Rain Water Basin Soils – Development, Morphology, and sedimentation tactics

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1) Vocabulary and

2) Fundamentals…

1) Soil Forming Factors
2) Soil Properties
3) Soil Morphology
4) Soil Horizons
5) Rain Water Basin Geomorphology

1. Soil Forming Factors

- **Soil = *F* (Cl, O, R, P, T, …)**

Hans Jenny, 1941

Climate: Precipitation & Temperature

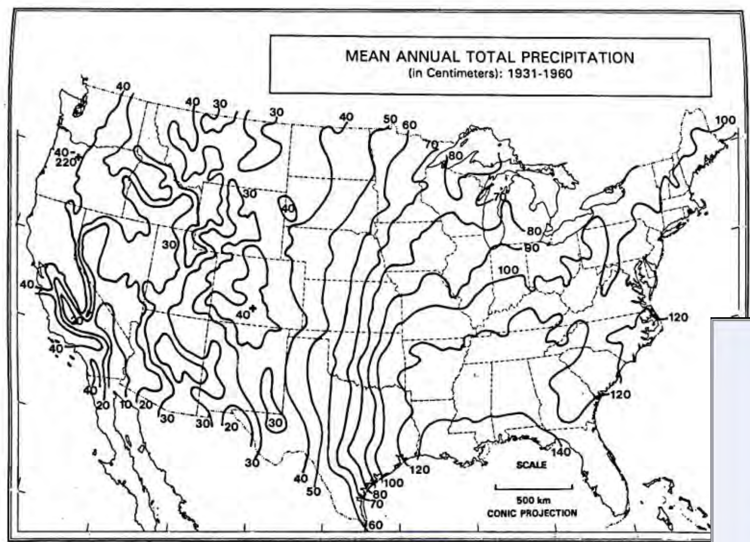
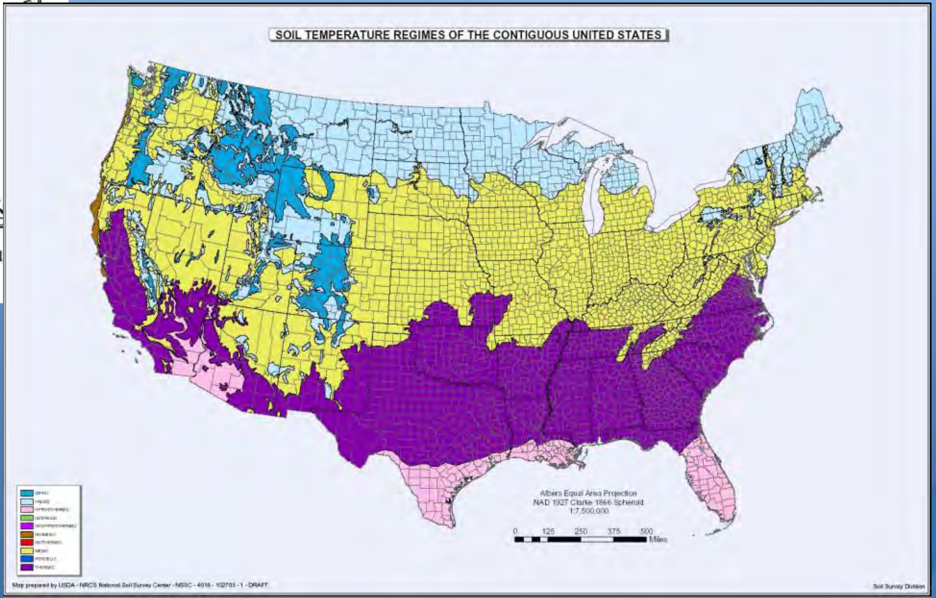


Figure 4.3. Mean annual total precipitation, illustrating the gradient of moisture from lower in the western Great Pl
higher in the east. (From Bryson and Hare [1974], with permission of Elsevier)



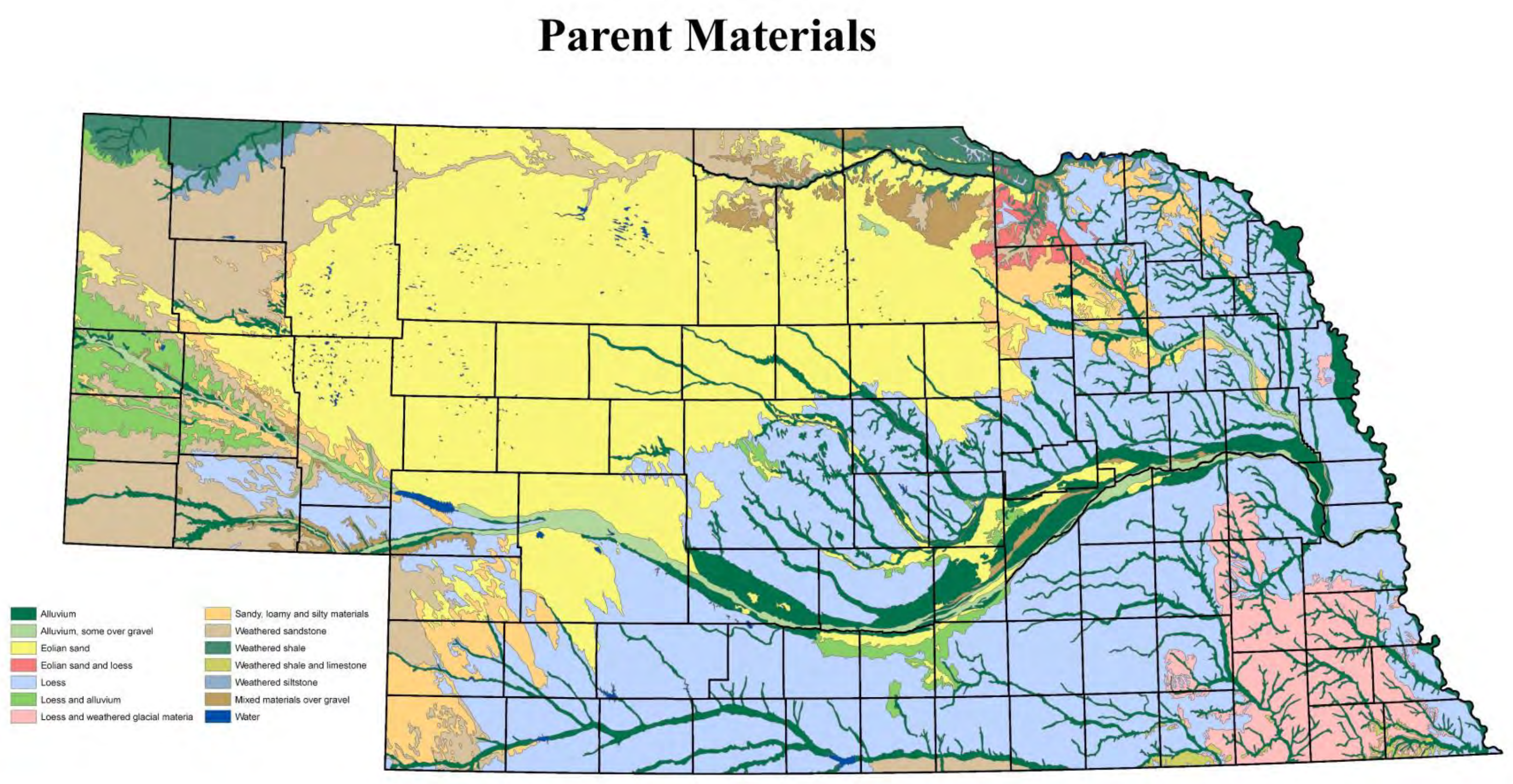
Organisms

- Vegetation…
- Grazers…
- Burrowers; from ants to badgers…
- Microbes and fungi…

Relief & Aspect (Microclimate)

Upper Mississippi River valley near Red Wing Minnesota

NE Parent Materials



TIME

Need a period of stability to form a soil!

On a regional scale and in geological time, the last (*Wisconsinan*) glacial period that ended ~ 10,000 ybp was a time of landscape instability.

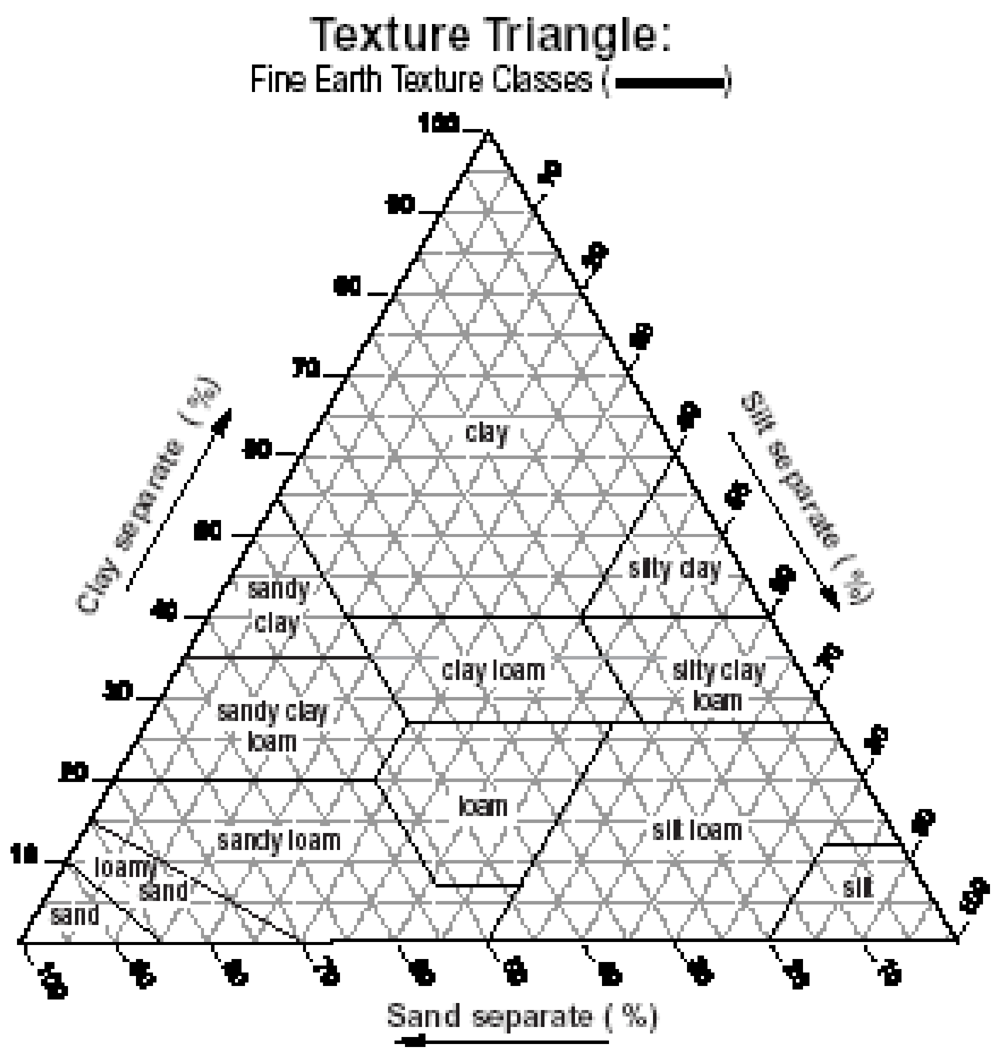
Time: Don’t forget, distinguish between age of parent material and age of the soil!

- Bedrock: 3MYA, 100-70 MYA
- Glacial till in eastern Nebraska: ~ 500,000ybp
- Loess deposits in Nebraska
  - Loveland: 130,000 ybp, Illinoian Glaciation
  - Gilman Canyon 27,000-22,000 ypb
  - Peoria 22,000-12,000 ybp
  - Bignell < 9000 ybp
- Aeolian sand: Widespread activity 700-800 ybp
- Alluvium and Colluvium: Much is Post-settlement

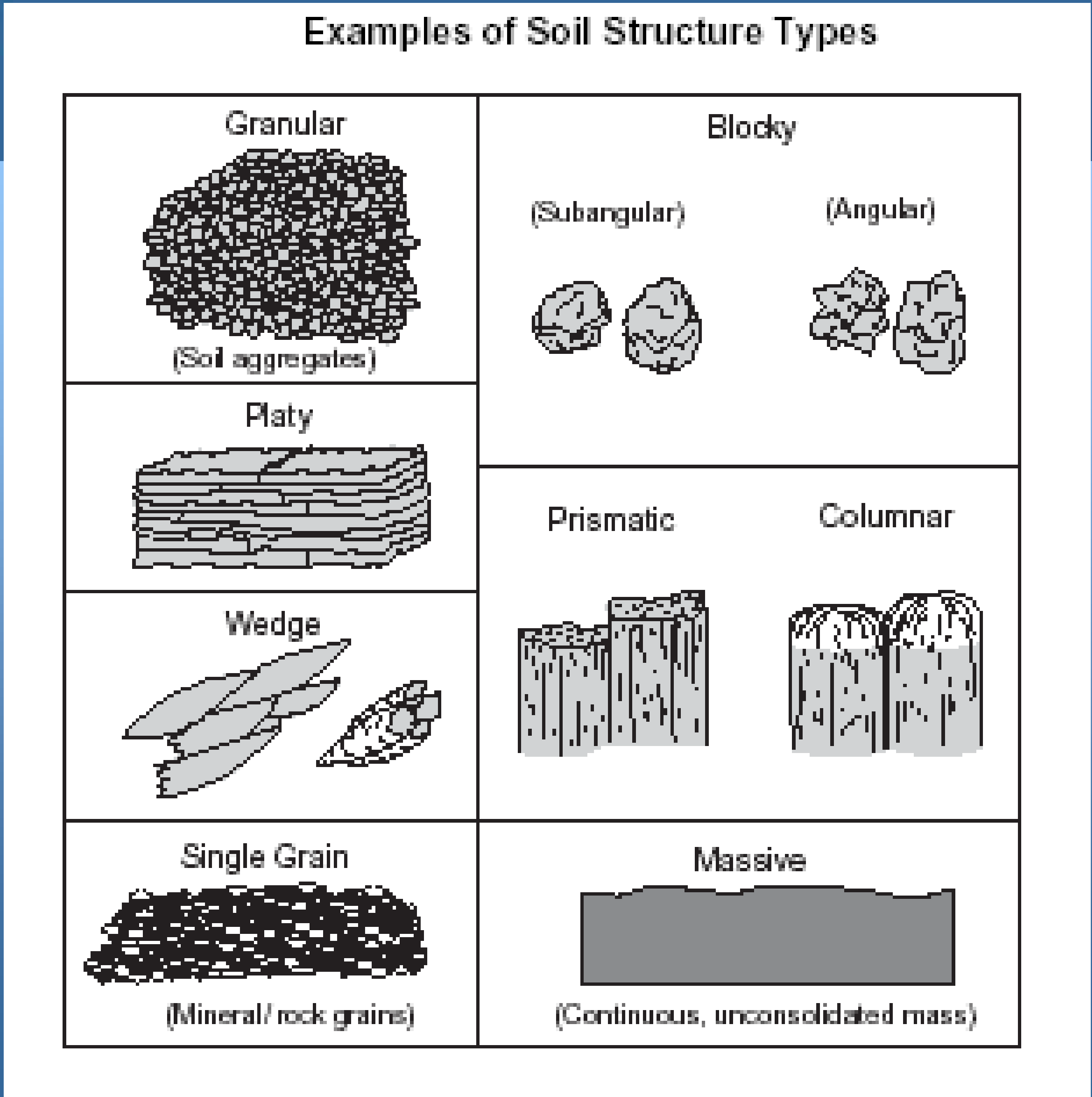
What are the "…" factors?

Soil Properties: *Strongly influenced by parent materials*

Texture



Soil Structure

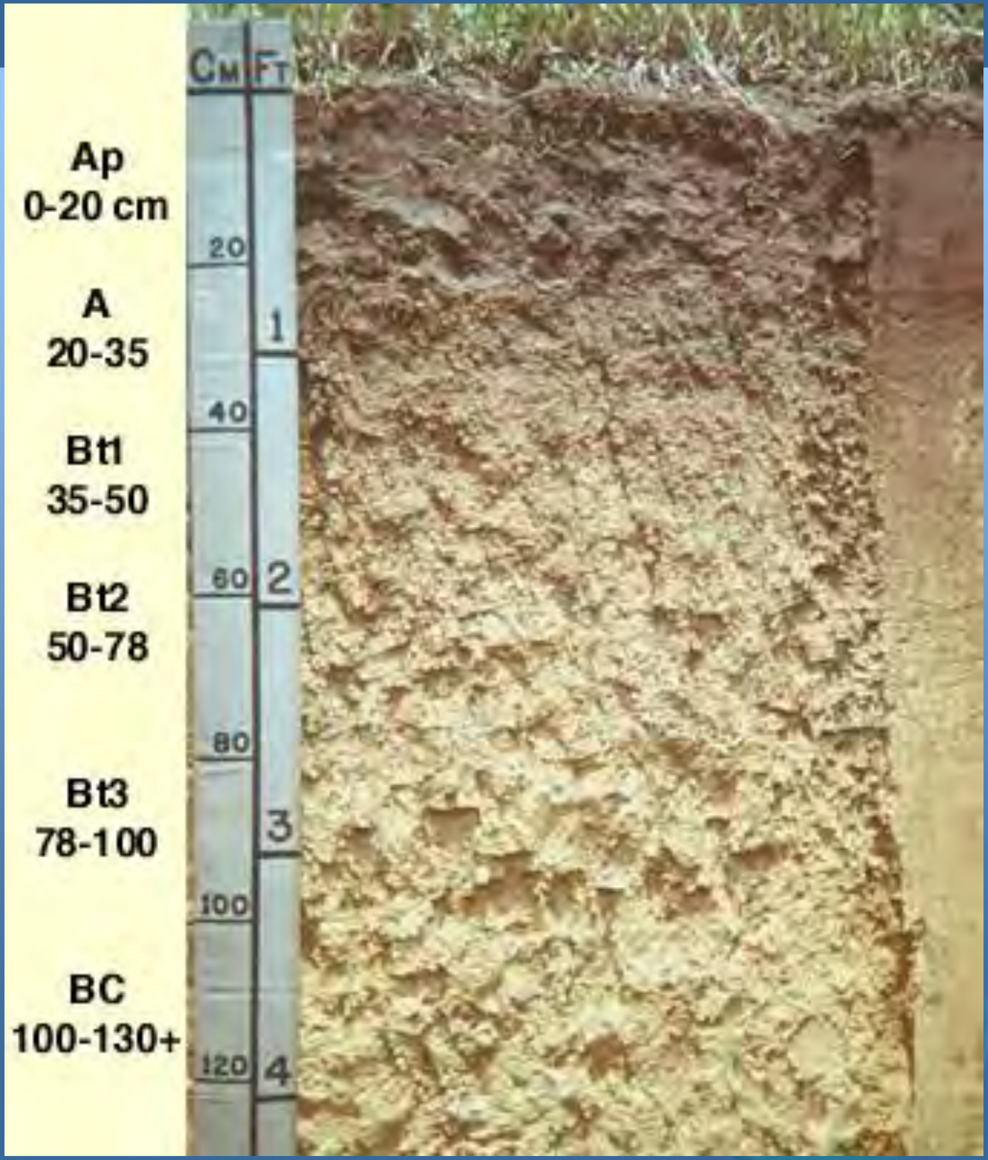


Describing soils: Soil Morphology

Texture
Color
Structure
Mottling
Skeletal
fragments
Consistence
Reaction (pH)
Horizons

Soil Horizons

- A
- B
- C
- E
- Modifiers
  - p
  - t
  - g
  - c
  - w



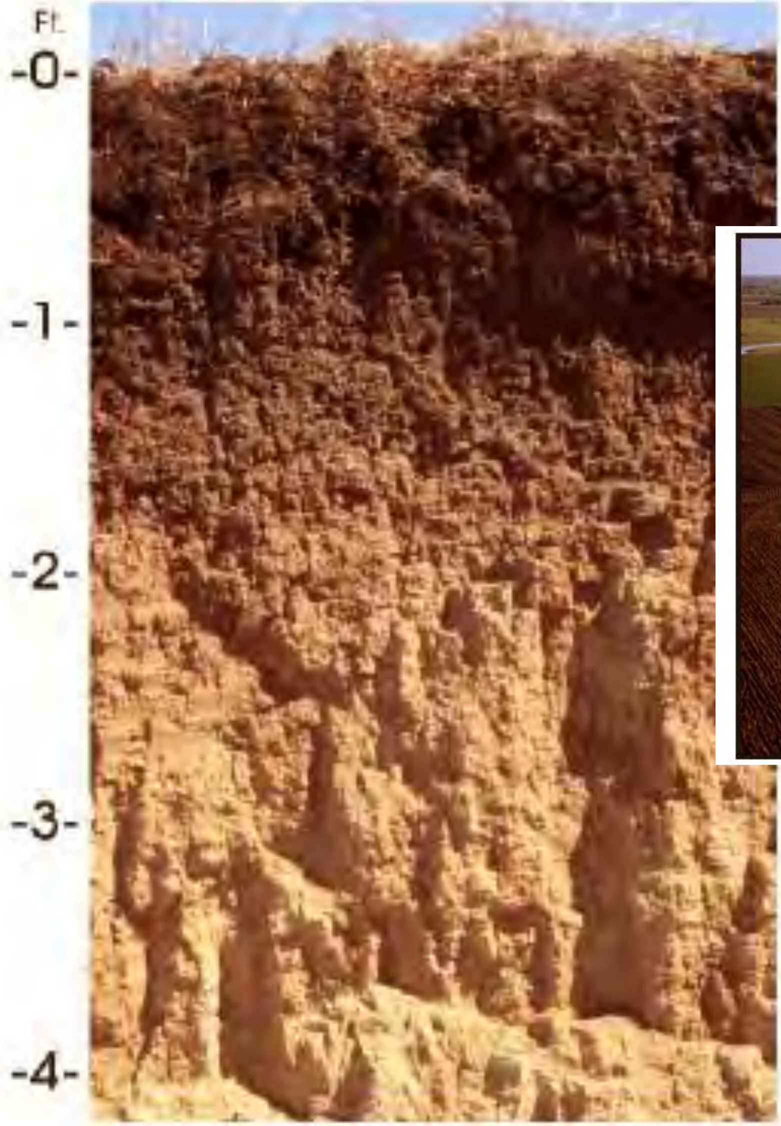
Soil Genesis

- **O**
  - Vegetative litter
- **A**
  - Brown colors from decomposing organic matter
- **B**
  - Clay % increases and structure develops as clays move downward and weathering occurs when there is excess precipitation and soil wets-dries & freezes-thaws, producing soil structure.
- **C**
  - “Parent material”
- **Modifiers**
  - p
    - Plowed (disturbed)
  - t
    - High clay

NRCS

Soil Genesis Cont.

- g
  - Gleyed (wet)
- c
  - Carbonate concentrations
- w
  - Some development in the B horizon



Holdrege Soil Profile

Surface layer: dark grayish brown silt loam

Subsoil - upper: dark grayish brown silty clay loam

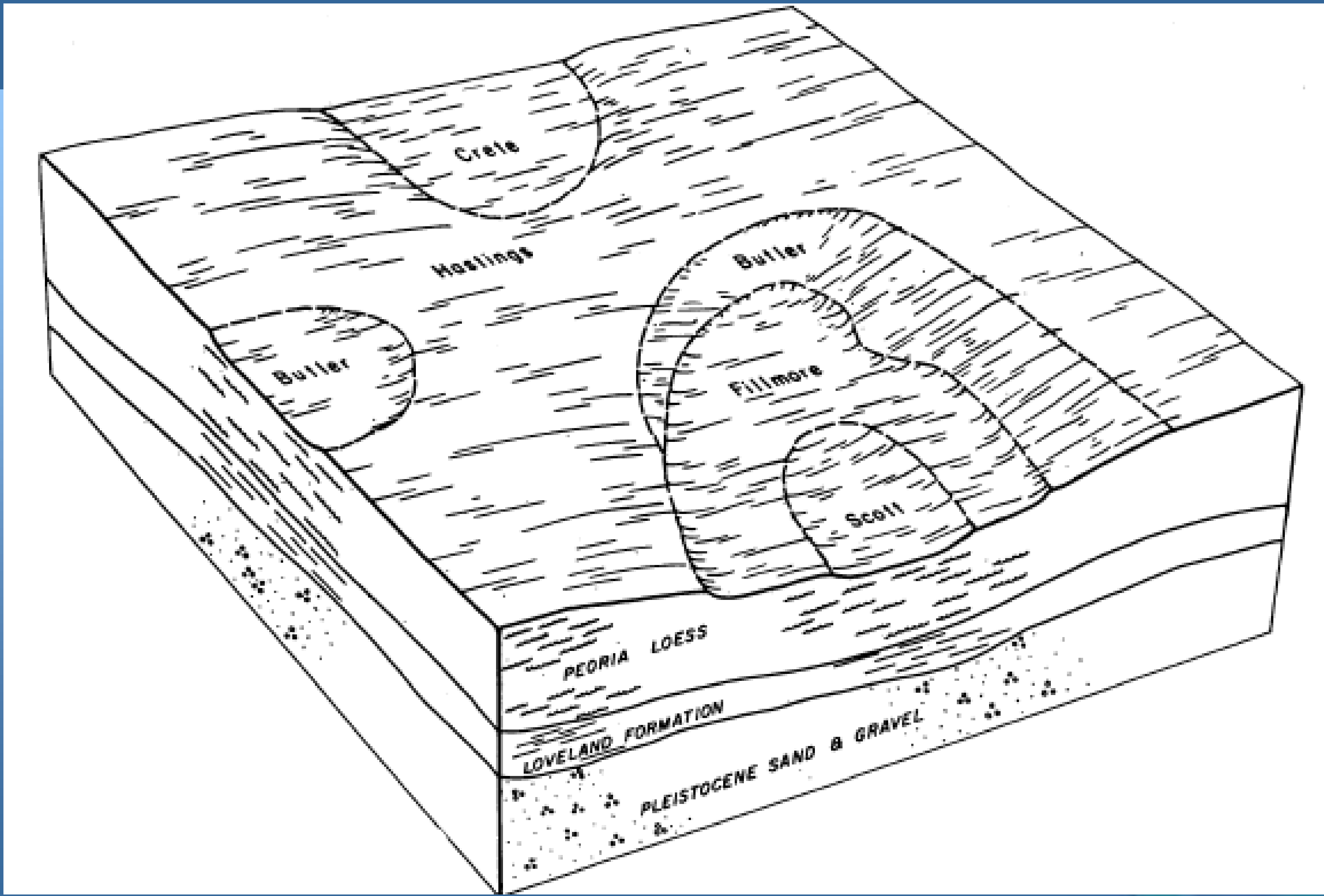
Subsoil - middle: light brownish gray silty clay loam

Subsoil - lower: light gray silt loam

Soil Series and Soil Development

- **Hastings – Upland**
- **Butler – Near upland**
- **Fillmore – SWP drained**
- **Scott – P drained**
- **Massie VP or P drained**
  - BT depths – land scape scale
  - E horizon development
  - Varability between counties

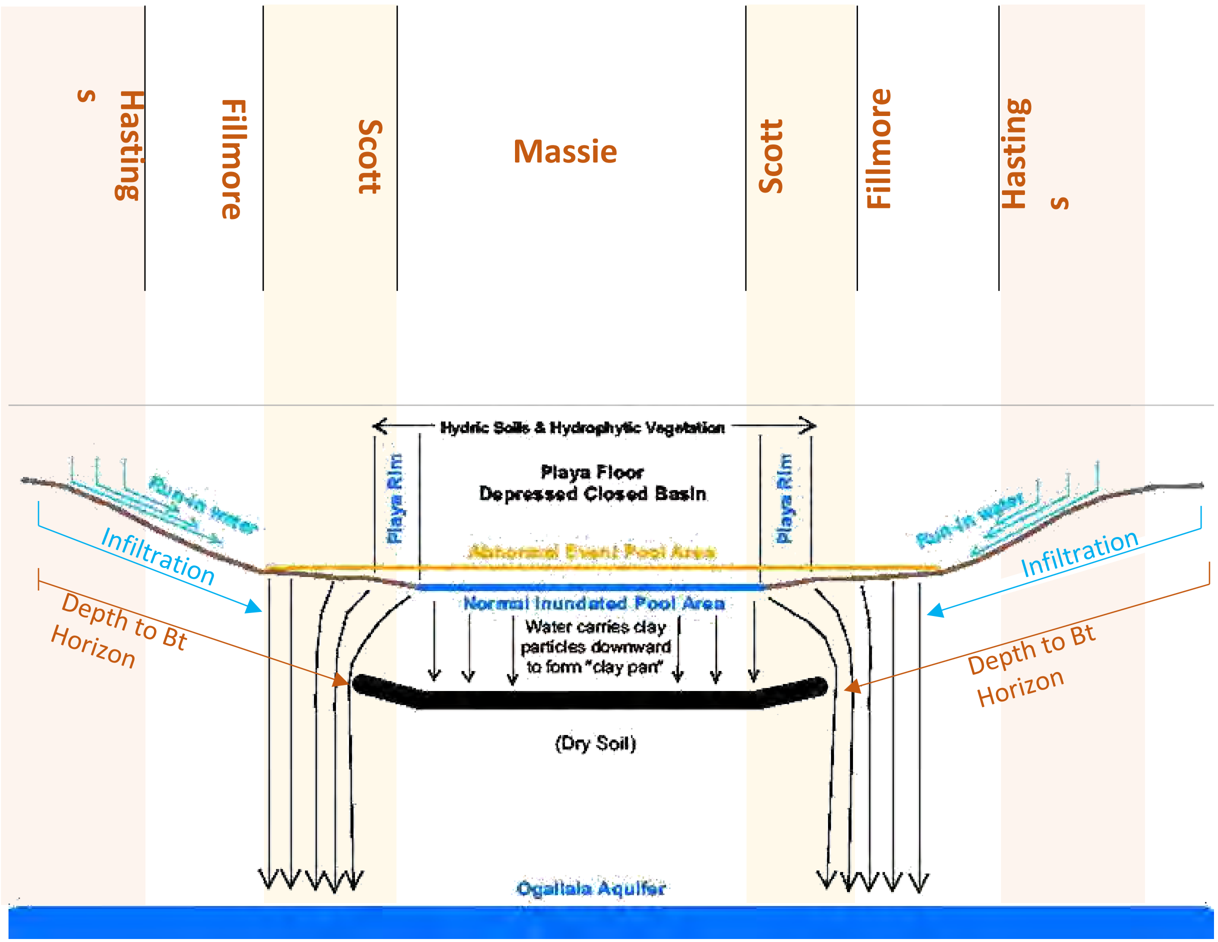
Rain Water Basin Catena



Catena Soils

e of Fillmore silt loam showing the claypan in the subsoil.

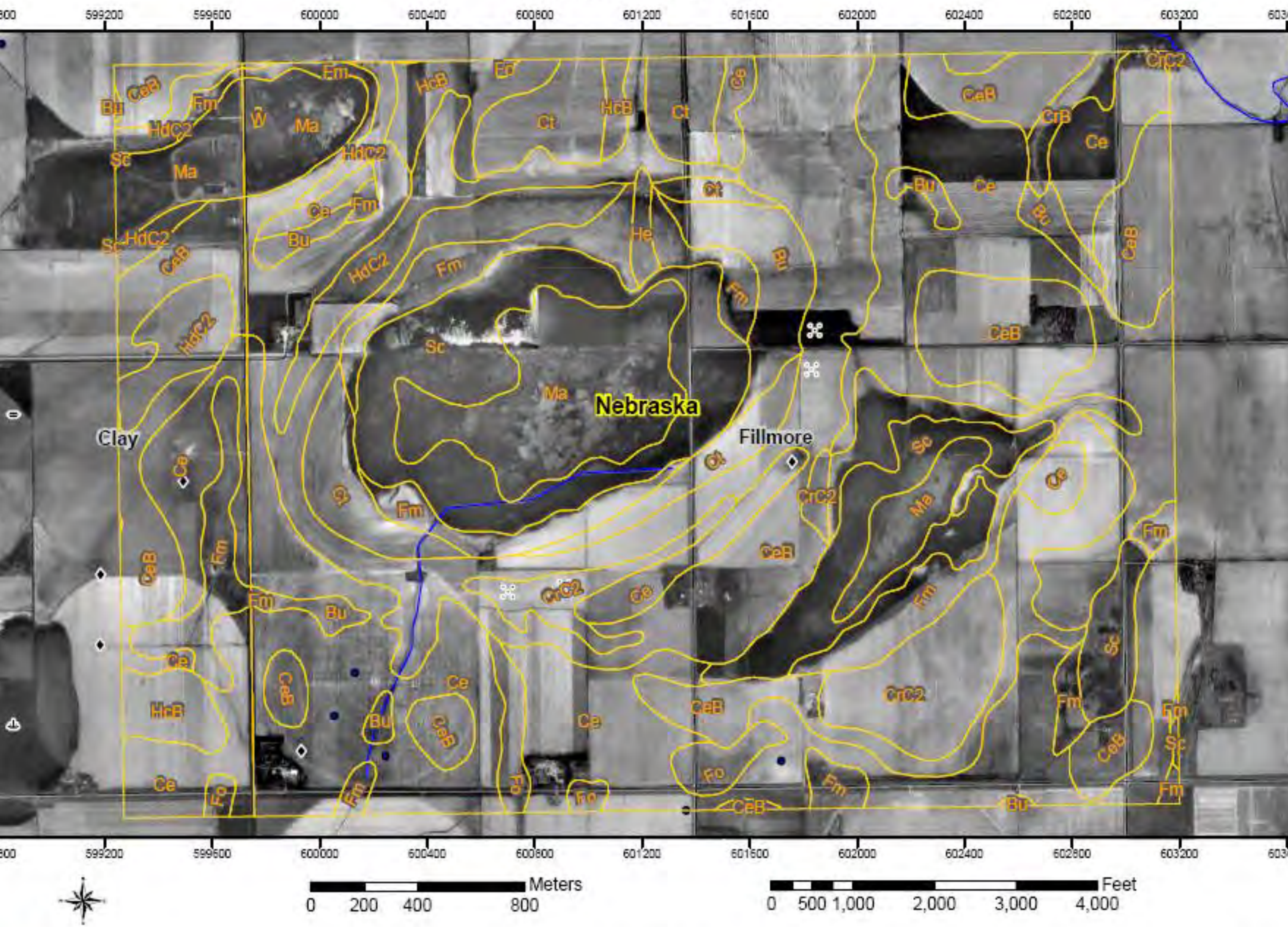
Playa Hydrology – Aquifer Recharge



Basin Origin

- The wetlands were primarily formed by wind action and generally the long axis of the basin runs in a northeast to southwest orientation (Kuzila and Lewis 1993).
- There frequently is a hill (lunette)located immediately south or southeast of the wetland where the windblown loess was deposited.
- Big Nell (Holocene recent1000ybp) – Peorian (14,000ybp) – Gilman Canyon (20k ybp)– Loveland loess (35ybp) – Sand and gravels (42YBP)

Clay County Map Sheets 32 & 37

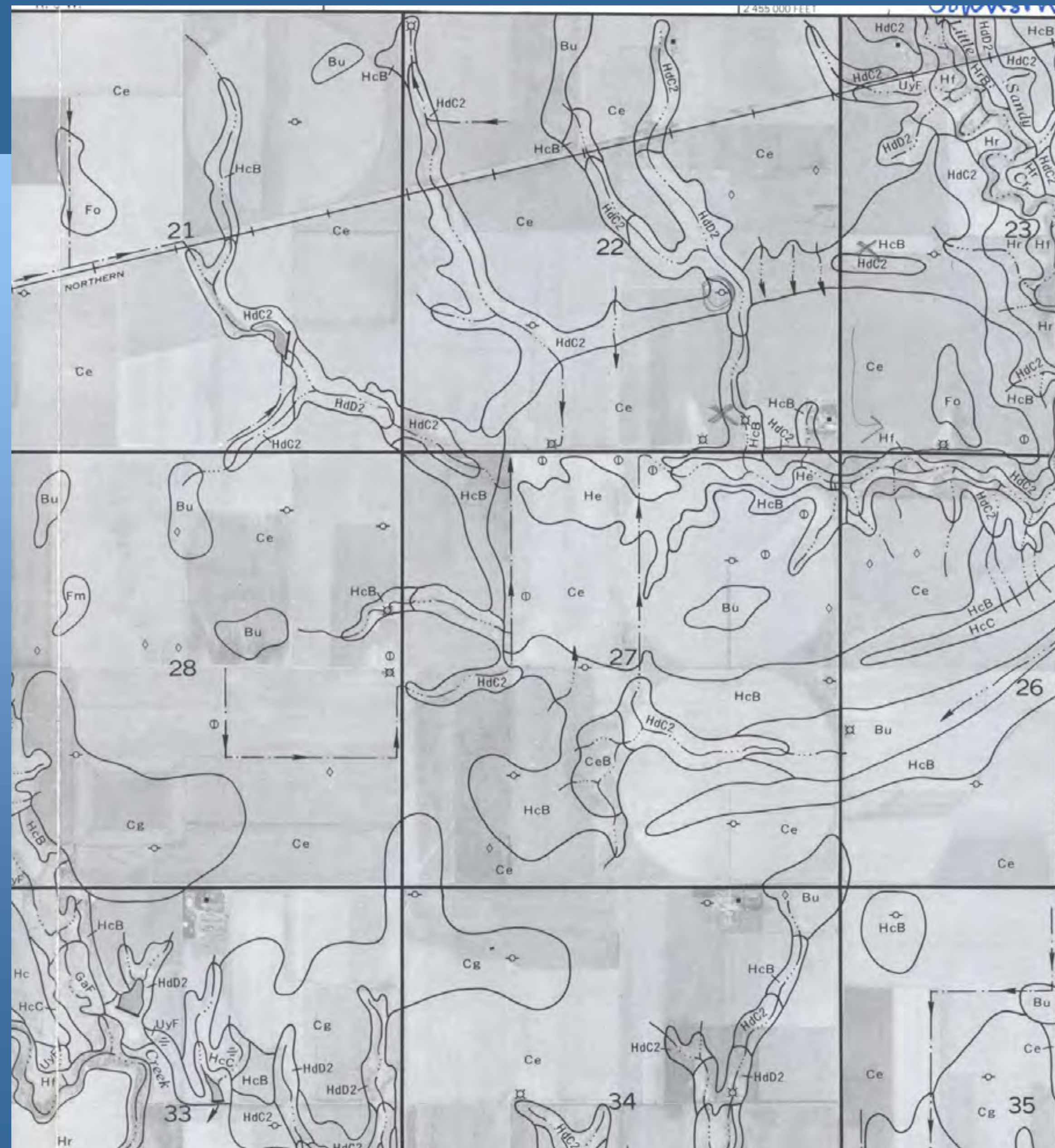


599200
599600
600000
600400
600800
601200
601600
602000
602400
602800
603200
Nebraska
Fillmore
Clay
Meters
0 200 400 800
Feet
0 500 1,000 2,000 3,000 4,000

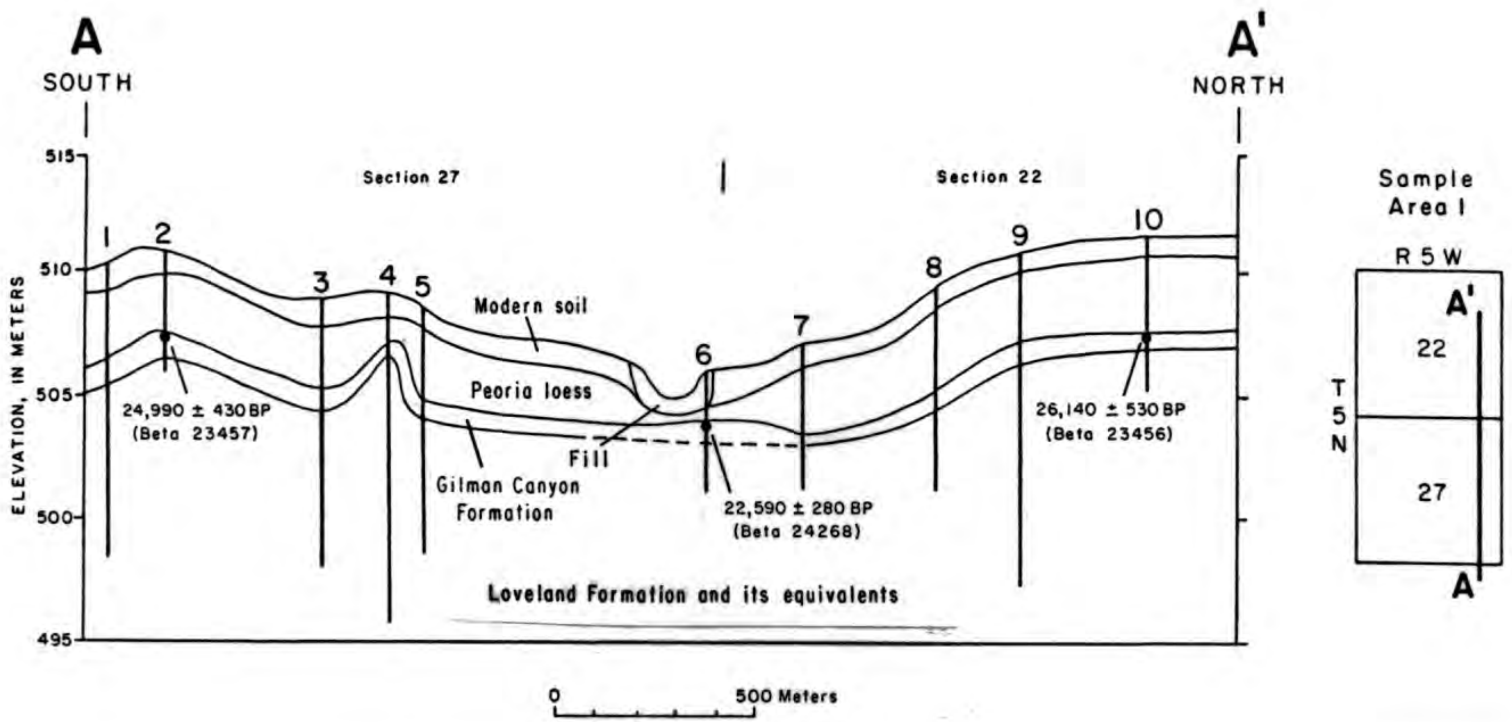
Findings from Kuzila

- Particle size and mineralogic data indicated the possibility of a lithologic discontinuity at a depth of approximately 60 cm in all of the pedons studied.
- Stratigraphic data indicated that eight to twenty-eight feet of loess, covered old landscapes that were marked by buried paleosols dating from 19,890 to 26,670 years before present.
- The soil parent materials above the paleosols were identified as Peoria and Bignell loesses
  - Kuzila, Mark Steven, "Genesis and morphology of soils in and around large depressions in Clay County, Nebraska" (1988). *ETD collection for University of Nebraska - Lincoln*

Work locations for Kuzila findings



Rainwater Basin stratigraphy



Mark Kuzila

RWB formation

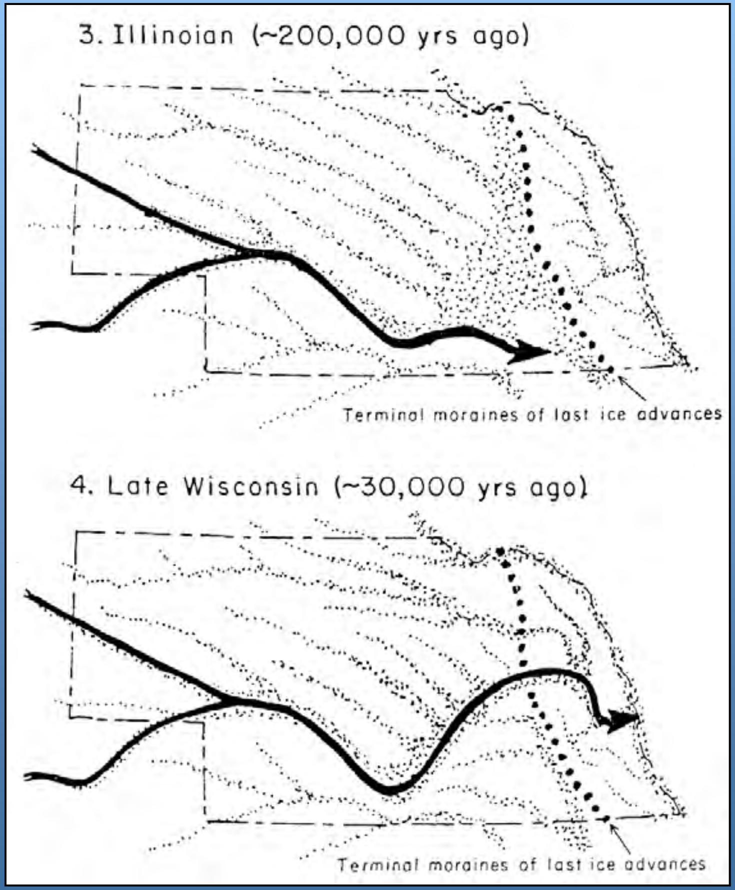
- **Sand is beneath the loess**
- **Old braided river (Platte?) channel**
- **Depressions formed in the sand**
- **Sand rims formed on east and south**
- **Several loess deposits drape pre--existing depressions**
- **Age?**
  - Gilman Canyon soil < 20,000-25,000 ybp

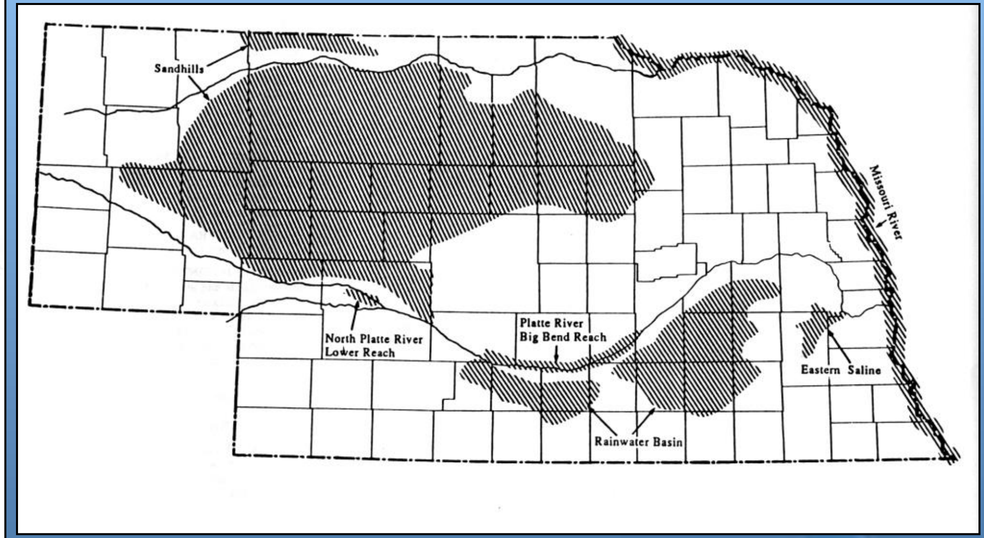
OSL ages, sand below surficical loess

Sample	Depth[1] (m)	Age
BZ-1	3.7	35.9±3.6
BZ-2	4.2	64.5±3.4
BZ-3	4.4	71.9±6.2
BZ-5	2.5	45.1±2.3
BZ-7	3.3	59.0±4.3

[1]Depth of sample below current land surface.

Conservation & Survey Div.





Conservation & Survey Division

Field Tactics

Stop #:	1		
HOR	DEPTH	COLOR	TEX/frag
Ap	8"	10YR 2/1	SIL
A	16"	10YR 2/1	SICL
Bt1	16"+	10YR 3/3	SIC

Component Name: Crete

NOTES: Thick A horizon - likely due to years of vegetative cover. Had a small area of transition (1") but not a full BA horizon, as is typic.

Stop #:	2		
HOR	DEPTH	COLOR	TEX/frag
Ap	4"	10YR 2/1	SIL
A	15"	Mixed	Fill SIL - SICL
AB	19"	10YR 2/2	SICL
Bt1	26"	10YR 3/3	SIC
Bt2	30"	10YR 4/2	SIC
BC	30+"		SICL

Component Name: Crete

NOTES: A - MIXED with fill
AB - some fill mixing

Stop #:	3		
HOR	DEPTH	COLOR	TEX/frag
Ap	5"	10YR 2/1	SIL
A	14"	Mixed	Fill SIL - SICL
AB	17"	10YR 2/2	SICL
Bt1	24"	10YR 3/3	SIC

Component Name: Crete

NOTES:

Stop #:	4		
HOR	DEPTH	COLOR	TEX/frag
A	6"	10YR 3/1	SIL
Mixed E	8"	10YR 4/1	SIL
Bt1	8+"	10YR 3/1	SIC

Component Name: Fillmore

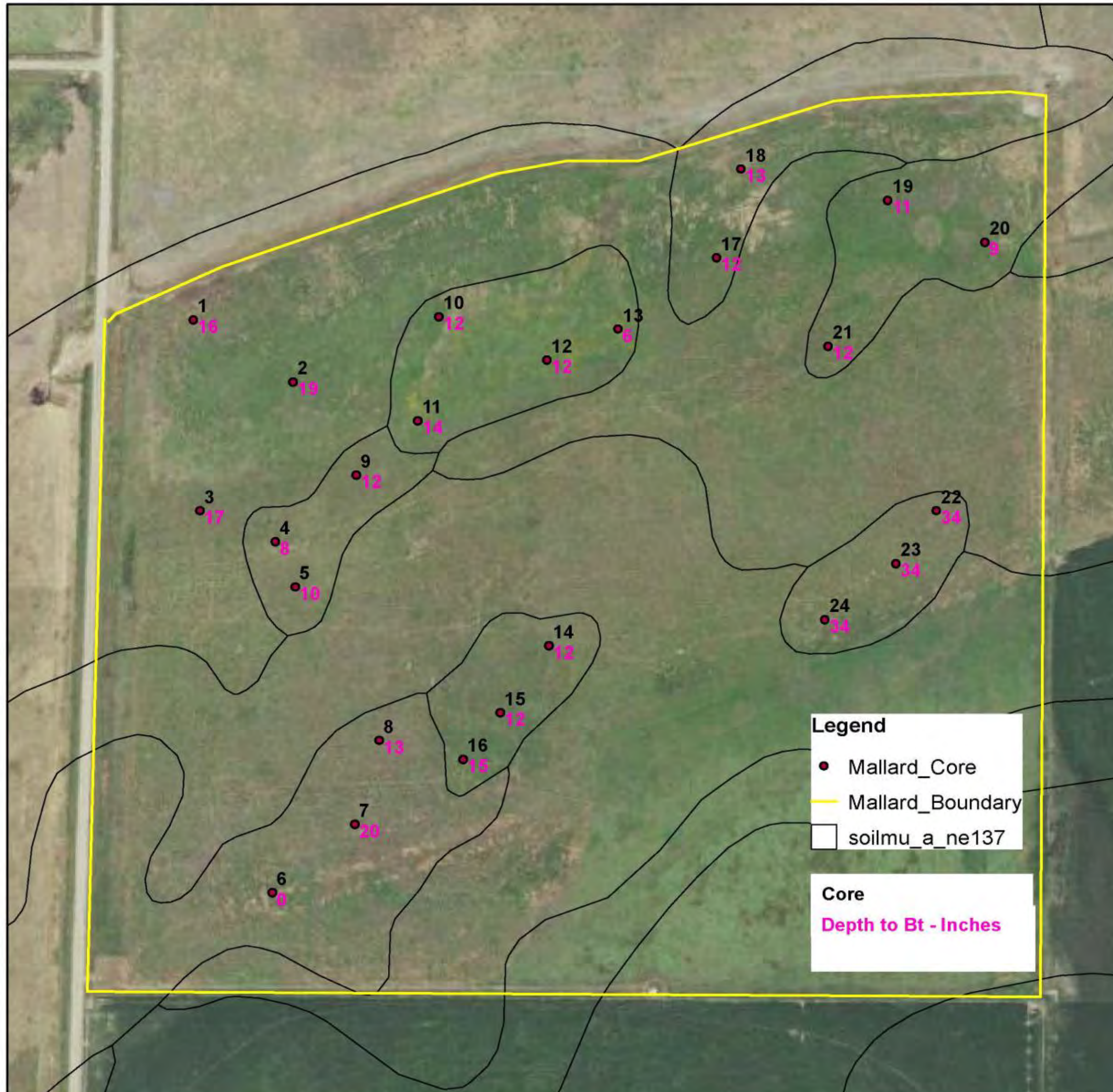
NOTES: Thin A and E. Site possibly scraped when area was leveled.

Mallard - Bt Depth

Date: 11/27/2018

Funk
11-6-17W
Phelps County, Nebraska

Field Office: AURORA SERVICE CENTER
Agency: USDA NRCS
Assisted By: REBECCA HODGES



210 0 210 420 630 840

N

Mallard - Sediment/Fill Depth

Date: 11/27/2018

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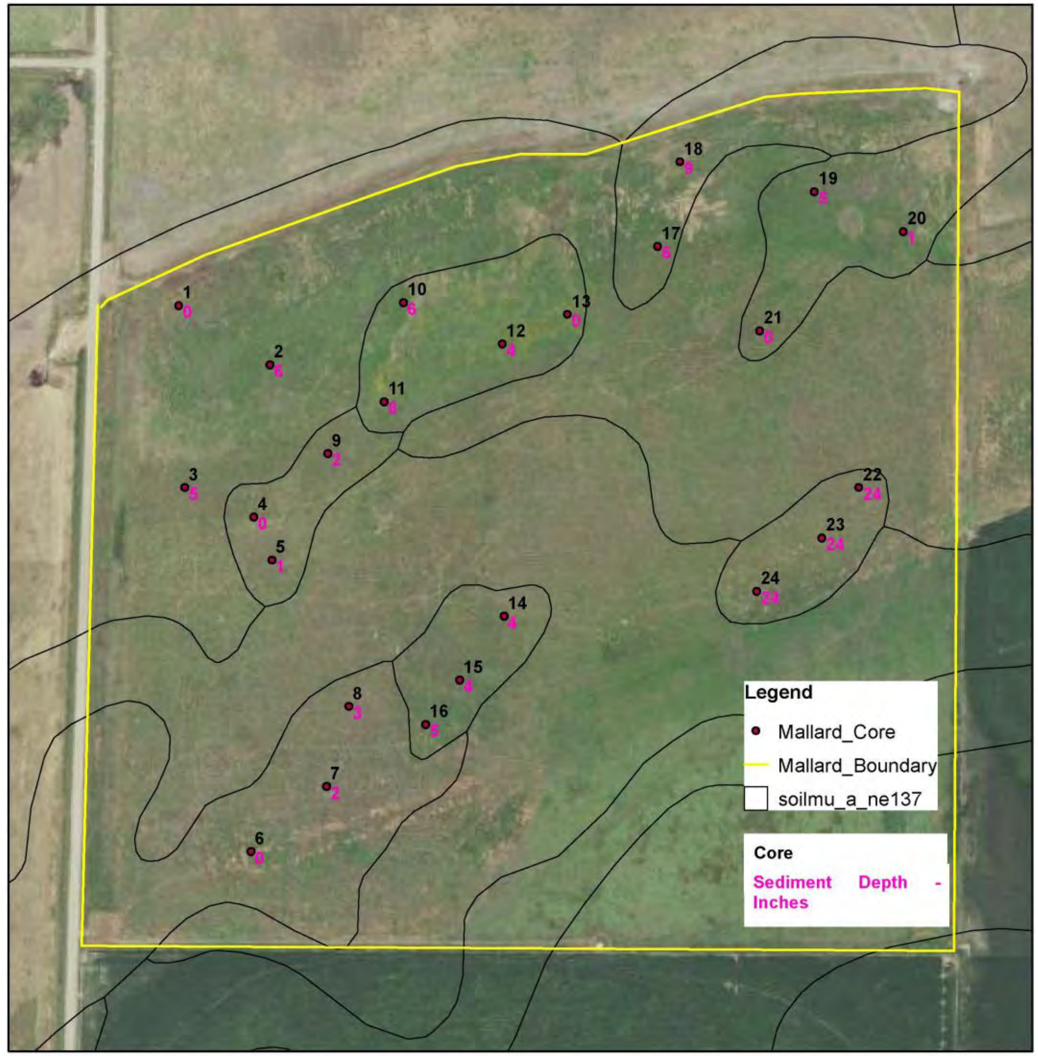
11-6-17W
Phelps County, Nebraska

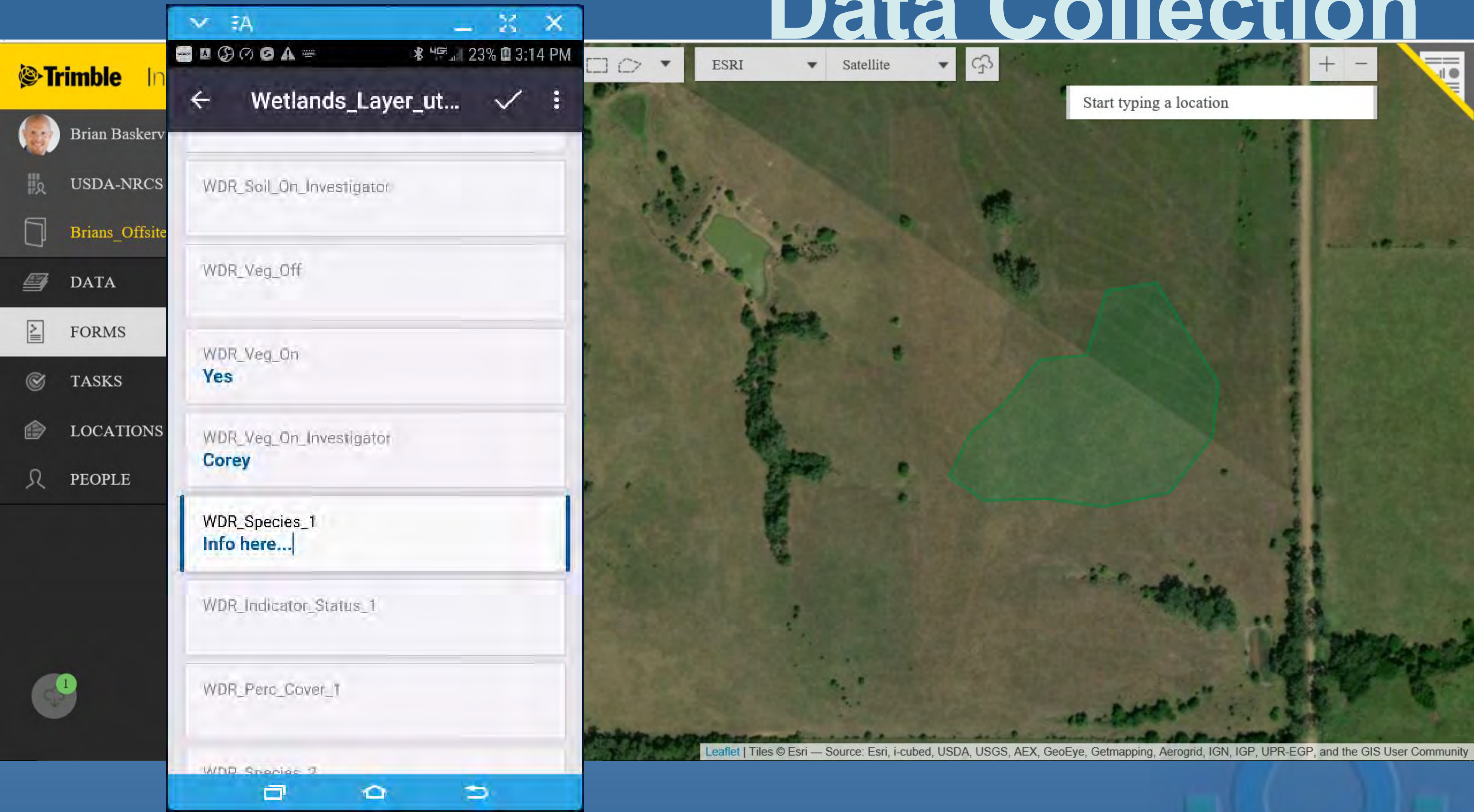
Field Office: AURORA SERVICE CENTER
Agency: USDA NRCS
Assisted By: REBECCA HODGES



210 0 210 420 630 840 Feet

N

Terra Flex Forms for Data Collection



Thanks!

Credit to this presentation goes to professors Retired Dr. Mark Kuzila and the late Dr. C.W. Zanner.

Chuck Markley and Rebecca Hodges Resource Soil Scientist in Nebraska

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