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Soils of the Wheat Taskforce Plots

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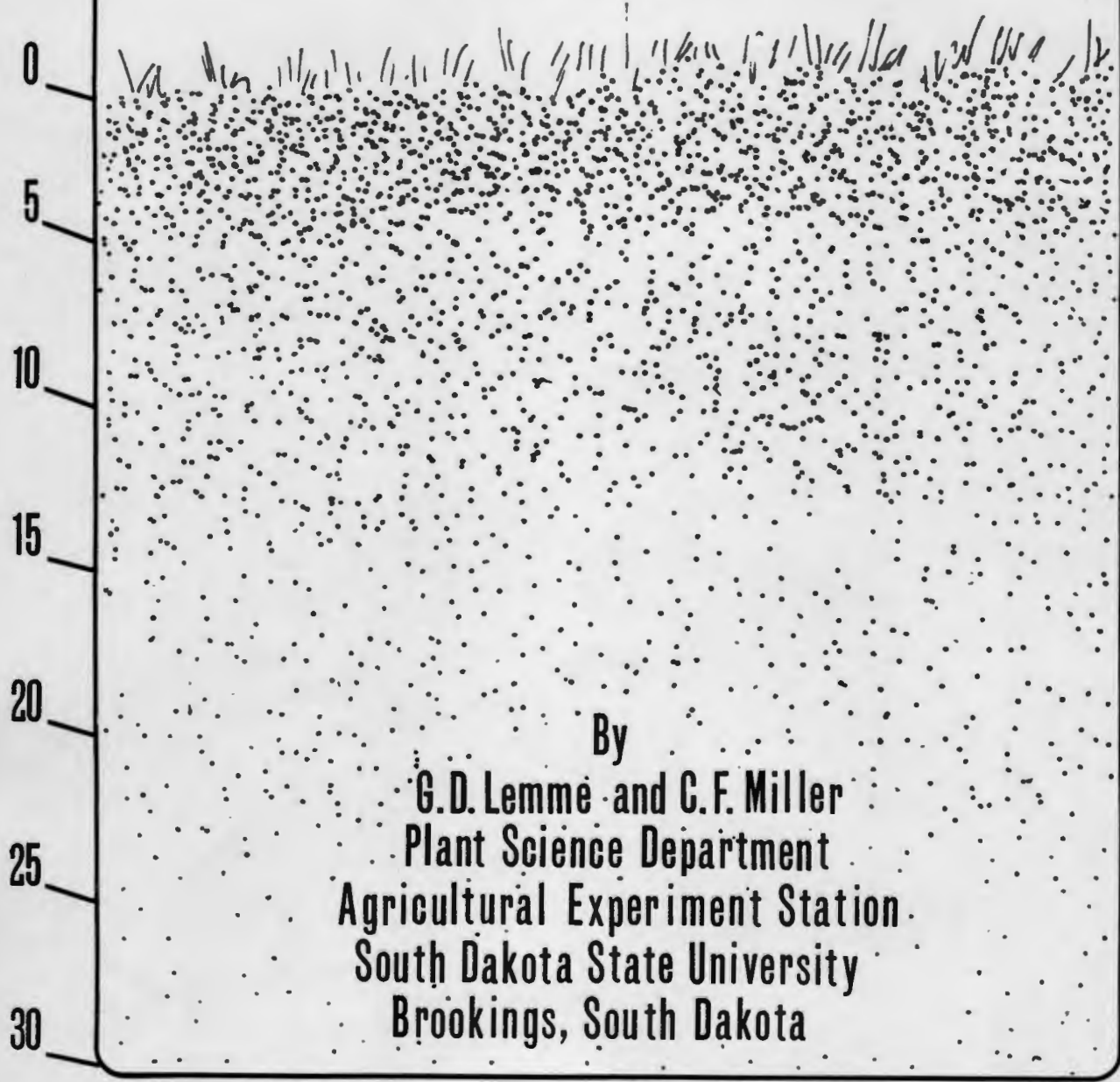
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Soils of the Wheat Taskforce Plots



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Soils of the Wheat Taskforce Plots

Houdek (fine-loamy, mixed, mesic Typic Argiustolls)
Prosper (fine-loamy, mixed, mesic Pachic Argiustolls)

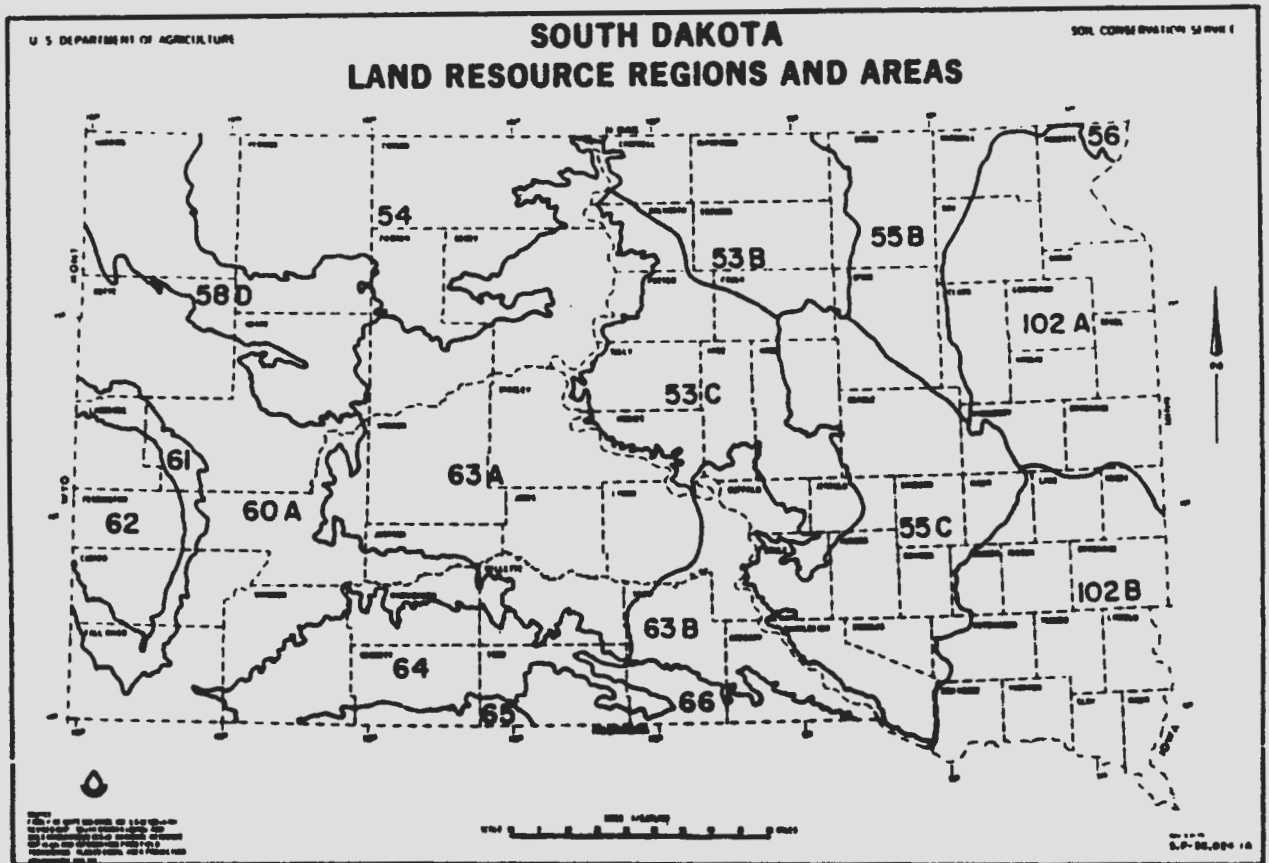
The wheat taskforce at South Dakota State University established a 5.26 hectare (13 acres) research area in 1979 to conduct interdisciplinary research on wheat production in South Dakota. A site near Raymond, South Dakota was selected to represent the southern black glaciated plains land resource area (SCS, 1981), see Figure 1.

The southern black glaciated plains represent a 20,240Km² (7,810mi²) area of east central South Dakota. Nearly 70% of the area is dryland corn, small grains, and alfalfa. About one-fourth of the area, consisting of the steeper sloping soils, is in native range and tame pasture. Most of the area is nearly level with some undulating till plains. Elevations range from 400 to 600 meters. More than half of the 450 to 525mm (17.7-20.6 inches) of annual precipitation falls during the growing season. Average annual temperature ranges from 7 to 9^oC with a freeze-free period of 130 to 155 days.

The native prairie vegetation of the area consists of western wheatgrass (*Agropyron smithii*), green needlegrass (*Stipa viridula*), needleandthread (*Stipa comata*), and porcupinegrass (*Stipa spartea*). Big blue stem is common on soils with imperfect drainage.

The parent materials of the area are all glacial derived. They range in age from the early to late substages of the Wisconsin glaciation. Most soils are deep, well drained, with between 18-35% clay in their subsoils. These soils have developed in glacial till with a mixed mineralogy under a contemporary climate that has an ustic moisture regime and mesic temperature regime.

Figure 1.



LEGEND

Central Feed Grains and Livestock

- 102A Rolling Till Prairie
- 102B Loess Uplands and Till Plains

Northern Great Plains Spring Wheat Region

- 53B Central Dark Brown Glaciated Plains
- 53C Southern Dark Brown Glaciated Plains
- 54 Rolling Soft Shale Plains
- 55B Southern Black Glaciated Plains
- 56 Red River Valley of the North

Western Great Plains and Irrigated Region

- 58D Northern Rolling High Plains (Eastern Part)
- 60A Pierre Shale Plains and Badlands (South Part)
- 61 Black Hills Footslopes
- 62 Black Hills
- 63A Rolling Pierre Shale Plains (North Part)
- 63B Rolling Pierre Shale Plains (South Part)
- 64 Mixed Sandy and Silty Tableland
- 65 Nebraska Sand Hills
- 66 Dakota-Nebraska Eroded Tableland

The nearly level to moderately sloping areas within this LRA are occupied by the Houdek and Prosper soils. These soils have been correlated on over 312,023 hectares (771,000 acres) in South Dakota (Table 1 and 2). These two soils alone represent over 15% of the area. Houdek soils occur on the uplands with Prosper soils being found in the shallow swales. These two soils dominate the wheat taskforce research site.

Table 1. Extent of Houdek and Prosper Soils in the Southern Black Glaciated Plains.

Series	Extent	% of LRA (4,998,400 acres)
Houdek	216,512 ha (534,995 acres)	10.7%
Prosper	95,573 ha (236,158 acres)	4.7%

Table 2. Extent of Houdek and Prosper Soils by County in the Southern Black Glaciated Plains.

County	Houdek	Prosper	Total
Aurora	118,665 acres	21,191 acres	139,856 acres
Beadle	128,705 acres	76,299 acres	205,004 acres
Douglas		18,838 acres	18,838 acres
Charles Mix	2,155 acres	955 acres	3,110 acres
Davidson	68,684 acres	27,958 acres	96,642 acres
Sanborn	26,129 acres	14,167 acres	40,296 acres
Hand	156,665 acres		156,665 acres

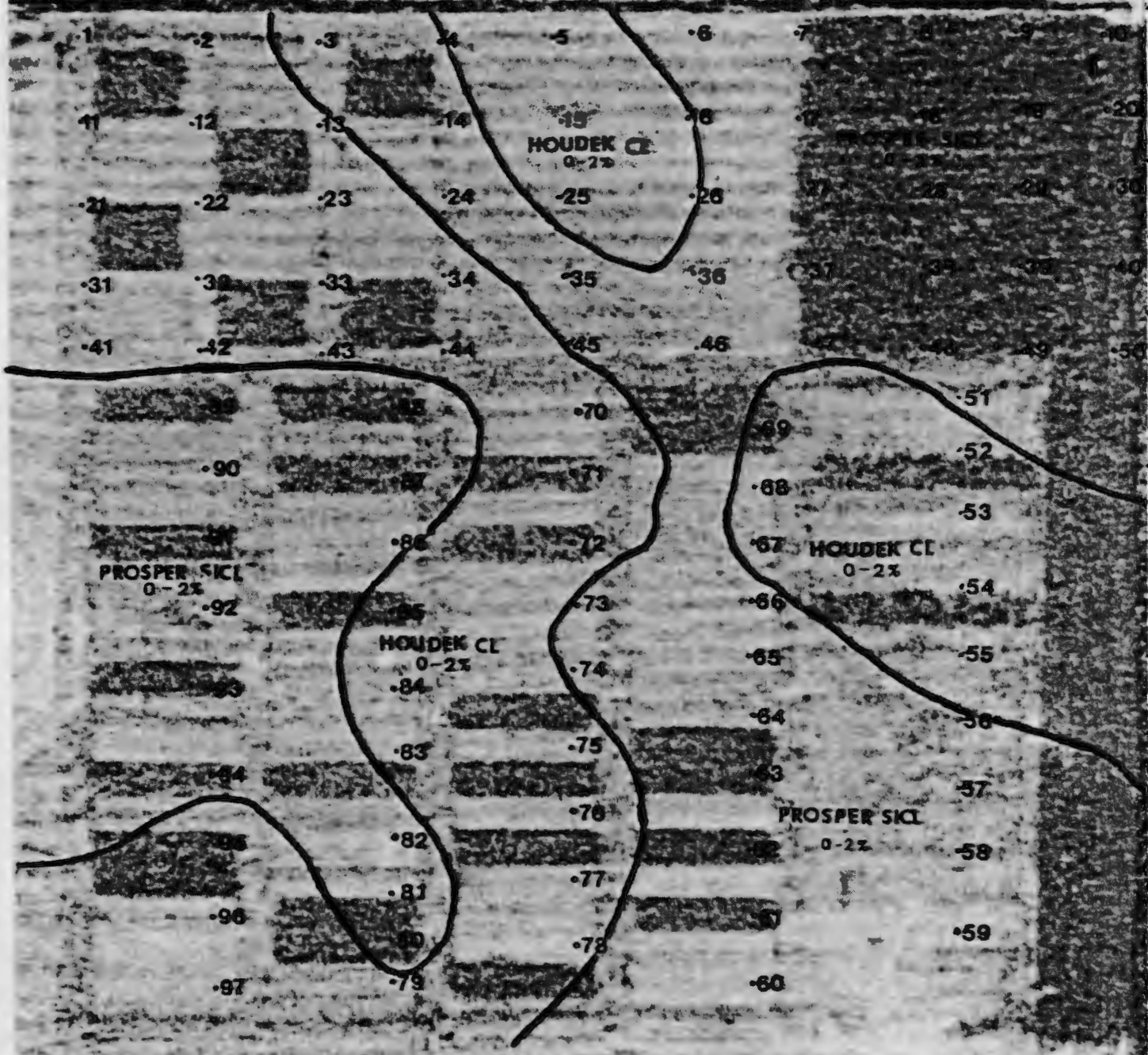
Wheat producers who have these or similar soils should expect similar results as those obtained from the wheat taskforce plots.

The soils of the research area were mapped at a scale of 1:1,284 (49.3 inches/mile), see figure 2. Pedon descriptions were prepared at 97 points within the research area. These points are identified on the soils map and abbreviated descriptions of each area is found in the appendix of this report.

WHEAT TASKFORCE PLOTS

DOLAND, S.D.

LN



scale 1:1284

Two map units were identified. They are as follows:

Houdek clay loam, 0-2 percent slope

This deep well-drained, gently sloping soil is formed on uplands developed in glacial till. Typically, the surface layer is black clay loam about 8 inches thick. The subsoil is about 20 inches of brown, dark brown, and grayish brown, firm, clay loam and clay. The lower part is calcareous. The underlying material to a depth of 60 inches is grayish brown, calcareous, clay loam and contains few iron oxide concretions and many fine nests of gypsum. Included in this soil in mapping are areas of Prosper soils in swales of the uplands. This soil is well suited to cultivated crops. Wheat is the main crop grown in this soil.

Prosper silty clay loam, 0-2 percent slope

This deep, moderately well-drained, gently sloping soil is found in the swales of the uplands over glacial till. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsoil is about 37 inches of very dark gray, light olive brown, grayish brown, olive brown, friable and firm, silty clay, clay loam, and loam. It is calcareous in the lower part. The underlying material to a depth of 60 inches is dark grayish brown calcareous, clay loam.

A modal pedon of each series was described and sampled for analyses.

Chemical and Physical Characteristics

Selected physical and chemical properties of the modal pedons were measured using standard soil survey procedures (Soil Survey Staff 1977). Particle size analysis indicates that both soils have developed from fine-loamy glacial till. (Tables 3 and 4). Prosper soils had evidence of more clay eluviation than did the Houdek soils. The additional moisture received by the Prosper soils through rain is responsible for most of the morphological, chemical, and physical differences observed between these two soils.

Soil Descriptions

Houdek

Fine-loamy, mixed, mesic Typic Argiustolls

Description

- Ap - 0-6 inches; clay loam, very dark gray (10YR2/1) moist; medium fine granular structure; friable; neutral; abrupt smooth boundary.
- Bt - 6-11 inches; clay loam, dark brown (10YR3/3) moist; weak medium prismatic parting to moderately medium subangular blocky, firm; neutral; abrupt smooth boundary.
- Btk - 11-18 inches, clay; brown (10YR5/3) moist; weak coarse subangular blocky; firm; common medium accumulations of carbonates; violent effervescence; clear wavy boundary.
- Bk - 18-29 inches; clay loam, grayish brown (2.5Y5/2) moist; few fine faint mottles gray (2.5Y5/0) massive firm; few coarse dark concretions of iron and manganese oxide; strong effervescence; abrupt wavy boundary.
- C - 29-42 inches; clay loam; grayish brown (2.5Y5/2) moist; few fine faint mottles gray (2.5Y5/0); massive; firm; few coarse dark concretions of iron and manganese oxide; strong effervescence; abrupt wavy boundary.
- Cy - 42-60 inches; clay loam; grayish brown (2.5Y5/2) moist; common fine faint gray, (2.5Y5/0) mottles; massive; few coarse dark concretions of iron and manganese oxide; many fine nests of gypsum crystals; slight effervescence

Prosper

Fine-loamy, mixed, mesic Pachic Argiustolls

Description

- Ap - 0-8 inches; silty clay loam; black (10YR2/1) moist; strong fine granular structure; very friable; abrupt smooth boundary.
- A - 8-12 inches; silty clay loam; very dark brown (10YR2/2) moist; moderate medium and fine subangular blocky structure; very friable clear wavy boundary.
- Bt - 12-26 inches; silty clay; very dark gray (10YR3/1) moist; strong medium prismatic structure parting to weak medium subangular blocky; friable; clear wavy boundary.
- Bk1 - 26-31 inches; silt loam; light olive brown (2.5Y5/4) moist; common fine faint gray (2.5Y5/0) mottles and medium prismatic structure; friable; common medium accumulations of carbonates; violent effervescence; clear wavy boundary.
- Bk2 - 31-43 inches; clay loam, grayish brown (2.5Y5/2) moist; many fine distinct gray (2.5Y5/0) mottles; moderately medium prismatic structure; friable; many medium accumulations of carbonates; violent effervescence; clear wavy
- BC - 43-49 inches; loam; olive brown (2.5Y4/4) moist; many fine distinct dark gray (2.5Y4/0) mottles; weak medium prismatic structure; friable; violent effervescence; abrupt wavy boundary.
- C - 49-60 inches; clay loam, dark grayish brown (2.5Y4/2) moist; many fine distinct dark gray (2.5Y4/0) mottles; weak medium prismatic structure; friable; strong effervescence.

Table 3

Series: Houdek

Classification: Fine-loamy, mixed, mesic Typic Argiustolls

Pedon No:

Area: Wheat Task Force Plots

Location: Doland, S.D.

DEPTH (inches)	TOTAL %			SILT %			SAND %					Textural Class	
	Clay <.002mm	Silt .002-.05mm	Sand .05-2mm	Fine .002-.005	Med .005-.02	Coar .02-.05	VF .05-.10mm	F .10-.25mm	M .25-.50mm	C .5-1mm	VC 1-2mm		>2mm
Ap	33.1	40.8	26.0	14.7	7.4	18.8	6.4	9.8	6.1	2.9	0.9		C1
Bt	39.5	31.2	29.3	3.6	14.4	13.3	6.3	10.2	7.8	4.3	0.6		C1
Btk	41.0	28.6	30.4	4.1	12.3	12.2	6.5	10.5	7.8	4.6	1.1		C
Bk	38.4	29.7	32.0	8.9	13.5	7.3	6.9	11.6	7.9	4.5	1.0		C1
C	36.3	31.3	32.4	11.0	15.6	4.8	6.8	11.2	8.2	4.9	1.2		C1
Cy	36.1	29.2	34.7	8.5	14.7	6.0	6.7	12.7	8.9	5.6	0.8		C1

Depth (inches)	.1 bar θm	.3 bar θm	1 bar θm	3 bar θm	15 bar θm	CEC meq/100g	Carbonates as CaCO3 %	Extractable bases meq/100g				CEC/ Clay
								Na	Ca	Mg	K	
Ap	35.1	32.5	23.6	22.8	12.3	14.91		.17	11.3	5.7	1.5	.45
Bt	36.4	30.0	25.1	23.9	14.7	17.08		.17	18.1	6.8	.76	.43
Btk	37.3	27.6	24.7	24.1	14.9	17.80	1.60	.13	33.4	7.9	.61	.43
Bk	34.8	29.3	24.2	23.5	14.2	12.77	2.13	.13	33.5	9.1	.64	.33
C	35.3	31.2	24.1	23.8	14.7	13.32	1.97	.21	33.4	9.5	.74	.36
Cy	34.7	31.8	25.5	24.8	15.3	19.85	1.19	.54	64.1	8.6	.76	.54

Table 4

Series: Prosper

Classification: Fine-loamy, mixed, mesic Pachic Argiustolls

Pedon No:

Area: Wheat Task Force Plots

Location: Doland, S.D.

DEPTH (inches)	TOTAL %			SILT %			SAND %						Textural Class
	Clay <.002mm	Silt .002- .05mm	Sand .05- 2mm	Fine .002 -.005	Med .005 -.02	Coar .02 -.05	VF .05- .10mm	F .10- .25mm	M .25- .50mm	C .5- 1mm	VC 1 - 2mm	>2mm	
Ap	33.2	52.7	14.1	7.9	25.6	19.2	3.9	5.2	3.2	1.5	0.3		Sic1
A	35.1	54.3	10.6	6.5	21.2	26.6	3.2	3.8	2.3	1.0	0.3		Sic1
Bt	46.0	41.0	13.0	28.2	0.0	12.8	3.9	5.1	2.5	1.2	0.3		Sic
Bk1	25.9	57.2	16.8	9.6	24.3	23.4	5.2	5.0	3.3	2.7	0.7		Si1
Bk2	27.7	48.4	23.9	18.9	8.4	21.1	6.9	8.2	5.0	3.2	0.6		C1
BC	24.5	40.1	35.3	5.7	18.9	15.6	8.4	13.2	8.4	4.2	1.0		1
C	35.1	34.7	30.3	7.4	14.8	12.5	5.6	10.4	7.6	4.9	1.7		C1

Depth (inches)	.1 bar θm	.3 bar θm	1 bar θm	3 bar θm	15 bar θm	CEC meq/100g	Carbonates as CaCO ₃ %	Extractable bases meq/100g				CEC/ Clay
								Na	Ca	Mg	K	
Ap	46.8	35.8	25.8	23.3	16.7	21.5		2.7	15	6.0	1.9	.64
A	45.0	35.7	24.9	23.9	16.6	20.9		2.6	15.5	6.6	1.3	.59
Bt	37.5	30.3	21.1	20.0	16.5	23.3		2.6	14.5	8.1	1.0	.50
Bk1	31.9	26.8	18.45	18.4	12.6	12.4	2.64	2.6	49	8.6	.56	.47
Bk2	29.5	25.3	17.2	16.8	11.2	10.0	2.47	2.6	42	8.3	.49	.36
BC	30.2	25.6	17.8	17.8	12.75	11.2	1.84	2.6	40.5	9.4	.48	.46
C	35.9	32.4	24.3	21.9	17.45	18.8	1.71	2.9	37	11.1	.56	.53

Cation exchange capacity and extractable bases were determined by the sodium acetate procedure at a pH of 8.2. The CEC/clay ratios of both soils support the mixed mineralogy classification of these soils.

Moisture release curves (Fig. 2-3) were prepared from data obtained at 0.1, 0.3, 1.3, and 15 Bars of tension. From this data an individual can determine how much available water remains in a profile or how much irrigation water to add to a soil.

Figure 3.

HOUDEK MOISTURE CURVE

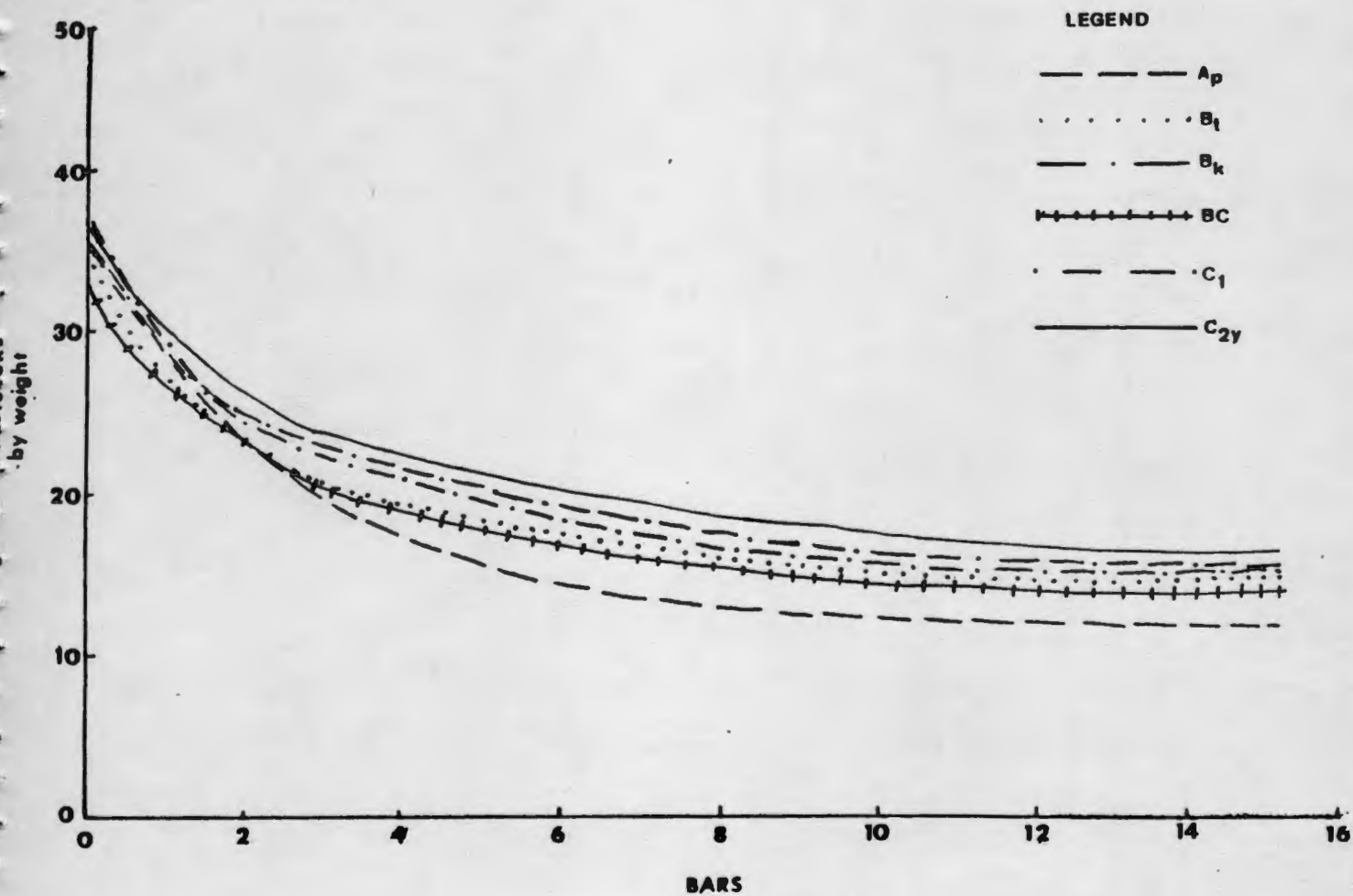
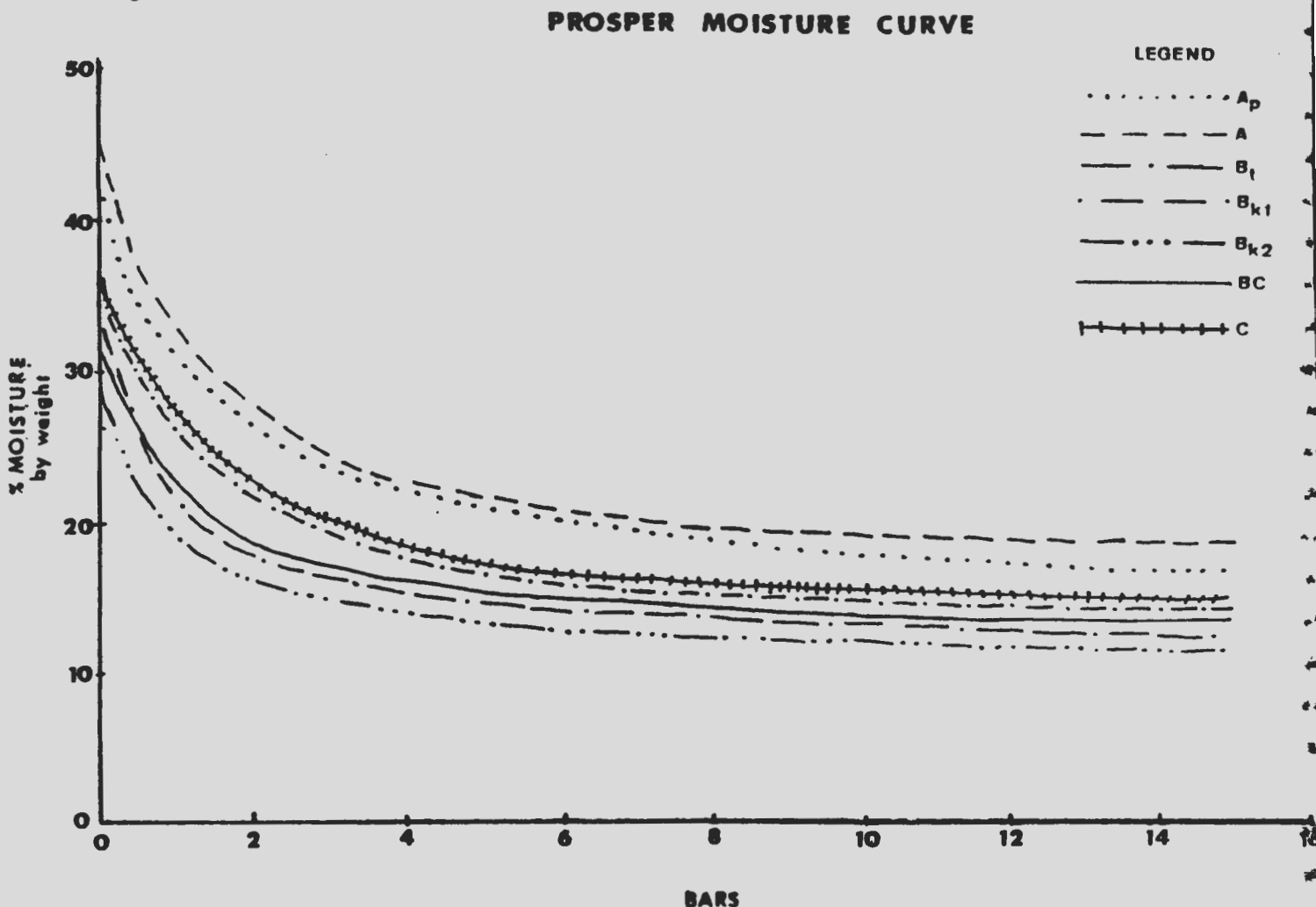


Figure 4.



Preliminary investigations were made of the bulk density, organic matter content, and pH levels across three replications of the tillage treatment plots. More detailed analyses of these plots is being made by the wheat taskforce. These data should be used as representative values for the Houdek soil.

No tillage layer was detected in any treatment that would impeded root penetration. Organic matter and soil reaction (pH) values are representative of those found on Houdek soils.

Table 5. Mean Bulk Density of Tillage Treatment Plots on Houdek Soils.¹

Depth Inches	Number	Plowed	Tillage Minimum	No-Till
0-2	3	1.14 (.07)	1.19 (.11)	1.19 (.07)
2-4	3	1.17 (.20)	1.21 (.11)	1.26 (.11)
4-6	3	1.15 (.21)	1.16 (.05)	1.20 (.03)
6-8	3	1.09 (.09)	1.24 (.20)	1.19 (.02)
8-10	3	1.24 (.19)	1.25 (.20)	1.11 (.14)
10-12	3	1.25 (.14)	1.30 (.08)	1.19 (.12)
12-14	3	1.22 (.13)	1.33 (.07)	1.26 (.12)

Standard deviation given in parenthesis.

No significant differences at the .10 level were found among the tillage treatments at any depth.

Table 6. Mean Organic Matter Levels of Tillage Treatment Plots on Houdek Soils.

Depth Inches	Number	Plowed	Minimum Till	No-Till
0-4	3	2.33 (.12)	2.67 (.29)	2.87 (.29)
4-8	3	2.10 (.85)	2.57 (.42)	2.57 (.31)

No significant differences were found at the .10 level due to tillage treatments.

Standard deviation is given in parenthesis.

Table 7. Mean pH Levels of Tillage Treatment Plots on Houdek Soils.

Depth Inches	Number	Plowed	Minimum Till	No-Till
0-4	3	6.57 (.17)	6.20 (.17)	6.27 (.23)
4-8	3	6.57 (.21)	6.63 (.21)	6.47 (.15)

Standard deviation is given in parenthesis.

No significant differences at the .10 level were found due to tillage treatments.

Appendix of
Observation Site Data

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
1.	0-4 4-10 10-29 29-42 42-54 54-60	Ap Bt Bk BC C1 C2Y	C1 C C1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/2 2.5Y5/2 2.5Y5/3 2.5Y6/3	ffd 10YR5/1 " "	10"	10"
2.	0-8 8-13 13-25 25-33 33-60	Ap Bt Bk BC C	C1 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y5/2 5Y5/3		13"	13"
3.	0-8 8-17 17-22 22-31 31-50 50-60	Ap A 8t Bk BC C	Sic1 Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR5/2 2.5Y5/3 2.5Y6/3	ffd5Y5/0	22"	22"
4.	0-8 8-12 12-21 21-40 40-60	Ap A Bt Bk C	Sic1 Sic1 Sic1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y5/2 2.5Y5/4	ffd5y5/0	21"	21"
5.	0-8 8-14 14-19 19-29 29-37 37-60	Ap A Bt Bk BC C	Sic1 Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 10YR4/2 2.5Y5/2 2.5Y5/4 5Y5/3	fff5y5/0	14"	19"
6.	0-8 8-15 15-23 23-29 29-35 35-60	Ap A Bt Bk BC C	Sic1 Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y4/3 2.5Y5/2 5Y5/3		23"	23"
7.	0-7 7-14 14-22 22-27 27-41 41-60	Ap A Bt Bk BC C	Sic1 Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/1 2.5Y4/2 2.5Y5/2 2.5Y5/4	ffd5Y4/0	22"	22"
8.	0-8 8-13 13-19 19-31 31-41 41-60	Ap A Bt Bk BC C	Sic1 Sic1 Sic C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y4/2 2.5Y5/2 2.5Y6/3	ffd5Y4/0	19"	19"
9.	0-7 7-17 17-25 25-60	Ap Bt BC C	Sic1 Sic C1 C1	10YR2/1 10YR3/2 2.5Y5/4 2.5Y5/3	ffd5Y4/0	17"	17"
10.	0-7 7-17 17-25 25-29 29-60	Ap 8t Bk BC C	Sic1 C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/1 2.5Y5/3 2.5Y6/3	ffd5Y4/0	17"	17"
11.	0-8 8-15 15-26 26-31 31-60	Ap Bt Bk BC C	Sic1 C1 C1 C1 C1	10YR2/1 10YR3/1 10YR4/3 2.5Y5/2 5Y5/3		15"	15"
12.	0-7 7-11 11-29 29-38 38-60	Ap Bt Bk BC C	C1 C1 C1 C1 C1	10YR2/1 10YR3/1 10YR4/3 2.5Y5/2 5Y5/3		11"	11"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
13.	0-7 7-11 11-22 22-33 33-60	Ap Bt Bk BC C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y4/3 5Y5/3		11"	11"
14.	0-7 7-12 12-20 20-32 32-39 39-60	Ap A Bt Bk BC C	Sic1 Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/1 10YR4/3 2.5Y5/2 2.5Y5/4	Cmd5Y4/0	20"	20"
15.	0-7 7-11 11-30 30-35 35-60	Ap Bt Bk BC C	S11 Sic C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/1 2.5Y5/3 2.5Y6/3		11"	11"
16.	0-5 5-10 10-30 30-60	Ap Bt Bk C	C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 5Y5/3		10"	10"
17.	0-8 8-16 16-25 25-38 38-45 45-60	Ap A Bt Bk BC C	Sic1 Sic Sic C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR5/3 2.5Y5/4 5Y5/3	Cmd2.5Y4/0	25"	25"
18.	0-9 9-17 17-24 24-33 33-44 44-60 sand lens 24-33"	Ap A Bt1 Bt2 Bk C	Sic1 Sic1 Sic Sic C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR5/4 2.5Y5/2 2.5Y6/3	Cmd2.5Y370	24"	33"
19.	0-7 7-14 14-28 28-36 36-60	Ap A Bt Bk C	Sic1 Sic Sic C1 C1	10YR2/1 10YR3/1 10YR3/2 10YR4/3 2.5Y5/3	fff2.5Y4/0	28"	28"
20.	0-9 9-18 18-22 22-38 38-49 49-60	Ap A Bt Bk BC C	S11 S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y4/2 2.5Y6/3 5Y5/3	fff5Y5/0	18"	22"
21.	0-7 7-14 14-28 28-35 35-60	A Bt Bk BC C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y5/4 2.5Y5/3	ffd5Y4/0	14"	14"
22.	0-7 7-13 13-29 29-60	A Bt Bk C	C1 Sic C1 C1	10YR2/1 10YR3/2 2.5Y5/2 5Y5/3		13"	13"
23.	0-7 7-12 12-30 30-60	A Bt Bk C	S11 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/3 5Y5/3		12"	12"
24.	0-9 9-19 19-36 36-44 44-60	Ap Bt Bk BC C	Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y5/2 2.5Y5/4	Cmd5Y5/0	19"	19"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
25.	0-7 7-11 11-30 30-60	Ap Bt Bk C	Sil Sic Cl Cl	10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/4		11"	11"
26.	0-6 6-12 12-30 30-37 37-60	Ap Bt Bk BC C	Cl C Cl Cl Cl	10YR2/1 10YR3/2 10YR4/3 2.5Y5/2 2.5Y5/3		12"	12"
27.	0-8 8-12 12-26 26-31 31-43 43-49 49-57	Ap A Bt Bk1 Bk2 BC C	Sic1 Sic1 Sic S11 Cl 1 Cl	10YR2/1 10YR2/2 10YR3/1 2.5Y5/4 2.5Y5/2 2.5Y4/4 2.5Y4/2	mm5Y5/0 " "	26"	26"
28.	0-9 9-16 16-23 23-31 31-60	Ap A Bt Bk C	Sic1 Sic1 Sic Cl Cl	10YR2/1 10YR3/1 10YR3/2 2.5Y5/4 5Y5/3	Cmd2.5Y4/0	23"	31"
29.	0-7 7-14 14-28 28-36 36-39 39-60	Ap A Bt Bk BC C	S11 Sic1 Sic Cl Cl Cl	10YR2/1 10YR2/2 10YR3/2 2.5Y5/2 2.5Y5/4 5Y5/3	fff5Y5/0	28"	28"
30.	0-8 8-18 18-21 21-33 33-60	Ap Bt1 Bt2 Bk C	Sic1 Sic Sic Cl Cl	10YR2/1 10YR3/2 10YR4/3 2.5Y4/3 5Y5/3	fff5Y5/0	18"	21"
31.	0-6 6-11 11-18 18-29 29-42 42-60	Ap Bt Bk BC Cl Cl C2	Cl Cl C Cl Cl Cl Cl	10YR3/1 10YR3/2 10YR5/3 2.5Y5/2 2.5Y5/3 2.5Y5/4		11"	11"
32.	0-6 6-10 10-14 14-32 32-60	Ap Bt1 Bt2 Bk Cy	S11 Sic1 Sic1 Cl Cl	10YR2/1 10YR2/2 10YR3/2 2.5Y4/3 5Y5/3		14"	14"
33.	0-7 7-10 10-14 14-30 30-38 38-60	Ap Bt1 Bt2 Bk BC C	S11 Sic1 Sic1 Cl Cl Cl	10YR2/1 10YR2/2 10YR3/2 2.5Y5/1 2.5Y5/3 2.5Y6/3	ffd5Y4/0	14"	14"
34.	0-7 7-11 11-15 15-29 29-38 38-60	Ap Bt1 Bt2 Bk BC C	S11 Sic1 Sic1 Cl Cl Cl	10YR2/1 10YR2/2 10YR3/2 2.5Y5/1 2.5Y5/3 2.5Y6/3	ffd5Y4/0	15"	15"
35.	0-9 9-19 19-39 39-45 45-60	Ap Bt Bk BC C	Sic1 Sic Cl Cl Cl	10YR2/1 10YR3/1 10YR4/3 2.5Y5/2 5Y5/3	Cmd2.5Y4/0	19"	19"
36.	0-6 6-17 17-38 38-46 46-60 Sand lens 38-43"	Ap Bt Bk BC C	Sic1 Sic Cl Cl Cl	10YR2/1 10YR3/2 2.5Y4/3 2.5Y5/2 2.5Y6/3	fff2.5Y6/0	17"	17"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
37.	0-8 8-15 15-21 21-25 25-48 48-60	Ap A Bt ₁ Bt ₂ Bk C	Sic1 Sic1 Sic Sic C1 C1	10YR2/1 10YR3/1 10YR3/2 10YR4/2 2.5Y5/3 5Y5/3	ffp10YR7/0	21"	25"
38.	0-9 9-17 17-38 38-60	Ap Bt Bk C	Sil Sic C1 C1	10YR2/1 10YR3/2 2.5Y5/3 5Y5/3	ffd2.5Y6/0	17"	17"
39.	0-8 8-17 17-34 34-60	Ap Bt Bk C	Sil Sic C1 C1	10Y2/1 10YR2/2 2.5Y5/3 5Y5/3		17"	17"
40.	0-7 7-14 14-23 23-41 40-60	Ap A Bt Bk C	Sil Sil Sic1 C1 C1	10YR2/1 10Yr3/1 10YR3/2 2.5Y5/3 2.5Y6/2	ffd5Y4/0	23"	23"
41.	0-6 6-11 11-18 18-29 29-42 42-60	Ap Bt Bk Bc C ₁ C ₂	C1 C C1 C1 C1 C1	10YR2/1 10YR3/2 10YR5/3 2.5Y5/2 2.5Y5/3 2.5Y6/2	fff2.5Y5/0	11"	11"
42.	0-7 7-10 10-13 13-33 33-60	Ap Bt ₁ Bt ₂ Bk C	Sil Sic1 Sic1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y4/3 5Y5/3		13"	13"
43.	0-7 7-10 10-14 14-30 30-38 38-60	Ap Bt ₁ Bt ₂ Bk Bc C	Sil Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y5/2 2.5Y6/2 2.5Y6/3		14"	14"
44.	0-8 8-13 13-15 15-30 30-40 40-60	Ap Bt ₁ Bt ₂ Bk Bc C	Sil Sic Sic1 C1 C1 C1	10Yr2/1 10YR2/2 10YR3/2 2.5Y5/1 2.5Y5/3 2.5Y6/3	ffd5Y4/0	15"	15"
45.	0-9 9-20 20-38 38-48 48-60	Ap Bt Bk Bc C	Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y5/2 2.5Y5/3	Cmf2.5Y5/0	20"	20"
46.	0-8 8-12 12-19 19-24 24-37 37-45 45-60	Ap A Bt ₁ Bt ₂ Bk Bc C	Sic1 Sic1 Sic Sic C1 C1 C1	10YR2/1 10YR3/1 10YR3/2 10YR4/2 2.5Y5/4 2.5Y5/5 2.5Y4/2	fff2.5Y5/0 " "	19"	19"
47.	0-5 5-11 11-20 20-24 24-29 29-44 44-60	Ap A Bt ₁ Bt ₂ Bk Bc C	Sil Sil Sic1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR4/3 2.5Y5/3 2.5Y5/4 5Y5/3		20"	24"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
48.	0-8 8-12 12-26 26-43 43-49 49-60	Ap A Bt Bk Bc C	Sic1 Sic1 Sic C1 C1 C1	10YR2/1 10YR2/2 10YR3/1 2.5Y5/2 2.5Y4/4 2.5Y6/4	Cmf2.5Y5/0 " "	26"	26"
49.	0-9 9-15 15-21 21-35 35-43 43-60	Ap A Bt Bk Bc C	Si1 Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 10YR3/3 2.5Y4/3 2.5Y4/4 5Y5/3	fffd2.5Y6/1	21"	21"
50.	0-7 7-11 11-17 17-30 30-43 43-60	Ap A Bt Bk Bc C	Si1 Si1 Sic1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR3/3 10YR5/3 2.5Y5/2	mcd2.5Y5/0	17"	17"
51.	0-8 8-17 17-28 28-48	Ap Bt Bc C	Si1 Sic1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 5Y5/4	fffd2.5Y5/0	17"	17"
52.	0-6 6-8 8-11 11-14 14-48	Ap Bt ₁ Bt ₂ Bc ₂ C	C1 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR3/3 10YR3/3 10YR3/3		8"	11"
53.	0-7 7-11 11-20 20-48	Ap Bt Bc C	C1 C1 C1 C1	10YR2/1 10YR2/2 2.5Y5/4 5Y5/3		11"	11"
54.	0-7 7-11 11-15 15-26 26-48	Ap Bt Bc C ₁ C ₂	C1 C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 5Y5/3 2.5Y5/4	cmd5Y5/0	11"	15"
55.	0-9 9-14 14-34 34-48	Ap Bt Bc C	C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/4	fffd5Y5/0	14"	14"
56.	0-7 7-16 16-24 24-29 29-48	Ap Bt Bc C ₁ C ₂	Si1 C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/4 5Y5/3	fff5Y5/0	16"	16"
57.	0-9 9-12 12-16 16-26 26-48	Ap A At Bc C	Si1 Si1 C1 C1 C1	10YR2/1 10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/4	fcd5Y5/0	16"	16"
58.	0-10 10-16 16-21 21-48	Ap Bt Bc C	Si1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y3/2 2.5Y5/4	fffd5Y5/0	16"	16"
59.	0-10 10-14 14-27 27-33 33-48	Ap A Bt Bc C	Sic1 Sic1 Sic C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y5/2 5Y5/3	fffd2.5Y6/1	2"	None

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
60.	0-9 9-15 15-21 21-25 25-48	Ap Bt ₁ Bt ₂ Bc C	Sil Sic1 Sic1 Cl Cl	10YR2/1 10YR3/2 10YR3/3 2.5Y4/3 5Y5/3	ffd2.5Y6/1	21"	25"
61.	0-8 8-17 17-21 21-24 24-48 48-60	Ap Bt ₁ Bt ₂ Bk Bc C	Sil Sic1 Sic1 Cl Cl	10YR2/1 10YR3/2 10YR4/2 2.5Y6/4 5Y5/3	ffd2.5Y6/1 2.5Y6/6	17"	24"
62.	0-7 7-11 11-19 19-26 26-48	Ap A Bt Bc C	Sil Sic1 Sic Cl Cl	10YR2/1 10YR3/2 10YR3/1 2.5Y5/2 2.5Y5/3		19"	26"
63.	0-7 7-14 14-18 18-24 24-48	Ap A Bt Bk C	Sil Sic1 Sic Cl Cl	10YR2/1 10YR3/2 10YR3/1 2.5Y5/2 2.5Y5/3		18"	24"
64.	0-8 8-12 12-26 26-31 31-43 43-49 49-57	Ap A Bt Bk ₁ Bk ₂ Bc C	Sic1 Sic1 Sic Sic Cl L Cl	10YR2/1 10YR2/2 10YR3/1 2.5Y5/4 2.5Y5/2 2.5Y4/4 2.5Y4/2		26"	26"
65.	0-8 8-12 12-19 19-25 25-45 45-60	Ap Bt ₁ Bt ₂ Bc C ₁ C ₂	Sil Sic1 Sic1 Cl Cl Cl	10YR2/1 10YR2/1 10YR3/2 2.5Y6/2 2.5Y4/4 2.5Y6/4		19"	19"
66.	0-7 7-13 13-20 20-30 30-48 48-60	Ap Bt Bk Bc C ₁ C ₂	Sic1 Sic Cl Cl Cl Cl	10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/2 2.5Y4/2 2.5Y4/2		16"	16"
67.	0-8 8-12 12-24 24-32 32-45 45-60	Ap Bt Bt ₁ Bt ₂ Bk Bc C	Sil Sic1 Sic1 Cl Cl Cl	10YR2/1 10YR4/2 10YR4/2 2.5Y5/1 2.5Y5/2 2.5Y5/4		8"	12"
68.	0-8 8-20 20-32 32-60	Ap Bt Bc C	Sil Sic1 L Cl	10YR2/1 10YR4/2 10YR5/4 10YR5/4		8"	8"
69.	0-8 8-14 14-23 23-33 33-42 42-60	Ap Bt Bk Bc C ₁ C ₂	Cl Sic1 Sic1 Cl Cl Cl	10YR2/1 10YR3/2 10YR4/2 2.5Y5/1 2.5Y5/2 2.5Y5/4		14"	14"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
70.	0-6 6-13 13-18 18-40 40-60	Ap Bt Bk Bc C	Si1 C1 L C1 C1	10YR2/1 10YR3/2 10YR4/3 2.5Y5/2 2.5Y5/2	fff2.5Y5/0	13"	13"
71.	0-6 6-11 11-19 19-41 41-60	Ap Bt ₁ Bt ₂ Bc ₂ C	C1 C1 C1 C1 L	10YR2/1 10YR3/3 10YR4/2 2.5Y5/1 2.5Y5/2	fff2/5Y5/0	6"	11"
72.	0-10 10-48	Ap C	Si1 C1	10YR2/1 5Y4/2	fff2.5Y5/0	10"	10"
73.	0-6 6-18 18-25 25-38 38-60	Ap Bt ₁ Bt ₂ Bc ₂ C	Si1 Si1 C1 C1 L	10YR2/1 10YR3/2 2.5Y4/1 2.5Y4/3 2.5Y5/4	fff5Y5/0	18"	25"
74.	0-5 5-10 10-17 17-30 30-60	Ap Bt ₁ Bt ₂ Bc ₂ C	Si1 Si1 Si1 C1 C1	10YR2/1 10YR3/2 10YR4/2 10YR5/2 2.5Y5/4		17"	17"
75.	0-7 7-11 11-19 19-48 48-60	Ap Bt Bk Bc C	C1 C1 C1 C1 C1	10YR2/1 10YR4/2 10YR5/2 2.5Y5/3 2.5Y5/4		7"	19"
76.	0-5 5-11 11-15 15-30 30-60	Ap Bt Bk Bc C	C1 Si1 C1 C1 C1	10YR2/1 10YR4/2 10YR5/2 2.5Y5/4 2.5Y5/5		5"	11"
77.	0-8 8-11 11-15 15-26 26-41 41-60	Ap Bt Bk Bc C ₁ C ₂	Si1 Si1 C1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/2 2.5Y5/2 2.5Y5/3 2.5Y5/4		11"	15"
78.	0-6 6-12 12-17 17-29 29-45 45-60	Ap Bt ₁ Bt ₂ Bk ₂ Bc C	Si1 Si1 Si1 C1 C1 C1	10YR2/1 10YR3/2 10YR4/2 2.5Y5/2 2.5Y5/3 2.5Y5/4		12"	17"
79.	0-5 5-11 11-16 16-21 21-46 46-60	Ap Bt ₁ Bt ₂ Bk Bc C	C1 Si1 Si1 C1 C1 C1	10YR2/1 10YR3/2 10YR5/2 2.5Y4/3 2.5Y4/4 2.5Y5/3	fff2.5Y6/1 "	11"	16"
80.	0-7 7-12 12-20 20-28 28-42 42-60	Ap A Bt ₁ Bt ₂ Bc ₂ C	Si1 Si1 Si1 Si1 C1 C1	10YR2/1 10YR2/2 10YR3/1 10YR3/2 2.5Y5/2 2.5Y4/4		28"	28"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
81.	0-8 8-14 14-20 20-43 43-60	Ap Bt Bk Bc C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR3/2 2.5Y5/2 5Y5/4	fff2.5Y4/0	20"	14"
82.	0-6 6-11 11-18 18-29 29-42 42-60	Ap Bt Bk Bc C ₁ C ₂	S11 Sic1 C1 C1 C1 C1	10YR2/1 10YR3/2 2.5Y4/2 2.5Y4/3 2.5Y5/4 2.5Y5/3	fff2.5Y5/0 "	18"	18"
83.	0-6 6-14 14-23 23-29 29-60	Ap Bt ₁ Bk ₁ Bc C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/3 2.5Y5/2 2.5Y5/5 5Y5/3	fff5Y5/0	14"	14"
84.	0-11 11-15 15-22 22-27 27-60	Ap Bt ₁ Bt ₂ Bk ₂ C	C1 C c C1 C1	10YR2/1 10YR3.2 2.5Y4/4 2.5Y5/4 5Y5/3	fff5Y5/0	15"	22"
85.	0-6 6-14 14-18 18-48 48-60	Ap Bt Bk Bc C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10Y3/3 2.5Y5/3 5Y5/3	fff5Y5/1	14"	14"
86.	0-8 8-22 22-32 32-40 40-60	Ap Bt Bk Bc C	Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 2/5Y5/3 2.5Y5/4 5Y5/4		22"	None
87.	0-8 8-18 18-26 26-35 35-60	Ap Bt Bk Bc C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR3/3 2.5Y5/3 2/5Y6/3	fff5Y5/1	18"	18"
88.	0-8 8-17 17-27 27-33 33-60	Ap Bt Bk Bc C	S11 Sic1 C1 C1 C1	10YR2/1 10YR3/2 10YR3/3 2.5Y4/4 2/5Y5/3		17"	17"
89.	0-9 9-11 11-19 19-32 32-45 45-60	Ap A Bt Bk Bc C	Sic1 Sic1 Sic C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR3/3 2.5Y4/3 2.5Y5/3	fff2.5Y6/1 2.5Y6/6	19"	19"
90.	0-7 7-18 18-30 30-38 38-60	Ap Bt Bk Bc C	Sic1 Sic C1 C1 C1	10YR2/1 10YR3/2 2.5Y5/2 2.5Y5/4 5Y5/3	fff5Y5/1	18"	13"
91.	0-7 7-13 13-19 19-34 34-60	Ap Bt ₁ Bt ₂ Bk ₂ C	Sic1 Sic Sic C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y4/2 2.5Y5/3		19"	19"
92.	0-7 7-11 11-18 18-27 27-41 41-60	Ap Bt ₁ Bt ₂ Bk ₂ Bc C	Sic1 Sic Sic C1 C1 C	10YR2/1 10YR2/2 10YR3/2 10YR4/3 2.5Y5/2 5Y5/2	fff2.5Y6/1	18"	27"

Site	Depth (inches)	Horizon	Texture	Color	Mottles	Depth of Mollic (inches)	Depth to Carbonates (inches)
93.	0-8 8-15 15-20 20-28 28-45 45-60	Ap A Bt Bk Bc C	Si1 Si1 Si1 C1 C1 C1	10YR2/1 10YR2/2 10YR3/2 10YR4/3 2.5Y5/2 2.5Y5/4	fff5Y5/1 "	20"	20"
94.	0-8 8-12 12-18 18-25 25-60	Ap Bt Bt ₁ Bk ² C	Si1 Si1 Si1 C1 C1	10YR2/1 10YR2/2 10YR3/2 2.5Y5/4 5Y5/3		18"	18"
95.	0-8 8-15 15-22 22-30 30-60	Ap Bt Bk Bc C	C1 C C1 C1 C1	10YR2/1 10YR3/2 2.5Y4/2 2.5Y4/3 2.5Y5/3	fff2/5Y4/0	15"	15"
96.	0-7 7-12 12-21 21-35 35-60	Ap Bt Bk Bc C	C1 C C1 C1 C1	10YR2/1 10YR2/2 10YR3/3 2.5Y5/4 5Y5/3		12"	12"
97.	0-7 7-12 12-28 28-42 42-60	Ap Bt Bk C ₁ C ₂	C1 C C1 C1 C1	10YR2/1 10YR3/2 10YR3/3 2.5Y5/4 5Y5/3	fff5Y5/1	12"	12"