2000

Field Trip Guide for the Upper Republican and Middle Republican NRD's Southwestern Nebraska Geology and Soils

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FIELD TRIP GUIDE

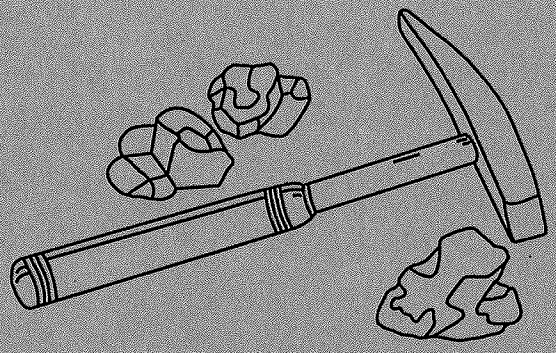
for the

Upper Republican and Middle Republican NRD'S

SOUTHWESTERN NEBRASKA GEOLOGY and SOILS

Duane Eversoll, Jim Goeke and Mark Kuzila

Conservation and Survey Division



NEBRASKA GEOLOGICAL SURVEY

Conservation and Survey Division
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln

March 29, 2000

UPPER REPUBLICAN NRD AND MIDDLE REPUBLICAN NRD
TOUR OF SOUTHWESTERN NEBRASKA
Wednesday March 29, 2000

Leaders: Jim Goeke, Mark Kuzila and Duane Eversoll, Conservation & Survey Division, IANR, UNL.
Bus from Ogallala will pick up URNRD members and meet rest of the group at 8:00am. at McCook in the old Walmart parking lot. Northwest corner of intersection of Highways 6 and 83. 8:10am. Leave McCook and drive east to Medicine Creek Dam. Arrive at 8:50. CSD will provide an overview of the geology, soils and water issues as we travel. View Niobrara Formation and Ogallala Group below Dam and importance of both to the area and Nebraska.

Leave 9:20 and drive across dam viewing Niobrara outcrops along east side of the Harry D. Strunk Lake and Ogallala quartzite quarry below the western end of the dam. Stop to look at the quartzite rip rap used at the dam site. The quartzite has inclusions of opal (poor gem quality). Coffee break. Discuss soils that develop on the Niobrara, Ogallala and Loess (wind blown deposits) in the area and importance to agriculture and natural resources. Leave at 9:50am.

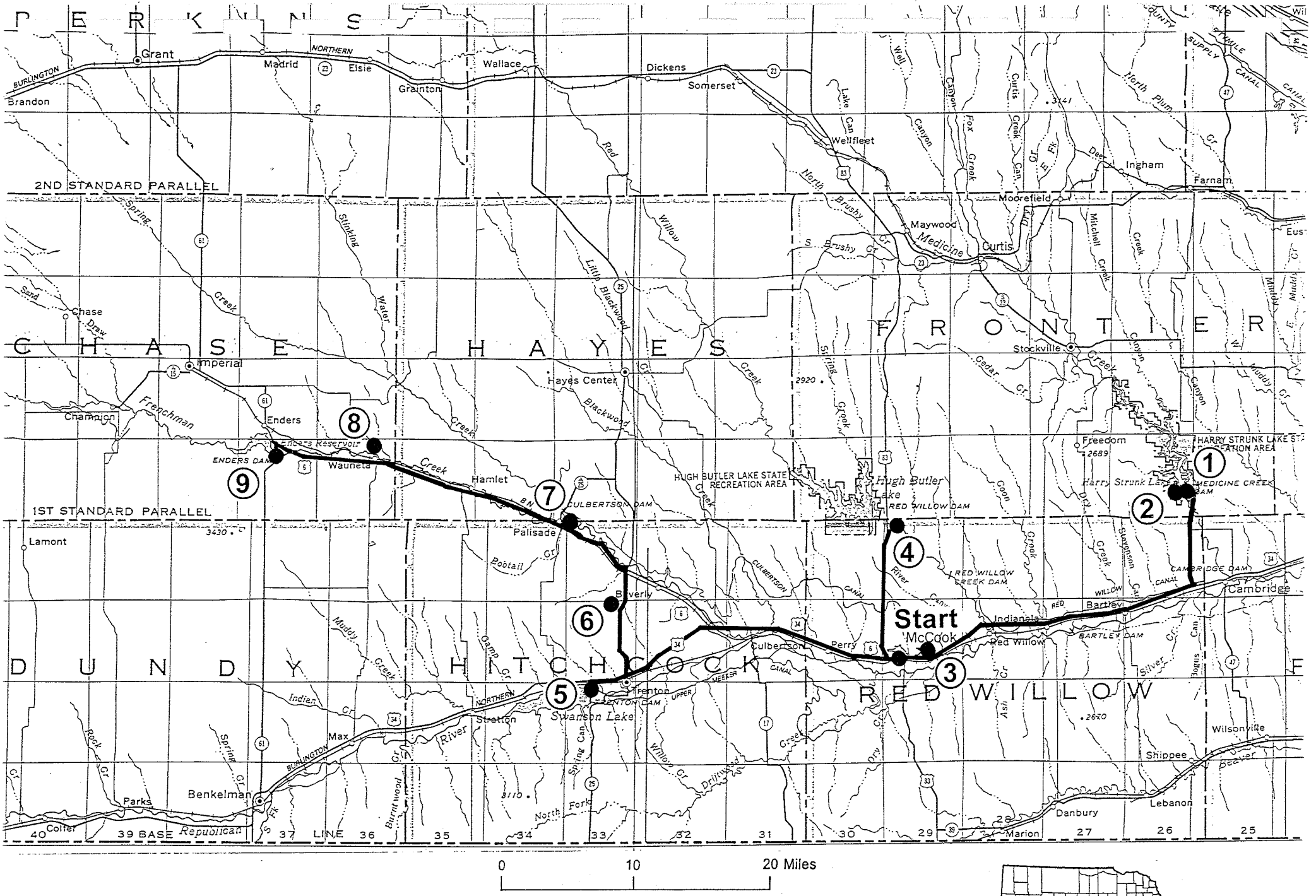
Return back to McCook making a short drive-by at the McCook Highway Rest Area to discuss the pumping test site on the main stem of the Republican River. Also discuss the water well for the rest area. Arrive at 10:35 leave at 10:40am.

Drive to Red Willow Creek north of McCook. Discuss McCook's plan for a proposed new water well field north of town. 11:00am arrive at Koetter's ranch. Discuss the pump test on the Red Willow and walk ½ mile to sample an Ogallala volcanic ash deposit and discuss the soils developed in the area. Leave at 12:00 and return to McCook for fast lunch break at Bonanza.

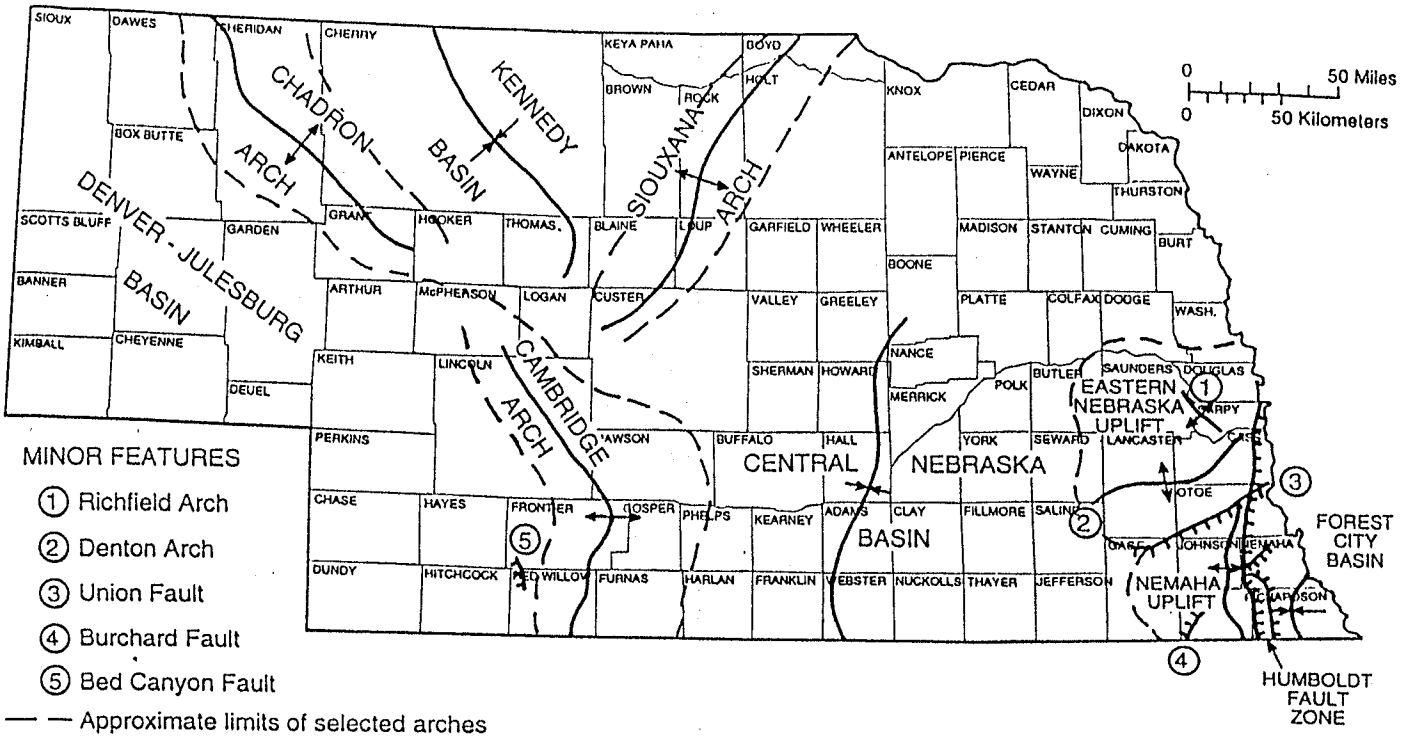
Drive to Trenton Dam arrive at 1:15pm. View dam, Swanson Reservoir and the Republican River. Drive or walk ½ mile to Pierre Shale outcrop. Discuss importance of Pierre Shale, the Ogallala and occasional springs along the side of the Republican River Valley.

Leave at 2:15pm. drive north of Trenton to make a drive-by and a short discussion of the new Trenton Water Well Field. Continue on to Palisade, Nebraska passing by the Frenchman Creek Pumping Test site. Drive west to Wauneta to view thick loess and paleosols (old soils), arrive at 3:00pm. Leave at 3:20pm. and drive to Enders Dam and Reservoir to view extensive Ogallala soils, and outcrops and deposition of the Ogallala. Arrive at 3:30pm. Discuss importance of soils and parent materials to the agriculture of Southwestern Nebraska. Leave at 4:00pm and return to McCook.

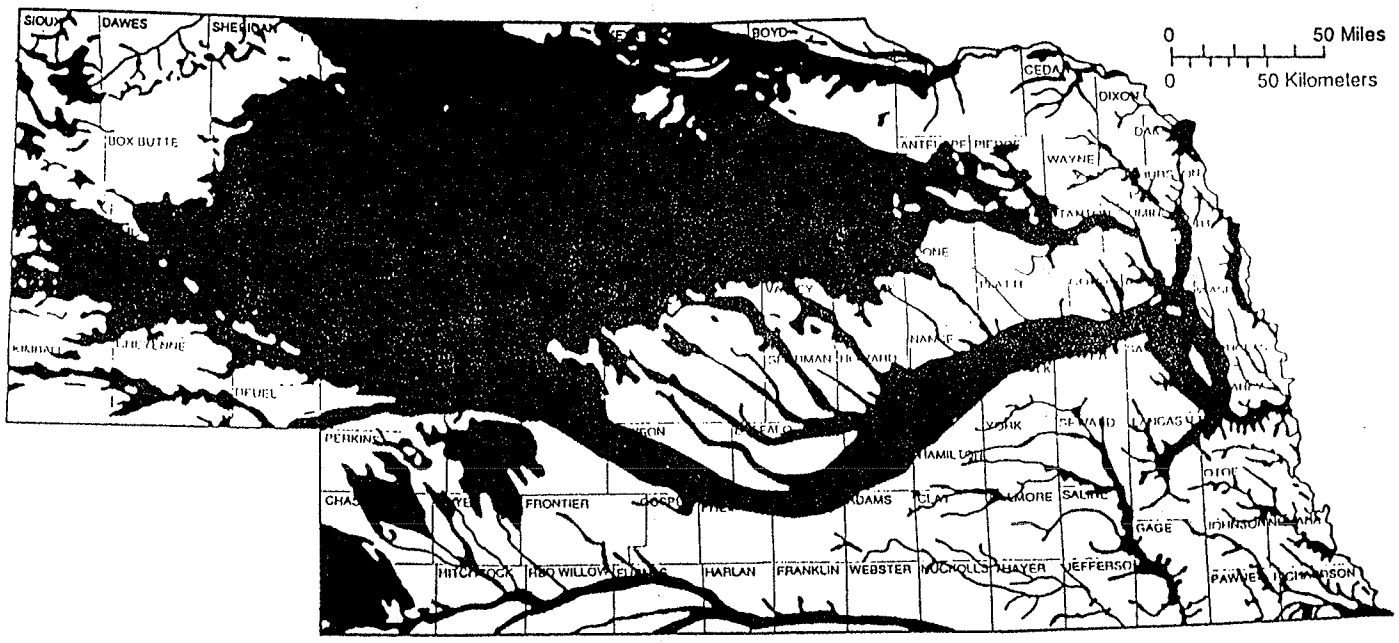
Note: Times are approximate and may be altered as necessary.



Index map showing location of stops

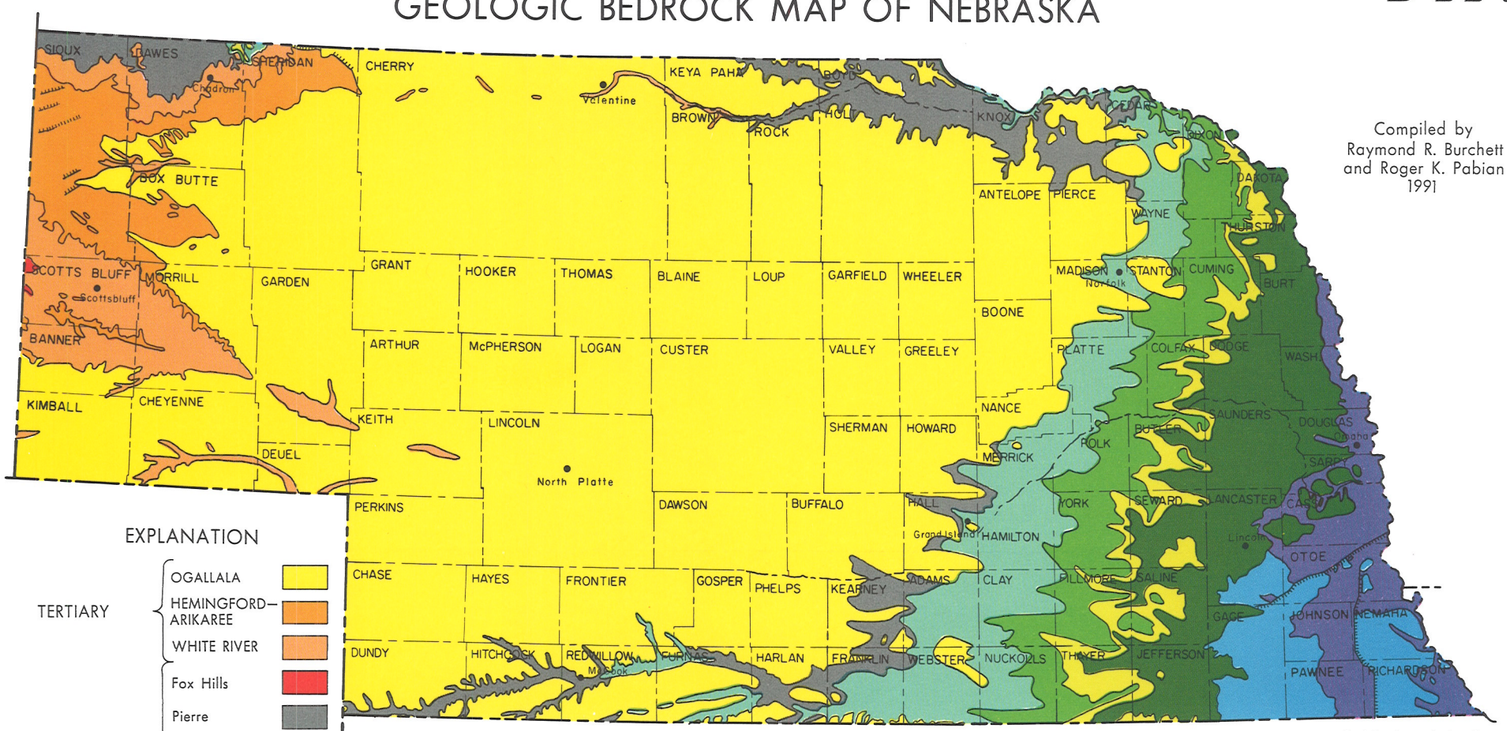


Principal structural features in Nebraska.



Locations of sand and gravel deposits at or near the surface in Nebraska.

GEOLOGIC BEDROCK MAP OF NEBRASKA



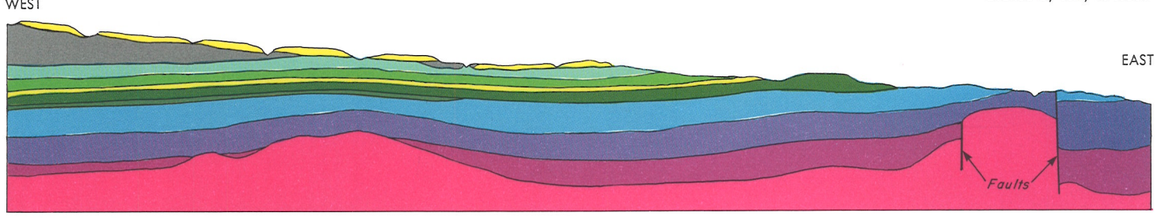
Compiled by
Raymond R. Burchett
and Roger K. Pabian
1991

Drafted by Jerry P. Leach

EXPLANATION

- TERTIARY
  - OGALLALA
  - HEMINGFORD–ARIKAREE
  - WHITE RIVER
- CRETACEOUS
  - Fox Hills
  - Pierre
  - Niobrara
  - Carlile
  - Greenhorn–Graneros
  - DAKOTA
- JURASSIC
- PERMIAN
- PENNSYLVANIAN
- MISSISSIPPIAN
- DEVONIAN
- SILURIAN
- ORDOVICIAN
- CAMBRIAN
- PRECAMBRIAN

Fault



GEOLOGIC CROSS SECTION ALONG SOUTHERN NEBRASKA BORDER

20 0 20 40 60
Scale in Miles

Conservation & Survey Division
Institute of Agriculture and Natural Resources
University of Nebraska—Lincoln

NOTE: Unconsolidated sediments of Recent and Pleistocene age cover the bedrock throughout much of the State and are not shown.

GMC—2

AGE (Millions of Years Ago)	Geologic Time Units		Rock Types	Mineral Resources and Products	Typical Fossils
1.6	CENOZOIC (RECENT LIFE)	QUATERNARY (Recent and Pleistocene)	Glacial till, silt, clay, sand, gravel, volcanic ash.	Agricultural soil, water, sand & gravel, volcanic ash.	MAMMALS: MAMMOTH
66		TERTIARY	Sandstone, siltstone, clay, gravel, marl, volcanic ash.	Agricultural soil, water, sand & gravel, volcanic ash, riprap & uranium.	MAMMALS
138	MESOZOIC (MIDDLE LIFE)	CRETACEOUS	Chalk, chalky shale, dark shale, varicolored clay, sandstone, conglomerate	Water, oil & gas, cement, brick, agricultural lime, & other construction materials.	REPTILES: DINOSAUR
205		JURASSIC	Subsurface only. Sandstones and shales		REPTILES
240		TRIASSIC			REPTILES: PLESIOSAUR
290	PALEOZOIC (ANCIENT LIFE)	PERMIAN	Shale, limestone, dolomite, gypsum, anhydrite sandstone, siltstone, chert.	Water, agricultural lime, oil, road rock, riprap.	AMPHIBIANS
330		PENNSYLVANIAN	Limestone, shale, sandstone, coal.	Oil, cement, brick, concrete aggregate, lightweight aggregate, road rock, agricultural lime, rip rap, water.	AMPHIBIANS: BRACHIOPOD
360		MISSISSIPPIAN	Subsurface only. Limestone, dolomite.	Oil, water.	FISH
410		DEVONIAN	Subsurface only. Dolomite, gray shale.		FISH: CORALS
435		SILURIAN	Subsurface only. Dolomite.		INVERTEBRATES
500		ORDOVICIAN	Subsurface only. Dolomite, sandstone, shale.		INVERTEBRATES: CRINOID
570		CAMBRIAN	Subsurface only. Dolomite, sandstone.		INVERTEBRATES: TRILOBITE
5,000 ?	CRYPTOZOIC (HIDDEN LIFE)	PRECAMBRIAN	Subsurface only. Granite, other igneous rocks, and metamorphic rocks.		?

FACTORS OF SOIL FORMATION

Parent Material

Material soils form in. Loess (eastern, south central), Aolian Sand (Sand Hills), Glacial Till (eastern), Residuum (Panhandle, southwestern, north central), Alluvium (river and stream valleys).

Relief or Topography

Landscape position. Upland ridgetop, sideslope, or tablelands; Terrace; Bottomlands or Floodplains.

Climate

The climatic condition that soils form under. In general, Nebraska has three climatic conditions; moist and humid in the east, moderately moist and humid in the central and somewhat dry in the southwest and Panhandle.

Biota

The plant and animal life living in the soil as it forms. Soils formed under abundant plant and animal life are more developed than those formed under sparse plant and animal life.

Time

The age of a soil. Soils formed for a long time are more developed than those formed for a short time. Soils on bottomlands are young and undeveloped because flooding frequently deposits new material. Soils on stable uplands are relatively old and well developed.

Guide For Textural Classification

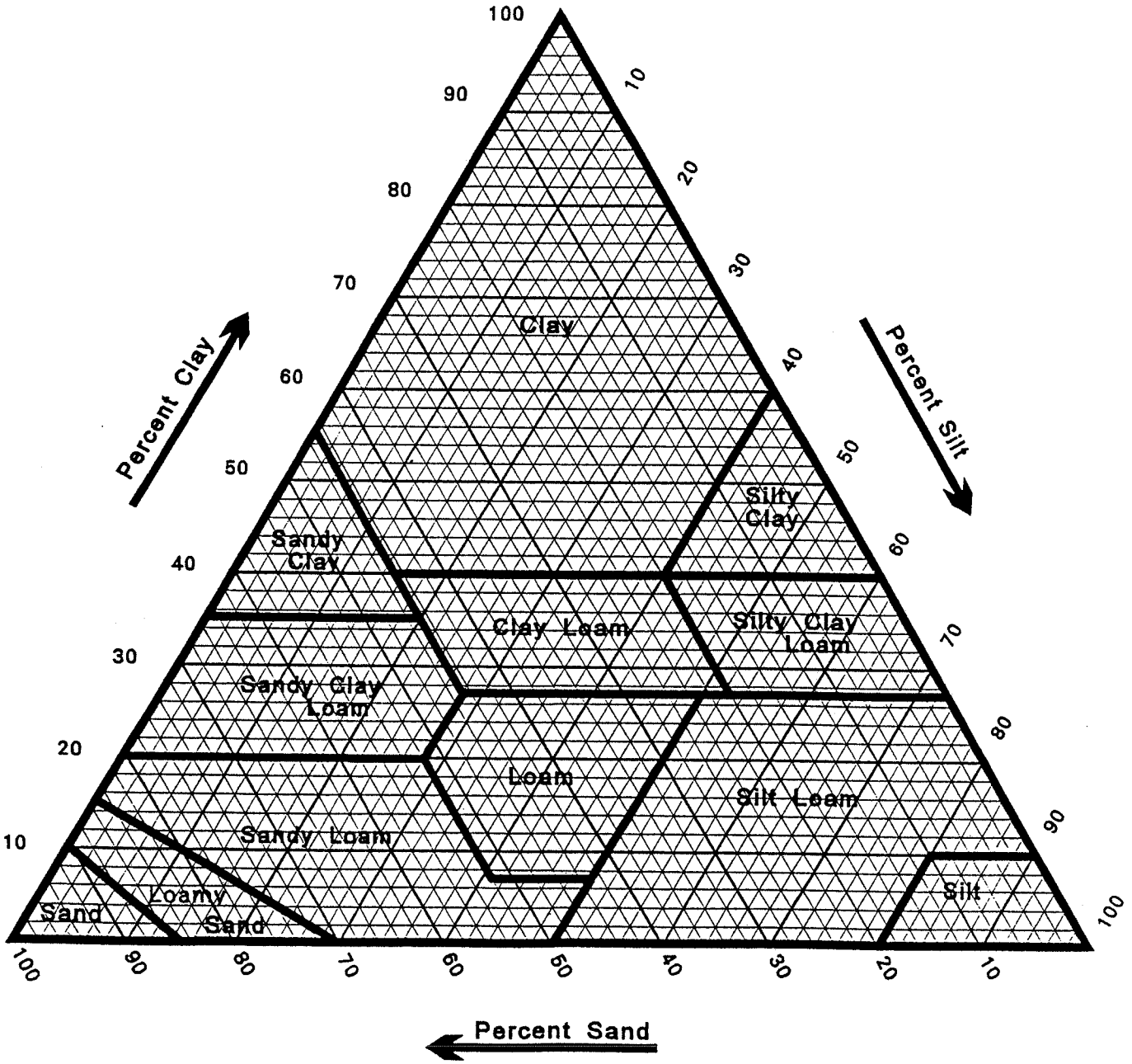
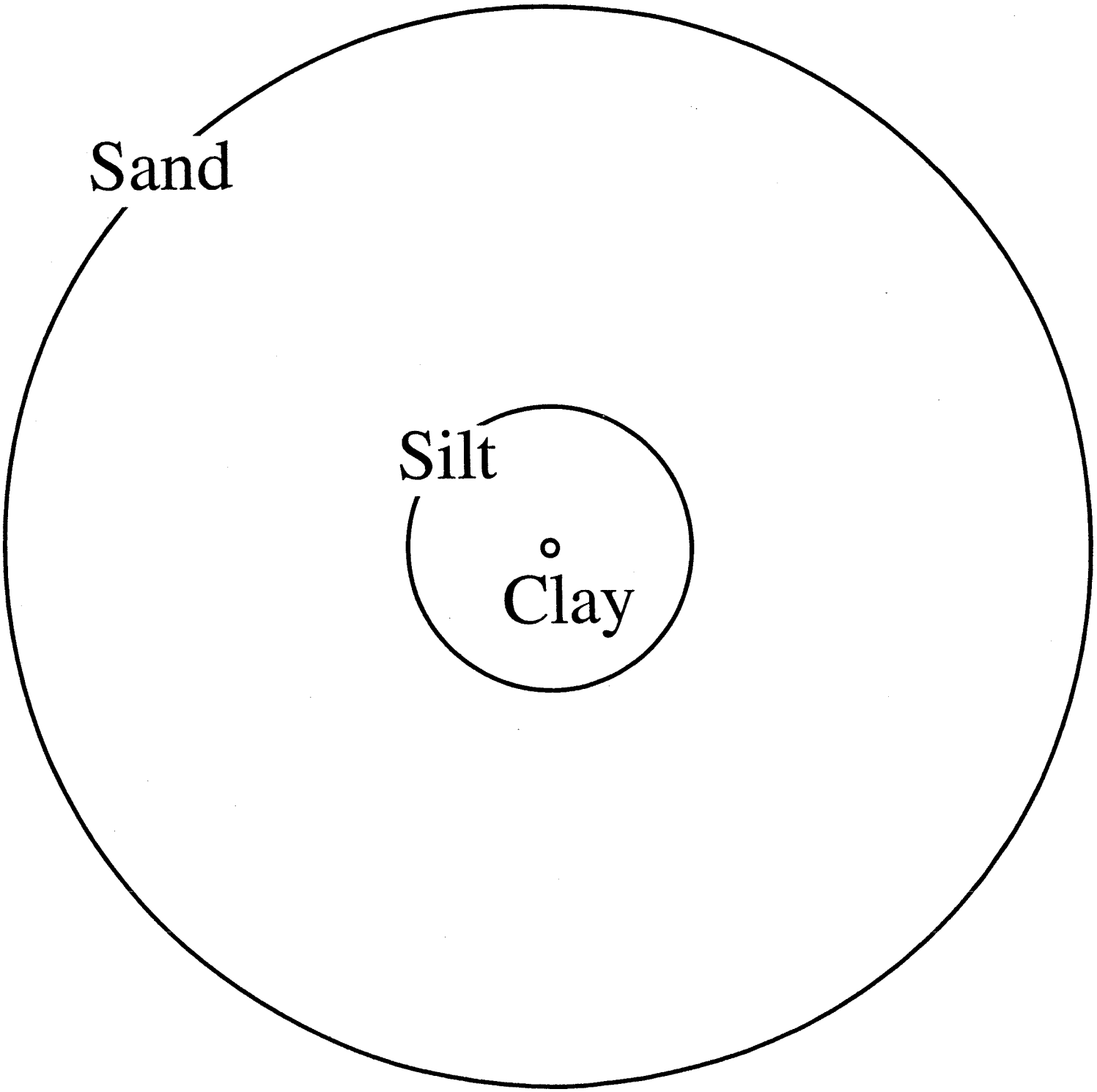


Chart showing relative proportions of sand, silt and clay in the basic soil textural classes.

Adapted from USDA Soil Survey Manual by Conservation and Survey Division of the University of Nebraska, 113 Nebraska Hall, Lincoln, Nebraska 68588-0517.

October 1992

Relative sizes of Sand, Silt and Clay



Pedon

A three dimensional body of soil. The smallest body we describe and sample. The surface has a area of about 1 to 10 square meters.

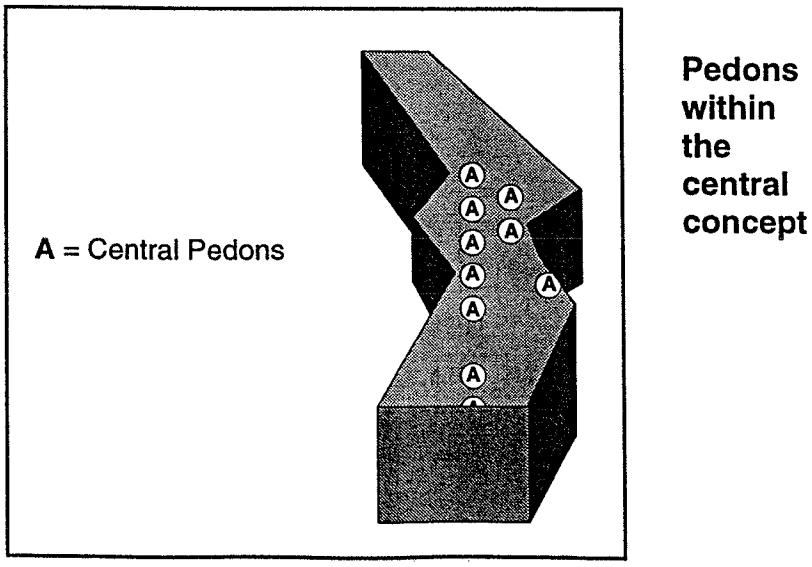
Soil Map Unit

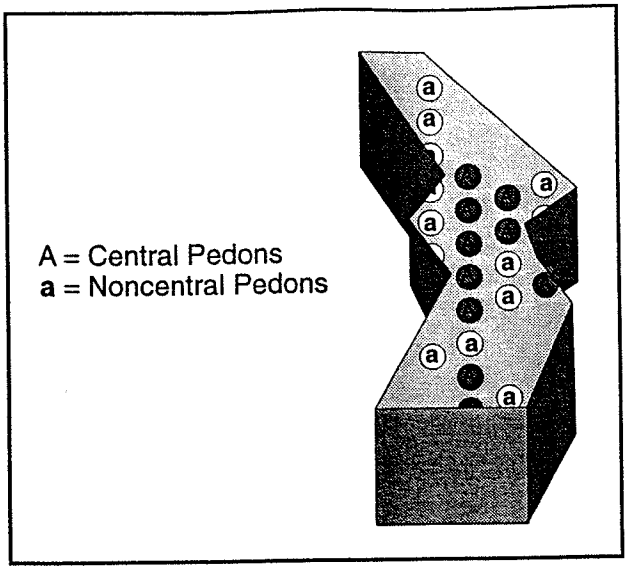
Soil map units are defined in terms of a taxonomic class but may contain more than one soil. There is a range for each soil property used to define the taxonomic class. However, there is also a central concept of each of those properties . For example, a certain taxonomic class may have a dark surface soil that ranges in depth from 10 to 19 inches. The **central concept** of surface soil thickness may be 14 to 16 inches. All pedons having 14, 15 or 16 inch thick surface soils are **within the central concept**. Pedons having 10, 11, 12, 13, 17, 18, or 19 inch thick surface soil are **outside the central concept** but still within the range of the taxonomic class.

Some pedons within a map unit have soil properties outside the range of the named taxonomic class but can be used and managed the same as the named soil. These pedons are called **similar inclusions.** A **similar inclusion** to the central concept discussed above may have 8 or 9 inches of surface soil.

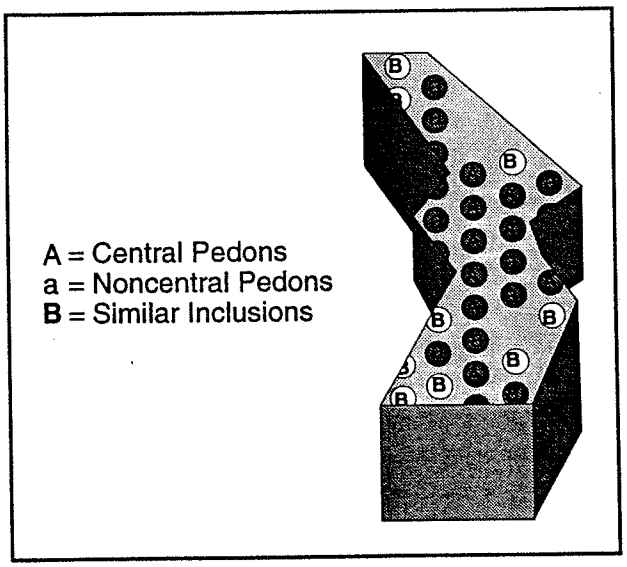
Some pedons within a map unit have soil properties outside the range of the named taxonomic class that should be used and managed differently than the named soil. These pedons are called **dissimilar inclusions**. A **dissimilar inclusion** to the central concept discussed above may have 2 or 3 inches of surface soil.

The makeup of a soil map unit is illustrated below. The illustrations were adapted from "Illustrations on Understanding a Soil Map Unit" USDA NRCS Nebraska State Office Staff 1985.

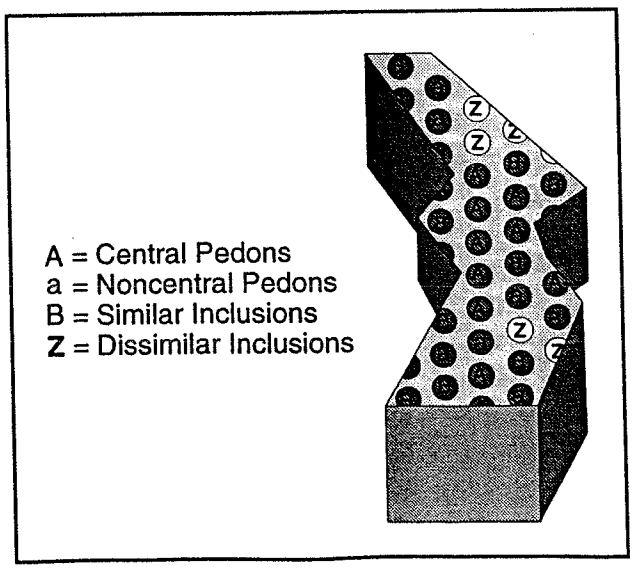




Pedons outside the central concept



Pedons similar to and used and managed the same as the named taxonomic class



Pedons dissimilar to and used and managed differently than the named taxonomic class

LOCATION ANSELMO NE+KS SD WY

Established Series
Rev. LGR
11/98

ANSELMO SERIES

The Anselmo series consists of very deep, well drained, moderately rapidly permeable soils formed in loamy and sandy wind-deposited sediments. These soils are on uplands and stream terraces and have slopes ranging from 0 to 30 percent. Mean annual temperature is 51 degrees F, and mean annual precipitation is 20 inches at the type location.

TAXONOMIC CLASS: Coarse-loamy, mixed, superactive, mesic Typic Haplustolls

TYPICAL PEDON: Anselmo fine sandy loam - on a 2 percent convex northwest-facing slope in a cultivated field. When described the soil was moist throughout. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 5 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

A--5 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable; neutral; gradual smooth boundary. (Combined thickness of A horizon is 7 to 20 inches.)

Bw--11 to 29 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; slightly alkaline; gradual smooth boundary. (4 to 20 inches thick)

C--29 to 60 inches; pale brown (10YR 6/3) fine sandy loam, grayish brown (10YR 5/2) moist; weak coarse prismatic structure; slightly hard, very friable; slightly alkaline.

TYPE LOCATION: Logan County, Nebraska; about 4 miles south and 4 miles east of Stapleton; 800 feet east and 150 feet north of the southwest corner, sec. 22, T. 17 N., R. 27 W.

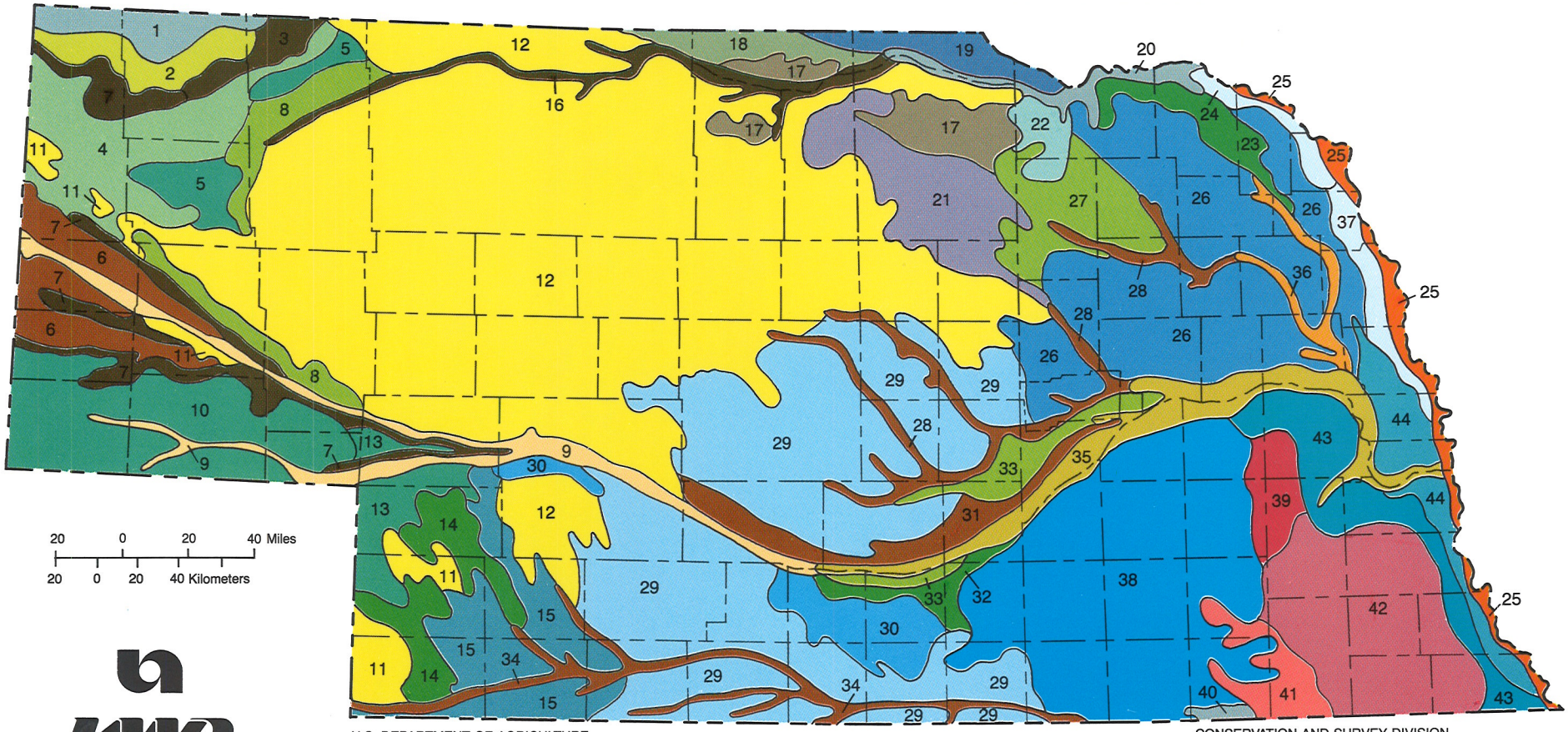
RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 11 to 40 inches, and the depth to free carbonates ranges from 26 to more than 60 inches. The mollic epipedon ranges from 7 to 20 inches in thickness and includes part of the upper B horizon in some pedons.

The A horizon has hue of 10YR, value of 3 to 5 and 2 or 3 moist, and chroma of 1 to 3. It typically is fine sandy loam; but loam, sandy loam, very fine sandy loam and loamy fine sand are in the range. Reaction ranges from moderately acid to neutral.

The Bw horizon has hue of 10YR, or 2.5Y value of 4 to 6 and 3 or 4 moist, and chroma of 2 to 4. It is fine sandy loam, sandy loam, or loam. Reaction is slightly acid to mildly alkaline.

Some pedons have a BC horizon.

GENERAL SOIL MAP OF NEBRASKA



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
JAMES R. CULVER - STATE SOIL SCIENTIST
STEVEN J. SCHAEFER - CARTOGRAPHER
JANUARY 1988

CONSERVATION AND SURVEY DIVISION
INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES
UNIVERSITY OF NEBRASKA–LINCOLN
MARK S. KUZILA - RESEARCH SOIL SCIENTIST
ANN M. MACK - CARTOGRAPHER

1 - Pierre-Samsil-Kyle
2 - Kadoka-Mitchell-Bufton
3 - Canyon-Bridget-Rock outcrop
4 - Busher-Jayem-Tassel
5 - Keith-Alliance-Rosebud
6 - Tripp-Mitchell-Alice
7 - Tassel-Busher-Rock outcrop
8 - Jayem-Sarben-Valent
9 - Las-Gothenburg-Platte
10 - Rosebud-Alliance-Canyon
11 - Valent
12 - Valentine-Elsmere-Tryon
13 - Kuma-Rosebud-Satanta
14 - Satanta-Keith
15 - Kuma-Keith-Colby
16 - Tassel-McKelvie-Rock outcrop
17 - Jansen-O'Neill-Meadin
18 - Valentine-Duda-Tassel
19 - Onita-Reliance-Labu
20 - Labu-Bristow-Redstoe
21 - Els-Valentine-Loup
22 - Brunswick-Paka-Simeon
23 - Moody-Thurman
24 - Crofton-Alcester-Nora
25 - Albaton-Haynie-Sarpy
26 - Nora-Moody-Crofton
27 - Thurman-Boelus-Nora
28 - Hord-Boel-Inavale
29 - Coly-Uly-Holdrege
30 - Holdrege
31 - Cozad-Hord
32 - Kenesaw-Hersh
33 - Hersh-Valentine
34 - Hord-McCook-Hobbs
35 - Gibbon-Gothenburg-Platte
36 - Shell-Muir-Colo
37 - Ida-Monona
38 - Hastings-Crete-Fillmore
39 - Sharpsburg-Pawnee-Steinauer
40 - Kipson-Benfield-Crete
41 - Crete-Mayberry
42 - Wymore-Pawnee
43 - Sharpsburg
44 - Marshall-Ponca

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 and 4 to 6 moist, and chroma of 2 to 4. It is typically fine sandy loam, but loamy fine sand, fine sand, or sand are included. Texture frequently becomes coarser with depth. Stratification caused by wind reworking is present in the C horizon of some pedons. Silty and loamy strata below a depth of 40 inches are common in some pedons.

COMPETING SERIES: These are the Caval and Orton series in the same family, and the related Jayem and Ortello series. Caval soils have redder hue. Orton soils have free carbonates at depth of 7 to 15 inches. Jayem soils are drier in the soil moisture control section for substantially longer periods during the 120 days following the summer solstice. Ortello soils are more moist in the soil moisture control section for substantially longer periods during the 120 days following the summer solstice.

GEOGRAPHIC SETTING: Anselmo soils are on uplands and stream terraces. Slope gradients range from 0 to 30 percent. These soils formed in loamy and sandy eolian material. The range of mean annual temperature is 45 to 57 degrees F. The average annual precipitation ranges from 18 to 24 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dunday, Hall, Hersh, Holdrege, O'Neill, Valentine, and Vetal soils. Dunday soils have more sand in the control section and are on similar landscape. Hall and Holdrege soils have fine-silty argillic horizons and are predominantly on nearly level slopes below Anselmo soils. Hersh soils lack a mollic epipedon and occur on similar landscapes. O'Neill soils developed over mixed sand and gravel, and are on similar landscapes. Valentine soils are sandy and usually are on more hummocky landscapes. Vetal soils have a mollic epipedon greater than 20 inches thick and are lower in the landscape.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is slow to medium depending on slope. Permeability is moderately rapid.

USE AND VEGETATION: Approximately 50 percent of the acreage of these soils is cultivated, and where water is available they are commonly irrigated. The principal crops are corn, winter wheat, milo, and alfalfa. The common native grasses are little bluestem, sand bluestem, needleandthread, prairie sandreed, western wheatgrass, and blue grama.

DISTRIBUTION AND EXTENT: Central Nebraska, south-central South Dakota, and north-central Kansas. The soil is extensive.

MLRA OFFICE RESPONSIBLE: Bismarck, North Dakota

SERIES ESTABLISHED: Custer County, Nebraska, 1926.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon--the zone from 0 to 11 inches (the Ap and A horizons); cambic horizon--the zone from 11 to 29 inches (Bw horizon).

ADDITIONAL DATA: Laboratory data of an Anselmo soil, S-60-Nebr-21-1 is provided on pages 8 and 9 of the Soil Survey Investigation Report No. 5.

National Cooperative Soil Survey
U.S.A.

LOCATION BRIDGEPORT KS+CO NE SD

Established Series
Rev. DER-ELF
12/1999

BRIDGEPORT SERIES

The Bridgeport series consists of deep, well drained, moderately permeable soils that formed in calcareous alluvial sediments. These soils are on flood plains or low stream terraces.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Fluventic Haplustolls

TYPICAL PEDON: Bridgeport silt loam - in a pasture. (Colors are for dry soil unless otherwise stated.)

A--0 to 12 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; many fine roots; few worm casts; slight effervescence to within 4 inches of the surface; moderately alkaline; gradual smooth boundary. (10 to 20 inches thick)

AC--12 to 22 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky and weak fine granular structure; slightly hard, friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary. (0 to 15 inches thick)

C--22 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; hard, friable; few fine roots; few fine pores; stratified with thin lenses of sandy loam and with broader bands of darker colored silt loam in the lower part of the horizon; few threads and films of free carbonates; strong effervescence; moderately alkaline.

TYPE LOCATION: Ness County, Kansas; 2 miles south and 1/2 mile east of Ness City; 320 feet south and 2440 feet west of the northeast corner, sec. 8, T. 19 S., R. 23 W.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 10 to 35 inches. Depth to free carbonates in the form of films and threads or disseminated throughout the soil mass is 0 to 15 inches. Stratification at depths below the mollic epipedon is evidenced by thin layers that range in color and in clay and sand content.

The A horizon has hue of 10YR and 2.5Y, value of 3 to 5 and 2 or 3 moist, and chroma of 1 to 3. It commonly is silt loam, but the range includes silty clay loam, clay loam, loam, and fine sandy loam. It ranges from neutral to moderately alkaline.

The AC horizon has hue of 10YR, value of 5 or 6 and 4 or 5 moist, and chroma of 2 or 3. It commonly is silt loam, but range includes silty clay loam and loam. It is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR, value of 5 to 7 and 4 to 6 moist, and chroma of 1 or 4. Texture is loam, silt loam, or silty clay loam. It is mildly alkaline or moderately alkaline. Contrasting sandy or clayey strata, mottles, and/or buried soils are within a depth of 40 inches in some pedons. Some pedons have a Ck horizon.

COMPETING SERIES: These are the Grigston series in the same family and the Bridget, Cozad, Eltree, Hobbs, Hord, Humbarger, McCook, Muir, Roxbury, and Tobin series. Grigston soils lack free carbonates within a depth of 15 inches. Bridget soils have coarse-silty textures. Cozad soils have a regular decrease in organic matter. Eltree, Hord, Humbarger, Muir, Roxbury, and Tobin soils have a mollic epipedon greater than 20 inches thick. Hobbs soils lack a mollic epipedon and are thinly stratified. McCook soils have coarse-silty textures.

GEOGRAPHIC SETTING: Bridgeport soils are on flood plains and low terraces near stream channels. The slope gradient commonly is 0 to 1 percent, but the range is 0 to 6 percent. These soils formed in calcareous loamy alluvium. The mean annual temperature varies from 50 to 57 degrees F, and mean annual precipitation varies from 16 to 27 inches. Thornthwaite Annual PE Index ranges from 30 to 54.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Coly, Colby, Hord, Penden, Roxbury, Uly, and Ulysses soils. Hord and Roxbury soils are on stream terraces or bottom lands but are further from stream channels. Penden soils have fine-loamy textures and are on adjacent uplands. Coly, Colby, Uly, and Ulysses soils are on adjacent uplands and lack stratification.

DRAINAGE AND PERMEABILITY: Well drained. Medium or slow runoff. Moderate permeability. These soils rarely or commonly flood for short periods when streams overflow.

USE AND VEGETATION: Bridgeport soils are cropped to small grain, sorghum, corn, and forage legumes. A small acreage is in range. Native vegetation is mostly mid and tall grasses with a few deciduous trees along adjacent stream channels.

DISTRIBUTION AND EXTENT: Western and central Kansas, western Nebraska, southwestern South Dakota, and eastern Colorado. The series is extensive.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Morrill County, Nebraska, 1917.

REMARKS: Diagnostic horizons and features recognized in this pedon are: mollic epipedon - the zone from the surface to a depth of about 12 inches.

ADDITIONAL DATA: Engineering test data by the Kansas State Department of Transportation is available for samples taken near the type location.

National Cooperative Soil Survey
U.S.A.

LOCATION COLBY KS+CO MT NE SD WY

Established Series
Rev. SAG
01/2000

COLBY SERIES

The Colby series consists of very deep, well drained and somewhat excessively drained, moderately permeable soils formed in calcareous loess.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, calcareous, mesic Aridic Ustorthents

TYPICAL PEDON: Colby silt loam, grassland. (Colors are for dry soil unless otherwise stated.)

A--0 to 4 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak fine platy structure to a depth of 2 inches, weak fine granular structure below 2 inches; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary. (3 to 6 inches thick)

AC--4 to 8 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak fine granular structure; slightly hard, friable; strong effervescence; moderately alkaline; gradual smooth boundary. (0 to 9 inches thick)

C1--8 to 20 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; few fine roots and root channels; porous; few soft lime accumulations; violent effervescence; moderately alkaline; gradual wavy boundary. (10 to 30 inches thick)

C2--20 to 80 inches; very pale brown (10YR 7/3) silt loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; porous; violent effervescence; moderately alkaline.

TYPE LOCATION: Hamilton County, Kansas; about 2.5 miles north of Syracuse; 0.3 mile north of the southwest corner of sec. 30, T. 23 S., R. 40 W.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 3 to 12 inches. Typically these soils have free carbonates at the surface, but some pedons lack carbonates in the upper 6 inches. Calcium carbonate equivalent is less than 5 percent in the upper part of the profile.

The A horizon has color value of 5 to 7 and 3 to 5 moist, and chroma of 2 or 3. Horizons having value of less than 5.5 dry or 3.5 moist are less than 4 inches thick. The A horizon is silt loam, loam, silty clay loam, sandy loam or very fine sandy loam, and is mildly alkaline or moderately alkaline.

The AC and C horizons have hue of 2.5Y to 7.5YR, value of 5 to 8 and 4 to 6 moist, and chroma of 2 to 4. they are silt loam or loam and are slightly to strongly alkaline. Visible accumulation of carbonates in the C1 horizon occurs as films on ped faces or soft masses. It is not a calcic horizon, and the horizon is not regarded as definitive for the series.

COMPETING SERIES: These are the Bainville, Manvel, Minnequa, and Rocky Ford series. Bainville and Minnequa soils have paralithic contact within 40 inches. Manvel soils have more than 5 percent

calcium carbonate equivalent in the surface. Rocky Ford soils have a thick man-made Ap horizon.

GEOGRAPHIC SETTING: Colby soils are on nearly level to steep hills and plains. Slope gradients are commonly 3 to 15 percent but range from 0 to 60 percent. The soils formed in calcareous silty loess. Mean annual precipitation ranges from 13 to 20 inches, and mean annual temperature ranges from 45 to 55 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Keith, Richfield, and Ulysses soils, all of which have mollic epipedons. Keith and Richfield soils commonly are on the nearly level areas above the Colby. Ulysses soils are on gently sloping to strongly sloping areas above Colby soils.

DRAINAGE AND PERMEABILITY: Well drained to somewhat excessively drained. Runoff is low to very high. Permeability is moderate.

USE AND VEGETATION: Mostly in native range. The less sloping areas are cultivated to irrigated wheat and sorghum. Native vegetation is mostly short grasses.

DISTRIBUTION AND EXTENT: Western Kansas, eastern Colorado, western Nebraska, southwestern South Dakota, and eastern Montana in MLRA 64, 67, and 72. The series is extensive.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Reconnaissance Soil Survey of Western Kansas, 1910.

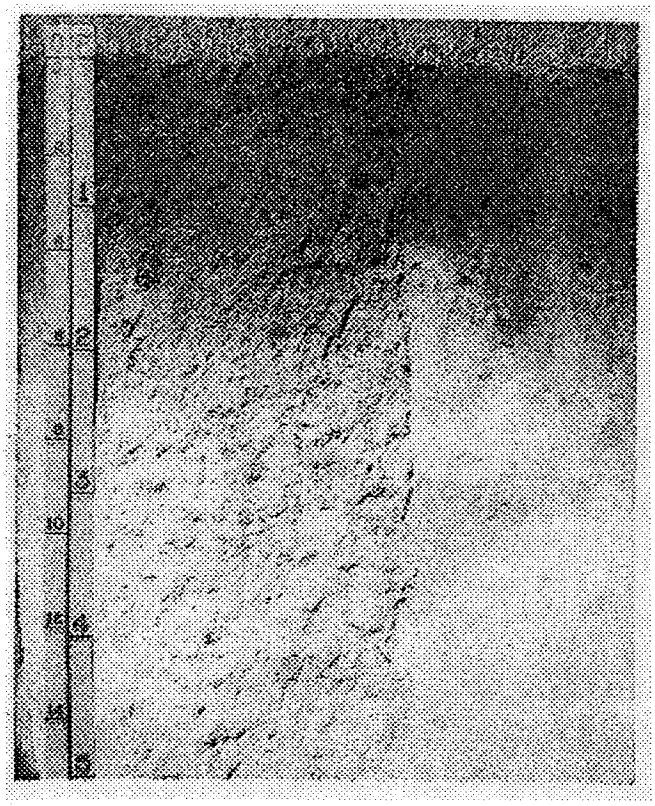
REMARKS: Colby soils were formerly classfied as Ustic Torriorthents. Diagnostic horizon recognized is ochric epipedon (A horizon)

National Cooperative Soil Survey
U.S.A.

LOCATION HOLDREGE NE+KS OK

Established Series
Rev. CWL, LGR
7/95

HOLDREGE SERIES



The Holdrege series consists of very deep, well drained, moderately permeable soils formed in calcareous loess. These upland soils have slopes ranging from 0 to 15 percent. Mean annual temperature is about 54 degrees F, and mean annual precipitation is about 23 inches at the type location.

TAXONOMIC CLASS: Fine-silty, mixed, mesic Typic Argiustolls

TYPICAL PEDON: Holdrege silt loam - on a 2 percent convex west-facing slope in a cultivated field. When described, the soil was moist throughout. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and very fine granular structure; soft, very friable; moderately acid, abrupt smooth boundary.

A--6 to 12 inches; dark grayish brown (10YR 4/2) light silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary. (Combined thickness of A horizon is 5 to 16 inches.)

Bt1--12 to 15 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable; shiny surfaces on most peds; neutral; clear smooth boundary.

Bt2--15 to 24 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; few thin discontinuous clay films in pores; shiny surfaces on most peds; neutral; clear smooth boundary. (Combined thickness of Bt horizons is 7 to 18 inches.)

BC--24 to 30 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable; slightly alkaline; gradual smooth boundary. (4 to 13 inches thick)

C--30 to 80 inches; very pale brown (10YR 7/4) silt loam, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable; violent effervescence; few soft white accumulations of carbonate and some cleavage planes coated with free carbonates; moderately alkaline.

TYPE LOCATION: Phelps County, Nebraska; two miles northwest of Holdrege; 325 feet north and 250 feet east of the southwest corner, sec. 25, T. 6 N., R. 19 W.

RANGE IN CHARACTERISTICS: The thickness of the solum and the depth to free carbonates typically is about 30 inches and ranges from 20 to 40 inches. The mollic epipedon ranges from 8 to 20 inches in thickness and includes the upper part of the argillic horizon in some pedons. The lower part of the solum contains free carbonates in some pedons.

The A horizon has hue of 10YR, value of 4 or 5 and 2 or 3 moist, and chroma of 2. It commonly is silt loam and less commonly very fine sandy loam, fine sandy loam or loam in the upper part and silt loam or light silty clay loam in the lower part. Some eroded Holdrege soils have silty clay loam Ap horizons. The A horizon ranges from neutral through moderately acid. A sandy overblown phase is recognized.

The Bt horizon has hue of 10YR, value of 4 through 7, and 3 through 5 moist, and chroma of 2 through 4, with the darker colors in the upper part. It is silty clay loam and averages between 28 and 35 percent clay; some pedons have thin subhorizons containing as much as 38 percent clay. It is neutral or slightly alkaline.

The BC horizon has hue of 10YR, value of 5 through 7 and 4 through 6 moist, and chroma of 2 through 4. It is silt loam, loam, or silty clay loam. It is neutral or slightly alkaline.

The C horizon has hue of 10YR or 2.5Y, value of 6 or 7 and 5 or 6 moist, and chroma of 2 through 4. It is silt loam or very fine sandy loam. It is slightly or moderately alkaline.

COMPETING SERIES: These are the Agar, Eakin, Fairlo, Highmore, Monticello, Northdale, and Paka series. Agar and Highmore soils typically contain free carbonates in the lower part of the solum and have mean annual soil temperatures of less than 50 degrees F. In addition, the Highmore soils are stratified in the lower part, having formed in silty glacial drift. Eakin soils contain free carbonates within a depth of 18 inches and in addition, are underlain by loamy till within a depth of 20 to 38 inches. Fairlo soils have clayey textures within a depth of 40 inches. Monticello and Northdale soils have redder hue. Paka soils have soft siltstone at a depth of 40 to 60 inches.

GEOGRAPHIC SETTING: Holdrege soils are on uplands with a plane or convex surface. Slope gradients are most commonly 0 to 4 percent and range from 0 to 15 percent. The soils formed in calcareous loess. The mean annual temperature ranges from 50 to 56 degrees F, and the mean annual precipitation ranges from 18 to 24 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Butler, Coly, Crete, Fillmore, Hall, Harney, Kenesaw, Scott and Uly soils. Butler soils are in slight depressions and have a fine textured argillic horizon. Coly soils lack a mollic epipedon and typically are on steep side slopes. Crete and Harney soils are on similar topographic positions but have fine textured argillic horizons. In addition, Crete soils have a thicker mollic epipedon. Fillmore and Scott soils are in shallow depressions within areas of Holdrege soils. Hall soils are in slightly lower areas and have a thicker mollic epipedon. Kenesaw soils lack an argillic horizon and have a coarse-silty control section. Uly soils lack an argillic horizon, are shallower to free carbonates and commonly are on steeper slopes below the Holdrege soils.

DRAINAGE AND PERMEABILITY: Well drained. Runoff is low to moderately high. Permeability is moderate.

USE AND VEGETATION: Almost all of the Holdrege soils are cultivated and much is irrigated. Sorghum and corn are the principal row crops. Wheat is the principal small grain. Native vegetation was mid and tall prairie grasses.

DISTRIBUTION AND EXTENT: South-central Nebraska and north central Kansas. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Phelps County, Nebraska, 1917.

ADDITIONAL DATA: The Holdrege pedon described in Soil Survey Investigations Report number 5, pp.. 72 to 75 is from the same general area as the typical pedon described here.

REMARKS: Severely eroded Holdrege soils will no longer classify as Mollisols and will need to be recorrelated to a new series. Diagnostic horizons and features recognized in this pedon are: mollic epipedon--the zone from 0 to 15 inches (Ap, a and Bt1 horizon); argillic horizon--the zone from 12 to 24 inche4s (Bt1 and Bt2 horizons) and typic-ustic moisture regime.

National Cooperative Soil Survey
U.S.A.

LOCATION KEITH NE+CO KS SD WY

Established Series
Rev. SLH/JWB
01/2000

KEITH SERIES

The Keith series consists of very deep, well drained, moderately permeable soils that formed in loess. These soils are on hills, plains, and stream terraces and have slopes ranging from 0 to 11 percent. Mean annual air temperature is 52 degrees F, and mean annual precipitation is 19 inches at the type location.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Aridic Argiustolls

TYPICAL PEDON: Keith silt loam, with a slope of 1 percent, in a cultivated field. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, friable; slightly acid; abrupt smooth boundary.

A--5 to 9 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; slightly acid; clear smooth boundary. (Combined A horizons is 6 to 20 inches thick.)

Bt1--9 to 14 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; slightly hard, friable; few thin patchy clay films; neutral; clear smooth boundary.

Bt2--14 to 23 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium and coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable; few thin patchy clay films; neutral; clear smooth boundary. (Combined Bt horizons is 8 to 18 inches thick.)

BC--23 to 33 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist, weak coarse subangular blocky structure; soft, very friable; violent effervescence; moderately alkaline; gradual smooth boundary. (0 to 18 inches thick)

C--33 to 60 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; soft, very friable; few accumulations and streaks of carbonate; strong effervescence; moderately alkaline.

TYPE LOCATION: Hitchcock County, Nebraska; 8 miles south and 5 miles west of Trenton; 1,100 feet south and 110 feet east of the northwest corner of sec. 13, T. 1 N., R. 34 W.

RANGE IN CHARACTERISTICS: The thickness of the solum ranges from 15 to 48 inches. The mollic epipedon includes the A horizon, and, in most cases, the upper part of the B horizon, and ranges from 7 to 20 inches in thickness. Depth to carbonates ranges between 15 and 38 inches. In the western and northern area of occurrence, Keith soils formed in less than 6 feet of loess.

The A horizon has hue of 10YR, value of 4 or 5 and 2 or 3 moist, and chroma of 1 to 3. It typically is silt loam and less commonly loam, very fine sandy loam, or fine sandy loam. It ranges from slightly acid to neutral.

The Bt1 horizon has hue of 10YR or 7.5YR, value of 4 or 5 and 2 through 4 moist, with chroma of 2 or 3. It is silt loam, silty clay loam, loam, or clay loam. It ranges from 20 to 35 percent clay. Reaction is neutral or slightly alkaline.

The Bt2 horizon has hue of 10YR or 7.5YR, value of 5 or 6 and 4 or 5 moist, with chroma of 2 or 3. Texture and reaction are similar to the Bt1 horizon. Reaction is neutral to slightly alkaline.

A Btk horizon is present in some pedons. It is silt loam, silty clay loam, loam or clay loam.

The BC or Bk horizon has hue of 10YR or 2.5Y, value of 5 through 7 and 3 through 6 moist, with chroma of 2 or 3. It typically is silt loam, ranging to include loam, very fine sandy loam, and silty clay loam. Reaction is slightly alkaline or moderately alkaline. Bk horizons have accumulations of secondary carbonates.

The C horizon has hue of 10YR or 2.5Y, value of 6 through 8 and 5 or 6 moist, and chroma of 2 or 4. It is typically silt loam, ranging to include loam or very fine sandy loam. Buried soils are below a depth of 40 inches in some pedons. Reaction is slightly alkaline or moderately alkaline in the upper part and strongly alkaline in the lower part. Some pedons have carbonate accumulation in the C horizon.

COMPETING SERIES: These are the Alliance, Beauvais, Cale, Kadoka, Norka, and Vale series in the same family and the closely related Agar, Eakin, Goshen, Highmore, Holdrege, Kuma, Richfield, Rosebud, Satanta, and Ulysses series. Alliance soils have substrata of soft, weathered sandstone or limestone. Beauvais and Norka soils have thinner sola and carbonates higher in the profile. Cale and Kadoka soils are moderately deep to residual siltstone. Vale soils have redder hue. Agar, Eakin, Highmore, and Holdrege soils have a wetter climate. In addition, Eakin soils formed in silty sediments over till and Highmore soils formed in silty glacial drift. Goshen and Kuma soils are pachic. Richfield soils are in the fine family. Satanta soils are fine-loamy. Rosebud soils are moderately deep over fine-grained sandstone or limestone and, in addition, are fine-loamy. Ulysses soils lack an argillic horizon and have carbonates nearer to the surface.

GEOGRAPHIC SETTING: Keith soils are nearly level to strongly sloping. They are on hills, plains, and stream terraces. Slope gradients typically are less than 6 percent and range from 0 to 11 percent. Keith soils formed in loess. The range of mean annual air temperature is from 46 to 55 degrees F, and the range of mean annual precipitation is from 14 to 20 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the competing Alliance, Goshen, Kuma, and Richfield soils, all of which are commonly lower than Keith soils, and the Colby, Creighton, Duroc, Tripp, and Ulysses soils. Colby soils lack a mollic epipedon, an argillic horizon, and are generally above Keith soils. Creighton soils are coarse-loamy, lack an argillic horizon, and are generally above Keith soils. Duroc soils are pachic, lack an argillic horizon, and are commonly in swales below Keith soils. Tripp and Ulysses soils lack an argillic horizon and are generally slightly higher than Keith soils.

DRAINAGE AND PERMEABILITY: Well drained. Runoff ranges from low on the nearly level slopes to high on moderately steep slopes. Permeability is moderate.

USE AND VEGETATION: About 80 percent of the acreage of these soils is in cultivated cropland and

20 percent is principally native range. The main crops under dryland farming are alfalfa, grain sorghum, millet, and winter wheat. The dominant grasses on native range are blue grama, buffalograss, little bluestem, needleandthread, threadleaf sedge, and western wheatgrass.

DISTRIBUTION AND EXTENT: Western Nebraska, northwestern Kansas, and southwestern South Dakota, eastern Wyoming, and northeastern Colorado in MLRA's 67 And 72. The acreage is of large extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Deuel County, Nebraska, 1921.

REMARKS: Additional information on Keith soils is available in "Soil Survey Laboratory Data and Descriptions for Some Soils of Nebraska," Soil Survey Investigation Report No. 5, pages 84 through 95. Diagnostic horizons and other features recognized in this pedon: mollic epipedon--the zone from 0 to 14 inches (Ap, A and Bt1 horizons); argillic horizon--the zone from 9 to 23 inches (Bt1 and Bt2 horizons) and aridic ustic moisture regime.

National Cooperative Soil Survey
U.S.A.

LOCATION KUMA CO+KS NE NM WY

Established Series
Rev. GB/JWB
9/97

KUMA SERIES

The Kuma series consists of very deep, well drained soils that formed in medium to moderately fine textured calcareous eolian deposits with an age discontinuity marked by a paleosol. Kuma soils are on upland flats and drainage ways have slopes of 0 to 8 percent. The mean annual precipitation is about 16 inches and the mean annual temperature is about 50 degrees F.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, mesic Pachic Argiustolls

TYPICAL PEDON: Kuma silt loam, cultivated (Colors are for dry soil unless otherwise noted.)

Ap--0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to fine granular; soft, very friable, slightly sticky, slightly plastic; neutral (pH 7.0); clear smooth boundary. (4 to 7 inches thick)

BA--5 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; few faint clay films on faces of peds and few faint clay films on the inside of some root channels and pores; neutral (pH 7.0); gradual smooth boundary. (4 to 6 inches thick)

Bt--10 to 20 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to medium subangular blocky; slightly hard, very friable, slightly sticky, slightly plastic; common faint clay films on faces of peds and clay films filling root channels and pores; neutral (pH 7.2); abrupt smooth boundary. (7 to 16 inches thick)

Btb--20 to 30 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; strong fine prismatic structure parting to fine subangular blocky; slightly hard, very friable, slightly sticky, slightly plastic; common distinct clay films on the faces of the peds and clay films filling root channels and pores; slightly alkaline (pH 7.4); clear smooth boundary. (0 to 12 inches thick)

Btkb1--30 to 45 inches; light yellowish brown (2.5Y 6/3) silt loam, olive brown (2.5Y 4/3) moist; moderate fine prismatic structure parting to fine subangular blocks; slightly hard, very friable, slightly sticky, slightly plastic; few faint clay films on the faces of peds and as fillings in root channels and pores; visible secondary calcium carbonate occurring mostly as concretions or as coatings on faces of peds; faces of peds are strongly effervescent but interiors are not effervescent; moderately alkaline (pH 8.2); clear smooth boundary. (5 to 16 inches thick)

Btkb2--45 to 50 inches; light yellowish brown (2.5Y 6/3) silt loam, olive brown (2.5Y 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; few faint clay films on faces of peds, few faint clay films in root channels and pores; visible secondary calcium carbonate in structural cracks and on faces of peds; peds are effervescent throughout; violently effervescent; moderately alkaline (pH 8.2); clear smooth boundary. (4 to 10 inches thick)

Bkb--50 to 60 inches; light yellowish brown (2.5Y 6/3) silt loam, olive brown (2.5Y 4/3) moist; massive; hard, very friable, slightly sticky, slightly plastic; secondary calcium carbonate occurring as soft masses, concretions and thin seams and streaks; violently effervescent; moderately alkaline (pH 8.2).

TYPE LOCATION: Washington County, Colorado; 2,140 feet west and 70 feet north of the SE corner of Sec. 1, T. 2 N., R. 52 W.

RANGE IN CHARACTERISTICS: Mean annual soil temperature ranges from 48 to 53 degrees F. The mollic epipedon ranges from 20 to 50 inches thick. Depth to uniformly calcareous material normally ranges from 10 to 40 inches. Depth to the base of the argillic horizon ranges from 27 to 60 inches or more. Depth to continuous subhorizons of visible secondary calcium carbonate and/or sulfate ranges from 20 to 40 inches. These soils have polygenetic solums in which a younger soil is superimposed and merges with a paleosol so that either or both of the following conditions occur. (1) Some subhorizon in the lower solum is at least 1/2 unit of value darker or 1/2 unit of chroma grayer than the overlying horizon accompanied by horizons of silicate clay accumulation in which visible secondary calcium carbonate has accumulated predominantly on the surfaces of the peds or in the structural cracks between peds. (2) Some subhorizon has solum more than 40 inches to the base of the argillic horizon accompanied by subhorizons of silicate clay accumulation in the lower solum having visible secondary calcium carbonate accumulation predominantly on the faces of the peds or in structural cracks between peds and with the interiors of at least some of the peds being noncalcareous. These soils are dry in all parts of the moisture control section for more than 1/2 the time soil temperature is 41 degrees F. or higher.

The A horizon has hue of 2.5Y through 7.5YR, value of 3 through 5 dry, 2 or 3 moist, and chroma of 1 through 3. It is slightly acid through slightly alkaline. It is silt loam, loam or very fine sandy loam.

The upper part of the Bt horizon has hue of 2.5Y through 7.5YR, value of 3 through 5 dry, 2 or 3 moist, and chroma of 1 through 3. It is typically loam, clay loam, silt loam or silty clay loam but clay ranges from 18 to 35 percent, silt from 35 to 70 percent and sand from 5 to 40 percent with less than 15 percent being fine or coarser sand. This horizon is neutral through moderately alkaline.

The Btb and Btkb horizons have hue of 5Y through 7.5YR, value of 4 through 7 dry, 2 through 6 moist, and chroma of 1 through 4. Subhorizons redder than 7.5YR occur in some pedons. The buried B horizons range from neutral to moderately alkaline. They have the same ranges of clay, silt, and sand as given for the Bt horizon above. Visible secondary carbonate usually occurs in some part and calcium carbonate equivalent ranges from 0 to about 14 percent. The Bk horizon has hue of 5Y through 7.5YR. Subhorizons redder than 7.5YR occur in some pedons. This horizon is typically loam, silt loam, or silty clay loam. Clay ranges from 10 to 35 percent, silt from 30 to 70 percent, and sand from 5 to 50 percent with less than 35 percent being fine or coarser sand. The C horizon is moderately or strongly alkaline. Calcium carbonate equivalent of the fine earth ranges from 1 to 14 percent.

COMPETING SERIES: These are the Goshen (NE), Hall (NE), Johnstown (NE), Mobridge (SD), and Simpatico (CO) series. Goshen and Mobridge soils lack a polygenetic profile involving soil horizons of different soil-forming periods. Hall soils lack a polygenetic solum and are moist in some part of the moisture control section more than 1/2 the time the soil temperature is 41 degrees F. or higher. Simpatico soils have moisture control sections that are dry for 15 consecutive days from May 15 to July 15 when the soil temperature is greater than 41 degrees F. Johnstown soils have sandy or sandy-skeletal material at depths of 40 to 60 inches.

GEOGRAPHIC SETTING: The Kuma soils are on upland flats and drainageways. Slopes typically

range from 0 to 8 percent. The soils formed in medium to moderately fine textured calcareous eolian deposits with an age discontinuity marked by a paleosol. At the type location the mean annual precipitation is 15 to 17 inches with peak periods of precipitation in the spring and early summer months. Mean annual temperature is 47 to 52 degrees F. and mean summer temperature is 72 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Keith and Rago soils. Keith soils have mollic epipedons less than 20 inches thick and lack polygenetic solums. Rago soils have argillic horizons with more than 35 percent clay.

DRAINAGE AND PERMEABILITY: Well drained; low to medium runoff; moderate permeability.

USE AND VEGETATION: Used for grazing or for dry or irrigated cropland. Native vegetation is blue grama, sage, cactus, and western wheat.

DISTRIBUTION AND EXTENT: Eastern Colorado and adjacent parts of Kansas, Nebraska, New Mexico and Wyoming. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Sedgwick County, Colorado, 1968.

REMARKS: Diagnostic features include a thickened mollic epipedon from 0 to 30 inches and an argillic horizon(s) with translocated clay from 5 to 45 inches. A buried soil surface and pedon is at 20 inches to 50 inches.

National Cooperative Soil Survey
U.S.A.

LOCATION MCCOOK NE+CO KS WY

Established Series
Rev. LGR
7/95

MCCOOK SERIES

The McCook series consists of very deep, well drained moderately permeable soils that formed in stratified, calcareous alluvium. These soils are on flood plains and have slopes that range from 0 to 3 percent. Mean annual temperature is 52 degrees F, and mean annual precipitation is 20 inches at the type location.

TAXONOMIC CLASS: Coarse-silty, mixed, mesic Fluventic Haplustolls

TYPICAL PEDON: McCook silt loam with a slope of less than 1 percent in a cultivated field. (Colors are for dry soil unless otherwise stated.)

Ap--0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; slight effervescence; slightly alkaline; abrupt smooth boundary.

A--6 to 15 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; soft, very friable; slight effervescence; slightly alkaline; abrupt smooth boundary. (Combined thickness of A horizons is 10 to 20 inches.)

AC--15 to 31 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium and fine granular; soft, very friable; strong effervescence; moderately alkaline; clear smooth boundary. (6 to 18 inches thick)

C1--31 to 38 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; fine stratification in upper part; strong effervescence; moderately alkaline; gradual smooth boundary. (5 to 20 inches thick)

C2--38 to 80 inches; light gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) moist; massive; soft, very friable; strong effervescence; moderately alkaline.

TYPE LOCATION: Red Willow County, Nebraska; 1 mile south and 3 miles west of McCook, Nebraska; 250 feet east and 100 feet south of the center, sec. 34, T. 3 N., R. 30 W.

RANGE IN CHARACTERISTICS: Thickness of the solum ranges from 16 to 33 inches, and thickness of the mollic epipedon ranges between 10 and 20 inches. Depth to free carbonates is less than 10 inches, and most pedons are calcareous at or near the surface. All horizons are slightly or moderately alkaline.

The A horizon has hue of 10YR, value of 4 or 5 and 2 or 3 moist, and chroma of 1 or 2. It typically is silt loam, but includes very fine sandy loam, loam, fine sandy loam, silty clay loam, and clay loam.

The AC and C horizons have hue of 10YR, value of 5 through 7, 4 through 6 moist, and chroma of 2 or 3 and strata with chroma of 1. These horizons are typically silt loam or very fine sandy loam but also

include loam. Buried soils or thin strata of slightly coarser or finer textured material are in the C horizon in most pedons. Sandy loam and coarser textures are below a depth of 40 inches in some areas.

COMPETING SERIES: These are the Cozad series in the same family and the closely related Blyburg, Bridgeport, Bridget, Cass, Eltree, Eudora, Hobbs, Hord, Munjor, and Roxbury series. Cozad soils have carbonates at depths of more than 10 inches. Blyburg and Eudora soils have a wetter climate, and Eudora soils are leached of free carbonates to depths greater than 20 inches. Bridgeport soils are fine-silty. Bridget soils have a regular decrease in organic carbon. Cass soils are coarse-loamy, and most pedons lack free carbonates in the solum. Eltree, Hord, and Roxbury soils are fine-silty and have a mollic epipedon thicker than 20 inches. In addition, the Hord soils are leached of free carbonates to a depth of 30 inches or more. Hobbs soils are fine-silty and lack a mollic epipedon. Munjor soils are coarse-loamy and lack a mollic epipedon.

GEOGRAPHIC SETTING: McCook soils are on flood plains. Slopes range from 0 to 3 percent. The soils formed in weakly stratified calcareous alluvium. The range of mean annual precipitation is 14 to 24 inches, and the range of mean annual temperature is 46 to 54 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Cozad, Eltree, Hord, Munjor, and Roxbury soils and the Gibbon, Glenberg, Haverson, Inavale, Las, Leshara, and Wann soils. Cozad, Eltree, Hord, and Munjor soils are higher in the landscape, and Roxbury soils are at the same level. Gibbon soils are fine-silty, are on lower elevations, and are somewhat poorly drained. Glenberg soils are coarse-loamy and are higher in the landscape. Haverson soils are fine-loamy and are lower in the landscape. Inavale soils are sandy and are lower in the landscape. Las and Leshara soils contain more clay, are wetter, and are lower in the landscape. Wann soils are coarse-loamy, are somewhat poorly drained, and are generally lower in the landscape.

DRAINAGE AND PERMEABILITY: Typically well drained. Moderately well drained and somewhat poorly drained phases are recognized on older surveys. Surface runoff is low. Permeability is moderate . These soils are rarely or occasionally flooded for brief duration. Depth to the seasonal high water table typically is below 6 feet.

USE AND VEGETATION: Most of the acreage of McCook soils is cultivated, and many areas are irrigated. Corn, grain sorghum, alfalfa, and winter wheat are the crops most commonly grown. Only a small acreage is still in native vegetation.

DISTRIBUTION AND EXTENT: South-central and western Nebraska, north-central and western Kansas, eastern Colorado, and possibly eastern Wyoming. The series is of large extent.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Red Willow County, Nebraska, 1965.

REMARKS: Physical and chemical data on the McCook typical pedon are available from the National Soil Survey Laboratory (sample numbers 71L915-71L917). Phases of McCook soils recognized to date are commonly flooded, rarely flooded, overwash, alkali, wet and sandy substratum. Diagnostic horizons and other features recognized in this pedon are: mollic epipedon--the zone from 0 to 15 inches (Ap and A horizon); irregular decrease in organic carbon from a depth of 25 to 125 cm; and ustic moisture regime.

LOCATION VALENTINE NE+KS MT NM SD TX WY

Established Series
Rev. CWL,LGR
5/96

VALENTINE SERIES

The Valentine series consists of very deep, excessively drained, rapidly permeable soils formed in eolian sands. These upland soils have slopes ranging from 0 to 60 percent. Mean annual temperature is about 51 degrees F, and mean annual precipitation is about 20 inches.

TAXONOMIC CLASS: Mixed, mesic Typic Ustipsamments

TYPICAL PEDON: Valentine fine sand - on an 8 percent convex northwest-facing slope in rangeland. When described the soil was moist throughout. (Colors are for dry soil unless otherwise stated.)

A--0 to 5 inches; grayish brown (10YR 5/2) fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure parting to single grained; loose; slightly acid; abrupt smooth boundary. (2 to 9 inches thick)

AC--5 to 9 inches; brown (10YR 5/3) fine sand, grayish brown (10YR 5/2) moist; weak, coarse prismatic structure parting to single grained; loose; slightly acid; clear smooth boundary. (0 to 8 inches thick)

C1--9 to 17 inches; pale brown (10YR 6/3) fine sand, pale brown (10YR 6/3) moist; weak coarse prismatic structure parting to single grained; loose; slightly acid; gradual smooth boundary. (0 to 12 inches thick)

C2--17 to 60 inches; very pale brown (10YR 7/3) fine sand, pale brown (10YR 6/3) moist, single grained, loose; neutral.

TYPE LOCATION: Logan County, Nebraska; about 12 1/2 miles north of Stapleton, Nebraska; 1060 feet north and 530 feet west of the center of sec. 36, T.20 N., R. 28 W.

RANGE IN CHARACTERISTICS: Texture of the profile typically is fine sand or loamy fine sand, but includes sand and loamy sand having less than 35 percent medium sand and less than 10 percent coarse or very coarse sand. The soil is moderately acid through neutral throughout the profile.

The A horizon has hue of 10YR, value of 4 through 6 and 3 through 5 moist, and chroma of 2 or 3.

Where present, the AC horizon has hue of 10YR, value of 5 through 7 and 4 through 6 moist, and chroma of 2 or 3.

The C horizon has hue of 10YR, value of 6 or 7 and 5 or 6 moist, and chroma of 2 through 4. In some pedons, dark colored loamy textured strata ranging from 1/8 to 2 inches in thickness are below depths of 20 inches. When Valentine soils are associated with clayey soils, clayey substratum phases are recognized at 40 to 80 inches.

COMPETING SERIES: These are the Duda, McKelvie, Peji, Roysa, Simeon, and Tonalea series in the same family. Duda Peji and Tonalea soils have sandstone at depths between 20 and 40 inches. McKelvie soils have sandstone fragments in their sola. Royosa soils have drier climate with less than 16 inches mean annual precipitation. Simeon soils have a control section of loamy coarse sand, loamy sand, sand or coarse sand and it contains more than 35 percent medium and coarse sand and less than 50 percent fine or very fine sand, and up to 15 percent by volume of gravel.

GEOGRAPHIC SETTING: Valentine soils are on nearly level to slightly hummocky to steep, hilly uplands. Slope gradient ranges from 0 to 60 percent. Relief ranges from 1 to over 100 feet. Soils formed in eolian sands. The mean temperature ranges from 45 to 57 degrees F, and mean annual precipitation ranges from about 18 to 24 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Duda and Simeon soils and the Doger, Dunday, Els, Elsmere, Gannett, Hersh, Loup, Ord, Ovina, and Tryon soils. Duda soils occur below Valentine soils. Simeon soils occur on nearly level to steep slopes below areas of Valentine soils. Doger and Dunday soils have mollic epipedons and occur on nearly level to strongly sloping areas below Valentine. The somewhat poorly drained Els, Elsmere, Ord, Ovina, and the poorly or very poorly drained Gannett, Loup, and Tryon soils occur in sandhill valleys and along bottom lands. Hersh soils have a coarse-loamy control section and occur below areas of Valentine.

DRAINAGE AND PERMEABILITY: Excessively drained. Runoff is very low to high depending on slope. Permeability is rapid.

USE AND VEGETATION: These soils are dominantly in native grass and used for grazing or hay. The main grasses are prairie sandreed, little bluestem, sand bluestem, switchgrass, sand lovegrass, needleandthread, blue grama and hairy grama. Some of these soils have been cultivated but unless irrigated, have been returned to grass.

DISTRIBUTION AND EXTENT: Principally north-central Nebraska, but also extending into South Dakota and Kansas. The series is of large extent. Estimated acreage is over 5,000,000 acres.

MLRA OFFICE RESPONSIBLE: Salina, Kansas

SERIES ESTABLISHED: Reconnaissance Survey of Western Nebraska, 1911.

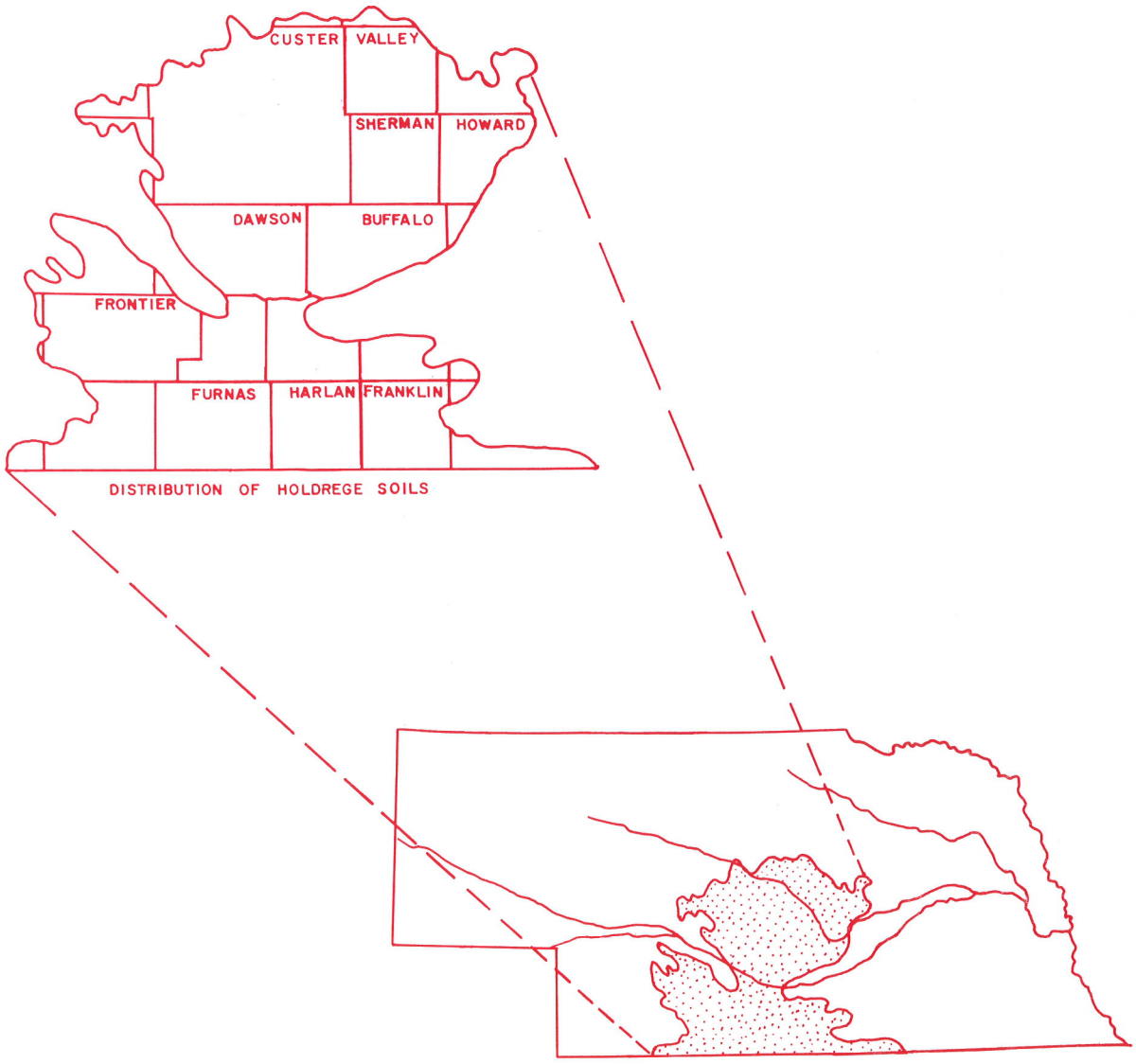
REMARKS: The Valentine soils were classified as Regosols in the former system. Diagnostic horizons and features recognized in this pedon are: ochric epipedon-- the zone from 0 to 5 inches (A horizon).

ADDITIONAL DATA: Samples No. S54-Neb-16-1 and 2; MSL No. 2440-2444 and 2445-2449, as published in Soil Survey Investigations No. 5.

National Cooperative Soil Survey
U.S.A.

HOLDREGE

NEBRASKA STATE SOIL



DISTRIBUTION OF HOLDREGE SOILS

Sponsored by

Nebraska Society of

Professional Soil Scientists

and

Farmland Industries Inc.

Winter wheat near harvest stage on Holdrege soil.

Holdrege Nebraska's State Soil

In 1979, the Nebraska Legislature found that designating one soil, representing the soil resource of the state, would benefit the people of the state. The Holdrege soil selected take its place with the goldenrod, the meadow lark, and the cottonwood as representatives of one of our very important natural resources.

Soils in the Holdrege series are recognized by features of their "profile" (created by horizontal layers) that are the result of the prairie environment. They are suggestive of soils formed under mixed grasses, in a climate where moisture stress is common, but where enough movement of water through the profile has resulted in downward movement of clays and lime. These processes have led to a soil with a thick, dark colored topsoil, a clay enriched subsoil and a substratum that contains free lime. Holdrege soils are among the most extensively cultivated soils in the state. Presently, nearly all Holdrege soils are cultivated. A very large part is irrigated. Corn and grain sorghum are the principal row crops. Winter wheat is the most commonly grown small grain. Their natural fertility, desirable tilth, and the landscape on which they exist join with irrigation water and the skillful management of Nebraska farms to provide a valuable agricultural resource.

Table 1: Some features of the Holdrege soils.

Slope	— 0-3% (for 75% of their area); range 0-11%
Intake rate of water	— moderately low
Permeability	— moderate (0.6-2.0 in/hr.)
Soil reaction	— medium to slightly acid (surface layer)
	— neutral (subsoil)
	— moderately alkaline (underlying material)
Capability class	— I-IV, depending on irrigation and slope
Erosion hazard	— slight 0-3% slopes moderate 3-6% slopes severe 6-11% slopes
Uses	— irrigated row crops (corn), dryland wheat and sorghum, some native rangeland
Predicted Yields[1], corn	— 150 bu/A, irrigated, 0-1% slopes 28 bu/A, dryland 3-6% slopes
Wheat	— 40 bu/A dryland, 0-1% slopes 30 bu/A, 3-6% slopes
grain sorghum	— 130 bu/A irrigated, 0-1% slopes 40 bu/A dryland, 3-6% slopes

Holdrege soils exist on 1.8 million acres (.72 million ha) of landscape in central Nebraska. They were initially separated from other soils during soil surveys of Phelps County in 1917. A good example of a Holdrege soil profile can be seen 325 feet north and 250 feet east of the southwest corner, sec. 25, T. 6 N., R. 19W., 6th principal meridian.

Holdrege soils are well drained, but will hold between 10 and 11 inches (25.4-28 cm) of water available to the plants within a 5 foot (150 cm) depth. Some additional statistics about them are presented in Table 1.

The chemical properties of Holdrege soils (Table 2) are those of a soil that formed under grasses in a climate where dryness is a fact of life that cannot be ignored. The lack of acidity in the soil accompanied by a limey subsoil and a relatively high amount of organic matter (around 3 percent under native grass) in the top soil attest to a low amount of leaching, to a recyling of basic elements by grass roots, and to a high level of native fertility.

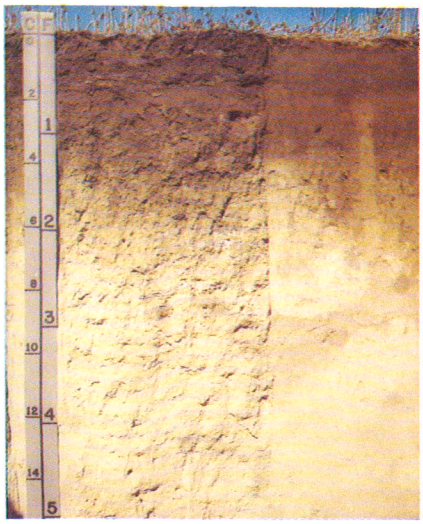
Sand content is quite low, as is expected of soils formed in loess (Table 3). Nearly all of the sand that exists is very fine sand and since silt is the major component of the mineral part, Holdrege soils are silty. Even so, clay content is high enough to bring about a high water and available nutrient holding capacity.

Because of properties that reflect the conditions under which they formed, Holdrege soils are in the Mollisol Soil Order. Mollisols are mostly soils of the grasslands. They are rich in basic elements, such as calcium, magnesium and potassium. Their family name is fine-silty, mixed, mesic Typic Argiustolls. "Fine-Silty" indicates that the subsoil is between 18 and 35 percent clay with less than 15 percent sand. The term "mixed" suggests that no one kind of mineral is most important in their mineral part. "Mesic" refers to an average annual soil temperature of between 8° and 15°C (46-52°F.)

Earlier classifications of soils in the United States referred to Holdrege soils as Pedocals and Chernozems. Such soils are typical throughout the world on the vast steppe regions. Here, before irrigation, nearly all cultivated land was used to grow wheat and stretched to the horizons. Before that, prairie supported buffalo and countless other wild creatures. The Holdrege soil profile is the result of that environment. The landscape is the result of geologic process operating over tens of thousands or more years. This is a soil of which we can be proud. It is one for which we must care, for it and other like it must sustain our agriculture — and our culture — for uncounted generations to come.

Brochure available from Nebraska Society of Professional Soil Scientists, 228 Keim Hall, University of Nebraska, Lincoln, Nebraska 68583; or the Soil Conservation Service Federal Building, Room 345, Box 82502, Lincoln, Nebraska 68501.

Brochure prepared by Nebraska Society of Professional Soil Scientists and printing courtesy of COOP Farmland Industries, Inc.



Holdrege soil profile. Note the dark color and thickness of the surface layer (mollic epipedon), and the presence of lime (light spots) in the subsoil. Soil photograph by Andrew R. Aandahl, and landscape photograph by Prof. David Lewis, used with their permission.

Table 2: Some chemical properties of the Holdrege soils[1].

Horizon	Depth Inches	pH	Organic C Carbon[2]	C.E.C.	Extractable Cations Ca	Mg	Na	K	Base Sat.
			%						%
Ap	0-7	6.6	1.7	19.5	11.7	3.9	0.1	1.8	90
A	7-13	7.1	1.3	24.0	17.0	5.2	0.1	1.0	97
Bt1	13-16	6.8	0.9	25.1	17.3	6.5	0.1	1.0	99
Bt2	16-24	7.1	0.5	24.5	16.5	6.8	0.1	1.2	100
Bt3	24-30	7.7	0.3	22.7	17.1	6.6	0.1	1.4	100
BC	30-34	8.5	0.2	21.8	Calc	Calc	0.2	1.5	Calc
BCk	34-42	8.6	0.2	20.0	Calc	Calc	0.2	1.7	Calc
Ck	42-60	8.8	0.1	19.8	Calc	Calc	0.3	2.1	Calc

[1]From Soil Survey Staff. 1966. Soil Survey Laboratory Data and Descriptions for some soils of Nebraska. Soil Survey Investigations Report #5, S.C.S., U.S.D.A.

[2]O.C. × 1.728 = % organic matter

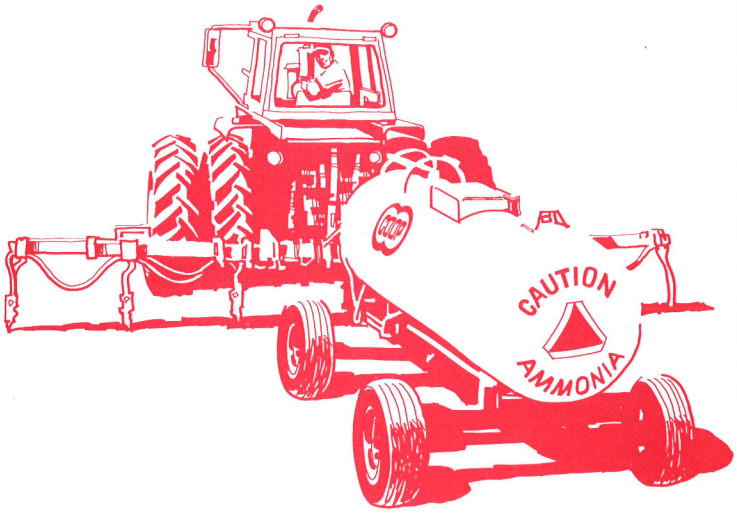
Table 3: Some physical properties of the Holdrege Soil.

Horizon	Depth Inches	Sand	Silt	Clay	Textural Class	available water capacity	water held at 15 A[3]
			---------%---------			In/in	%
AP	0- 7	16.6	61.4	22.0	sil[1]	0.22-0.24	9.9
A	7-13	12.0	58.4	29.6	sicl[2]	0.18-0.20	13.5
Bt1	13-16	13.3	55.3	31.4	sicl	0.18-0.20	14.4
Bt2	16-24	11.2	58.9	29.9	sicl	0.18-0.20	13.5
Bt3	24-30	13.1	62.1	24.8	sil	0.20-0.22	11.8
BC	30-34	14.9	64.3	20.8	sil	0.20-0.22	11.0
BCk	34-42	16.2	65.1	18.7	sil	0.20-0.22	10.3
Ck	42-60	16.8	64.5	18.7	sil	0.20-0.22	9.8

[1]sil = silt loam

[2]sicl = silty clay loam

[3]Water held at 15 atmosphere of tension. This means that a force 15 times that of the atmosphere is required to remove the water. This is the "permanent wilting point", or point where most plants cannot get water. It is used as the lower boundary of available water, and is governed by the clay and organic matter content in Holdrege soils.



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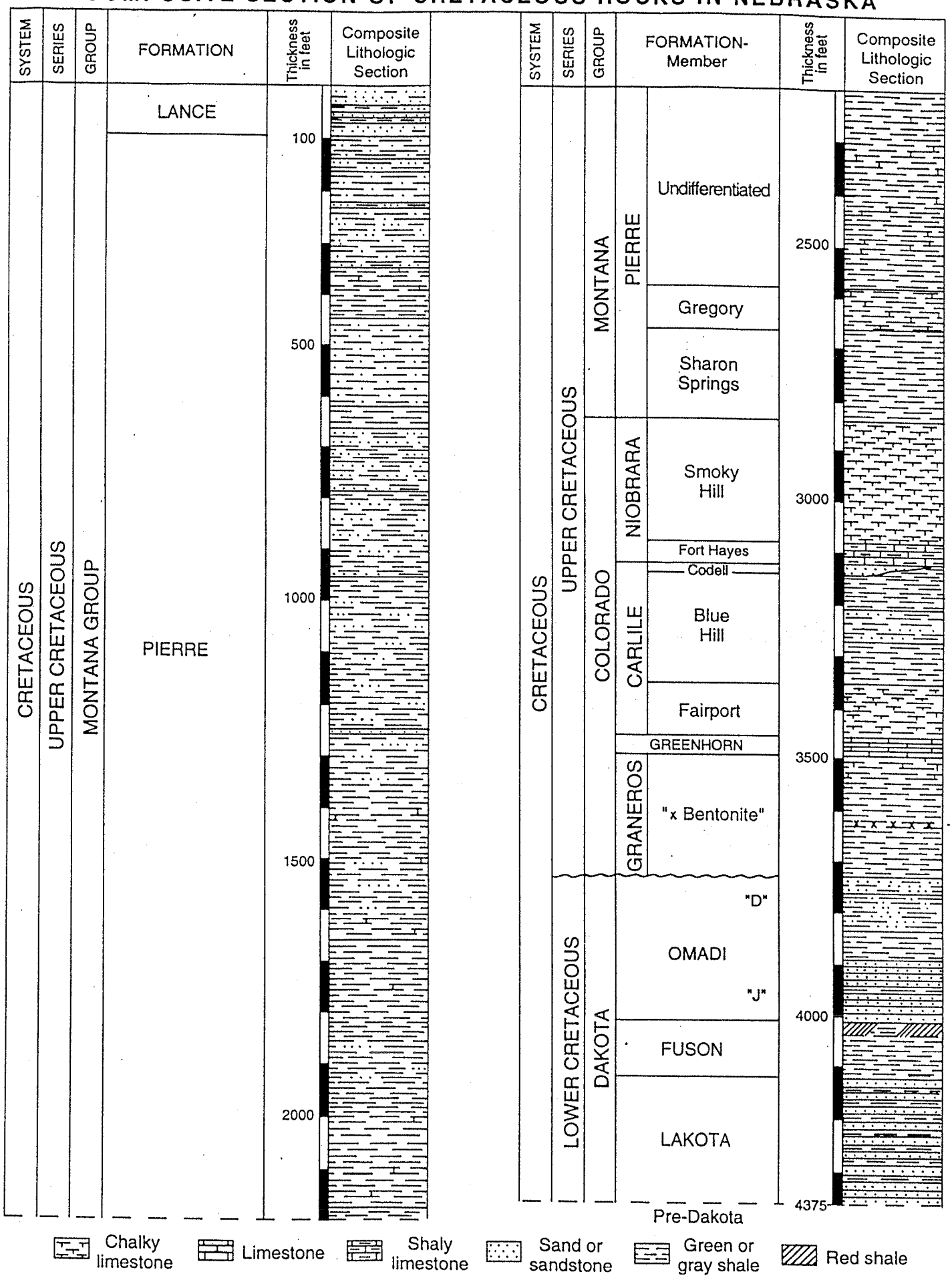
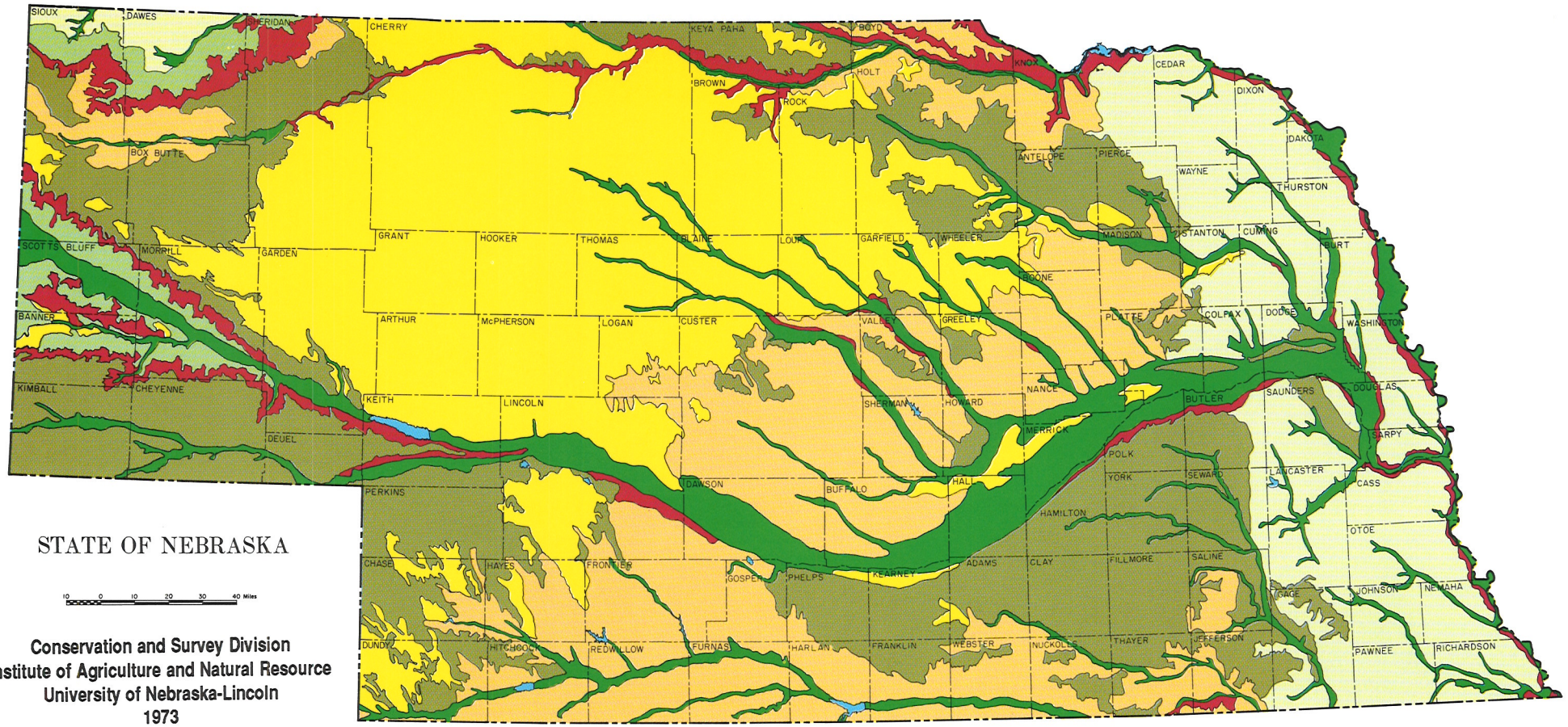
COMPOSITE SECTION OF CRETACEOUS ROCKS IN NEBRASKA



Raymond R. Burchett
Nebraska Geological Survey
Conservation and Survey Division
IANR, UNL-Lincoln 68588-0517

TOPOGRAPHIC REGIONS MAP



STATE OF NEBRASKA

10 0 10 20 30 40 Miles

Conservation and Survey Division
Institute of Agriculture and Natural Resource
University of Nebraska-Lincoln
1973

EXPLANATION

Valleys—flat-lying land along the major streams. The materials of the valleys are stream-deposited silt, clay, sand, and gravel.

Large Reservoirs—constructed for purposes such as water storage for irrigation, generation of electricity, flood control, or recreation.

Dissected Plains—hilly land with moderate to steep slopes, sharp ridge crests, and remnants of the old, nearly level plain. The Dissected Plains are old plains eroded by water and wind.

Rolling Hills—hilly land with moderate to steep slopes and rounded ridge crests. In eastern Nebraska, the Rolling Hills are mostly glacial till that has been eroded and mantled by loess, while in northwestern Nebraska the hills were produced by the erosion of clay and clay-shale beds.

Valley-Side Slopes—moderately sloping land which occurs between the escarpments and the major stream valleys in western Nebraska. These areas are mostly siltstone bedrock covered by a few feet to a few tens of feet of sand, gravel, or silt.

Plains—flat-lying land which lies above the valley. The materials of the plains are sandstone or stream-deposited silt, clay, sand, and gravel overlain by wind-deposited silt (loess).

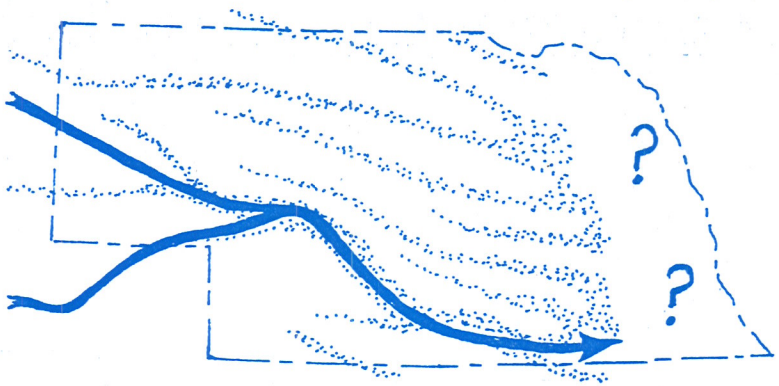
Sand Hills—hilly land composed of low to high dunes of sand stabilized by a grass cover. The sand dunes mantle stream-deposited silt, sand and gravel, and sandstone.

Bluffs and Escarpments—rugged land with very steep and irregular slopes. Bedrock materials, such as sandstone, shale, and limestone, are often exposed in these areas.

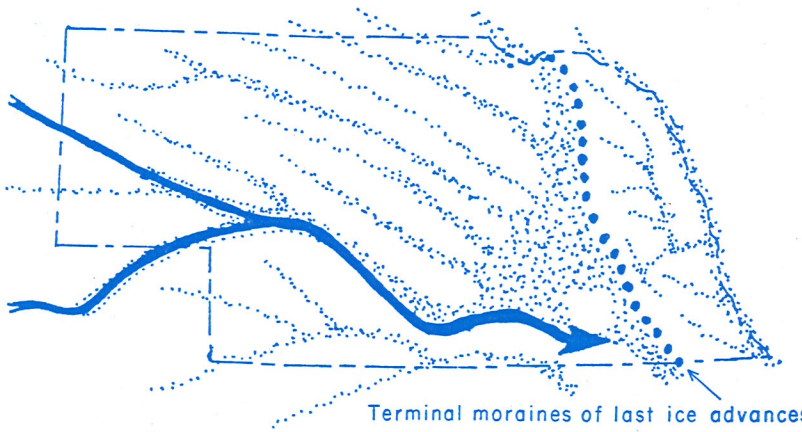
POSTULATED EVOLUTION OF PLATTE RIVER AND RELATED DRAINAGES

1. Late Pliocene (~2,500,000 yrs ago)

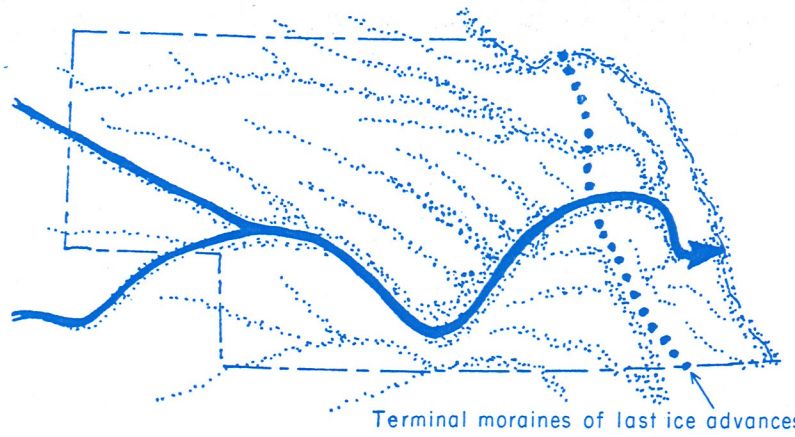
2. Early Pleistocene (~1,500,000 yrs ago)



3. Illinoian (~200,000 yrs ago)



4. Late Wisconsin (~30,000 yrs ago)

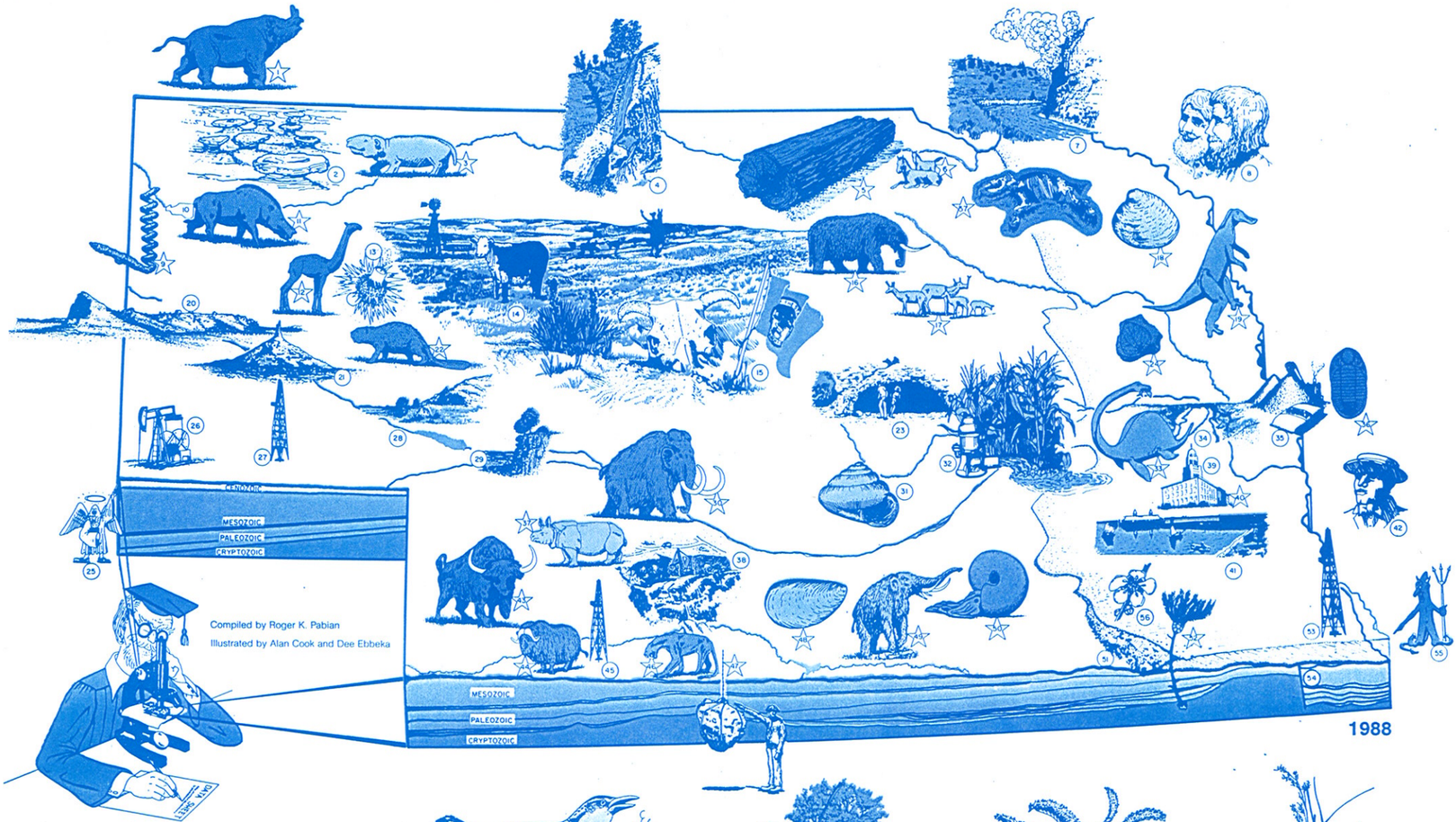


Sketch maps of Nebraska indicating postulated drainage patterns when there was no glacial ice in eastern Nebraska. Solid lines show main ancestral Platte drainage. Stippled pattern indicates probable areas of fluvial deposition for a relatively large period of time before and after the suggested dates. Maps compiled from published and work-copy maps and geologic sections by V.L. Souders, J.B. Swinehart, and V.H. Dreeszen of the Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

September 1990

IANR

RESOURCEFUL SCENES FROM PAST AND PRESENT



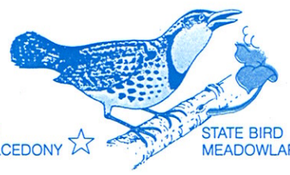
STATE SOIL
HOLDREGE SOILS

STATE INSECT
HONEYBEE

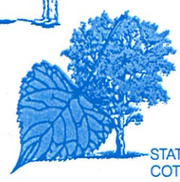
STATE FOSSIL
MAMMOTH (no. 30) ☆

STATE ROCK
PRAIRIE AGATE ☆

STATE GEM
BLUE CHALCEDONY ☆



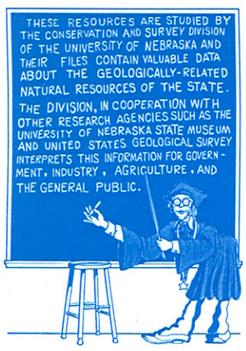
STATE BIRD
MEADOWLARK ☆

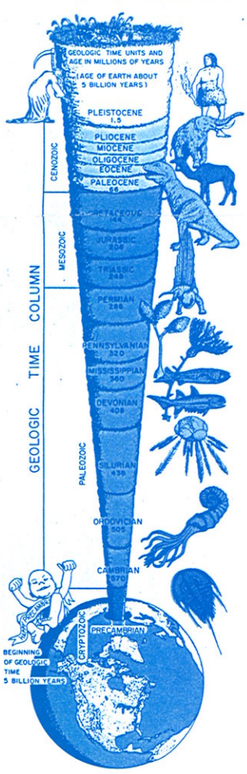


STATE TREE
COTTONWOOD ☆

STATE FLOWER
GOLDENROD ☆

STATE GRASS
LITTLE BLUESTEM





1. Titanotheres such as *Brontops* roamed western Nebraska during Oligocene time. Titanotheres stood as tall as 6 feet; however, their brains were only as large as a fist.

2. Toadstool Park, Sioux County. Erosion has carved these interesting badland features from a series of bedded sandstones and clays. The resistant sandstones formed the "toadstool" caps and the less resistant clays formed the pedestals. The rocks are of Oligocene age.

3. Oreodonts were perhaps the most abundant mammals ever to have roamed Nebraska. They appeared in Oligocene time and died out in Pliocene time. They resembled modern sheep or pigs and ranged in height from less than a foot to more than 3 feet.

4. Several scenic waterfalls are to be seen in Cherry County. Water cascades over resistant beds of sandstone and siltstone of Tertiary age in a number of tributary valleys of the Niobrara River valley.

5. Opalized wood is found in Miocene rocks of Cherry, Boyd, Keya Paha, and Brown counties. Large logs weighing several tons each have been found. Various kinds of petrified wood are found throughout Nebraska.

6. Fossil horses such as *Hipparion* have been found in Miocene rocks in Cherry, Boyd, Keya Paha, and Brown counties.

7. The "Ionia Volcano" along the Missouri River bluffs in Dixon County is presumed to have resulted from the oxidation of iron sulfides in the Cretaceous-age Carlile Shale, producing sufficient heat to cause condensation of moisture in the air.

8. Meek and Hayden led some of the early geological expeditions in Nebraska. They described and named many fossils and rock units, including the Cretaceous-age Dakota Group for Dakota County, Nebraska.

9. Devil's corkscrews, or "Daemonelices," are casts of burrows of a primitive beaver, *Paleocastor,* that lived in western Nebraska during early Miocene time. Some burrows contain the fossil skeleton of the beaver.

10. Agate Springs National Monument in Sioux County is known throughout the world for its abundant early Miocene fossils. The two best known fossil quarries, Carnegie Hill and University Hill, are in limy sandstones deposited in the channel of an ancient river.

11. *Dinohyus,* a large fossil hog, lived in Nebraska during early Miocene time. The largest known specimen was collected in Sioux County, Nebraska.

12. The world's largest fossil camel, *Gigantocamelus,* has been collected from Pliocene rocks near Lisco in Garden County.

13. Potash, an essential component of many explosives and fireworks, was produced from briny Sand Hills lakes in Garden and Sheridan counties between 1912 and 1921 until discovery of more commercially feasible deposits in other areas.

14. Where bison once teemed over the vast Sand Hills, cattle now graze on the luxuriant grasses stabilizing the dunes and growing in the wet meadows.

15. The geographic center of Nebraska is situated between Merna and Anselmo, Custer County.

16. The mastodont *Eubelodon* roamed Brown County during late Miocene time.

17. Small fossil antelope such as *Cosoryx* were plentiful in Cherry, Rock, and Brown counties during Miocene time.

18. During the last advance of Cretaceous seas, rocks were deposited containing clams such as *Cyrena,* the fossils of which have been collected in Dakota County.

19. The largest dinosaur remains discovered to date in Nebraska consist of a part of a femur of a trachodont (duck-billed dinosaur) found in the Cretaceous-age Dakota Group near Tekamah, Burt County.

20. Scotts Bluff, a prominent erosional feature composed of the Miocene- and Oligocene-age rocks of the Arikaree and White River groups, was a landmark for pioneer travelers on the Mormon and Oregon trails and for Pony Express riders.

21. Chimney Rock, Morrill County, was also a landmark to the westward-moving pioneers. It is an erosional feature composed of Oligocene rocks of the Gering Formation overlying the Brule Formation.

22. The remains of the large fossil beaver, *Castoroides,* have been collected from Pleistocene rocks in Sheridan County.

23. Chalk Mine State Wayside Area is now a favorite picnic spot in Greeley County. Chalk was once mined here from rocks of the Miocene-age Ogallala Group.

24. Fossil leaf imprints are abundant in sandstones and shales in the Cretaceous-age Dakota Group. The presence of many subtropical species indicates that the climate of ancient Nebraska was very different from the climate of our time.

25. The highest point in Nebraska, 5,424 feet above sea level, is in southwestern Kimball County.

26. The deepest hole drilled in Nebraska is in northwestern Kimball County. Drilled in 1979, it is 9,971 feet deep. In addition, some of Nebraska's deepest producing oil wells are located in Kimball County. Petroleum is an important industry in the southern part of Nebraska's Panhandle. Oil and gas are produced from sandstones of Late Cretaceous age and limestones of Early Permian and Middle to Late Pennsylvanian age.

27. The first producing oil well in Nebraska's Panhandle, Mary Egging No. 1 in Cheyenne County, was drilled in 1949.

28. Ash Hollow was the site where the pioneers on the Oregon Trail lowered their covered wagons from the uplands to the North Platte River valley. Archeological excavations show that some of the earliest Indians in the region inhabited this area.

29. A geologically important section of Miocene rocks is exposed at Cedar Point on the south side of Lake McConaughy, Nebraska's largest lake.

30. Remains of the largest known fossil elephant, *Mammuthus (Archidiskodon),* were collected from Pleistocene sediments near Brady in Lincoln County.

31. Fossil Pleistocene land snails are commonly found in loess deposits in most counties in central and eastern Nebraska.

32. Abundant groundwater has made it possible to irrigate much of the fertile soils of Nebraska. Many large, irrigated farms are seen along Interstate 80 in central Nebraska.

33. A plesiosaur collected near Valparaiso in Saunders County has the longest neck of any creature known to have inhabited the earth. The skeleton was collected by members of the Lincoln Gem and Mineral Club, whose work was supervised by personnel of the University of Nebraska State Museum.

34. Todd Valley, a broad terrace-plain feature in Saunders County, marks the course of a late Pleistocene river. It provides geologists with a classic example of the concept of stream piracy.

35. Limestone is an important product in Sarpy, Cass and Washington counties. The many quarries in this area serve as a nucleus of a large agricultural-lime, cement, building-stone, and road-aggregate industry.

36. Some of the "last of the trilobites," such as *Ditomopyge,* crawled over the bottoms of the Pennsylvanian and Permian seas that covered Nebraska.

37. Rhinoceros such as *Aphelops* once roamed much of Nebraska. Their remains are found in Miocene rocks in Frontier and Hayes counties.

38. The world's largest open-pit silica (volcanic ash) mine, now inactive, is in Pleistocene deposits in northeastern Frontier County.

39. The State Capitol in Lincoln is decorated with fine stone from all over the world. The mosaics and tiles should be seen by all lapidary students.

40. Some of the world's finest collections of vertebrate and invertebrate fossils and rocks and minerals are maintained by the University of Nebraska State Museum. The museum is best known for Elephant Hall, which has on display the world's most inclusive collection of fossil elephants.

41. Nebraska's Salt Lake at Lincoln is filled with salt water that has its source in sandstones of the Cretaceous-age Dakota Group. Salt was scraped from natural crusts and brine was evaporated from salt springs. Hopes for a salt-extraction industry led to the original settlement of Lincoln, but the industry never developed beyond its infancy. Nebraska's Salt Lake was once a popular resort known as Burlington Beach, later an amusement park area known as Capitol Beach, and now a housing development of that name.

42. Jules Marcoux, a French explorer, made the first geologic map of North America under the direction of Secretary of Interior Jefferson Davis (later president of the Confederate States of America). Marcoux did much of his better known work describing Pennsylvanian rocks near Nebraska City.

43. Large herds of bison roamed most of Nebraska in Pleistocene time. *Bison* is a common fossil; its remains are sometimes associated with artifacts made by Indians of the Folsom culture.

44. Musk-oxen are now restricted to the polar areas of the world. The presence of the fossil musk ox *Symbos* in Red Willow County tells of the harsh Pleistocene climate in Nebraska.

45. The first significant producing oil well in southwestern Nebraska, Barger No. 1, was drilled in Red Willow County in 1956 and opened this area to some of Nebraska's largest producing oil fields.

46. Saber-tooth tigers were among the large predators to have lived in Frontier and Red Willow counties during the Pleistocene age.

47. The largest recovered meteorite in the world to have been seen falling was collected near Beaver City, Furnas County, on February 18, 1948.

48. Fossils of the Cretaceous clam *Inoceramus* are abundant in exposures of the Niobrara Chalk in Harlan County.

49. A very well-preserved fossil four-tusked mastodont, *Trilophodon,* was collected from Miocene rocks near Red Cloud, Webster County.

50. Ammonites such as *Clioscaphites* swam through the Cretaceous seas of Nebraska. Their fossil shells are found in the Niobrara Chalk in south-central Nebraska.

51. The western boundary of Ice Age glacial deposits passes through eastern Nebraska. These deposits contain igneous and metamorphic rocks that were transported into Nebraska by the glaciers from as far north as Hudson Bay.

52. Some of the last primitive kinds of crinoids lived in the Permian seas of eastern Nebraska. Specimens of *Nebraskacrinus* have been collected near Odell in Gage County.

53. Nebraska's first producing oil well, the Bucholz well, was drilled in Richardson County in 1940. It produced oil from Devonian rocks in sufficient quantity to win the $15,000 bonus offered by the state for the first commercial oil well in Nebraska.

54. The down-dropped rocks along the Humboldt Fault mark the eastern flank of the Nemaha Ridge in southeastern Nebraska. These subsurface features record a period of mountain building in Nebraska's geologic past.

55. The lowest point in Nebraska, 840 feet above sea level, is in Richardson County.

56. Some the world's oldest fossil flowers have been found in shales of the Cretaceous-age Dakota Group in Jefferson County.

57. Numerous articulated skeletons of Miocene rhinoceroses, including babies and pregnant females, have been found at Ash Fall State Park near Royal in Antelope County. This is a world-class discovery of fossil mammal remains.

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Stars designate items on display at the University of Nebraska State Museum, Lincoln.

Conservation and Survey Division
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University of Nebraska–Lincoln

SOILS