occasional concave terrain. The surface is characterized by shallow depressions of slick or barren spots.

The Winnett-Bald complex or mapping unit may be associated with any of the mapping units used in the surveyed area. However, it is usually associated with the Tullock-Shale complex (TS), Glendive-Tullock complex (GT), Glendive loamy sand (G), Ryegate sandy loam (R), Regent silty clay loam (Re), and Shale Badlands (SB). The Winnett

and Bald soils of this complex are developing primarily from sandy and clayey shales and the outwash materials from these shales.

The Winnett soils consist of light-colored, strongly alkaline solidized-Solonetz soils developing usually in calcareous loam or clay loam materials. The horizons usually consist of a light-brownish gray loam A2, a strongly alkaline, columnar structured silty clay or clay B2t, silty clay or silty clay loam B3 and Ccs with accumulations of gypsum. The Winnett soils contain strongly alkaline B2t horizons with nests of gypsum and other salts in the lower B and upper C horizons.

The Winnett and Bald soils of this complex have very slow subsoil permeability rates. Infiltration of the Winnett soil is moderate while that of the Bald soil is almost negligible due to the sealing effect of the barren surface. The soil profiles as described in the Appendix under the Winnett loam and Bald clay loam are characteristic of the soils in this complex.

The Winnett soil occupies 35 to 65 percent of the complex in some areas with the Bald soil comprising 30 to 60 percent in other areas, while 5 to 10 percent of other soils may be present within the area mapped as a complex. The other included soils may be Glendive loamy sand, Ryegate sandy loam, and Regent silty clay loam.

The Bald soils occur as the pan or slick spots of the complex. Horizonation of the Bald soil seems to be inconsistent with some

profiles revealing what appears to be a layering effect without any definite soil development through structural formation, while others contain some development such as revealed by the soil profile description that appears in the Appendix which is considered typical for the series.

Erosion Classification	Erosion Hazard
Water - Slight	Water - High
Wind	Wind
Winnett - Negligible Bald - Slight	Winnett - High Bald - Moderate

Typical view of the Winnett-Bald complex mapping unit.

Soil Map Explanation

The soil map (p. 63) depicts the principal kinds of soil, soil complexes and miscellaneous land types present on the Gilbert Creek Community and Isaac grazing allotments. Delineation lines were made by field determination of the soil series and land types present. Vegetation also served as an indicator of the type or kind of soil present.

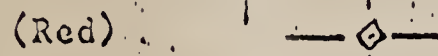
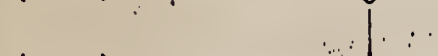
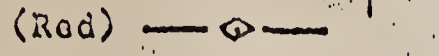
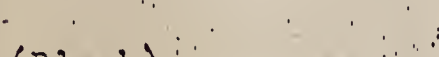
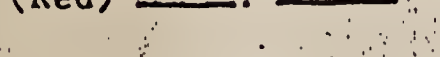
The soil symbols are explained on the Survey Identification Legend (p. 50) and Table 1 (p. 18). The soil series are listed with a detailed description of each in the Appendix, and the mapping unit descriptions have been discussed previously in the report. This map was made to provide a tool to facilitate management decisions for the area.

Fieldwork was accomplished by using aerial photographs with a scale of 4 inches equals 1 mile. The mapping information and drainage patterns were transferred from the aerial photographs to a base map of 2 inches to the mile scale. The base map was prepared and the information transferred by the Montana State Office cartographic section. By reducing the scale of the field sheets, it reflects a rather cluttered appearing map with too much detail. However, the field sheets do not reflect this feature. The fieldwork was carried out as a standard detailed soil survey of low intensity. That is, mapping units of complexes and miscellaneous land types were utilized where applicable and soil series were mapped when areas were large enough to plot on the map.

SURVEY IDENTIFICATION LEGEND

Mapping Unit	Soil Name	Percent Slope	Range Sites
A	Assinniboine sandy loam	3-8	Sy
F	Fort Peck silt loam	3-7	Si
Fc	Fort Peck silt loam	8-12	Si
G	Glendive loamy sand	5-12	Sa
GS	Glendive-shaleflow complex	5-12	Sa
GT	Glendive-Tullock complex	7-25	Sa
HL	Havre-Lohmiller complex	2-4	Ov
R	Ryegate sandy loam	3-8	Sy
RDL	Rough dissected land	All	Lo
Re	Regent silty clay loam	3-8	Cy
SB	Shale-Badlands	All	Bl
SM	Shale-Midway complex	15-45	Sh
T	Tullock loamy sand	10-25	Sa
TR	Tullock-Rock outcrop	25-75	TB
TS	Tullock-Shale complex	25-75	TB
TSc	Tullock-Shale complex	10-25	SwSy
WB	Winnett-Bald complex	2-8	Ps

MAPPING SYMBOLS

		Intermittent unclassified streams
(Red)		Section corners not located
(Red)		Section corners located
(Red)		1/4 corners located
(Black)		Unimproved roads or trails
		Springs
		Wells
(Red)		Game Range boundary
		Scabspot - less than 2 acres in size
		Rock outcrop - less than 2 acres in size
		Clay buttes - less than 5 acres in size
		Clay spots - less than 5 acres in size
		Reservoirs
		Cabins or dwellings
(Red)		Center of section, section number

Interpretations

Erosion Hazard Index

The inherent erosion hazard depends partly on erodibility and partly on climate, slope, and many other environmental factors. (See Erosion Hazard Index Maps, pp. 67-69; and Table 1, p. 18.) Erodibility depends primarily upon two qualities of the soil: the stability of the aggregates in the surface layer, and the ease with which the soil becomes saturated. Stability of the soil aggregates refers to their resistance to dispersion when wetted. The erosion hazard is an indication of the relative susceptibility of the soils to accelerated erosion if the vegetation is disturbed as a result of fire, clear cutting of timber, or overgrazing and trampling by livestock, concentration of big game, or other causes. A description of each of the three classes of water and wind erosion hazard follows:

1. Slight erosion hazard may occur from either water or wind because of natural features. For water, this usually means some hilly or rolling terrain with moderate slopes and fairly stable and absorptive soils. For wind, this means undulating or rough topography with few level areas subject to wind sweep.

2. Moderate erosion hazard may result from all erosive forces because of natural features, intermediate conditions of topography and steepness of slope, and moderately stable and absorptive soils.

3. High erosion hazard may develop from either water or wind because of natural features. For water, this usually means relatively steep to precipitous slopes, dissected terrain, badlands, rather

unstable soils, and sharply cut water courses. For wind, this means much smooth or flat topography which offers little protection from wind sweep and loose or light soils that are easily subject to blowing.

Hydrologic Soil Groups 3/

Soil properties influence the rate of runoff from precipitation and must be considered in runoff estimation. The soil properties can be represented by the hydrologic parameter: "The minimum rate of infiltration obtained for a bare soil after prolonged wetting." The soils are classified into four major groups on the basis of water intake rate at the end of long duration storms which occur after prior wetting and opportunity for swelling and without the protective effects of vegetation. (See Table 1, p. 18.) The major hydrologic soil groups are defined as:

1. Group A (low runoff potential). Soils containing high infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

2. Group B. Soils having moderate infiltration rates when thoroughly wetted and consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

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3. Group C. Soils containing slow infiltration rates when thoroughly wetted and consisting chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission.

4. Group D (high runoff potential). Soils containing very slow infiltration rates when thoroughly wetted and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very slow rate of water transmission.

In the soil group definitions, the infiltration rate is the rate at which water enters the soil at the surface and is influenced by surface conditions. The transmission rate is the rate at which the water moves within the soil and is determined by the subsurface horizons.

Range Sites

The soils on the survey area, as previously stated, are capable of producing many different kinds of native vegetation. These different kinds or types of soil may be grouped into units or sites according to their surface textural and topographical features. Units, so designated, are known as range sites. A range site may be defined as a natural area that is capable of producing and maintaining a certain type and amount of native vegetation due to its combination of soil, climate and topography. Therefore, the following

range sites or range soil groups are designated for the corresponding soils mapped on the survey area.[4/]

I. Soil groups that can produce more herbage than ordinary range uplands because of plainly superior soil moisture availability. (The "Postclimax" areas of Clements.)

Lo Lowland: This site occurs on colluvial-alluvial material in low lying areas of steep, rough to broken topography. The parent material of the developing soils varies greatly, depending on the type of geologic material present. Run-in water from adjacent higher elevations provides extra moisture for vegetative growth.

This range site may contain all or most plant species identified on the remaining range sites. However, the most prevalent plant species present are: western wheatgrass (Agropyron smithii) and needle-and-thread (Stipa comata) which are mid grasses, prairie sandreed (Calamovilfa longifolia) a tall grass and blue grama (Bouteloua gracilis) a short grass. Threadleaf sedge (Carex filifolia) a grass-like species is present. Shrubs include silver sagebrush (Artemisia cana), fringed sagebrush (A. frigida), and small soapweed (Yucca glauca).

4/ See the Survey Identification Legend for range site-soil correlation, p. 50. Range site descriptions follow SCS nomenclature.

Ov Overflow: This site is found in drainageway positions which receive additional moisture from overflow of intermittent streams or run-in water from adjacent slopes. (Not subirrigated or wet land.) Topsoils may vary from a sandy loam through light-silty clay loams. Coarser or finer textured surface soils may also be present, provided they are less than 2 to 4 inches thick.

Plant species found most abundant on this range site are: prairie sandreed (Calamovilfa longifolia) a tall grass, western wheatgrass (Agropyron smithii), and little bluestem (Andropogon scoparius) are mid grasses and blue grama (Bouteloua gracilis) a short grass. Shrubs most prevalent are silver sagebrush (Artemisia cana) and fringed sagebrush (A. frigida).

Sa Sands: This site is usually found in an upland position and may occur on all slopes. It consists of moderately deep to deep loamy sand to sand in the surface and subsoil.

Vegetation found most abundant on this range site is: prairie sandreed (Calamovilfa longifolia) a tall grass, needle-and-thread (Stipa comata) and little bluestem (Andropogon scoparius) are mid grasses and blue grama (Bouteloua gracilis) and muhly (Muhlenbergia sp.) are short grasses. Threadleaf sedge (Carex filifolia), a grasslike species

is present. Shrubs present include silver sagebrush (Artemisia cana), fringed sagebrush (A. frigida), small soapweed (Yucca glauca) and cacti (Opuntia sp.).

II. The ordinary (normal) upland soils with gentle to slightly sloping relief and no obvious soil inhibitory factors. The vegetation can make a normal response to climate reflecting regional climax. (The "climax" areas of Clements.)

Cy Clayey: This site occurs in an upland position, on slopes of less than 10 percent, and where the soil depth exceeds 20 inches. In the 5- to 9-inch precipitation zone, the soil depth may be 15 inches.

The topsoil or A horizon must be at least 2 to 5 inches thick and be of one or more of the following textures: silty clay, the finer portions of sandy clay loam, silty clay loam and clays which do not develop severe cracks or become extremely hard when dry and very sticky when wet.

Plant species found most abundant on this range site are: western wheatgrass (Agropyron smithii) and needle-and-thread (Stipa comata) which are mid grasses and blue grama (Bouteloua gracilis) a short grass. Western wheatgrass and blue grama were the dominant species with some needle-and-thread. Big sagebrush (Artemisia tridentata),

a shrub, is present. Also present, in a limited quantity, are cacti (Opuntia sp.).

Si Silty: This site occurs in an upland position, on slopes of less than 15 percent, and where the soil depth exceeds 20 inches. In the 5- to 9-inch precipitation zone, the soil depth may be 15 inches.

The surface soil or A horizon must be 3 to 6 inches thick, depending on the texture and permeability of the subsoil. Surface soil texture must be one or more of the following: very fine sandy loam, loam, silt loam, the friable portions of sandy clay loam, silty clay loam, or clay loam.

Plant species found most abundant on this range site are: blue grama (Bouteloua gracilis), a short grass, and western wheatgrass (Agropyron smithii) and needle-and-thread (Stipa comata) which are mid grasses. A grass-like species, threadleaf sedge (Carex filifolia), is quite prevalent as well as clubmoss (Lycopodium sp.).

Sy Sandy. This site occurs in upland positions, on slopes up to 25 percent, and where the soil depth exceeds 20 inches except in the 5- to 9-inch precipitation zone, where the soil may be 15 inches in depth.

The surface soil or A horizon must be at least 3 to 6 inches thick (depending on texture and permeability of the subsoil) and of one or more of the following textures: fine sandy loam, sandy loam or loamy very fine sand. Coarser topsoils may be included if underlain by finer textured subsoils.

The most abundant plant species found on this range site are: needle-and-thread (Stipa comata), junegrass (Koeleria cristata), and western wheatgrass (Agropyron smithii) which are mid grasses and blue grama (Bouteloua gracilis) a short grass. The dominant grasses are blue grama and needle-and-thread. Other grass and grass-like species present are threeawn (Aristida sp.) and threadleaf sedge (Carex filifolia), respectively. Shrubs present are silver sagebrush (Artemisia cana) and big sagebrush (A. tridentata). Also present, in a limited quantity, are cacti (Opuntia sp.).

III. Uplands with soil factors that prevent the development of regional climax vegetation. (The "preclimax" areas of Clements.)

Ps Panspots: This site occurs usually on relatively flat to gently sloping areas and contains numerous shallow depressions scattered throughout the area. The soils (solodized Solonetz) are usually fine textured, particularly in the depressions, and may contain many of the characteristics common to saline sites. However, there has been sufficient

natural reclamation that halophytes do not exist, or occur only in limited numbers.

Plant species found most abundant on this range site are: western wheatgrass (Agropyron smithii) and junegrass (Koeleria cristata) which are mid grasses and blue grama (Bouteloua gracilis) a short grass. Also present is the threeawn (Aristida sp.). Shrubs present are big sagebrush (Artemisia tridentata) and winterfat (Eurotia lanata) with some cacti (Opuntia sp.). The dominant grass species are western wheatgrass and blue grama. Only remnants of plants or plants in a very weakened condition occur on the Bald soils.

Sh Shale: This site is usually found in the upland position and on steep slopes. The soil is generally less than 15 inches deep with occurrence of numerous raw shale knobs and steep clayey shale slopes. These clayey shales are usually salty in various degrees, and normally produce some species of halophytes.

The most prevalent plant species found on this range site are: western wheatgrass (Agropyron smithii), bluebunch wheatgrass (A. spicatum) and a limited amount of needle-and-thread (Stipa comata), mid grasses, blue grama (Bouteloua gracilis), a short grass, are all present on the Midway soil. Also, big sagebrush (Artemisia tridentata) and cacti

(Opuntia sp.) are present. The practically barren shale portion of the site contains a few scattered plants of shadscale (Artiplex confertifolia), greasewood (Sarcobatus vermiculatus), and big sagebrush.

SwSy Shallow Sandy: This site is usually situated in an upland position on slopes of 10 to 25 percent. There is a thin veneer of fractured sandstone and sandy to loamy sand material over clayey shale. The soil depth ranges from 10 to 20 inches. This site has a much better overall vegetative cover than the thin breaks range site, i.e., there are not large unvegetated areas due to exposed bedrock.

Vegetation consists of needle-and-thread (Stipa comata) and bluebunch wheatgrass (Agropyron spicatum) mid grasses, prairie sandreed (Calamovilifi longifolia) a tall grass, and blue grama (Bouteloua gracilis) and muhly (Muhlenbergia sp.) short grasses. Shrubs present include silver sagebrush (Artemisia cana), fringed sagebrush (A. frigida), small soapweed (Yucca glauca) and skunkbush (Rhus trilobata).

TB Thin Breaks: This site usually occurs on steep to broken slopes of 25 to 75 percent in an upland position. It includes mixed soils of varying depths but generally less than 10 inches deep derived from various parent materials. However, there may be many small no-soil areas and/or pockets of deep soil. The bedrock consists mainly of sandstone and shale.

Plant species on this site are essentially the same as on the shallow sandy site with the exception of rocky mountain juniper (Juniperus scopulorum) and a very limited number of pondersa pine (Pinus ponderosa). The vegetation on this site is less dense than on the shallow sandy site.

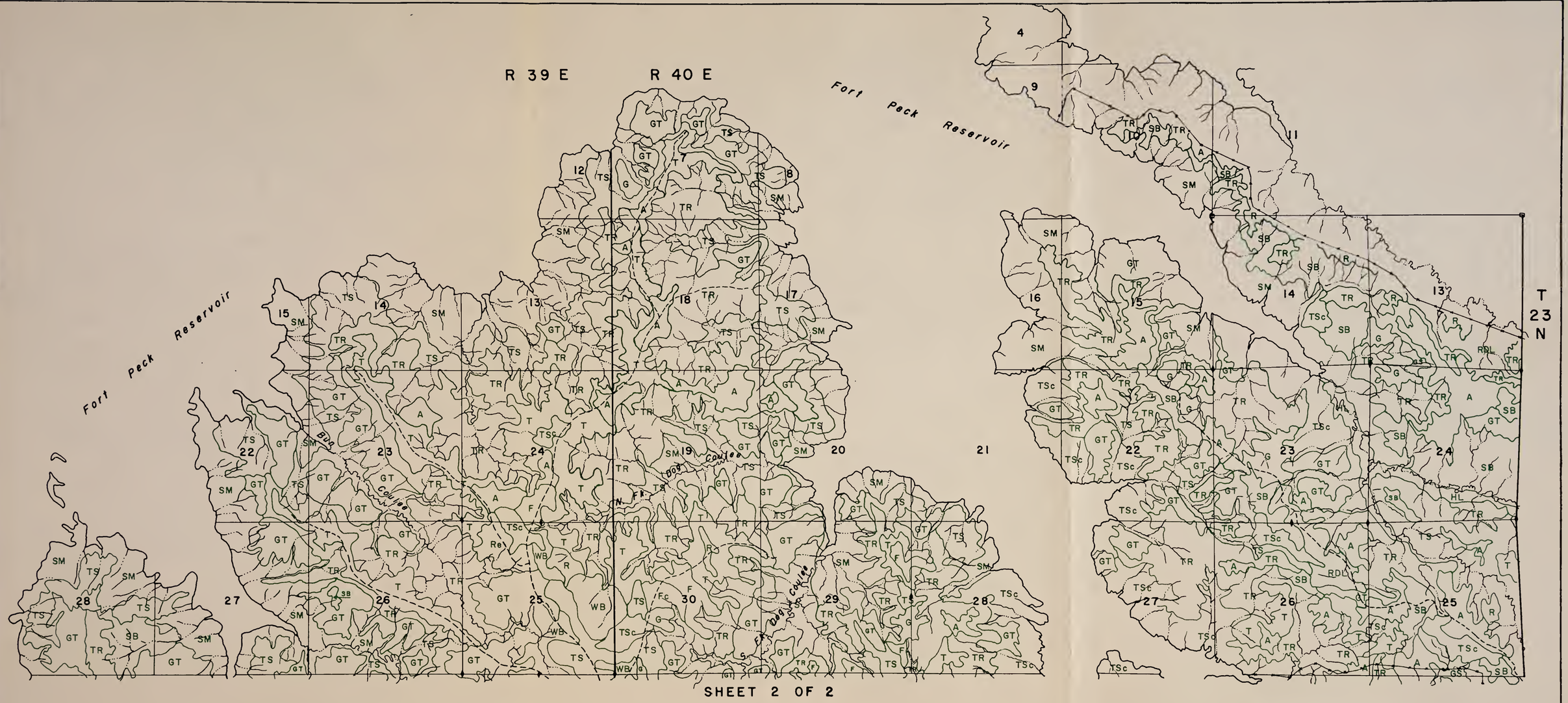
B1 Badlands: This site includes nearly barren lands and geologic material that is broken or dissected by drainages which are dry most of the year. There are small intermingled grazable areas which are too small or too narrow to justify mapping separately. This site is essentially unsuitable for livestock grazing and is primarily valuable for wildlife and watershed use.

From a visual observation, it appears that the Gilbert Creek Community allotment is in better condition than the Isaac allotment as far as watershed protection is concerned. This is due primarily to a more luxuriant grass cover.

SOILS INVENTORY
OF
GILBERT CREEK COMMUNITY ALLOTMENT
AND
ISAAC ALLOTMENT
WITHIN
C.M. RUSSELL NATIONAL WILDLIFE RANGE
MONTANA

SOIL MAP
(See Survey Legend)

Scale 2"= 1 Mile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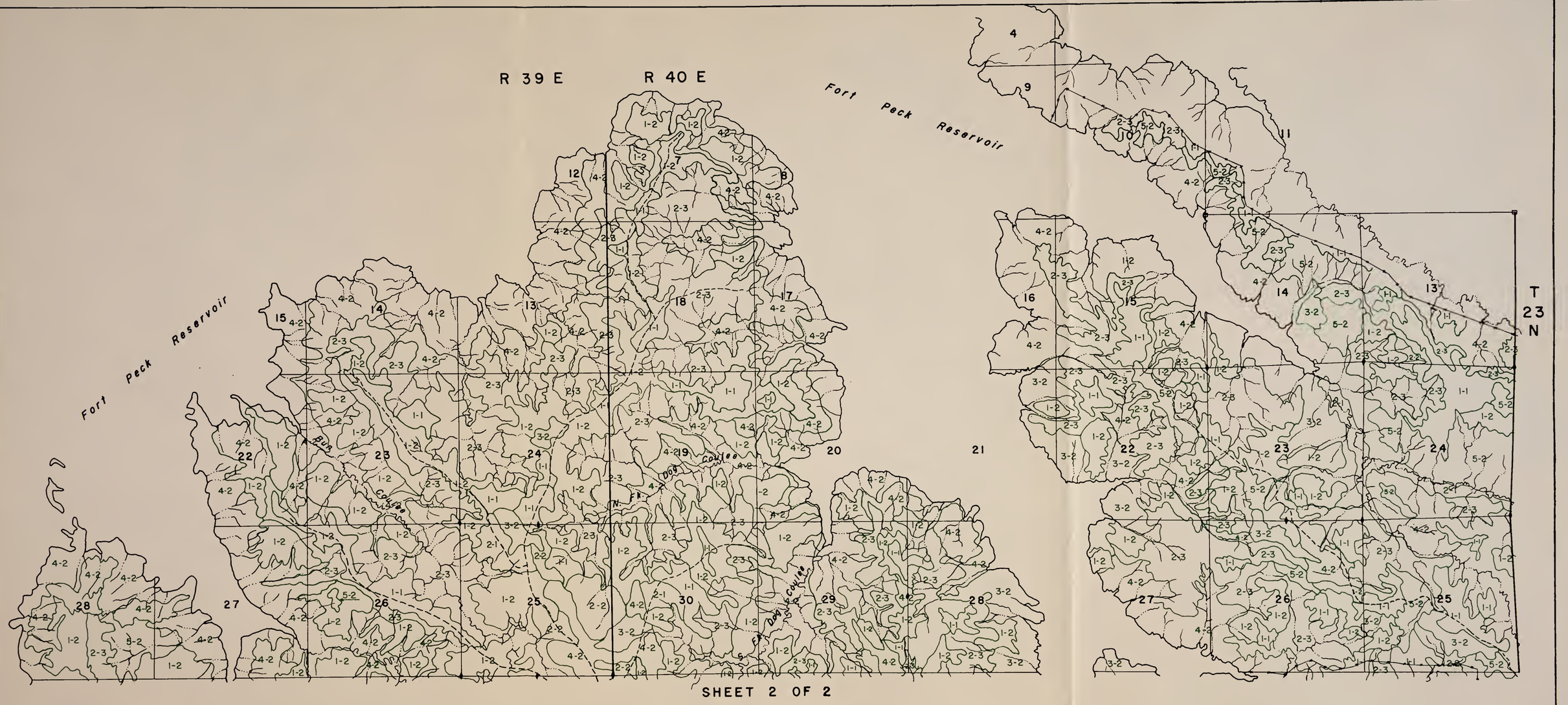
R 40 E
T 23 N
Fort Peck Reservoir
Fort Peck Reservoir
Big Dog Coulee
N. Fk. Big Dog Coulee
Big Dog Coulee
SHEET 2 OF 2

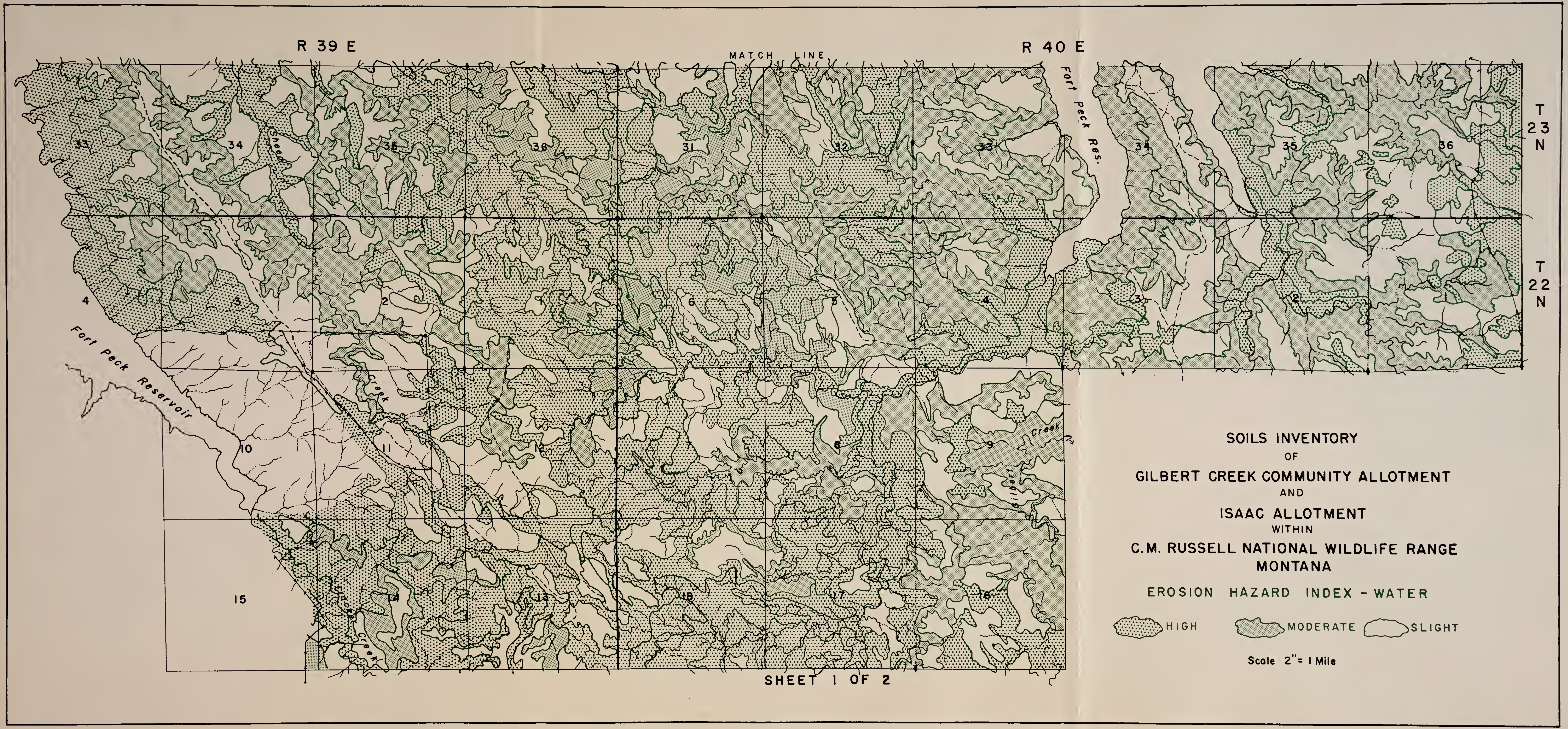
SOIL MAP

SOILS INVENTORY
OF
GILBERT CREEK COMMUNITY ALLOTMENT
AND
ISAAC ALLOTMENT
WITHIN
C.M. RUSSELL NATIONAL WILDLIFE RANGE
MONTANA

EROSION CLASSIFICATION GROUP
WATER - WIND

Scale 2"= 1 Mile


R 39 E
R 40 E
Fort Peck Reservoir
Fort Peck Reservoir
T 23 N
Bull Coulee
Dog Coulee
N. Fk. Dog Coulee
SHEET 2 OF 2
EROSION CLASSIFICATION WATER - WIND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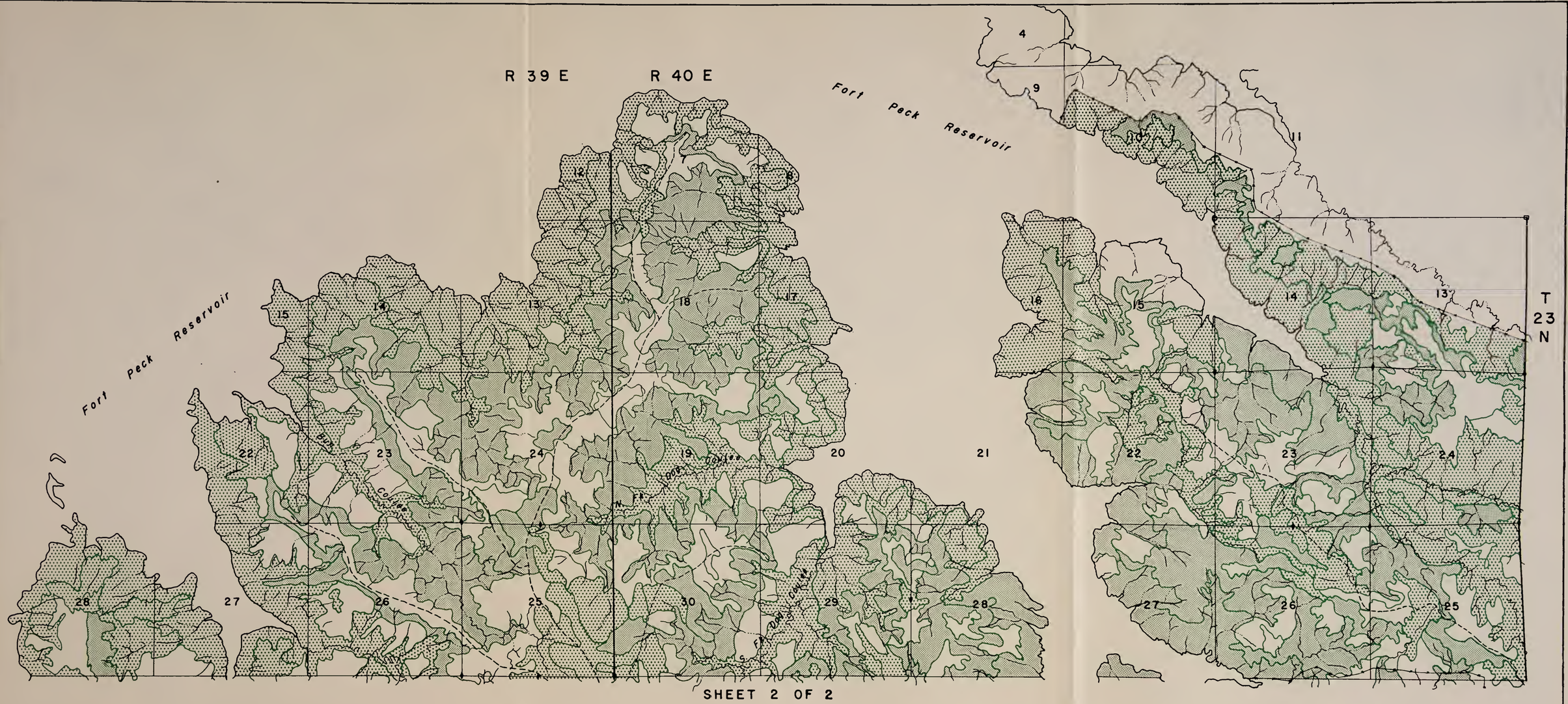
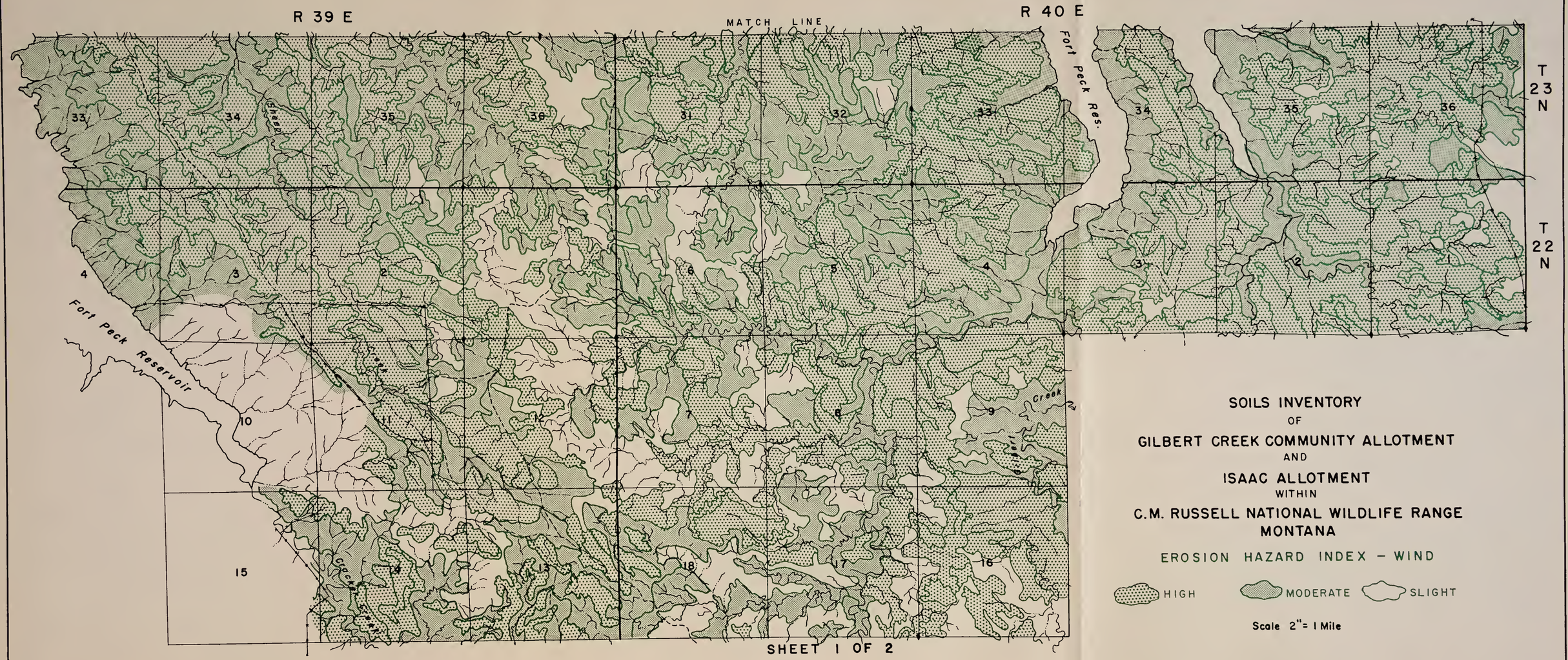
MATCH LINE
R 40 E
Fort Peck Res.
T 23 N
T 22 N
Fort Peck Reservoir
Creek
33
34
35
36
31
32
33
34
35
36
4
3
2
1
6
5
4
3
2
1
10
11
12
7
8
9
15
14
13
18
17
16
SHEET 1 OF 2
SOILS INVENTORY
OF
GILBERT CREEK COMMUNITY ALLOTMENT
AND
ISAAC ALLOTMENT
WITHIN
C.M. RUSSELL NATIONAL WILDLIFE RANGE
MONTANA
EROSION HAZARD INDEX - WATER
HIGH
MODERATE
SLIGHT
Scale 2" = 1 Mile

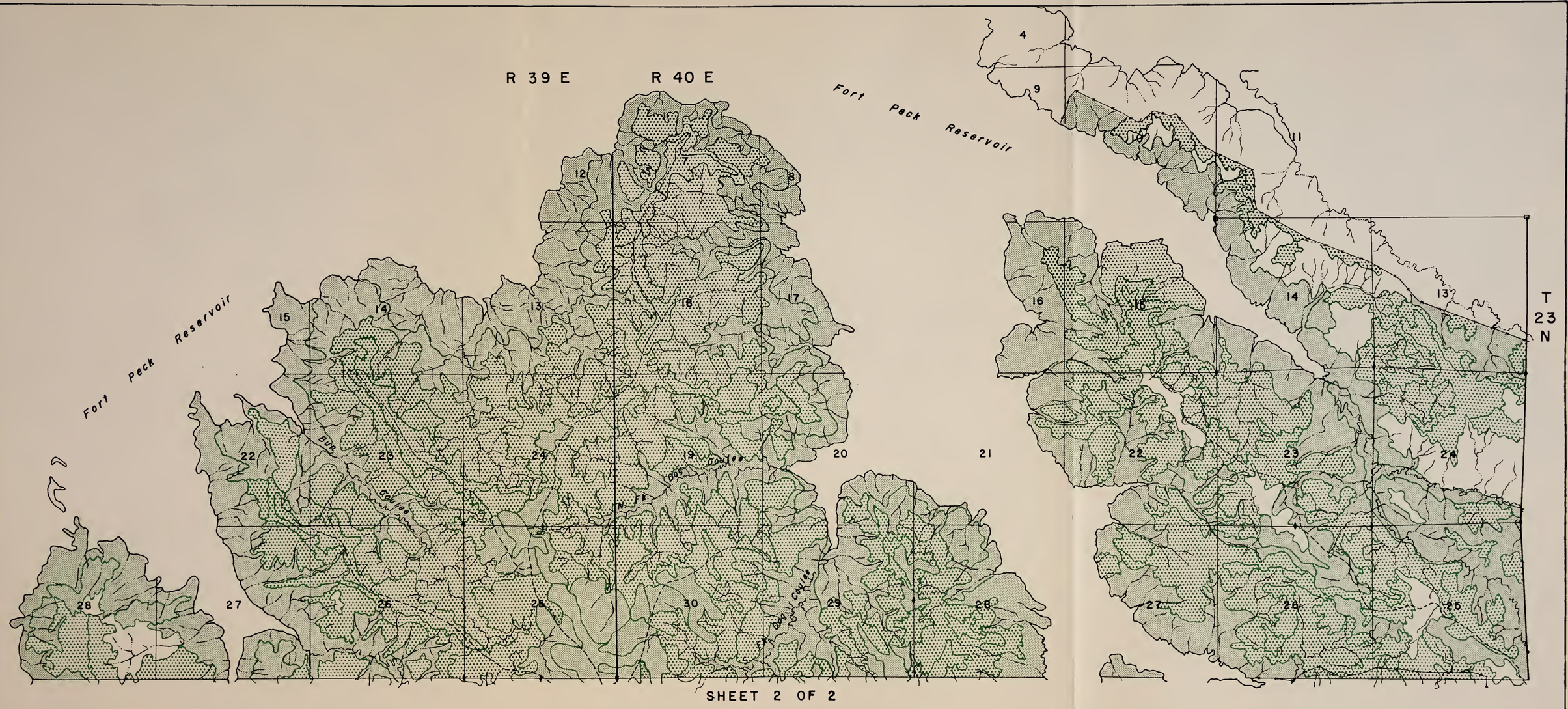
67



SHEET 2 OF 2

EROSION HAZARD INDEX - WATER


R 39 E
MATCH LINE
R 40 E
T 23 N
T 22 N
Fort Peck Res.
Fort Peck Reservoir
Sheep
Creek
Cache
SOILS INVENTORY
OF
GILBERT CREEK COMMUNITY ALLOTMENT
AND
ISAAC ALLOTMENT
WITHIN
C.M. RUSSELL NATIONAL WILDLIFE RANGE
MONTANA
EROSION HAZARD INDEX – WIND
HIGH
MODERATE
SLIGHT
Scale 2"= 1 Mile
SHEET 1 OF 2


R 39 E
R 40 E
T 23 N
Fort Peck Reservoir
Fort Peck Reservoir
Fort Peck Reservoir
BUG COULEE
DOG COULEE
N. FK.
S. FK.
SHEET 2 OF 2
EROSION HAZARD INDEX - WIND

APPENDIX

SOIL SERIES DESCRIPTIONS

ASSINNIBOINE SERIES

Typical Profile: Assinniboine sandy loam; location, NW¼SW¼SE¼SW¼ sec. 24, T. 23 N., R. 39 E., M.P.M.

A1 0-4" Grayish brown (10YR 4.5/2, dry) to dark grayish brown (10YR 3.5/2, moist) sandy loam with weak fine granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; clear boundary.

B1 4-7" Dark grayish brown (10YR 4/2.5, dry) to very dark grayish brown (10YR 3/2.5, moist) heavy silt loam with weak to moderate subangular blocky structure; slightly hard when dry, friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; gradual boundary.

B2 7-18" Brown (10YR 4/3, dry) to dark brown (10YR 3/3, moist) light sandy clay loam with strong medium prismatic to strong medium subangular blocky structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful fine roots; weak continuous clay films; non-calcareous; clear boundary.

Cca 18-40" Pale brown (10YR 5.5/2.5, dry) to brown (10YR 4.5/3, moist) light sandy clay loam to loam with massive to weak coarse subangular blocky structure; soft when dry, friable when moist, nonsticky and nonplastic when wet; strongly calcareous

with pockets and streaks of lime; rock fragments throughout; clear boundary.

R 40+" Weakly consolidated sandstone.

Range in Characteristics: Loam and sandy loam are the principal texture phases, but there may be loamy sand textures also. The B horizon has moderate to strong grades of structure. The Cca is calcic and it is usually encountered at depths of 16 to 22 inches. Weakly consolidated sandstone may be present at depths of 35 to 45 inches.

FORT PECK SERIES

Typical Profile: Fort Peck silt loam; location, SW¼SE¼NW¼ sec. 30, T. 23 N., R. 40 E., M.P.M.

A1 0-4" Dark grayish-brown (10YR 4.5/2.5, dry) to very dark grayish-brown (10YR 3.5/2, moist) heavy silt loam with weak granular structure; soft when dry, friable when moist, non-sticky and nonplastic when wet; noncalcareous; abundant fine roots; clear boundary.

B21t 4-8" Dark grayish-brown (10YR 4/2.5, dry) to very dark grayish-brown (10YR 3.5/2, moist) silty clay loam with weak medium to fine prismatic structure that breaks to weak medium sub-angular blocky; hard when dry, friable when moist, sticky and plastic when wet; patchy clay films on peds; abundant fine roots; noncalcareous; gradual boundary.

B22t 8-17" Dark brown (10YR 3/3, moist) heavy silty clay loam with moderate medium prismatic to moderate medium subangular blocky structure; very hard when dry, firm when moist, sticky and plastic when wet; prominent, continuous clay films on peds; plentiful fine roots; noncalcareous; clear boundary.

B3 17-20" Dark brown (10YR 3.5/3, moist) silty clay loam with weak coarse prismatic to weak medium subangular blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet; few patchy clay films on peds; slight effervescence of matrix with splotches and streaks of $CaCO_3$ in the lower extremity of horizon; clear boundary.

Cca 20-30" Dark brown (10YR 4.5/3, moist) light silty clay loam to heavy silt loam with very weak medium to coarse prismatic structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; strong effervescence with splotches and streaks of $CaCO_3$ throughout; gradual boundary.

R 30+" Partially weathered shale and outwash gravel, silts and clays.

Range in Characteristics: Surface soil textures of the Fort Peak may vary from loam to light silty clay loam. The B2 horizon contains considerably more clay than the A1 and the structure varies from weak to moderately strong prismatic and subangular blocky. Depth to lime varies from 17 to 24 inches and is present in the Cca horizon.

GLENDIVE SERIES

Typical Profile: Glendive loamy sand; location NW¼NW¼SW¼SE¼ sec. 12, T. 22 N., R. 39 E., M.P.M.

A 0-6" Very dark grayish-brown (10YR 3/2, moist), loamy sand with very weak fine granular structure; loose when dry, very friable when moist; abundant fine roots; noncalcareous; clear boundary.

AC 6-12" Dark grayish-brown (10YR 3.5/2, moist), loamy sand with massive to weak fine granular structure; loose when dry, very friable when moist; plentiful fine roots; noncalcareous; gradual boundary.

C 12-50" Pale brown (10YR 5.5/3, dry) to brown (10YR 4.3, moist); loamy sand; massive structure; loose when dry, very friable when moist; plentiful fine roots to 20"; noncalcareous to 36" then strongly so.

Range in Characteristics: Principal types in the area are loamy sand, loamy fine sand and fine sandy loam.

HAVRE SERIES

Typical Profile: Haver loamy sand; location, 260 feet west and 520 feet north of SE. corner sec. 4, T. 22 N., R. 40 E., M.P.M.

1. 0-3" Dark grayish brown (10YR 4/1.5, moist), loamy sand with single grain to very weak granular structure; loose when dry,

very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; abrupt boundary.

2. 3-5" Light gray (10YR 7/1.5, dry) to gray (10YR 5/1.5, moist); very fine sand with single grain; loose when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; abrupt boundary.

3. 5-7" Dark grayish brown (10YR 4/1.5, moist), loamy sand with very fine gravel; single grain; loose when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; noncalcareous; abrupt boundary.

4. 7-10" Light gray (10YR 7/2, dry) to dark grayish brown (10YR 4/2, moist), heavy silt loam with very thin platy structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; noncalcareous; abrupt boundary.

5. 10-14" Dark grayish brown (10YR 4/2, moist), light clay loam with weak fine granular structure; soft when dry, friable when moist, slightly sticky and slightly plastic when wet; plentiful fine roots; noncalcareous; abrupt boundary.

6. 14-16" Dark grayish brown (10YR 4/2.5, moist), sandy loam with single grain structure; loose when dry, very friable when moist, nonsticky and nonplastic when wet; plentiful fine roots; noncalcareous; abrupt boundary.

7. 16-20" Very dark grayish brown (10YR 3.5/2, moist), clay loam; weak, fine granular structure; soft when dry, very friable

when moist, slightly sticky and slightly plastic when wet; plentiful fine roots; noncalcareous; abrupt boundary.

8. 20-23" Dark grayish brown (10YR 4/2, moist) sandy loam; single grain; loose when dry, very friable when moist, nonsticky and nonplastic when wet; noncalcareous; abrupt boundary.

9. 23-55" Loose sand.

10. 55-60+" Stratified sands and clays.

Range in Characteristics: Most textures will vary from loamy sand to very fine sandy loam. However, there will be stratifications of loams to silty clay loams. Stratifications will vary in thickness from about 2 inches to 30 inches.

LOHMILLER SERIES

Typical Profile: Lohmiller loam; location about 2,500 feet north and 100 feet east of SW. corner of sec. 3, T. 22 N., R. 40 E., M.P.M.

1. 0-5" Very dark grayish-brown (10YR 3/2, moist), loam with mottles of 4/2 to 6/2; weak fine granular structure; soft when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; abrupt boundary.

2. 5-8" Dark grayish-brown (2.5Y 4/2, moist), silty clay; weak, medium blocky structure; hard when dry, firm when moist, sticky and plastic when wet; abundant fine roots; noncalcareous; abrupt boundary.

3. 8-16" Dark grayish-brown (2.5Y 4/2, moist), clay; massive; hard when dry, firm when moist, very sticky and plastic when wet; slightly calcareous with few nodules of lime; particles of shale mixed throughout the layer; plentiful fine roots; abrupt boundary.

4. 16-24" Dark grayish-brown (2.5Y 3.5/2, moist), clay; massive structure; hard when dry, firm when moist, very sticky and plastic when wet; abundant nodules of lime; strongly calcareous; stratified partially weathered shales mixed throughout the layer; abrupt boundary.

5. 24-36" Grayish brown (2.5Y 4.5/2, moist), clay; massive structure; hard when dry, firm when moist, very sticky and plastic when wet; strongly calcareous.

Range in Characteristics: Thickness of the surface soils and upper subsoil horizons will vary considerably. Silty clay and clay subsoils are the principal textural phases with fairly distinct mottles. Thin strata of silty, loamy and sandy materials are common.

MIDWAY SERIES

Typical Profile: Midway clay loam, location, NE¼NW¼NW¼ sec. 33, T. 23 N., R. 39 E., M.P.M.

A 0-4" Grayish brown (2.5Y 5/2.5, dry) to dark grayish-brown (2.5Y 4/2, moist) clay loam with weak granular structure; slightly hard when dry, friable when moist, slightly sticky

and slightly plastic when wet; abundant fine roots; noncalcareous; clear boundary.

AC 4-8" Light brownish-gray (2.5Y 5.5/2, dry) to dark grayish-brown (2.5Y 4/2, moist) silty clay with weak very fine granular structure; slightly hard when dry, friable when moist, very sticky and very plastic when wet; noncalcareous to 6 inches; plentiful fine roots; clear boundary.

C 8-16" Light brownish-gray (2.5Y 5.5/2, dry) to grayish brown (2.5Y 4.5/2, moist) silty clay mottled with light gray (2.5Y 7/2) and light olive brown (2.5Y 5/4); thin platy clayey and silty partially weathered shale; strongly calcareous; plentiful fine roots to 10"; clear boundary.

R 16+" Grayish brown (2.5Y 5/2, dry) unweathered interbedded thinly plated silty and clayey shale; strongly calcareous.

Range in Characteristics: Clay loam and silty clay loam are the principal texture phases. The depth to the unweathered shale is 10-16 inches.

RYEGATE SERIES

Typical Profile: Ryegate sandy loam; location, NW¼NW¼ sec. 11, T. 22 N., R. 39 E., M.P.M.

A1 0-3" Grayish-brown (2.5Y 5/2, dry) to dark grayish-brown (2.5Y 4/2, moist) sandy loam with weak medium granular structure; soft when dry, very friable when moist, nonsticky

and nonplastic when wet; abundant fine roots; noncalcareous; clear boundary.

B21t 3-7" Brown (10YR 5/3, dry) to very dark grayish-brown (10YR 3.5/2, moist) light sandy clay loam with moderate medium prismatic structure that breaks to moderate medium subangular blocky; hard when dry, very friable when moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; gradual boundary.

B22t 7-14" Yellowish brown (10YR 5/4, dry) to dark brown (10YR 4/3, moist) light sandy clay loam with strong medium prismatic structure; very hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; plentiful fine roots; weak patchy clay films on peds; noncalcareous; abrupt boundary.

Cca 14-28" Pale brown (10YR 6/3, dry) to light olive brown (2.5Y 5/4, moist) light sandy clay loam with weak medium subangular blocky structure; hard when dry, very friable when moist, slightly sticky and slightly plastic when wet; plentiful fine roots; strongly calcareous; clear boundary.

R 28-36" Softly consolidated sandstone, grayish colored and weakly calcareous.

Range in Characteristics: Textures of the Ryegate series may vary from the dominant textures of fine sandy loam and sandy loam to a sandy clay loam. The B2 horizon contains approximately 15 percent

more clay than the A1. The structure of the B2 horizon ranges from moderate to strong. A prominent Cca horizon occurs in some Ryegate soils while only lime crusts on sandstone fragments occurs in the upper R horizon of other soils in this series.

REGENT SERIES

Typical Profile: Regent silty clay loam; location, SW¼NE¼NW¼ sec. 25, T. 23 N., R. 39 E., M.P.M.

A1 0-3" Very dark-grayish-brown (10YR 3/2.5, moist) light silty clay loam with moderate fine granular structure; slightly hard when dry, friable when moist, slightly sticky and slightly plastic when wet; abundant fine roots; noncalcareous; clear boundary.

B1 3-6" Dark brown (10YR 3/3.5, moist) heavy silty clay loam with moderate fine subangular blocky structure breaking to strong granular; hard when dry, firm when moist, sticky and plastic when wet; abundant fine roots; noncalcareous; patchy clay films on peds; clear boundary.

B21t 6-11" Dark brown (10YR 4/3 moist) silty clay with strong medium and fine prismatic structure breaking to strong medium and fine subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; plentiful fine roots; continuous clay films on peds; noncalcareous; gradual boundary.

B22t 11-20" Dark grayish-brown (10YR 4/2, moist) clay with strong medium prismatic structure breaking to strong medium subangular blocky; very hard when dry, firm when moist, sticky and plastic when wet; plentiful fine roots; continuous clay films on peds; noncalcareous; clear boundary.

B3cs 20-28" Dark brown (10YR 4/3.5, moist) heavy silty clay loam with moderate coarse prismatic/structure breaking to weak coarse subangular blocky; hard when dry, friable when moist, sticky and plastic when wet; strongly calcareous with Ca salts in nests and streaks; gradual boundary.

C1 28-39" Brown (10YR 5/3.5, moist) silty clay loam with massive structure; slightly hard when dry, friable when moist, sticky and plastic when wet; strongly calcareous with abundant salts; abrupt boundary.

R 39+" Partially weathered shale.

Range in Characteristics: Silty clay and silty clay loam are the dominant textures of the Regent series. Firm silty clay loam to clay subsoils and substrata are common. Generally, the soil profile is mildly calcareous near the surface and has a moderately calcareous subsoil and substrata but some soils may be noncalcareous, others are weakly calcareous while some have prominent Cca horizons. Bedded shale, generally clay shale, occurs at a minimum depth of 20 to 30 inches but usually at a greater depth. The Regent soil may contain either salinity or alkalinity or both in its substrata.

TULLOCK SERIES

Typical Profile: Tullock loamy sand; location, NE¼SW¼SW¼ sec. 12, T. 22 N., R. 39 E., M.P.M.

A1 0-4" Dark grayish-brown (10YR 4.5/2, moist) loamy sand with gravel throughout; weak fine granular structure; soft when dry, very friable when moist; calcareous; abundant fine roots; clear boundary.

AC 4-15" Dark brown (10YR 4.5/2, moist) loamy sand with gravel; very weak fine granular to single-grained structure; loose when dry, very friable when moist; plentiful fine roots; strongly calcareous; abrupt boundary.

R 15+" Fractured or weakly consolidated sandstone.

Range in Characteristics: The texture of the Tullock series is loamy sand. The AC profile ranges from slightly calcareous in the upper part to strongly calcareous in the lower part. The combined thickness of the A and AC horizons ranges from 5 to 15 inches over sandstone bedrock. The Tullock Rock outcrop mapping unit has an average soil profile much thinner than the typical profile described above.

WINNETT SERIES

Typical Profile: Winnett loam; location, NE¼NW¼NE¼ sec. 13, T. 22 N., R. 39 E., M.P.M.

A1 0-5½" Dark grayish-brown (10YR 4/2, moist) loam texture with weak granular structure; soft when dry, very friable when

moist, nonsticky and nonplastic when wet; abundant fine roots; noncalcareous; clear boundary.

A2 5½-9" Pale brown (10YR 6/3, dry) to dark brown (10YR 4.5/3, moist) clay loam with very weak platy structure breaking to weak granular; soft when dry, very friable when moist, slightly sticky and slightly plastic when wet; abundant fine roots; noncalcareous; clear boundary.

B2t 9-16" Very dark grayish-brown (2.5Y 3.5/2, moist) clay with strong medium to coarse columnar structure breaking to strong medium subangular blocky; very hard when dry, very firm when moist, very sticky and very plastic when wet; plentiful fine roots; thick continuous clay films on peds; noncalcareous; clear boundary.

B3ca 16-24" Dark grayish-brown (2.5Y 4.5/2, moist) sandy clay with weak coarse subangular blocky structure breaking to weak fine subangular blocky; very hard when dry, very firm when moist, very sticky and plastic when wet; few fine roots; matrix noncalcareous with common lime mottles 5 to 15 mm in size and some other salts present; gradual boundary.

Ccs 24-40" Grayish brown (2.5Y 5.5/2, moist) sandy clay loam with massive structure; very hard dry, very firm moist, slightly sticky and slightly plastic wet; matrix calcareous with lime mottles 5 to 15 mm in size and other salts increasing in abundance; abrupt boundary.

R 40+" Partially weathered grayish-colored shale with yellowish mottles.

Range in Characteristics: Surface soil texture may be loam, silt loam, silty clay loam, clay loam, or sandy loam. The combined thickness of the A1 and A2 may be 5 to 9 inches. The B2 may contain 35 to 50 percent clay. Solum thickness to the cs horizon may vary from 12 to 24 inches. The streaks and nests of gypsum are sometimes absent in the B3 and range from few to many in the Ccs.

BALD SERIES 1/

Typical Profile: Bald clay loam; location, 125 feet northwest of ¼ corner between secs. 25 and 36, Tps. 22 and 23 N., R. 39 E., M.P.M.

A 0-2" Grayish-brown (2.5Y 5/2, dry) to very dark grayish-brown (2.5Y 3/2, moist) light clay loam with moderate granular structure (a vesicular crust ½ to ¼ inch thick on surface with a light gray 2.5Y 7/2, dry); soft when dry, friable when moist, slightly sticky and slightly plastic when wet; remnants of roots; noncalcareous; clear boundary.

1/ The Bald series is not an established series but is a tentative series name applied to the panspots of the Winnett-Bald complex.

B21t 2-5" Grayish-brown (2.5Y 5/2, dry) to very dark grayish-brown (2.5Y 3/2, moist) silty clay with weak and moderately fine subangular blocky structure; hard when dry, firm when moist, very sticky and very plastic when wet; some remnants of roots; thin patchy clay films on peds; noncalcareous; clear boundary.

B22t 5-11" Grayish-brown (2.5Y 5/2, dry) to dark grayish-brown (2.5Y 4/2, moist) silty clay with moderate and fine coarse and medium subangular blocky structure; very hard dry, very firm moist, very sticky and very plastic when wet; thin patchy clay films on peds; noncalcareous; clear boundary.

Ccs 11-30" Dark brown (7.5YR 3.5/2, moist) clay with massive structure; very hard when dry, very firm when moist, very sticky and very plastic when wet; matrix noncalcareous with common splotches and nests of salts 5 to 15 mm in size; gradual boundary.

R 30+" Partially weathered shale with yellow, brown and olive mottling.

Range in Characteristics: Texture of the thin surface horizon may range from light clay loam to light clay. The subsoil textures are very clayey. A vesicular crust varying in thickness from ¼ to 1 inch is usually present and may be indicated as an A2 horizon (leached layer). Structure of the B horizon varies from moderate to strong

subangular blocky with clay films on peds and some prismatic or columnar structure is likely. Salt crystals occur between 10 and 30 inches and increase in abundance with depth.