Soil Survey Investigations Report No. 2

Soil Survey Laboratory Data and Descriptions for Some Soils of...

NORTH DAKOTA

SOIL CONSERVATION SERVICE • U.S. DEPARTMENT OF AGRICULTURE
In cooperation with
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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August 1966

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1. SAMPLE COLLECTION AND PREPARATION
   A. Field sampling
      1. Site selection
      2. Soil sampling
         a. Stony soils
   B. Laboratory preparation
      1. Standard (airdry)
         a. Square-hole 2-mm sieve
         b. Round-hole 2-mm sieve
      2. Field moist
      3. Carbonate-containing material
      4. Carbonate-indurated material
2. CONVENTIONS
   A. Size-fraction base for reporting
      1. <2-mm
      2. <size specified
   B. Data-sheet symbols
      tr: trace, not measurable by quantitative procedure used or less than reportable amount
      tr(s): trace, detectable only by qualitative procedure more sensitive than quantitative procedure used
      analysis run but none detected
      -(s): none detected by sensitive qualitative test
      blank: analysis not run
      nd: analysis not run
      <: less than reported amount or none present
3. PARTICLE-SIZE ANALYSES
   A. <2-mm fraction (pipet method)
      1. Airdry samples
         a. Carbonate and noncarbonate clay
      2. Moist samples
         a. Carbonate and noncarbonate clay
   B. >2-mm fraction
      1. Weight estimates
      2. Volume estimates
4. FABRIC-RELATED ANALYSES
   A. Bulk density
      1. Saran-coated clods
         a. Field state
         b. Airdry
         c. 30-cm absorption
         d. 1/3-bar desorption I
         e. 1/3-bar desorption II
         f. 1/3-bar desorption III
         g. 1/10-bar desorption
         h. Ovendry
      2. Paraffin-coated clods
         a. Ovendry
      3. Cores
         a. Field moist
      4. Nonpolar-liquid-saturated clods
   B. Water retention
      1. Pressure-plate extraction (1/3 or 1/10 bar)
         a. Sieved samples
         b. Soil pieces
         c. Natural clods
         d. Cores
      2. Pressure-membrane extraction (15 bars)
      3. Sand table absorption
      4. Field state
      5. Airdry
   C. Water-retention difference
      1. 1/3 bar to 15 bars
      2. 1/10 bar to 15 bars
   D. Coefficient of linear extensibility
      1. Dry to moist
   E. Micromorphology
      1. Thin sections
         a. Preparation
         b. Interpretation
         c. Moved-clay percentage
5. ION-EXCHANGE PROPERTIES
   A. Cation-exchange capacity
      1. NH_4OAc, pH 7.0
         a. Direct distillation
         b. Displacement, distillation

5A. Cation-exchange capacity (cont.)
      2. NaOAc, pH 8.2
         a. Centrifuge method
      3. Sum of cations
         a. Acidity by $BaCl_2$-TEA, pH 8.2; bases by NH_4OAc, pH 7.0
      4. KOAc, pH 7.0
      5. $BaCl_2$, pH 8.2
         a. Barium by flame photometry
   B. Extractable bases
      1. NH_4OAc extraction
         a. Uncorrected
         b. Corrected (exchangeable)
      2. KCl-TEA extraction, pH 8.2
   C. Base saturation
      1. NH_4OAc, pH 7.0
      2. NaOAc, pH 8.2
      3. Sum of cations
   D. Sodium saturation (exchangeable Na pct.)
      1. NaOAc, pH 8.2
      2. NH_4OAc, pH 7.0
   E. Sodium adsorption ratio
6. CHEMICAL ANALYSES
   A. Organic carbon
      1. Acid dichromate digestion
         a. $FeSO_4$ titration
         b. CO_2 evolution, gravimetric
      2. Dry combustion
         a. CO_2 evolution I
         b. CO_2 evolution II
      3. Peroxide digestion
         a. Weight loss
   B. Nitrogen
      1. Kjeldahl digestion
         a. Ammonia distillation
      2. Semimicro Kjeldahl
         a. Ammonia distillation
   C. Iron
      1. Dithionite extraction
         a. Dichromate titration
         b. EDTA titration
      2. Dithionite-citrate extraction
         a. Orthophenanthroline colorimetry
      3. Dithionite-citrate-bicarbonate extraction
         a. Potassium-thiocyanate colorimetry
      4. Pyrophosphate-dithionite extraction
   D. Manganese
      1. Dithionite extraction
         a. Permanganate colorimetry
   E. Calcium carbonate
      1. HCl treatment
         a. Gas volumetric
         b. Manometric
         c. Weight loss
         d. Weight gain
         e. Titrimetric
      2. Sensitive qualitative method
         a. Visual, gas bubbles
   F. Gysum
      1. Water extract
         a. Precipitation in acetone
   G. Aluminum
      1. KCl extraction I, 30 min
         a. Aluminon I
         b. Aluminon II
         c. Aluminon III
         d. Fluoride titration
      2. KCl extraction II, overnight
         a. Aluminon I
      3. NH_4OAc extraction
         a. Aluminon III
      4. NaOAc extraction
         a. Aluminon III
   H. Extractable acidity
      1. $BaCl_2$-triethanolamine I
         a. Back-titration with HCl
      2. $BaCl_2$-triethanolamine II
         a. Back-titration with HCl
      3. KCl-triethanolamine
         a. Back-titration with NaOH
   I. Carbonate
      1. Saturation extract
         a. Acid titration

6. CHEMICAL ANALYSES (cont.)
   J. Bicarbonate
      1. Saturation extract
         a. Acid titration
   K. Chloride
      1. Saturation extract
         a. Mohr titration
         b. Potentiometric titration
   L. Sulfate
      1. Saturation extract
         a. Gravimetric, $BaSO_4$
      2. NH_4OAc extraction
         a. Gravimetric, $BaSO_4$
   M. Nitrate
      1. Saturation extract
         a. PDS acid colorimetry
   N. Calcium
      1. Saturation extract
         a. EDTA titration
      2. NH_4OAc extraction
         a. EDTA-alcohol separation
         b. Oxalate-permanganate I
         c. Oxalate-permanganate II Fe, Al, and Mn removed
         d. Oxalate-cerate
      3. NH_4Cl-EtOH extraction
         a. EDTA titration
      4. KCl-TEA extraction
         a. Oxalate-permanganate
   O. Magnesium
      1. Saturation extract
         a. EDTA titration
      2. NH_4OAc extraction
         a. EDTA-alcohol separation
         b. Phosphate titration
         c. Gravimetric, $Mg_2P_2O_7$
      3. NH_4Cl-EtOH extraction
         a. EDTA titration
   P. Sodium
      1. Saturation extract
         a. Flame photometry
      2. NH_4OAc extraction
         a. Flame photometry
   Q. Potassium
      1. Saturation extract
         a. Flame photometry
      2. NH_4OAc extraction
         a. Flame photometry
   R. Sulfur
      1. $NaHCO_3$ extraction, pH 8.5
         a. Methylene blue
   S. Total phosphorus
      1. Perchloric-acid digestion
         a. Molybdovanadophosphoric-acid colorimetry
7. MINERALOGY
   A. Instrumental analysis
      1. Preparation
         a. Carbonate removal
         b. Organic-matter removal
         c. Iron removal
         d. Particle-size fractionation
      2. X-ray diffraction
      3. Differential thermal analysis
   B. Optical analysis
      1. Grain studies
   C. Total analysis
      1. Chemical
      2. X-ray emission spectrography
   D. Surface area
      1. Glycerol retention
8. MISCELLANEOUS
   A. Saturated paste, mixed
      1. Saturation extract
         a. Conductivity
      2. Conductivity, saturated paste
   B. Saturated paste, capillary rise
      1. Saturation extract
         a. Conductivity
   C. pH
      1. Soil suspensions
         a. Water dilution
         b. Saturated paste
         c. KCl
   D. Ratios
      1. To total clay
      2. To noncarbonate clay
      3. Ca to Mg (extractable)

PREFACE

This publication is one in a new U.S. Department of Agriculture series established to preserve and make available technical information resulting from soil survey investigations. These investigations have been going on for about two decades. Data from them have been distributed in unpublished form to those immediately concerned. Some of the data and descriptions have appeared in technical journals, in regional bulletins, in USDA technical bulletins, and in the text of published soil surveys. But most were not available to all who might use them.

We intend to publish in this series all data from the soil survey laboratories that form reasonably complete characterizations of soils. Already-assembled data and descriptions will be published just as rapidly as they can be prepared for printing. Fragmentary data collected as reference points for specific soil surveys will not be included.

While these data were being assembled, there were many changes in laboratory methods. Some were improved and some new ones were devised. Consequently, laboratory data for different soils cannot always be directly compared without allowance for the method.

The method used is indicated by symbol in the column headings of the data table. These symbols are identified in the code sheet on the opposite page. Each method is described in the first number of this series, "Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples," SSIR No. 1.

Ways of describing soils have also changed. Soil descriptions have become explicit on more and more features. The systems for designating horizons and for classifying soils have been changed.

The soil descriptions published here were prepared as working documents to meet a specific need of a soil survey at the time the soil samples were collected. The soil scientists who wrote them had no idea they would be published. Editing has been limited for the most part to that necessary for conformance to the "Soil Survey Manual." Field textural estimates have been retained, even though some are at variance with the laboratory data, because the field estimates themselves are important data.

There were several reasons for sampling these soils. Some were sampled to study soil genesis, some to facilitate classification, and some to obtain data to permit more useful interpretations. Those sampled for genesis or classification studies do not always fit neatly into our present concepts of soil series. Partly because of these studies, our concepts of some soil series have been modified. As a consequence, the soil series name assigned a soil at the time of sampling is not always the name that would be assigned today. Soil series names in this publication follow 1965 series definitions.

Soil Survey
Soil Conservation Service

NORTH DAKOTA

Soil Series	County	Soil Survey No.	Page
Aastad	Renville	S50NDak-38-5	3
	Sargent	S56NDak-41-1	5
	Sargent	S56NDak-41-6	7
Arnegard	Stark	S58NDak-45-14	9
	Stark	S58NDak-45-15	11
Bainville	Stark	S58NDak-45-11	13
	Stark	S58NDak-45-12	15
Barnes	Barnes	S53NDak-2-1	17
	Cavalier	S54NDak-10-1	19
	Cavalier	S54NDak-10-2	21
	Dickey	S53NDak-11-2	23
	Renville	S50NDak-38-2	25
	Renville	S50NDak-38-3	27
	Steele	S53NDak-46-1	29
Bearden	Cass	S53NDak-9-5	31
	Cass	S53NDak-9-6	33
	Pembina	S54NDak-34-1	35
	Pembina	S54NDak-34-2	37
*Brantford	Griggs	S59NDak-20-1	39
	Griggs	S59NDak-20-2	41
	Nelson	S59NDak-32-1	43
	Nelson	S59NDak-32-2	45
Cavour	Burke	S49NDak-7-1	47
	Burke	S58NDak-7-5	49
	Renville	S49NDak-38-1	51
	Ward	S58NDak-51-2	53
Cresbard	Renville	S49NDak-38-7	55
	Ward	S58NDak-51-3	57
	Ward	S58NDak-51-4	59
*Des Lacs	Burke	S49NDak-7-3	61
Eckman	Wells	S53NDak-52-1	63
	Wells	S53NDak-52-2	65
Embden	Bottineau	S51NDak-5-6	67
Exline	Sargent	S56NDak-41-7	69
	Sargent	S56NDak-41-9	71
Fargo	Bottineau	S51NDak-5-5	73
	Bottineau	S51NDak-5-4	75
	Bottineau	S51NDak-5-8	77
	Bottineau	S51NDak-5-9	79
	Cass	S53NDak-9-3	81
	Cass	S53NDak-9-4	83
	Walsh	S54NDak-50-1	85
	Walsh	S54NDak-50-2	87
Farland	Stark	S58NDak-45-13	89
	Stark	S58NDak-45-20	91
Forman	Barnes	S59NDak-2-1	93
	Barnes	S59NDak-2-2	95
	Dickey	S53NDak-11-1	97
	Ransom	S59NDak-37-3	99
	Sargent	S56NDak-41-2	101
	Sargent	S56NDak-41-5	103
	Sargent	S59NDak-41-1	105
Gardena	Bottineau	S51NDak-5-7	107
	Renville	S50NDak-38-1	109
	Wells	S53NDak-52-3	111
	Wells	S53NDak-52-4	113
Glyndon	Bottineau	S53NDak-5-3	115
	Bottineau	S53NDak-5-4	117
	Bottineau	S53NDak-5-5	119
	Bottineau	S53NDak-5-6	121
	Bottineau	S51NDak-5-2	123
	Bottineau	S53NDak-5-1	125
	Bottineau	S53NDak-5-2	127
Hamerly	Nelson	S53NDak-32-1	129
	Nelson	S53NDak-32-2	131
	Renville	S50NDak-38-4	133

*Soil series names preceded by an asterisk are names of tentative series.

NORTH DAKOTA

Soil Series	County	Soil Survey No.	Page
Hamerly	Renville	S50NDak-38-7	135
Hecla	Bottineau	S51NDak-5-1	137
	Sargent	S56NDak-41-1[illegible]	139
	Sargent	S56NDak-41-13	141
*Kenaston	Burke	S58NDak-7-2	143
	Burke	S58NDak-7-3	145
	Burke	S58NDak-7-6	147
	Burke	S49NDak-7-2	149
	Ward	S49NDak-51-1	151
Lefor	Stark	S58NDak-45-22	153
Maddock	Richland	S54NDak-39-1	155
	Richland	S54NDak-39-2	157
Makoti	Mountrail	S58NDak-31-2	159
	Mountrail	S58NDak-31-3	161
Manning	Stark	S58NDak-45-1	163
Miranda	Burke	S58NDak-7-4	165
	Ward	S58NDak-51-1	167
Morton	Hettinger	S54NDak-21-3	169
	Stark	S58NDak-45-16	171
	Stark	S58NDak-45-17	173
Overly	Cass	S53NDak-9-1	175
	Cass	S53NDak-9-2	177
Parnell	Sargent	S56NDak-41-4	179
	Sargent	S56NDak-41-8	181
Promise	Stark	S58NDak-45-7	183
	Stark	S58NDak-45-8	185
	Stark	S58NDak-45-18	187
	Stark	S58NDak-45-19	189
Regent	Dunn	S58NDak-13-1	191
	Hettinger	S54NDak-21-1	193
	Hettinger	S54NDak-21-2	195
	Stark	S54NDak-45-3	197
	Stark	S58NDak-45-4	199
	Stark	S58NDak-45-9	201
	Stark	S58NDak-45-10	203
Renshaw	LaMoure	S59NDak-23-1	205
	Ransom	S59NDak-37-1	207
	Ransom	S59NDak-37-2	209
*Renville	Renville	S49NDak-38-3	211
	Renville	S49NDak-38-4	213
	Renville	S50NDak-38-6	215
*Sen	Golden Valley	S58NDak-17-1	217
	Golden Valley	S59NDak-17-1	219
*Sherwood	Renville	S49NDak-38-2	221
	Renville	S50NDak-38-8	223
	Renville	S50NDak-38-11	225
Stirum	Sargent	S56NDak-41-11	227
	Sargent	S56NDak-41-14	229
Straw	Stark	S58NDak-45-2	231
	Stark	S58NDak-45-3	233
Svea	Barnes	S53NDak-2-2	235
	Barnes	S53NDak-2-3	237
	Renville	S49NDak-38-6	239
*Tagus	Burke	S58NDak-7-1	241
	Mountrail	S58NDak-31-1	243
*Temvik	Emmons	S54NDak-15-1	245
	Emmons	S54NDak-15-2	247
Tetonka	Sargent	S56NDak-41-3	249
	Sargent	S56NDak-41-10	251
*Towner	Bottineau	S51NDak-5-3	253
	Bottineau	S51NDak-5-10	255
Vebar	Stark	S54NDak-45-1	257
	Stark	S54NDak-45-2	259
*Westhope	Renville	S50NDak-38-9	261
	Renville	S50NDak-38-10	263
Williams	Ward	S54NDak-51-1	265
	Ward	S54NDak-51-2	267
	Williams	S54NDak-53-1	269
	Williams	S54NDak-53-2	271

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NORTH DAKOTA

County	Soil Series	Soil Survey No.	Page
Barnes	Barnes	S53NDak-2-1	17
	Forman	S59NDak-2-1	93
	Forman	S59NDak-2-2	95
	Svea	S53NDak-2-2	235
	Svea	S53NDak-2-3	237
Bottineau	Embden	S51NDak-5-6	67
	Fargo	S51NDak-5-5	73
	Fargo	S51NDak-5-4	75
	Fargo	S51NDak-5-8	77
	Fargo	S51NDak-5-9	79
	Gardena	S51NDak-5-7	107
	Glyndon	S53NDak-5-3	115
	Glyndon	S53NDak-5-4	117
	Glyndon	S53NDak-5-5	119
	Glyndon	S53NDak-5-6	121
	Glyndon	S51NDak-5-2	123
	Glyndon	S53NDak-5-1	125
	Glyndon	S53NDak-5-2	127
	Hecla	S51NDak-5-1	137
	*Towner	S51NDak-5-3	253
	*Towner	S51NDak-5-10	255
Burke	Cavour	S49NDak-7-1	47
	Cavour	S58NDak-7-5	49
	*Des Lacs	S49NDak-7-3	61
	*Kenaston	S58NDak-7-2	143
	*Kenaston	S58NDak-7-3	145
	*Kenaston	S58NDak-7-6	147
	*Kenaston	S49NDak-7-2	149
	Miranda	S58NDak-7-4	165
	*Tagus	S58NDak-7-1	241
Cass	Bearden	S53NDak-9-5	31
	Bearden	S53NDak-9-6	33
	Fargo	S53NDak-9-3	81
	Fargo	S53NDak-9-4	83
	Overly	S53NDak-9-1	175
	Overly	S53NDak-9-2	177
Cavalier	Barnes	S54NDak-10-1	19
	Barnes	S54NDak-10-2	21
Dickey	Barnes	S53NDak-11-2	23
	Forman	S53NDak-11-1	97
Dunn	Regent	S58NDak-13-1	191
Emmons	*Temvik	S54NDak-15-1	245
	*Temvik	S54NDak-15-2	247
Golden Valley	*Sen	S58NDak-17-1	217
	*Sen	S59NDak-17-1	219
Griggs	*Brantford	S59NDak-20-1	39
	*Brantford	S59NDak-20-2	41
Hettinger	Morton	S54NDak-21-3	169
	Regent	S54NDak-21-1	193
	Regent	S54NDak-21-2	195
LaMoure	Renshaw	S59NDak-23-1	205
Mountrail	Makoti	S58NDak-31-2	159
	Makoti	S58NDak-31-3	161
	*Tagus	S58NDak-31-1	243
Nelson	*Brantford	S59NDak-32-1	43
	*Brantford	S59NDak-32-2	45
	Hamerly	S53NDak-32-1	129
	Hamerly	S53NDak-32-2	131
Pembina	Bearden	S54NDak-34-1	35
	Bearden	S54NDak-34-2	37
Ransom	Forman	S59NDak-37-3	99
	Renshaw	S59NDak-37-1	207
	Renshaw	S59NDak-37-2	209
Renville	Aastad	S50NDak-38-5	3
	Barnes	S50NDak-38-2	25
	Barnes	S50NDak-38-3	27
	Gavour	S49NDak-38-1	51
	Cresbard	S49NDak-38-7	55
Renville	Gardena	S50NDak-38-1	109
	Hamerly	S50NDak-38-4	133
	Hamerly	S50NDak-38-7	135
	*Renville	S49NDak-38-3	211
	*Renville	S49NDak-38-4	213
	*Renville	S50NDak-38-6	215
	*Sherwood	S49NDak-38-2	221
	*Sherwood	S50NDak-38-8	223
	*Sherwood	S50NDak-38-11	225
	Svea	S49NDak-38-6	239
	*Westhope	S50NDak-38-9	261
	*Westhope	S50NDak-38-10	263
Richland	Maddock	S54NDak-39-1	155
	Maddock	S54NDak-39-2	157
Sargent	Aastad	S56NDak-41-1	5
	Aastad	S56NDak-41-6	7
	Exline	S56NDak-41-7	69
	Exline	S56NDak-41-9	71
	Forman	S56NDak-41-2	101
	Forman	S56NDak-41-5	103
	Forman	S59NDak-41-1	105
	Hecla	S56NDak-41-12	139
	Hecla	S56NDak-41-13	141
	Parnell	S56NDak-41-4	179
	Parnell	S56NDak-41-8	181
	Stirum	S56NDak-41-11	227
	Stirum	S56NDak-41-14	229
	Tetonka	S56NDak-41-3	249
	Tetonka	S56NDak-41-10	251
Stark	Arnegard	S58NDak-45-14	9
	Arnegard	S58NDak-45-15	11
	Bainville	S58NDak-45-11	13
	Bainville	S58NDak-45-12	15
	Farland	S58NDak-45-13	89
	Farland	S58NDak-45-20	91
	Lefor	S58NDak-45-22	153
	Manning	S58NDak-45-1	163
	Morton	S58NDak-45-16	171
	Morton	S58NDak-45-17	173
	Promise	S58NDak-45-7	183
	Promise	S58NDak-45-8	185
	Promise	S58NDak-45-18	187
	Promise	S58NDak-45-19	189
	Regent	S54NDak-45-3	197
	Regent	S58NDak-45-4	199
	Regent	S58NDak-45-9	201
	Regent	S58NDak-45-10	203
	Straw	S58NDak-45-2	231
	Straw	S58NDak-45-3	233
	Vebar	S54NDak-45-1	257
	Vebar	S54NDak-45-2	259
Steele	Barnes	S53NDak-46-1	29
Walsh	Fargo	S54NDak-50-1	85
	Fargo	S54NDak-50-2	87
Ward	Cavour	S58NDak-51-2	53
	Cresbard	S58NDak-51-3	57
	Cresbard	S58NDak-51-4	59
	*Kenaston	S49NDak-51-1	151
	Miranda	S58NDak-51-1	167
	Williams	S54NDak-51-1	265
	Williams	S54NDak-51-2	267
Wells	Eckman	S53NDak-52-1	63
	Eckman	S53NDak-52-2	65
	Gardena	S53NDak-52-3	111
	Gardena	S53NDak-52-4	113
Williams	Williams	S54NDak-53-1	269
	Williams	S54NDak-53-2	271

*Soil series names preceded by an asterisk are names of tentative series.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Aastad loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-5 **LAB. NOS.** 465-471

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-9	A1p	1.5	4.6	5.4	10.5	11.8	41.3	24.9	38.1	21.3	1	l
9-13	A3	2.1	4.5	5.3	10.6	10.7	35.8	31.0	34.8	17.9	1	cl
13-19	B	1.6	5.3	6.1	13.8	11.8	31.2	30.2	34.3	16.7	4	cl
19-38	C1ca	2.8	5.5	5.9	13.1	11.2	32.8	28.7	33.7	18.1	4	cl
38-48	C21	3.9	5.4	5.8	12.3	10.7	34.8	27.1	32.3	20.6	5	cl
48-57	C22											
57-72	C3cs	3.0	5.5	6.1	12.8	11.4	35.8	25.4	34.6	20.2	6	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS.
6.5	7.0	7.1	2.99	.265	11.3	-	0.4	-	-			12.3
6.5	7.4	7.6	0.93	.111	8.4	-	0.4	-	-			12.6
7.1	7.8	8.0	0.70	.088	8.0	-	0.6	1	-			11.9
8.0	8.8	9.0	0.34	.043	7.9	-	3.0	18	-			9.0
8.0	8.8	9.1	0.20	.025		0.23	4.5	15	-			10.6
7.9	8.6	8.8	0.18	.023		0.30	6.8	12	2			10.6
7.8	8.2	8.4	0.15	.020		0.36	8.0	11	36			11.2

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6L1a SO_4	8A MOISTURE AT SATURATION %
←	←	milliequivalents per 100g. soil			→		←	milliequivalents per liter			→	
26.0	17.4	5.8		-	1.6	-	0.4	0.4				49.6
24.2	13.3	9.2		-	0.1	-	0.4	0.2				43.6
21.4		9.9		-	0.7	-	0.9	0.2				46.1
12.7				0.6	0.3	5	13.0	0.7				41.4
13.6				1.4	0.4	10	26.6	0.4				48.4
14.2				1.5	0.5	11	34.7	0.8				49.6
13.6				1.5	0.4	11	42.1	0.6	4.1	1.8	27.3	45.6

Soil type: Aastad loam
Soil No.: 850NDak-38-5
Location: Northwest quarter of northwest quarter, Sec. 5, T161N, R85W, Renville County, North Dakota.
Vegetation: Wheat stubble.
Parent material: Glacial till; slightly gravelly, mildly calcareous, firm clay loam.
Physiographic position: Upland till plain; 500 feet from large wet depression.
Topography: Very gently undulating.
Slope: 1 percent.
Erosion: Very slight.
Drainage: Moderately well.
Stoniness: Very slight.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 19, 1950.

Horizon and Mandan Lab. Number	
Alp 465	0 to 9 inches. Dark gray, dry, and black, moist (10YR 4/1, 2/1), noncalcareous loam having a soft moderately developed fine crumb structure; very friable when moist. This grades into
A3 466	9 to 13 inches. Grayish brown streaked with gray, dry, and olive brown streaked with dark gray, moist (2.5Y 5/2, 10YR 5/1 dry, 2.5Y 4/3, 10YR 4/1 moist), noncalcareous clay loam; moderately developed fine prismatic structure; prisms tend to separate into moderately developed fine blocky or fine nuciform aggregates; hard when dry; friable when moist. This grades into
B 467	13 to 19 inches. Light brownish gray, faintly mottled with fine spots of light olive brown and coated with grayish brown, few fine spots of brownish yellow when dry, light olive brown mottled with olive brown coated with very dark grayish brown and with spots of yellowish brown when moist (2.5Y 6/2, 5/4, 5/2, and 10YR 6/6 dry, 2.5Y 5/3, 4/4, and 3/2 and 10YR 5/6 moist), noncalcareous clay loam; structure and consistence as in the horizon above. This changes clearly into
C1ca 468	19 to 38 inches. Distinctly mottled light gray, light olive brown and white in a fine pattern when dry, mottled gray, olive brown and light gray when moist (2.5Y 7/1, 5/4, and 9/2 dry, 2.5Y 5/1, 4/4, and 7/2 moist), strongly calcareous clay loam having a moderate amount of segregated lime; weakly developed, medium-sized blocky structure; blocks tend to separate into moderately developed medium-sized granules; hard when dry; friable when moist. This grades into
C21 469	38 to 48 inches. Faintly mottled light gray and light yellowish brown with a very few very small spots of yellowish red, dry, and mottled gray, olive brown with spots of yellowish red when moist (2.5Y 7/1, 6/3 and 5YR 4/8 dry, 2.5Y 5/1, 4/3 and 5YR 4/6 moist), mildly calcareous clay loam; structure and consistence as in the horizon above.
C22 470	48 to 57 inches. Faintly mottled light yellowish brown and light gray with a few very small spots of yellowish red when dry, mottled olive brown and grayish brown with spots of yellowish red when moist, (2.5Y 6/3 and 6/1, 5YR 5/8 dry, 2.5Y 4/3 and 5/2, 5YR 4/6 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; very firm when moist. This horizon has a slight amount of segregated crystalline gypsum.
C3cs 471	57 to 72 inches. Horizon the same as the one above, excepting that it has a moderate amount of crystalline gypsum.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Aastad clay loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-1-(1-8) **LAB. NOS.** 4441-4448

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-8	A1p	1.3	2.8	3.6	8.3	8.0	42.8	33.2	31.5	24.3	2.4	cl
8-15	B2	0.8	3.0	3.8	8.4	7.4	37.0	39.6	28.1	21.3	-	cl
15-19	B3ca1	0.5	1.4	2.0	6.3	7.4	45.4	37.0	27.7	29.2	-	sicl
19-27	B3ca2	0.5	1.6	2.8	8.4	9.0	42.9	34.8	29.5	27.8	-	cl
27-36	C1	2.2	3.9	4.9	10.6	9.8	37.2	31.4	30.4	23.0	-	cl
36-45	C2	2.5	5.0	5.6	11.1	9.7	36.3	29.8	30.5	22.2	-	cl
45-57	Ccs	3.4	5.7	5.8	11.8	9.7	35.2	28.4	30.5	21.4	-	cl
57-60	C3	4.0	6.0	6.3	12.6	10.0	34.9	26.2	31.5	20.8	6.0	l

8C1b SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.2	7.3	7.5	4.42	.362	12.2	<0.20	1.3	-				16.8
7.1	7.4	7.4	2.26	.208	10.9	<0.20	1.0	-				16.5
7.9	8.6	8.6	1.14	.117	9.7	<0.20	0.8	25				12.1
7.8	8.3	8.6	0.68	.076	8.9	<0.20	2.0	27				10.7
8.0	8.5	8.7	0.28			0.27	6.4	25				10.1
8.0	8.5	8.6	0.22			0.32	7.4	25	Tr.			9.6
8.1	8.2	8.3	0.18			0.32	7.9	21	39			10.2
8.1	8.2	8.4	0.16			0.45	7.8	21	6			9.3

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	4A3a Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
33.4	26.5	8.1		0.1	2.1	-	0.5	1.3	7.2	4.3		66.8
30.4	23.4	9.0		0.1	1.0	-	0.6	0.4	6.7	3.2	1.18	58.6
19.7				0.1	0.5	-	0.6	0.3	4.2	2.7		56.1
15.6				0.4	0.4	1	3.4	0.3	8.5	12.4	1.46	53.4
13.6				1.4	0.3	4	17.9	0.2	20.1	65.3		49.5
13.3				2.0	0.2	8	21.9	0.2	20.2	79.2		48.0
12.3				1.9	0.3	6	24.0	0.2	21.6	86.9		51.1
12.1				2.0	0.4	7	23.9	0.3	21.4	86.7	1.71	51.0

Soil type: Aastad clay loam
Soil No.: S56NDak-41-1-(1-8)
Location: 1065 feet east and 200 feet south of northwest corner of Sec. 18, T130N, R55W, Sargent County, North Dakota.
Vegetation or crop: Plowing.
Parent material: Glacial till.
Physiographic position: Upper part of a short concave slope.
Topography: Gently undulating with 1 to 3 percent short slopes.
Slope: 1 percent.
Drainage: Moderately well.
Root distribution: Good.
Described by: Wesley M. Larsen.
Date: July 12, 1956.

Horizon and Lincoln Lab. Number	
Alp 4441	0 to 8 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) clay loam; weak fine crumb structure; hard, friable; abrupt smooth boundary with tongues of this horizon extending down through the B horizon. Abundant clear very fine and fine sand quartz and a few clear coarse sand grains throughout the horizon.
B2 4442	8 to 15 inches. Very dark gray (10YR 3/1 crushing to 10YR 3/2 dry) to black (10YR 2/1 crushing to 2/2 moist) clay loam; compound medium moderate prisms and blocks; very hard, friable. Continuous distinct clay on all faces; many clear fine sand quartz; clear irregular boundary.
B3ca1 4443	15 to 19 inches. Dark grayish brown with coatings of very dark gray (2.5Y 4/2 and 3/1 dry) to very dark grayish-brown and black (10YR 3/2 and 2/1 moist) clay loam; moderate coarse prisms and medium to fine angular blocks; very hard, friable; weakly to strongly calcareous. Continuous distinct clay skins on all ped faces. Clear wavy boundary on insides of some prisms and blocks.
B3ca2 4444	19 to 27 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam; coarse moderate prisms and blocks; very hard, friable; strongly calcareous; prism faces are coated with very dark grayish-brown (2.5Y 3/2 moist); continuous distinct clay skins on all ped faces. Gradual smooth boundary.
C1 4445	27 to 36 inches. Light brownish gray with many fine faint light olive brown and common medium distinct white mottlings (2.5Y 6/2, 5/4 and 8/2 dry) to grayish brown mottled with olive brown and light gray (2.5Y 5/2, 4/4 and 6/1 moist) clay loam; weak blocky structure; very hard, friable; strongly calcareous with a small amount of soft segregated lime. Gradual boundary.
C2 4446	36 to 45 inches. Same as horizon above; horizons broken for sampling.
Ccs 4447	45 to 57 inches. Light brownish gray (2.5Y 6/2 dry) to grayish brown (2.5Y 5/2 moist) with many prominent mottles of yellowish brown (10YR 5/6 moist) clay loam; fine blocky structure; very hard, friable; contains numerous nests of gypsum crystals. Lower boundary is diffuse.
C3 4448	57 to 60 inches. Light brownish gray (2.5Y 6/2 dry) mottled with light gray and light olive brown (N 6/0 and 2.5Y 5/4 dry) to grayish brown (2.5Y 5/2 moist) highly mottled with olive (5Y 4/3 moist), very dark gray (5Y 3/1 moist), brownish yellow (10YR 6/8 moist) and white spots of gypsum crystals. A friable, weak blocky, moderately calcareous clay loam till; very hard when dry.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Aastad loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-6-(1-7) **LAB. NOS.** 4480-4486

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-7	A1p	3.2	6.4	6.2	10.3	7.3	37.8	28.8	29.9	21.1	Tr.	cl
7-14	B1	3.9	5.5	5.8	10.6	7.6	33.8	32.8	28.7	18.5	3.5	cl
14-17	B2	4.2	5.0	4.5	7.6	7.3	39.8	31.6	27.2	24.1	5.4	cl
17-28	Cca1	10.2	11.4	4.7	10.8	4.6	31.5	26.8	20.1	19.5	3.0	l
28-32	Cca2	8.4	10.4	7.7	12.5	10.8	28.8	21.4	29.1	17.3	15.5	l
32-43	Cca3	6.4	7.9	6.4	10.6	9.0	34.2	25.5	27.9	21.2	18.1	l
43-60	Ccs	5.4	7.1	6.2	10.5	9.2	35.9	25.7	28.2	22.9	8.8	l

8C1b SATURATED PASTE	pH 8C1a 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4	7.8	7.9	3.99	.331	12.0	<0.20	0.9	-				14.1
7.3	7.9	8.0	1.60	.140	11.4	<0.20	0.8	-				13.0
7.6	8.4	8.6	1.25	.111	11.3	<0.20	1.0	12				12.0
7.7	8.5	8.8	0.48	.060	8.0	<0.20	3.1	32				7.4
8.0	8.5	8.7	0.32			0.35	7.4	26				6.3
8.1	8.5	8.6	0.21			0.45	7.9	29	-			7.7
7.8	8.3	8.3	0.16			0.40	7.5	22	33			8.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a	6O1a	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
31.9	26.0	8.0		0.1	1.1	-	0.7	0.4	5.3	3.5		59.3
27.6	19.3	9.1		0.1	0.5	-	0.8	0.2	4.4	3.8		54.2
23.0				0.1	0.4	-	1.1	0.2	4.6	4.6		55.4
11.5				0.5	0.2	2	7.2	0.2	14.1	22.5		43.4
9.1				1.3	0.2	4	22.3	0.2	20.3	80.8		38.6
10.8				1.9	0.2	6	27.2	0.2	20.5	82.7		43.3
10.2				1.6	0.2	6	24.0	0.3	22.2	75.7		42.2

Soil type: Aastad loam
Soil No.: S56NDak-41-6-(1-7)
Location: 135 feet west and 90 feet south of northeast corner of Sec. 13, T131N, R56W, Sargent County, North Dakota.
Vegetation or crop: Summer fallow.
Parent material: Glacial till.
Physiographic position: Lower part of a very gentle short slope.
Topography: Gently undulating with 1 to 3 percent slopes.
Drainage: Moderately well.
Moisture: Moist.
Root distribution: Plentiful to 30 inches, few through 60 inches.
Described by: Wesley M. Larsen.
Date: July 12, 1956.

Horizon and Lincoln Lab. Number	
Alp 4480	0 to 7 inches. Black (10YR 2.5/1 dry, N 2/0 moist) fine granular loam; slightly hard, very friable, slightly sticky, slightly plastic. Clear quartz sand grains common throughout. Abrupt smooth boundary.
B1 4481	7 to 14 inches. Black (10YR 2.5/1 dry, 2/1 moist) clay loam; hard, friable, sticky and plastic; clear quartz grains common throughout; weak fine prisms with indistinct clay skins. Diffuse boundary.
B2 4482	14 to 17 inches. Very dark grayish brown and black (2.5Y 3/2 dry, 2/2 moist) clay loam; moderate medium prisms and blocks with distinct continuous clay skins; firm, sticky and plastic; strongly calcareous without segregated lime. Wavy boundary. This horizon was missing in some places in the pit that was dug for sampling.
Cca1 4483	17 to 28 inches. Light olive brown (2.5Y 5/4 dry) to olive brown (2.5Y 4/4 moist) clay loam; moderate fine blocky structure; hard, firm, friable, slightly sticky and plastic. Very strongly calcareous with many fine white threads and nodules and coatings on gravels of soft segregated lime.
Cca2 4484	28 to 32 inches. Light yellowish brown to grayish brown (2.5Y 6/3 dry, 2/5Y 5/2 moist) with many prominent mottles of 7.5YR 5/6 dry and moist, and white (2.5Y 8/2 dry, 2.5Y 7/2 moist) loam; a fine blocky structure; hard, friable, slightly sticky and slightly plastic. Strongly calcareous with many threads of segregated lime and with soft lime coatings around gravels and in gravel sockets.
Cca3 4485	32 to 43 inches. Light brownish gray to grayish brown (2.5Y 6/2 dry to 5/2 moist) mottled with yellowish brown (10YR 5/8 moist) and very dark gray (2.5Y 3/0 moist) clay loam; hard, friable, sticky, plastic; strongly calcareous with many threads of segregated lime and with soft lime coats on gravels and in gravel sockets.
Ccs 4486	43 to 60 inches. Grayish brown (2.5Y 5/2 moist) prominently mottled with white gypsum crystals (2.5Y 8/2 moist), gray (N/5) and olive brown (2.5Y 4/8 moist) clay loam; fine blocks; sticky, plastic; strongly calcareous; small amount of segregated lime.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Arnegard loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-14-(1-9) **LAB. NOS.** 8569-8577

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4	Ap	0.5a	2.4a	10.0a	22.7a	8.8a	35.6	20.0	36.3	19.1	-	l
4-7	A1	0.1a	1.7a	7.8a	22.4a	9.8a	36.7	21.5	38.1	20.0	-	l
7-15	B21	0.2a	1.8a	8.1a	25.5a	9.5a	31.2	23.7	38.0	16.2	Tr.	l
15-21	B22	0.2a	1.6a	7.6a	25.4a	10.6a	30.7	23.9	39.6	15.5	Tr.	l
21-28	B3	0.2a	1.5a	6.8a	22.9a	11.0a	34.8	22.8	41.7	16.9	-	l
28-40	Bb1	1.3b	1.0b	4.5b	43.1b	14.4b	16.0	19.7	50.7	8.7	1.7	fsl
40-53	C1	<0.1	0.2b	3.5b	52.0b	12.8b	12.5	19.0	50.1	7.2	-	fsl
53-63	D1	<0.1	0.4b	6.5b	50.6b	11.8b	12.3	18.4	46.2	6.8	-	fsl
63-68	D2	<0.1	0.5c	5.5c	47.3d	11.0d	15.7	20.0	44.9	10.2	-	scl/fsl

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.1	6.5	6.6	2.63	0.229	11.5	<0.20	0.6					9.6
5.9	6.3	6.4	2.02	0.182	11.1	<0.20	0.5					9.7
6.0	6.5	6.5	0.89	0.097	9	<0.20	0.4					9.4
6.1	6.6	6.6	0.79	0.088	9	<0.20	0.4					9.6
6.5	6.9	6.8	0.92	0.091	10	<0.20	0.4					9.6
6.9	7.3	7.1	0.28			<0.20	0.4	<1				9.6
7.1	7.5	7.3	0.17			<0.20	0.5	<1				10.0
7.4	7.7	7.7	0.12			<0.20	0.5	<1				10.2
8.2	8.8	9.0	0.21			<0.20	0.6	7				10.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLES 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
19.6	12.3	3.0	6.4	<0.1	1.7	87	0.3	1.5				49.0
20.2	12.8	3.5	7.0	<0.1	1.2	87	0.3	0.7				48.9
17.9	11.2	4.2	4.6	<0.1	0.9	91	0.3	0.4				44.3
18.2	12.1	4.8	4.2	<0.1	0.6	96	0.3	0.3				43.0
18.9	13.3	5.1	3.2	<0.1	0.4	99	0.4	0.2				44.4
19.3	12.8	6.5	1.8	0.1	0.2	102	0.5	0.2				49.0
20.6	13.8	7.5	1.4	0.1	0.2	105	0.4	0.2				49.9
20.5	13.4	7.5	1.4	0.1	0.1	103	0.5	0.2				50.0
19.5				0.2	0.1		0.7	0.1				54.1

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?), also, few shale fragments.
c. Common $CaCO_3$ concr.
d. Few $CaCO_3$ concr.

Soil type: Arnegard loam
Soil No.: 858NDak-45-14-(1-9)
Location: 0.28 mile west and 120 feet north of south quarter corner of Sec. 6, T139N, R93W, Stark County, North Dakota.
Vegetation: Summer fallow.
Parent material: Local colluvium from sands and silts.
Physiography: Small swale in gently undulating uplands.
Slope: 2 percent south facing.
Drainage: Well.
Permeability: Moderate.
Root distribution: Numerous to 40 inches, few to 63 inches.
Moisture: Moist to 68 inches.
Described by: A. F. Bahr.
Date: July 23, 1958.

Horizon and Lincoln Lab. Number	
Ap 8569	0 to 4 inches. Very dark grayish brown (10YR 3/2 dry) to black (10YR 2/1 moist) loam; medium moderate angular blocks breaking to fine weak crumb structure; slightly hard, very friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
A1 8570	4 to 7 inches. Very dark grayish brown (10YR 3/2 dry) to black (10YR 2/1 moist) loam; medium moderate angular blocks that break to fine weak crumb structure; slightly hard, very friable, slightly sticky and slightly plastic consistence; noncalcareous; clear and wavy boundary.
B21 8571	7 to 15 inches. Dark brown (10YR 3/3 dry) to very dark grayish brown (10YR 3/2 moist) clay loam; medium and coarse moderate prisms that break to fine moderate angular blocks; hard, friable, slightly sticky and plastic consistence; top and vertical faces of peds have patches of clay skins of 10YR 2/2 moist; noncalcareous; gradual and smooth boundary.
B22 8572	15 to 21 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (10YR 3/2 moist) clay loam; medium and coarse moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and plastic consistence; top and vertical faces of peds have patches of clay skins of 10YR 2/2 moist; noncalcareous; gradual and wavy boundary.
B3 8573	21 to 28 inches. Olive brown (2.5Y 4/3 dry) to very dark grayish brown (10YR 3/2 moist) sandy clay loam; coarse weak prisms that break to fine and medium angular blocks; hard, friable, slightly sticky and plastic consistence; patches of clay skins on vertical surfaces of prisms; noncalcareous; gradual and wavy boundary.
Bb1 8574	28 to 40 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) loam; coarse moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and slightly plastic consistence; patches of clay skins on vertical surfaces of prisms; noncalcareous; abrupt and wavy boundary.
C1 8575	40 to 53 inches. Light olive brown (2.5Y 5/4 dry) to olive brown (2.5Y 4/4 moist) loam; medium moderate angular blocky structure; hard, very friable, slightly sticky and slightly plastic consistence; few fine and prominent iron mottles of 7.5YR 5/8; noncalcareous; clear and wavy boundary.
D1 8576	53 to 63 inches. Pale yellow (2.5Y 7/3 dry) to olive (5Y 5/3 moist) sandy clay loam; fine weak angular blocky structure; hard, friable, slightly sticky and plastic consistence; strongly calcareous with many medium and distinct lime nodules 5Y 8/2; clear and smooth boundary.
D2 8577	63 to 68 inches. Light gray (5Y 7/2 dry) to light olive gray (5Y 6/2 moist) loam; slightly hard, very friable, slightly sticky and slightly plastic consistence; weakly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Arnegard loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-15-(1-9) **LAB. NOS.** 8578-8586

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	0.2	1.2	5.6	19.2	10.4	38.8	24.6	34.0	24.7	-	l
5-11	A1	0.1	0.8	5.6	18.7	10.1	38.5	26.2	34.2	23.8	-	l
11-20	B21	0.2a	1.3a	8.0	27.0	10.9	29.1	23.5	34.5	18.6	Tr.	l
20-29	B22	<0.1	1.4a	9.4	35.5	14.6	21.4	17.7	42.1	11.8	-	fsl
29-37	B3	<0.1	1.6b	10.0b	37.2c	17.8c	18.0	15.4	44.6	10.1	-	fsl
37-43	Ab	0.2b	2.3b	11.9b	35.8c	14.2c	20.2	15.4	40.9	10.5	-	fsl
43-48	Bb1	0.3b	1.8b	11.0b	33.8c	13.9c	22.2	17.0	41.3	11.0	-	fsl
48-53	Bb2	0.1b	1.8b	11.8b	40.9c	13.5c	17.2	14.7	41.5	8.0	-	fsl
53-64	D1	0.2a	2.2a	16.5	52.3	11.7	7.8	9.3	38.6	4.5	-	lfs

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUF)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
5.7	6.1	6.2	3.28	0.267	12.3	<0.20	0.7					12.1
6.0	6.3	6.5	2.25	0.184	12.2	<0.20	0.5					11.6
6.2	6.6	6.8	1.01	0.096	10.5	<0.20	0.4					9.4
6.3	6.8	6.9	0.59	0.058	10	<0.20	0.4					6.9
6.4	6.9	7.0	0.49			<0.20	0.4					6.3
6.5	6.9	6.9	0.55			<0.20	0.4					6.4
6.3	6.8	6.9	0.48			<0.20	0.4					7.1
6.4	6.9	6.9	0.30			<0.20	0.5					6.0
6.5	7.0	7.0	0.18			<0.20	0.5	<1				4.2

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
24.8	14.9	3.6	9.8	<0.1	1.8	82	0.8	0.1				54.3
22.7	14.2	4.0	7.9	<0.1	1.4	86	0.9	0.1				49.7
17.0	10.5	3.6	4.6	<0.1	1.2	90	0.2	0.6				39.7
12.4	7.6	2.9	3.2	<0.1	0.9	92	0.3	0.6				32.9
10.8	6.7	2.5	2.7	<0.1	0.8	92	0.3	0.6				33.9
11.1	7.1	2.7	3.2	<0.1	0.9	96	0.4	0.6				32.1
11.5	7.4	2.8	2.8	<0.1	0.8	96	0.4	0.6				36.0
9.6	6.1	2.6	1.8	<0.1	0.6	97	0.4	0.6				35.5
6.9	4.4	1.8	1.4	<0.1	0.4	96	0.5	0.5				31.4

a. Many light brown to dark brown shale fragments.
b. Few smooth brown and black concr. (Fe-Mn?);also, few brown shale fragments.
c. Few smooth brown and black concr. (Fe-Mn?)

Soil type: **Arnegard loam**
Soil No.: S58NDak-45-15-(1-9)
Location: 300 feet south and .35 mile east of northwest corner of Sec. 5, T139N, R94W, Stark County, North Dakota.
Vegetation: Summer fallow.
Parent material: Local colluvium from silts and sands.
Physiography: Center of swale in uplands.
Slope: 1 percent north facing.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate.
Moisture: Moist to 60 inches.
Stoniness: None.
Salt or alkali: None.
Described by: K. E. Larson.
Date: July 23, 1958.

Horizon and Lincoln Lab. Number	
Ap 8578	0 to 5 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; fine and medium moderate crumb structure (first one inch has moderate platy structure); slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt and smooth boundary.
A1 8579	5 to 11 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) loam; medium weak prisms that break to medium moderate angular blocks; hard, very friable, slightly sticky and slightly plastic; noncalcareous; clear and wavy boundary.
B21 8580	11 to 20 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (10YR 3/2 moist) clay loam; coarse moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and plastic; clay skins on top and vertical surfaces of prisms; noncalcareous; gradual and smooth boundary.
B22 8581	20 to 29 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (10YR 3/2 moist) sandy clay loam; coarse moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and plastic; clay skins on all surfaces of the peds; noncalcareous; clear and smooth boundary.
B3 8582	29 to 37 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (10YR 3/2 moist) loam; coarse moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and slightly plastic; clay skins on all surfaces of peds; noncalcareous; abrupt and smooth boundary.
Ab 8583	37 to 43 inches. Dark grayish brown (2.5Y 4/2 dry) to black (10YR 2/1 moist) loam; coarse weak prisms that break to medium moderate subangular blocks; hard, friable, slightly sticky and slightly plastic; clay skins on all faces of peds; noncalcareous; abrupt and smooth boundary.
Bb1 8584	43 to 48 inches. Dark gray brown (2.5Y 4/2 dry) to very dark grayish brown (10YR 3/2 moist) sandy clay loam; medium moderate prisms that break to medium moderate angular blocks; very hard, friable, slightly sticky and plastic; clay skins on all faces of peds, 10YR 2/2; calcareous; abrupt and smooth boundary.
Bb2 8585	48 to 53 inches. Olive brown (2.5Y 4/4 dry) to dark grayish brown (2.5Y 4/2 moist) sandy clay loam; other characteristics same as Bb1.
D1 8586	53 to 64 inches. Olive brown (2.5Y 4/4 dry, 4/3 moist) loamy fine sand; single grain; slightly hard, very friable, nonsticky and nonplastic; noncalcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Bainville silt loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-11-(1-8) **LAB. NOS.** 8546-8553

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	0.9a	1.1a	3.6a	13.4a	9.7a	52.2	19.1	39.3	28.4	Tr.	sil
2-9	ACca	0.4b	0.4b	0.7c	2.5c	5.7c	64.9	25.4	22.5	49.4	-	sil
9-16	Cca	0.2b	0.9b	0.8c	2.5c	16.3c	64.6	14.7	47.2	35.2	-	sil
16-25	C1	0.1d	0.1d	<0.1	0.3a	0.7a	76.4	22.4	25.1	52.2	-	sil
25-33	C21	<0.1	0.1d	<0.1	0.1e	0.9e	77.3	21.6	30.3	48.0	-	sil
33-42	C22	<0.1	<0.1	<0.1	0.3e	1.4e	76.7	21.6	32.4	46.0	-	sil
42-54	C3	<0.1	<0.1	<0.1	0.3e	1.3e	78.2	20.2	33.6	46.1	-	sil
54-60	C4	<0.1	0.1d	<0.1	0.3e	2.1e	81.7	15.8	45.6	38.4	-	sil

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.1	8.3	3.99	0.320	12.5	<0.20	0.8	11				11.5
8.0	8.4	8.6	1.77	0.144	12.3	<0.20	0.7	27				11.5
8.3	8.8	8.9	0.70	0.052	13	<0.20	0.6	20				6.3
8.6	9.2	9.3	0.29	0.021	14	<0.20	0.7	21				8.2
9.0	9.6	9.6	0.12			<0.20	0.8	18				8.4
9.0	9.6	9.7	0.08			<0.20	1.0	17				9.2
9.0	9.6	9.7	0.07			<0.20	1.3	16				8.9
9.1	9.8	9.9	0.07			<0.20	1.6	15				7.6

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a Ca	Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
19.6				<0.1	0.7	<1	0.4	0.7				79.0
14.0				<0.1	0.4	<1	0.5	0.4				72.3
7.5				<0.1	0.3	<1	0.5	0.5				60.5
9.8				0.3	0.3	2	2.0	0.4				59.0
10.0				1.3	0.2	11	2.4	0.2				66.5
10.3				2.4	0.2	21	2.2	0.1				80.0
10.3				3.0	0.2	21	9.5	0.1				85.8
9.2				3.0	0.2	23	11.1	0.1				81.6

a. Few smooth dark brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.
b. Common $CaCO_3$ concr.
c. Few smooth dark brown to black concr. (Fe-Mn?); also common $CaCO_3$ concr.
d. Few $CaCO_3$ concr.
e. Common smooth and irregular light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Bainville silt loam
Soil No.: S58NDak-45-11-(1-8)
Location: 260 feet north and .15 mile west of southeast corner of Sec. 18, T140N, R92W, Stark County, North Dakota.
Vegetation: Little bluestem and threadleaf sedge.
Parent material: Silts and siltstones.
Physiography: Top of small knob in upland--rolling.
Slope: 9 percent.
Drainage: Well to excessive.
Erosion: Slight.
Permeability: Moderate.
Stoniness: None.
Root distribution: Numerous to 20 inches; native grass considered nearly a relict site.
Described by: K. E. Larson.
Date: July 23, 1958.

Horizon and Lincoln Lab. Number	
A11 8546	0 to 2 inches. Very dark grayish brown (2.5Y 3/2 dry) to very dark grayish brown (10YR 3/2 moist) silt loam; medium weak crumb structure; hard, friable, slightly sticky and slightly plastic; calcareous; gradual and smooth boundary.
ACca 8547	2 to 9 inches. Light gray (5Y 7/2 dry) to dark grayish brown (2.5Y 4/2 moist) silt loam; fine weak angular blocks that break to medium moderate crumbs; slightly hard, friable, slightly sticky and slightly plastic; very strongly calcareous; clear and smooth boundary.
Cca 8548	9 to 16 inches. Light gray (5Y 7/2 dry) to grayish brown (2.5Y 5/2) silt loam; medium weak prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and slightly plastic; very strongly calcareous; clear and wavy boundary.
C1 8549	16 to 25 inches. Pale yellow (5Y 7/4 dry) to light olive brown (2.5Y 5/4 moist) silt loam; medium moderate angular blocks that break to medium moderate plates; slightly hard, firm, slightly sticky and slightly plastic; very fine sand coatings on plates; very strongly calcareous; gradual and smooth boundary.
C21 8550	25 to 33 inches. Pale yellow (5Y 7/4 dry) to light olive brown (2.5Y 5/4 moist) silt loam; coarse strong plates; hard, firm, slightly sticky and slightly plastic; strongly calcareous; gradual and smooth boundary.
C22 8551	33 to 42 inches. Same description as C21; split for laboratory purposes.
C3 8552	42 to54 inches. Pale yellow (5Y 8/4 dry) to light olive brown (2.5Y 5/5 moist) silt loam; very coarse strong plates; very hard, firm, slightly sticky and slightly plastic; very fine sand coatings on faces of plates. Strongly calcareous; gradual and smooth boundary.
C4 8553	54 to 60 inches. Pale yellow (5Y 7/3 dry) to light olive brown (2.5Y 5/4 moist) silt loam; very coarse strong plates; very hard, firm, slightly sticky and slightly plastic; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Bainville loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-12-(1-8) **LAB. NOS.** 8554-8561

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-2	A1	0.3a	0.6a	0.8a	22.6a	20.9a	40.8	14.0	62.0	20.0	-	l
2-6	ACca	0.2b	0.3b	0.4b	6.7b	7.0b	61.9	23.5	26.2	48.4	-	sil
6-12	Cca	0.1c	0.2a	0.1b	1.4b	3.0b	69.7	25.5	16.0	57.9	-	sil
12-18	C1	<0.1	0.2c	<0.1	0.4a	0.8a	73.8	24.8	12.9	62.0	-	sil
18-34	C2	<0.1	0.1c	<0.1	0.5a	0.6a	77.4	21.4	25.6	52.7	-	sil
34-41	C3	<0.1	0.1c	<0.1	0.5a	3.6a	73.0	22.8	31.9	45.0	-	sil
41-56	C4	<0.1	<0.1	<0.1	0.5d	0.6d	65.0	33.9	5.1	60.8	-	sicl
56-59	C5	<0.1	0.3b	0.1b	1.2b	22.2b	69.3	6.9	76.3	16.0	-	sil

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST'D SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.2	8.4	3.41	0.305	11.2	<0.20	0.8	3				10.1
8.0	8.5	8.8	2.46	0.212	11.6	<0.20	0.8	22				12.9
8.4	8.9	9.1	0.85	0.061	14	<0.20	0.6	21				9.1
8.7	9.2	9.4	0.26	0.026	10	<0.20	0.7	19				8.8
8.9	9.4	9.5	0.13	0.014		<0.20	0.7	16				8.5
9.1	9.7	9.9	0.09			<0.20	0.7	14				9.6
9.0	9.6	9.8	0.11			<0.20	0.7	13				13.8
9.5	9.9	10.0	0.07			<0.20	0.9	16				3.6

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS Ca	Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K			8A1	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
17.0				<0.1	0.7	<1	0.6	0.8				88.4
14.2				<0.1	0.6	<1	0.4	1.1				80.9
9.8				0.1	0.3	1	0.6	0.6				59.8
9.9				0.2	0.4	1	1.4	0.6				59.0
10.3				0.7	0.4	5	3.2	0.5				61.9
11.4				2.0	0.4	17	1.6	0.2				67.3
12.2				2.9	0.4	20	5.6	0.2				97.2
4.8				1.3	0.1	21	6.4	0.1				47.3

a. Few smooth and irregular light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

b. Few smooth and irregular light brown to black concr. (Fe-Mn?); also common $CaCO_3$ concr.

c. Few $CaCO_3$ concr.

d. Many smooth and irregular light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Bainville loam
Soil No.: S58NDak-45-12-(1-8)
Location: 220 rods east and 140 rods south of west quarter corner of Sec. 28, T140N, R92W, Stark County, North Dakota.
Vegetation: Little bluestem.
Parent material: Ft. Union siltstones.
Physiography: Hilly with dendritic stream pattern.
Slope: 6 percent northwest facing (45 feet below crest of hill).
Drainage: Well to excessive.
Erosion: Slight.
Permeability: Moderate.
Stoniness: None.
Root distribution: Numerous to 18 inches, moderate to 34 inches, few beyond 50 inches.
Described by: Lloyd Shoesmith.
Date: July 21, 1958.

Horizon and Lincoln Lab. Number	
A1 8554	0 to 2 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark brown (10YR 2/2 moist) loam; fine weak crumb structure; slightly hard, very friable, slightly sticky and slightly plastic; calcareous; clear and smooth boundary.
ACca 8555	2 to 6 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) silt loam; medium moderate crumb structure; slightly hard, friable, slightly sticky and slightly plastic; very strongly calcareous; gradual wavy boundary.
Cca 8556	6 to 12 inches. Pale yellow (5Y 7/3 dry) to olive (5Y 5/4 moist) silt loam; medium moderate plates and medium moderate angular blocky; slightly moderate angular blocky; slightly hard, friable, sticky and plastic; very strongly calcareous with few lime nodules; gradual and wavy boundary.
C1 8557	12 to 18 inches. Pale yellow (5Y 7/4 dry) to olive (5Y 5/3 moist) silt loam; fine and medium strong plates; hard, friable, sticky and plastic; strongly calcareous; abrupt and smooth boundary.
C2 8558	18 to 34 inches. White (5Y 8/2 dry) to olive gray (5Y 5/2 moist) silt loam; medium strong plates hard, firm, slightly sticky and plastic; strongly calcareous; abrupt and smooth boundary.
C3 8559	34 to 41 inches. Pale yellow (5Y 8/4 dry) to olive gray (5Y 5/2 moist) silt loam with thin layers of very fine sand between plates, 5Y 6/1 moist; very coarse strong plates; very hard, firm, sticky and plastic; strongly calcareous; abrupt and smooth boundary.
C4 8560	41 to 56 inches. Pale yellow (5Y 7/4 dry) to olive (5Y 5/4 moist) silty clay loam; very coarse strong plates; extremely hard, very firm, sticky and plastic; strongly calcareous; abrupt and smooth boundary.
C5 8561	56 to 59 inches. Pale yellow (5Y 7/3 dry) to light olive gray (5Y 6/2 moist) very fine sandy loam; very fine weak plates; very friable, nonsticky and nonplastic; strongly calcareous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Barnes loam **LOCATION** Barnes County, North Dakota

SOIL NOS. S53NDak-2-1 **LAB. NOS.** 1640-1647

DEPTH INCHES	HORIZON	1R1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	3.6	6.7	7.4	16.4	10.1	34.3	21.5	34.8	19.1	2.1	1
6-8	A12	2.8	5.1	5.9	13.3	10.1	39.3	23.5	36.7	20.7	1.0	1
8-16	B2	2.6	5.0	5.8	13.3	12.4	37.8	23.1	38.7	19.5	2.5	1
16-24	Cca	3.8	5.0	5.1	11.7	8.4	39.9	26.1	29.7	25.6	3.6	1
24-31	Ccs1	2.9	4.8	4.8	10.8	8.4	45.1	23.2	29.5	30.6	2.8	1
31-39	Ccs2	3.6	4.9	4.5	9.2	6.8	45.1	25.9	25.4	32.1	2.6	1
39-47	C1	3.8	6.5	6.3	12.7	8.9	39.0	22.8	30.4	25.0	4.3	1
47-60	C2	4.7	8.1	8.2	16.2	10.5	33.1	19.2	34.9	17.9	4.8	1

pH 8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS.
7.7			2.87	0.212	13.5	<0.20	0.7	-				12.2
7.8			2.46	0.188	13.1	<0.20	0.7	-				13.4
7.8			0.93	0.099	9.4	<0.20	0.7	-				11.4
7.9			0.56	0.060	9.3	<0.20	1.2	25	-			10.7
7.8			0.39	0.040	9.8	<0.20	3.5	19	57			12.2
7.9			0.20	0.026		<0.20	4.7	15	10			12.4
7.9			0.16	0.020		0.21	5.5	16	-			10.8
8.0			0.14	0.015		0.21	6.5	16	3			7.9

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	6Q2a K	5B1a	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO₃	6K1a Cl	6L1a SO₄	8A1	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →							← milliequivalents per liter →						
28.2	21.6	4.8		0.1	0.5		1.2	0.2	0.4					46.5
26.3	18.7	5.9		0.1	0.4		1.2	0.4	0.1					49.4
21.0	13.5	7.2		0.1	0.2		-	0.4	-					44.4
								1.5	-					45.1
								6.5	-					45.7
								13.9	-	3.8	4.0	64.0		47.8
								21.5	0.1	1.6	7.8	77.0		42.5
								33.0	0.1	1.6	7.5	89.3		35.3

Soil type: Barnes loam
Soil No.: S53NDak-2-1
Location: 400 feet north and 90 feet west of SE corner Sec. 20, T142N, R56W, Barnes County, North Dakota.
Crop: Fallow land following wheat.
Climate: Average annual precipitation 19 inches; mean annual temperature 39° F.
Parent material: Friable, calcareous loam glacial till, very probably of Mankato (late Wisconsin) age.
Physiography: Undulating to gently rolling till plain, in an area of Barnes, Hamerly, Aastad and Buse soils.
Slope: 3 percent facing toward the northeast.
Drainage: Well drained; runoff medium; permeability medium in the solum, moderately slow in the till below.
Described by: W. M. Johnson, 1953.

Mandan Lab. No.	Horizon	
1640	A1p	0 to 6 inches. Very dark gray to black (10YR 3/1 dry; 2/1 moist) soft, friable, moderately very fine granular loam. The upper few inches that have been cultivated recently tend to be cloddy. Lower boundary is abrupt and smooth.
1641	A12	6 to 8 inches. Very dark gray to black (10YR 3/1 dry; 2/1 moist) soft, friable, loam. Moderate medium blocky structure that breaks down to moderate fine granules. Lower boundary is clear and wavy--it "tongues" down to the base of the B2 horizon.
1642	B2	8 to 16 inches. Grayish brown to very dark grayish brown (10YR 5/2.5 dry; 3.5/2.5 moist) soft, friable, loam. Structure is moderate medium prismatic; some of the prisms' faces have black coatings. Clear, slightly wavy lower boundary.
1643	Cca	16 to 24 inches. Light gray to brown (1Y 7.5/2.5 dry; 5.5/3 moist) with a very few tiny white specks. Very strongly calcareous, soft, friable, moderate very fine granular heavy loam. This horizon has a distinctly silty feel to it. Calcium carbonate is in disseminated form. Gradual, wavy lower boundary.
1644	Ccs1	24 to 31 inches. Light yellowish brown to olive brown (2.5Y 6.5/3 dry; 4/3 moist) soft, friable loam. There are many prominent white spots of gypsum crystals. Weak very fine irregular blocky structure. Strongly calcareous. Lower boundary is diffuse and slightly wavy.
1645	Ccs2	31 to 39 inches. Light yellowish brown to olive brown (2.5Y 6/3 dry; 4/4 moist) soft, friable, loam, with a few medium and fine gray, white, and reddish brown mottles. Weak coarse blocky structure. Strongly calcareous. Contains numerous "nests" of small gypsum crystals. Lower boundary is diffuse and slightly wavy.
1646	C1	39 to 47 inches. Uniformly mottled light brownish gray and light yellowish brown (2.5Y 6/2 and 6/3 dry) to dark grayish brown and olive brown (2.5Y 4/2 and 4/3 moist) friable, weak coarse blocky loam till. Moderately calcareous. Has a few fine white spots of calcium carbonate and calcium sulphate crystals. Clear, wavy lower boundary.
1647	C2	47 to 60 inches. Layered and mottled light yellowish brown and light olive brown (2.5Y 5.5/3 and 6/3 dry; 4/3 and 3/2 moist) parent till. The material is mixed and layered sandy clay loam, loam, and silt loam. Moderately calcareous. Crystalline gypsum concentrations in the lower 1½ inches. Soft when dry, friable when moist. Has a few fine mottles of red and yellowish red.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-9-55

SOIL TYPE Barnes loam, in close association with Cresbard loam **LOCATION** Cavalier County, North Dakota

SOIL NOS. S54NDak-10-1-(1-8) **LAB. NOS.** 2150-2157

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	5.9	6.9	6.3	11.9	7.6	38.4	23.0	29.3	23.3	3.0	l
6-10	B21	3.0	5.2	5.8	10.2	6.2	33.7	35.9	24.5	20.9	3.0	cl
10-13½	B22	3.1	5.8	5.7	9.9	6.1	36.8	32.6	24.1	24.2	2.5	cl
13½-19	B3	3.8	6.5	6.2	11.4	7.2	38.2	26.7	27.1	24.9	3.5	l
19-29	Cca1	4.8	7.5	7.4	13.3	8.6	37.5	20.9	31.2	22.4	3.8	l
29-39	Cca2	4.0	8.2	8.4	15.6	10.9	35.4	17.5	35.3	19.9	2.9	l
39-46	C1	3.6	7.2	8.7	19.7	12.6	31.5	16.7	35.2	20.1	4.2	l
46-60	C2	6.2	7.1	5.6	9.5	8.8	42.5	20.3	28.2	28.7	7.0	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.8	7.4	7.5	3.61	.297	12.2	-	0.5	-				15.3
6.9	7.4	7.7	1.40	.151	9.3	-	0.5	-				17.9
7.1	7.7	8.1	0.80	.087	9.2	-	0.7	-				18.2
7.4	8.4	8.7	0.69	.075	9.2	-	0.9	2				16.9
7.7	8.8	9.1	0.26			0.25	4.0	11	-			11.6
7.8	8.9	9.2	0.14			0.34	7.0	7	-			11.2
7.9	9.1	9.3	0.14			0.34	6.5	8	-			11.3
7.7	8.9	9.1	0.18			0.42	8.0	4	-			15.4

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
29.3	21.4	6.0		0.6	1.1	2	1.4	0.2				60.4
30.4	20.8	8.6		0.7	0.4	2	1.4	-				58.4
27.7	19.5	8.6		1.0	0.4	3	1.7	-				58.2
24.8				1.3	0.3	5	2.3	-				56.8
16.6				3.3	0.1	13	25.0	0.1				44.2
14.6				5.3	0.2	21	53.0	0.1	5.6	5.0	94.2	42.5
15.1				6.2	0.3	25	55.0	0.2				43.9
19.7				8.9	0.6	26	69.0	0.3	6.1	4.0	107.2	54.6

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Barnes loam, in close association with Cresbard
Soil No.: S54NDak-10-1
Area: Cavalier County, North Dakota.
Location: 745 feet west, 125 feet north of S1/4 corner Sec. 15, T162N, R60W.
Vegetation or crop: New sweetclover in stubble.
Parent material: Moderately shaly loam to clay loam till of Mankato age. The till contains more shale than is common in North Dakota and this soil may be separated as Langdon loam.
Physiographic position: 35 feet below shoulder and 70 feet below crest of 100-foot long slope on ground moraine having high frequency undulations.
Slope: 8 percent north by northwest.
Drainage: Well.
Ground water: 10 feet plus.
Permeability: Moderate.
Moisture: Moist.
Stoniness: Some.
Described by: C. A. Mogen.
Date: June 4, 1954.

Mandan Lab.No.	Horizon	
2150	A1p	0 to 6 inches. Very dark gray (10YR 3.5/1 dry) to black (10YR 2/1 moist) loam; soft, very friable; moderately developed fine granules. Clear smooth boundary.
2151	B21	6 to 10 inches. Dark grayish brown (10YR 4/2 dry) with coatings of very dark grayish brown (10YR 3/2 dry) to dark yellowish brown (10YR 4/3 moist) coated with very dark brown (10YR 2/2 moist) and very dark grayish brown (10YR 3/2 moist) clay loam; slightly hard, friable; moderately developed medium prisms separating to strongly developed very fine blocks; there are distinct thin clay skins on the faces of the prisms; very few small clay skins on the faces of the very fine blocks from inside of the prisms. Clear, slightly wavy boundary.
2152	B22	10 to 13½ inches. Grayish brown (1Y 5.5/2 dry) to dark grayish brown (10YR 4/2 moist) clay loam; slightly hard, friable; moderately developed medium-sized prisms which separate to moderately developed very fine blocks. Clear, slightly wavy boundary.
2153	B3	13½ to 19 inches. Grayish brown (2.5Y 5/2 dry) and light brownish gray (2.5Y 6/2 dry) to dark grayish brown (1Y 4/2 moist) loam; slightly hard, friable; weak medium prisms, separating to weak fine blocks. Clear, slightly wavy boundary.
2154	Cca1	19 to 29 inches. Light gray (2.5Y 7/2 dry) to dark grayish brown (2.5Y 4/2 moist) and light olive brown (2.5Y 5/4 moist) moderately calcareous heavy textured loam with a moderate amount of segregated lime in threads and films; hard, friable; weak medium-sized blocks or massive structure with many pores and root holes. Gradual boundary.
2155	Cca2	29 to 39 inches. Colors as in the horizon above in moderately calcareous loam in which there is a moderate amount of segregated lime in threads and films; hard, friable; weak medium blocks or porous massive structure. Clear boundary.
2156	C1	39 to 46 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) mildly calcareous loam with a slight amount of segregated lime in threads and small soft concretions; very thin strata of loamy sand; slightly hard, friable. Clear boundary.
2157	C2	46 to 60 inches. Light gray (5Y 7/2 dry) to dark gray (5Y 4/1 moist) with many fine faint mottlings of olive (5Y 5/3 moist) mildly calcareous loam with a very slight amount of segregated lime in threads and films; hard, friable; moderate, medium blocks.

Remarks: There are considerable shale fragments throughout the profile; the dry shale is light gray (5Y 6/1 dry).

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-9-55

SOIL TYPE Barnes loam, in close association with Cresbard loam **LOCATION** Cavalier County, North Dakota

SOIL NOS. S54NDak-10-2-(1-6) **LAB. NOS.** 2158-2163

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	A1p	5.0	8.1	7.0	12.6	7.5	40.5	19.3	26.6	28.2	2.2	l
5-10	B21	3.0	5.4	5.2	10.0	7.1	37.8	31.5	25.2	25.5	2.0	cl
10-14	B22	3.7	6.1	5.4	10.5	7.2	36.5	30.6	23.3	26.1	3.7	cl
14-27	Ccacs	5.2	6.2	5.2	9.9	7.2	40.2	26.1	26.3	26.8	4.5	l
27-34	Cca	4.2	6.0	5.1	9.5	8.0	43.2	24.0	26.3	30.4	7.2	l
34-60	C	4.7	7.2	6.0	11.1	9.2	42.0	19.8	28.6	29.1	8.7	l

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.6	8.2	8.4	3.21	.274	11.7	-	0.7	-				15.2
7.5	8.2	8.5	1.06	.118	9.0	-	0.7	-				17.5
7.4	8.8	8.9	1.00	.118	8.5	-	0.9	1				19.7
7.7	8.1	8.3	0.29			0.25	4.9	13	76			15.6
7.8	8.8	9.0	0.21			0.40	7.5	13	-			15.9
7.8	9.0	9.3	0.19			0.46	7.5	8	-			15.5

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
28.5	26.0	5.1		0.4	0.9	1	1.4	0.2				58.0
27.9	20.4	7.0		1.3	0.3	4	2.6	0.1				58.8
29.6				2.0	0.3	6	4.0	-				63.7
17.5				4.1	0.2	15	28.0	0.1	5.6	3.5	59.6	51.4
18.7				7.4	0.4	24	55.0	0.2				52.4
19.3				9.2	0.6	30	65.0	0.3	5.6	23.0	67.9	52.3

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Barnes loam, in close association with Cresbard
Soil No.: S54NDak-10-2
Area: Cavalier County, North Dakota.
Location: 965 feet north and 50 feet east of southwest corner Sec. 10, T162N, R60W.
Vegetation or crop: Disked wheat stubble.
Parent material: Moderately shaly till of Mankato age; due to shale content of till this soil may be separated from the Barnes soil as Langdon loam.
Physiographic position: 80 feet below crest of 15-foot high hill; 60 feet above trough.
Topography: Undulating.
Slope: 7 percent north by northeast.
Drainage: Well.
Moisture: Moist.
Described by: C. A. Mogen.
Date: June 4, 1954.

Mandan Lab.No.	Horizon	
2158	A1p	0 to 5 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; slightly hard, very friable; moderately developed fine crumb structure; abrupt boundary.
2159	B21	5 to 10 inches. Grayish brown (10YR 5/2 dry) coated with dark grayish brown (10YR 4/2 dry) to brown (10YR 4/3 moist) coated with very dark brown (10YR 2.5/2 moist) clay loam; hard, friable; compound structure of moderately developed fine prisms separating to strongly developed subangular blocks; distinct sheen on the faces of the peds when moist; tongues of A1; very few fine patches of clay skins on the dry peds. Gradual boundary.
2160	B22	10 to 14 inches. Brown (1Y 5/3 dry) to dark yellowish brown (1Y 4/4 moist) coated with very dark brown (1Y 2.5/2 moist) clay loam; hard, friable to firm; compound structure of moderate fine prisms separating to moderate fine subangular blocks; coatings as in the horizon above. Clear boundary.
2161	Ccacs	14 to 27 inches. Light gray (2.5Y 7/1 dry) to light yellowish brown (2.5Y 6/3 moist) mottled with white (2.5Y 8/2 moist) strongly calcareous loam with a moderate amount of segregated lime and a large amount of crystalline gypsum; slightly hard, very friable; weak fine granules. Gradual boundary.
2162	Cca	27 to 34 inches. Light gray (2.5Y 7/1 dry) to light olive brown (2.5Y 5/3 moist) moderately calcareous light-textured loam with a moderate amount of segregated lime in threads and films; hard, friable; weak fine granular structure. Gradual boundary.
2163	C	34 to 60 inches. Light yellowish brown (3.5Y 6/3 dry) to olive (3.5Y 4/3 moist) mildly calcareous light-textured loam; slightly hard, friable; weak medium blocky or massive structure.

Remarks: There is a moderate amount of shale in all horizons of this profile along with some granitic gravel and stones. Krotovinas appear on the walls of the pit.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Barnes loam **LOCATION** Dickey County, North Dakota

SOIL NOS. S53NDak-11-2 **LAB. NOS.** 1877-1883

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4½	Ap	4.1	5.6	8.1	17.1	11.3	33.7	20.1	36.2	18.2	2	l
4½-10	B21	4.2	7.4	8.8	19.3	11.4	27.3	21.6	34.8	14.4	5	scl
10-15	B22	2.7	5.6	8.7	20.6	12.4	29.6	20.4	37.1	16.6	1	l
15-24	Cca1	4.5	5.9	7.5	17.1	11.2	33.8	20.0	34.0	20.7	2	l
24-36	Cca2	4.7	6.1	8.0	17.2	11.5	33.0	19.5	34.2	20.1	3	l
36-47	C1	3.5	5.5	7.5	17.3	12.6	35.5	18.1	37.3	20.9	2	l
47-60	C2	3.7	5.3	7.1	17.0	12.7	36.9	17.3	38.3	21.6	2	l

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	6.8	7.0	1.93			<0.20	0.5	-				9.9
6.6	6.7	6.9	0.90			<0.20	0.4	-				10.1
7.1	7.3	7.4	0.62			<0.20	0.5	-				9.2
7.8	8.6	8.9	0.34			<0.20	0.6	16	-			7.6
8.3	9.0	9.3	0.19			<0.20	0.9	15	-			8.4
8.2	9.2	9.3	0.12			<0.20	1.4	11	-			8.5
8.1	9.0	9.1	0.13			<0.20	2.3	11	-			8.4

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →				
20.8	14.0	5.0	-	0.9	-	0.6	0.6			39.3
18.8	12.2	6.0	-	0.4	-	0.6	0.2			38.6
17.6	12.6	6.9	0.1	0.3	-	0.6	0.2			41.3
13.3		9.8	0.4	0.2	3	1.7	0.2			39.0
12.9			1.0	0.2	8	5.8	0.2			40.0
13.1			1.6	0.2	12	8.4	0.2			38.4
12.7			1.5	0.2	12	14.1	0.2			37.7

Soil type: Barnes loam
Soil No.: S53NDak-11-2
Area: Dickey County, North Dakota.
Location: 840 feet east and 340 feet north of W1/4 corner Sec. 8, T129N, R60W.
Vegetation: Weedy flax.
Parent material: Calcareous, friable, loam-textured glacial till (Mankato).
Physiographic position: Upland, ground moraine, near 50-foot crest of 1000-foot long undulating slope from higher plain into glacial valley, 1/2 mile wide; slope changes to 3 percent to northwest at 60 feet below sample pit.
Topography: Undulating (relief 5 to 25 feet).
Slope: 5 percent.
Drainage: Well.
Moisture: Dry.
Stoniness: Some
Described by: C. A. Mogen.
Date: September 18, 1953.

Mandan Lab.No.	Horizon	
1877	Ap	0 to 4½ inches. Dark gray crushing to grayish brown, dry, to very dark gray crushing to very dark grayish brown, moist, (10YR 4.5/1.5, 5/2 crushed, dry; 3/1 crushing to 3/1.5 moist) noncalcareous loam; hard; weak fine granular and cloddy structure; very friable. This rests on
1878	B21	4½ to 10 inches. Yellowish brown with dark grayish brown coatings, dry, to dark yellowish brown with very dark grayish brown coatings, moist, (10YR 5/4 and 4/1.5 dry; 3.5/4 with 3/1.5 coatings moist) noncalcareous sandy clay loam; hard; strongly developed medium-sized prismatic structure; prisms separate out into weakly developed medium-sized blocks; friable. This changes clearly into
1879	B22	10 to 15 inches. Brown to dark grayish brown (1Y 5/3 dry; 10YR 4/2 moist) noncalcareous loam; hard; strongly developed medium-sized prismatic structure; friable. This changes in a slightly wavy boundary to
1880	Ccal	15 to 24 inches. Light brownish gray with many fine distinct mottlings of white, dry, to brown to pale brown mottled with white, moist, (2.5Y 6/2, 8/2 dry; 10YR 5/3, 6/3 and 8/2 moist) strongly calcareous loam with a moderate amount of segregated lime; hard; weak coarse prismatic structure; friable. This grades into
1881	Cca2	24 to 36 inches. Colors as in the horizon above in strongly calcareous loam with a moderate amount of segregated lime; hard; weak medium-sized blocky structure; friable. This changes clearly into
1882	C1	36 to 47 inches. Light yellowish brown with common fine distinct mottlings of white, dry, to light olive brown, moist, (2.5Y 6/3 and 8/2 dry; 5/4 moist) moderately calcareous loam with a very slight amount of segregated lime; hard; moderately developed medium and fine blocky structure; friable. This grades into
1883	C2	47 to 60 inches. Light yellowish brown with a very few very fine prominent mottlings of black and yellowish red, dry, to light olive brown mottled with black and yellowish red, moist, (2.5Y 6/3 and 2/1 and 5YR 5/8 dry; 2.5Y 5/4 and 2/1 and 5YR 4/8 moist) moderately calcareous loam; hard; moderately developed medium and fine blocky structure; friable.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Barnes loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-2 **LAB. NOS.** 444-451

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	Ap	1.7	3.6	5.6	16.0	17.5	37.7	18.0	48.7	16.5	-	1
7-16	B2,3	0.9	3.5	6.7	22.0	17.3	33.1	16.5	51.2	12.9	-	1
16-32	Cca	3.2	3.8	5.3	15.7	11.1	41.5	19.4	38.0	24.6	-	1
32-42	D1ca	6.8	6.4	6.3	12.0	9.8	33.3	25.4	30.5	19.5	2	1
42-48	D2	7.8	7.0	6.8	12.2	10.1	33.5	22.6	31.3	19.3	2	1
48-62	D2	5.6	6.5	7.0	12.8	10.6	34.0	23.3	32.6	19.6	6	1
62-72	D3	4.4	6.6	6.9	12.8	10.5	35.9	22.9	32.8	21.0	6	1
72-84	D3	4.8	6.6	6.8	12.8	10.4	35.6	23.1	33.0	20.6	6	1

8C1b SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.0	7.5	7.5	2.88	.252	11.4	-	0.6	-	-			11.2
7.7	8.4	8.4	0.76	.087	8.7	-	0.5	-	-			7.4
8.3	9.0	9.1	0.44	.054	8.1	-	1.3	26	-			6.1
8.1	8.8	9.0	0.16	.022		0.38	9.0	19	-			9.4
8.2	8.8	9.0	0.13	.018		0.37	8.0	17	-			9.3
8.2	8.7	8.9	0.08	.019		0.37	8.5	15	-			9.4
8.0	8.3	8.5	0.10	.018		0.43	9.0	15	24			9.9
7.9	8.3	8.5	0.12	.020		0.39	9.5	15	31			10.3

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
22.8	19.0	4.1		-	1.2	-	0.2	0.6				50.2
15.2	14.8	4.1		-	0.3	-	0.2	-				38.5
9.3				-	0.2	-	4.7	-				34.1
12.7				1.7	0.2	13	44.3	0.2	2.0	2.5	22.4	43.1
12.8				1.8	0.3	14	48.0	0.2				42.3
13.2				1.6	0.4	12	54.2	0.2	3.3	2.5	7.1	42.4
12.6				1.6	0.4	13	52.1	0.5				42.8
12.5				1.5	0.4	12	56.8	0.5	1.7	2.8	25.6	41.2

Soil type: Barnes loam
Soil No.: 850NDak-38-2
Location: 70 paces south and 15 paces west of northeast corner of northeast quarter of northeast quarter of Sec. 34, T163N, R84W, Renville County, North Dakota.
Vegetation: Hay field; quackgrass.
Parent material: Glaciofluvial over till.
Physiographic position: Upland crest of long slope.
Topography: Very gently undulating.
Erosion: Slight.
Drainage: Well drained.
Ground water: Very deep.
Moisture: Moist, recent rains.
Stoniness: Free.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 18, 1950.

Horizon and Mandan Lab. Number	
Ap 444	0 to 7 inches. Dark gray, dry, between very dark gray and black, moist (10YR 4/1 between 3/1 and 2/1) noncalcareous loam; soft; moderately developed fine-crumb structure; very friable when moist; this changes clearly into
B2 (see 445 note)	7 to 12 inches. Grayish brown, dry, dark grayish brown, moist (10YR 5/2, 4/2) noncalcareous loam; slightly hard; moderately developed medium-sized prismatic structure; prisms separate into moderately developed fine nuciform and medium-sized granules; very friable when moist. This grades into
B3 (see 445 note)	12 to 16 inches. Light olive brown, dry, olive brown, moist (2.5Y between 5/2 and 5/4, dry, between 4/2 and 4/4 moist) noncalcareous loam having a slightly hard, weakly developed, medium-sized prismatic structure; prisms separate into moderately developed fine nuciform medium-sized granules; very friable when moist. This changes clearly into
Cca 446	16 to 32 inches. Grayish brown, dry, olive brown, moist (2.5Y between 5/2 and 5/4 dry, between 4/2 and 4/4 moist) moderately calcareous, slightly hard, loam with a weakly developed prismatic and granular structure; slightly hard when dry; very friable when moist. There is a moderate amount of segregated lime. This changes clearly into
IIca 447	32 to 42 inches. Pale yellow distinctly mottled with some medium-sized white mottlings and with very few fine spots of strong brown, dry, light olive brown mottled with light gray, moist (2.5Y between 7/2 and 7/4 mottled with 8/2 and 7.5YR 5/8 dry, 2.5Y between 5/2 and 5/4 mottled with 7/2 and 7.5YR 5/8 moist) moderately calcareous hard loam till; weak granular structure; moderate amount of segregated lime; friable to firm when moist; some rounded and subangular quartz and shale. This grades into
D2 (see 448 note) and 449	42 to 62 inches. Faintly mottled light yellowish brown and light gray with distinct mottlings of a few fine spots of strong brown, dry, mottled light olive brown and gray, moist (5Y between 6/2 and 6/4 with 10YR 7/1 and 7.5YR 5/8 dry, 2.5Y between 5/2 and 5/4 with 10YR 5/1 and 7.5YR 5/8 moist) moderately calcareous loam; moderate very thick platy; hard when dry; firm when moist; some angular and subangular fine- and medium-sized gravels.
D3 (see 450 note) and 451	62 to 84 inches. Mottled light gray, pale yellow, and olive brown with a few spots of yellowish red, dry, mottled grayish brown, olive brown, pale yellow with a few spots of yellowish red, moist (2.5Y 7/2, 5/4 and 8/4 with 5YR 5/8 dry, 2.5Y 5/2, 4/4 and 7/4 with 5YR 4/6 moist) moderately calcareous loam till containing a few angular and subangular gravels; has a hard consistence when dry and a firm consistence when moist; moderate very thick platy; there is a moderate amount of crystalline gypsum apparent in this depth.

Note: Horizons B2 and B3 were combined for analysis; horizons D2 and D3 were split for analysis.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Barnes fine sandy loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-3 **LAB. NOS.** 452-458

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 <19mm	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	4.1	5.4	7.0	22.4	14.7	28.6	17.9	43.3	14.1	-	fsl
6-10	B1	3.5	4.8	6.2	16.4	10.9	32.2	26.0	38.3	15.0	-	l
10-18	B2	4.3	6.7	7.1	15.4	10.0	30.7	25.8	33.5	16.2	6	l
18-40	D1ca	4.3	7.4	7.5	15.1	10.5	29.7	25.5	32.4	16.8	8	l
40-60	D2											
60-72	D3	4.4	6.9	6.9	16.2	11.1	33.6	21.0	35.3	19.5	7	l
72-84	D4											

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4	7.9	8.0	2.42	.212	11.4	-	0.7	1	-			8.9
6.4	7.1	7.3	0.98	.109	9.0	-	0.4	-	-			10.3
7.4	8.4	8.6	0.76	.099	7.7	-	0.6	2	-			10.2
8.0	8.7	9.0	0.27	.036	7.5	0.21	4.9	26	-			8.6
8.1	9.0	9.2	0.14	.018		0.24	6.4	16	-			8.4
8.1	8.8	9.1	0.14	.019		0.33	7.5	17	-			9.0
8.1	8.8	9.1	0.13	.019		0.38	8.3	15	-			10.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →					
20.9		4.1	-	1.0	-	0.5	0.5				39.3
20.9	10.0	8.4	-	0.4	-	0.5	-				39.9
18.6			-	0.3	-	1.6	-				42.6
11.8			1.0	0.1	16	22.6	-				38.5
11.2			1.9	0.2	17	45.1	-				37.7
11.7			1.9	0.3	16	56.6	0.2	2.4	2.0	18.1	40.8
12.6			1.7	0.3	14	67.2	0.2				44.2

Soil type: Barnes fine sandy loam
Soil No.: S50NDak-38-3
Location: 16 paces west and 27 paces south of northeast corner of northeast quarter, Sec. 20, T163N, R84W, Renville County, North Dakota.
Vegetation: Grain stubble.
Parent material: Shallow glaciofluvial over till.
Physiographic position: Very slight depression in upland plain.
Topography: Very gently undulating
Drainage: Moderately well.
Ground water: Very deep.
Moisture: Moist.
Stoniness: Till contains stones.
Described by: C. A. Mogen.
Date: September 18, 1950.

Horizon and Mandan Lab. Number	
Ap 452	0 to 6 inches. Dark gray, dry, and very dark brown, moist (10YR 4/1, 2/2), noncalcareous fine sandy loam; weak fine crumb structure; slightly hard when dry, very friable when moist.
B1 453	6 to 10 inches. Grayish brown, dry, and very dark grayish brown, moist (10YR 5/2, 3/2), noncalcareous loam; has a moderately developed, medium prismatic structure; prisms readily separate into moderately developed fine nuciform and medium granular aggregates; hard when dry; very friable when moist. This grades into
B2 454	10 to 18 inches. Light olive brown, dry, and olive brown, moist (2.5Y between 5/2 and 5/4, between 4/2 and 4/4), noncalcareous heavy-textured loam; structure as in the horizon above; hard when dry; friable when moist. This changes in a clear boundary to
D1ca 455	18 to 40 inches. Distinctly mottled in a medium-sized pattern of light yellowish brown and white and a few fine prominent mottlings of yellowish red, dry; moist soil is mottled light olive brown and light gray (2.5Y 6/4, 8/2, 8/0 and 5YR 5/8 dry, 2.5Y 5/4 and 7/2 moist), moderately calcareous loam in which there is a moderate amount of segregated lime; weakly granular structure; hard when dry; friable when moist; a few stones and gravel occur in this horizon.
D2 456	40 to 60 inches. Faintly mottled light yellowish brown and light gray with numerous very small distinct mottlings of brownish yellow, dry, and mottled light olive brown and light gray with spots of yellowish brown, moist (2.5Y 6/3, 10YR 7/1 and 6/6, dry, 2.5Y 5/3, 10YR 5/1 and 5/6 moist), moderately calcareous loam; moderate very thick platy; very hard when dry; firm when moist.
D3 457	60 to 72 inches. Distinctly mottled in a medium-sized pattern of light yellowish brown and light olive gray with a few very small stains of olive yellow, dry, and mottled olive brown, dark olive gray, and light olive brown, moist (2.5Y 6/3, 5Y 6/2, 2.5Y 6/6 dry, 2.5Y 4/3, 5Y 3/2, 2.5Y 5/6 moist), moderately calcareous loam; moderate very thick platy; very hard when dry; firm when moist.
D4 458	72 to 84 inches. Light yellowish brown distinctly mottled with some medium-sized light gray and a very few small stains of yellowish brown, dry, and light olive brown mottled with dark gray and stained with yellowish brown, moist (2.5Y 6/3, 5Y 6/1, 10YR 5/8 dry, 2.5Y 5/3, 5Y 4/1, 10YR 5/8 moist), moderately calcareous clay; moderate very thick platy; very hard when dry; firm when moist. There are lenses of fine sand mixed in with the till below a depth of 18 inches.

OIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE Barnes loam **LOCATION** Steel County, North Dakota

SOIL NOS. S53NDak-46-1 **LAB. NOS.** 1675-1681

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	2.5	4.6	5.2	12.2	9.8	38.2	27.5	36.4	18.9	1.4	cl
6-12	B2	3.8	5.7	6.8	16.3	10.2	30.5	26.7	34.2	16.3	2.9	l
12-21	Cca1	3.2	5.5	5.7	12.8	8.8	36.5	27.5	31.0	21.7	3.5	cl
21-36	Cca2	4.3	6.0	5.6	11.9	8.3	35.5	28.4	28.9	21.9	3.7	cl
36-41	C1	1.7	3.9	4.0	9.0	7.3	43.2	30.9	27.8	28.1	2.0	cl
41-50	C2	3.4	6.2	6.0	13.6	10.1	36.8	23.9	33.9	21.3	3.7	l
50-60	C3	3.7	5.4	5.6	12.3	9.3	37.5	26.2	32.1	22.0	3.8	l

pH 8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6H1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 6A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS.
7.7			3.49	0.307	11.4	<0.20	0.5	-				14.7
7.7			1.36	0.138	9.8	<0.20	0.6	5				11.2
8.0			0.55	0.066	8.3	<0.20	0.6	23				8.9
8.6			0.23	0.030		<0.20	1.9	26	-			9.1
8.3			0.16	0.023		<0.20	4.0	20	-			11.2
8.4			0.14	0.017		<0.20	5.0	17	-			8.8
8.4			0.11	0.017		<0.20	4.5	18	-			9.6

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6F1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
34.3	24.4	7.2		-	0.5	2.2	-	0.1				56.5
		11.0		-	0.2	1.3	0.2	0.1				45.9
		12.8		0.1	0.1	-	0.6	0.1				42.1
							8.3	-				43.6
							19.1	-	1.6	4.2	50.1	47.3
							23.0	-	2.7	3.2	66.5	40.2
							23.9	-	3.2	0.5	60.6	44.1

Soil type: Barnes loam
Soil No.: S53NDak-46-1
Location: 270 feet north and 75 feet east of southeast corner of Sec. 28, T144N, R56W, Steele County, North Dakota.
Crop: Hard spring wheat.
Climate: Mean annual precipitation 18 inches; average annual temperature 39° F.
Parent material: Friable, calcareous, loam glacial till, very probably of Mankato (late Wisconsin) age.
Physiography: Undulating to gently rolling till plain, in an area that is dominantly of Barnes-Aastad soils.
Slope: 4 percent facing toward northeast.
Drainage: Well drained; runoff and permeability are medium.
Described by: W. M. Johnson, 1953.
Mandan

Lab.No.	Horizon	
1675	A1p	0 to 6 inches. Very dark gray to black (10YR 2.5/1 dry; 1.5/1 moist) soft, friable, moderate very fine granular loam. Contains scattered pebbles and an occasional stone. Gradual "tongued" lower boundary that in places reaches to the base of B2.
1676	B2	6 to 12 inches. Dark grayish brown to very dark grayish brown (10YR 4/2 dry; 3/2.5 moist) friable heavy loam. Moderate medium prisms break to moderate medium blocks. Prisms have black films on their surfaces. Noncalcareous. Gradual lower boundary.
1677	Cca1	12 to 21 inches. Light brownish gray to dark grayish brown (1Y 6/2.5 dry; 4/2.5 moist) friable light clay loam, with common fine and medium white mottles (dry). Weak medium prisms may be crushed to form weak fine granule-like aggregates. Very strongly calcareous, the lime being mainly in floury, disseminated form, with only a few spots of soft segregations. Lower boundary is diffuse and wavy.
1678	Cca2	21 to 36 inches. Light brownish gray to dark grayish brown (2.5Y 6/2 dry; 4/2 moist) friable clay loam with common, conspicuous, medium and coarse white mottles and a few small spots of red and brown. Weak coarse blocks break down to weak fine blocks. Plastic and slightly sticky when wet. Undersides of pebbles have lime accumulations, and there are a few soft lime-carbonate concretions from 1/4 to 1/2 inch in diameter. Lower boundary is clear and wavy.
1679	C1	36 to 41 inches. Light brownish gray to dark grayish brown (2.5Y 6/2.5 dry; 4/2.5 moist) friable clay loam till, with a few fine and medium white lime spots and a few fine inconspicuous gray and brown mottles. Moderately calcareous. Moderate coarse blocks break down to moderate very fine blocks. Lower boundary is clear and wavy.
1680	C2	41 to 50 inches. Light yellowish brown to olive brown (2.5Y 6.5/3 dry; 4.5/3 moist) friable loam till with a few fine and medium white mottles and a few tiny yellowish red specks. Strongly calcareous. Plastic and slightly sticky when wet. Moderate very coarse platy aggregates break down to weak fine blocks. Diffuse lower boundary.
1681	C3	50 to 60 inches. Light yellowish brown to olive brown (2.5Y 6.5/3 dry; 4.5/3 moist) friable loam till, with a few tiny yellowish red and reddish brown specks, and an occasional white lime spot from 1/8 to 1/2 inch in diameter. Strongly calcareous. Weak very coarse platy aggregates break down to moderate fine blocks.

Note: The layer C1, 36 to 41 inches, probably indicates slight stratification due to water reworking of the parent till. Account should be taken of this possibility when interpreting laboratory data on samples from this profile.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Bearden silty clay loam **LOCATION** Cass County, North Dakota

SOIL NOS. 853NDak-9-5 **LAB. NOS.** 1785-1791

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 <19mm	TEXTURAL CLASS
0-8	A1p	0.5	0.9	1.1	3.8	13.4	50.0	30.3	42.5	23.8	-	sicl
8-15	Ccal	0.1	0.4	0.5	1.9	6.6	57.1	33.4	37.9	27.2	-	sicl
15-22	Cca2	0.1	0.3	0.4	1.6	3.2	65.6	28.8	33.4	36.5	-	sicl
22-31	Cgca	0.1	0.3	0.4	0.8	1.1	59.9	37.4	19.7	41.9	-	sicl
31-40	Cg1	0.3	0.4	0.4	0.6	0.8	63.1	34.4	17.6	46.8	-	sicl
40-48	Cg2	0.1	0.4	0.4	0.8	0.8	59.0	38.5	13.4	46.9	-	sicl
48-60	Cg3	0.1	0.1	0.2	0.7	1.0	49.3	48.6	11.2	39.6	-	sic

8C1b pH SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8			3.23	0.268	12.0	<0.20	0.8	3				19.3
8.2			0.81	0.086	9.4	<0.20	1.1	24				15.1
8.2			0.53	0.059	9.0	<0.20	1.0	26				15.0
8.2			0.28	0.042	6.7	<0.20	0.8	13				17.1
8.2			0.25	0.036	6.9	<0.20	0.9	21				17.4
8.1			0.23	0.036		<0.20	0.9	18				21.2
7.9			0.22	0.037		<0.20	1.2	16				23.4

EXTRACTABLE CATIONS Ca	Mg	H	Na	K	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →					← milliequivalents per liter →					
					-	0.5				65.1
					0.4	0.5				58.2
					0.6	0.5				58.7
					1.1	0.4				64.7
					1.5	0.8				68.8
					1.5	0.5				76.2
					1.5	0.5				85.4

Soil type: Bearden silty clay loam
Soil No.: S53NDak-9-5
Area: Cass County, North Dakota.
Location: 220 feet east and 160 feet north of S1/4 corner Sec. 4, T141N, R50W.
Vegetation: Barley - rank straw.
Parent material: Lacustrine silty clay loam.
Physiographic position: Glacial Lake Agassiz plain.
Topography: Level to very slightly undulating.
Slope: 1/2 percent.
Drainage: Somewhat poor.
Permeability: Moderately slow.
Moisture: Moist to 20 inches; field capacity below 20 inches.
Stoniness: Free.
Described by: C. A. Mogen.
Date: August 11, 1953.

Mandan Lab.No.	Horizon	
1785	A1p	0 to 8 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) mildly calcareous silty clay loam; strong fine granular and very fine blocky structure; slightly hard when dry, friable when moist. Abrupt boundary.
1786	Cca1	8 to 15 inches. Light gray (2.5Y 7/2 dry) with streaks of gray (10YR 5/0.5 dry) to light brownish gray (2.5Y 6/2 dry) with streaks of dark gray (10YR 4/0.5 moist) very strongly calcareous silty clay loam; strong very fine granules and very fine blocks; soft when dry, very friable when moist. Clear boundary.
1787	Cca2	15 to 22 inches. Pale yellow (2.5Y 7/3 dry) with streak of gray (2.5Y 5/1 dry) to light olive brown (2.5Y 5/4 moist) with streaks of dark grayish brown (2.5Y 4/2 moist) strongly calcareous light textured silty clay loam; strong very fine granules and very fine blocks; soft when dry, very friable when moist. Clear boundary.
1788	Cgca	22 to 31 inches. Light gray (2.5Y 7/2 dry) and pale yellow (2.5Y 7/3 dry) with many fine distinct mottlings of white and brownish yellow (10YR 9/1 and 6/8 dry) to light olive brown (2.5Y 5/4 moist) mottled with light brownish gray (2.5Y 6/2 moist) strongly calcareous silty clay loam with a moderate amount of segregated lime in threads and some small soft round concretions; moderate very fine granules and very fine blocks; slightly hard when dry, friable when moist. Clear boundary.
1789	Cg1	31 to 40 inches. Light gray (2.5Y 7/2 dry) with many fine distinct mottlings of brownish yellow (10YR 6/8 dry) to grayish brown (2.5Y 5/2 moist) mottled with yellowish brown (10YR 5/6 moist) moderately calcareous silty clay loam with a slight amount of segregated lime; moderate medium laminations separating out into moderate very fine blocks; slightly hard when dry, friable when moist. Gradual boundary.
1790	Cg2	40 to 48 inches. Light gray (5Y 7/2 dry) with many medium-sized prominent mottlings of brownish yellow (10YR 6/8 dry) to olive gray (5Y 5/2 moist) mottled with strong brown (7.5YR 5/6 moist) moist moderately calcareous silty clay loam; moderate medium-sized laminations breaking out into strong very fine blocks; slightly hard when dry, friable when moist. Gradual boundary.
1791	Cg3	48 to 60 inches. Colors as in the horizon above in moderately calcareous silty clay that is strongly laminated or varved; hard when dry, friable when moist.

OIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Bearden clay loam **LOCATION** Cass County, North Dakota

SOIL NOS. S53NDak-9-6 **LAB. NOS.** 1792-1800

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	A1p	0.2	0.8	2.1	8.9	22.6	36.6	28.8	47.9	18.2	-	cl
7-10	Aca	0.2	0.4	1.2	6.5	18.3	41.8	31.6	43.5	21.7	-	cl
10-16	Cca	0.3	0.2	0.4	2.6	4.8	48.3	43.4	22.6	32.3	-	sic
16-23	Cca2	0.1	0.2	0.2	0.7	1.2	57.6	40.0	19.0	40.2	-	sic
23-31	Cca3	-	0.2	0.3	0.6	0.8	59.9	38.2	20.3	40.8	-	sicl
31-44	Cg1	0.4	0.5	0.4	1.4	1.4	62.0	33.9	18.7	45.8	-	sicl
44-52	Cg2	-	0.3	0.3	0.9	1.2	59.5	37.8	18.0	43.4	-	sicl
52-58	Cg3	0.8	1.3	1.6	15.4	10.2	41.6	29.1	40.9	24.4	0.5	cl
58-72+	Dg	0.4	0.4	0.2	0.9	0.9	9.8	87.4	4.8	6.6	0.4	c

8C1b pH SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST'D SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4			1.90	0.188	10.1	<0.20	0.6	-				15.6
7.7			1.19	0.114	10.4	<0.20	0.6	6				16.1
8.1			0.55	0.070	7.8	<0.20	0.6	19				16.6
8.1			0.41	0.047	8.7	<0.20	0.7	17				15.6
8.1			0.32	0.039	8.2	<0.20	0.8	14				16.0
8.1			0.25	0.039	6.4	<0.20	1.1	19				17.3
8.0			0.20	0.032		<0.20	1.3	18				18.9
7.9			0.18	0.026		<0.20	1.9	13				14.2
			0.29	0.040	7.2			4				30.7

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
34.8	17.2	14.9		0.2	0.6	1.9	-	0.5				55.7
							0.2	0.4				60.0
							0.2	0.5				58.5
							1.1	0.5				60.9
							1.5	0.5				61.7
							3.5	0.5				66.7
							4.1	0.8				76.1
							5.6	0.8				60.6

Soil type: Bearden clay loam
Soil No.: S53NDak-9-6
Area: Cass County, North Dakota.
Location: 250 feet southeast of northwest corner, Sec. 33, T142N, R50W.
Vegetation: Very good field of spring wheat.
Parent material: Lacustrine silt, clay and sand.
Physiographic position: Glacial Lake Agassiz plain, a level plain here.
Topography: Level (relief in inches).
Drainage: Somewhat poor.
Permeability: Moderate.
Moisture: Moist to 20 inches; at field capacity below.
Stoniness: Free.
Described by: C. A. Mogen.
Date: August 12, 1953.

Mandan Lab.No.	Horizon	
1792	A1p	0 to 7 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) clay loam; strong very fine granules; slightly hard when dry, friable when moist. Clear boundary.
1793	Aca	7 to 10 inches. Light gray (10YR 7/1 dry) streaked with dark gray (10YR 4/1 dry) to dark gray (10YR 4/1 moist) streaked with black (2.5Y 2/1 moist) moderately calcareous and very calcareous clay loam; strong very fine granules; slightly hard when dry, friable when moist. Clear boundary.
1794	Cca	10 to 16 inches. White (2.5Y 9/2 dry), light gray (2.5Y 7/2 dry) and gray mottled (2.5Y 5/1 dry) to light gray (2.5Y 7/2 moist) with a few medium-sized distinct mottlings of grayish brown (2.5Y 5/2 moist) with tongues of black (10YR 2/1 moist) very strongly calcareous silty clay; compound structure of weak medium-sized prisms and moderate fine granules or very fine blocks; slightly hard when dry, friable when moist. Gradual boundary.
1795	Cca2	16 to 23 inches. Light gray (2.5Y 7/2 dry) to light olive brown (2.5Y 5/3 moist) with many fine distinct mottlings of light brownish gray (2.5Y 6/2 and 5/4 moist) strongly calcareous silty clay; moderate fine granules or very fine blocks; slightly hard when dry, friable when moist. Gradual boundary.
1796	Cca3	23 to 31 inches. Light brownish gray (2.5Y 6/2 dry) with a few fine prominent mottlings of brownish yellow and white (10YR 5/6 and 9/2 dry) to olive brown (2.5Y 4/3 moist) mottled with light brownish gray (2.5Y 6/2, 8/2 and 5/6 moist) white and light olive brown, moderately calcareous silty clay loam with a moderate amount of segregated lime in threads and very fine small, soft, round concretions; moderate very fine blocks; slightly hard when dry, friable when moist. Clear boundary.
1797	Cg1	31 to 44 inches. Light gray (2.5Y 7/2 dry) and pale yellow (2.5Y 7/4 dry) with common fine prominent mottlings of brownish yellow (10YR 6/8 dry) to olive gray (5Y 5/2 moist) with common fine prominent mottlings of strong brown (7.5YR 5/8 moist) moderately calcareous silty clay loam; moderate medium-sized laminations separating into well defined fine blocks; slightly hard when dry, friable when moist. Gradual boundary.
1798	Cg2	44 to 52 inches. Light gray (5Y 7/2 dry) and pale yellow (2.5Y 7/4 dry) with mottlings of brownish yellow (10YR 6/8 dry) to olive gray (5Y 5/2 moist) mottled with strong brown (7.5YR 5/8 moist) moderately calcareous silty clay loam; structure as in the horizon above; hard when dry, friable when moist. Clear boundary.
1799	Cg3	52 to 58 inches. Pale yellow (2.5Y 7/4 dry) and light gray (5Y 7/2 dry) with common fine distinct mottlings of brownish yellow (10YR 6/8 dry) to light olive brown (2.5Y 5/4 moist) light brownish gray and yellowish brown (2.5Y 6/2 and 10YR 5/8 moist) moderately calcareous stratified fine sand and silty clay; loose to hard when dry, friable when moist. Abrupt boundary.
1800	Dg	58 to 72+ inches. Gray (5Y 6/1 dry) with common fine prominent mottlings of dark brown to very dark gray (7.5YR 4/4 dry) to (5Y 3/1 moist) mottled with dark brown (7.5YR 4/4 moist) moist moderately calcareous varved clay; very hard when dry, very firm when moist.

Remarks: A representative profile of Bearden. These high-lime soils have granular Cca horizons and have laminated silty clay loam substrata with lenses of fine sand and layers of clay.

SOIL SURVEY LABORATORY Mandan, North Dakota[1/] 9-9-55

SOIL TYPE Bearden clay loam **LOCATION** Pembina County, North Dakota

SOIL NOS. S54NDak-34-1-(1-6) **LAB. NOS.** 2124-2129

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Alp	0.6	1.8	2.0	6.0	17.3	40.2	32.1	39.7	21.8	-	cl
7-18	ACca	0.2	0.6	0.7	2.5	17.4	41.1	37.5	39.2	21.1	-	cl
18-28	Cca	0.2	0.4	0.4	1.0	4.3	55.8	37.9	23.5	37.1	-	sicl
28-36	Cl	0.1	0.2	0.3	0.7	2.5	62.3	33.9	22.1	43.2	-	sicl
36-46	Cg1	0.8	1.1	0.6	0.9	1.4	59.7	35.5	20.4	41.2	-	sicl
46-60	Cg2	-	0.3	0.5	1.1	2.2	64.5	31.4	27.0	40.3	-	sicl

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.3	8.5	3.40	.284	12.0	-	4.0	8				16.6
7.9	8.6	8.8	1.08	.090	12.0	0.31	6.0	13	2			15.2
8.0	8.7	8.9	0.48			0.34	7.0	25	-			14.3
8.0	8.7	8.9	0.34			0.43	8.0	15	-			14.0
7.9	8.3	8.5	0.30			0.43	8.5	15	62			15.9
7.8	8.3	8.5	0.29			0.43	8.5	15	76			14.4

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a Ca	Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
28.5				0.6	0.9	1	4.3	0.8				67.3
20.3				1.6	0.3	3	15.2	0.3	3.5	4.5	93.3	58.8
18.8				2.4	0.4	6	23.0	0.4				56.6
20.7				3.1	0.7	5	32.0	0.6	4.0	14.2	120.7	62.2
19.5				2.9	0.6	6	26.0	0.7				68.5
19.7				3.0	0.7	6	26.0	0.6	5.1	13.8	132.2	65.9

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Bearden clay loam
Soil No.: S54NDak-34-1
Area: Pembina County, North Dakota.
Location: 640 feet east, 160 feet south of northwest corner Sec. 29, T160N, R52W.
Vegetation or crop: Summer fallow.
Parent material: Glaciolacustrine silt and clay.
Physiographic position: Outer edge Pembina River delta of Glacial Lake Agassiz.
Topography: Nearly level with 50 percent shallow swales of Colvin silty clay loam.
Slope: 1 percent.
Drainage: Somewhat poor.
Ground water: 60 inches plus.
Permeability: Moderately slow.
Moisture: Above field capacity.
Stoniness: Free.
Described by: C. A. Mogen.
Date: June 2, 1954.

Mandan

Lab.No.	Horizon	
2124	A1p	0 to 7 inches. Very dark gray (10YR 3/0.5 dry) to black (10YR 2/1 moist) moderately calcareous clay loam with a few threads of segregated lime; very hard, friable; weak fine granules and moderate very fine blocks. Abrupt boundary.
2125	ACca	7 to 18 inches. Dark gray (10YR 4/0.5 dry) and gray (10YR 5/0.5 dry) to very dark gray (10YR 3/1 moist) and dark gray (10YR 4/1 moist) very strongly calcareous fine-textured clay loam with a slight amount of segregated lime in threads; clods and large peds are hard breaking to very fine blocks; friable when moist. Clear irregular boundary.
2126	Cca	18 to 28 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) very strongly calcareous fine-textured silty clay loam; hard, friable; moderately developed very fine blocks. Clear boundary.
2127	C1	28 to 36 inches. Light brownish gray (2.5Y 6/2 dry) strongly calcareous silty clay loam; dry soil has many fine faint mottlings of light yellowish brown (2.5Y 6/4 dry) and light gray (2.5Y 7/1 dry); the moist soil is olive brown (2.5Y 4/3 moist) withmany fine distinct mottlings of light olive brown (2.5Y 5/4 moist); hard, friable; moderately developed very fine blocks; a few pipestem-shaped iron concretions. Clear boundary.
2128	Cg1	36 to 46 inches. Light brownish gray (2.5Y 6/2 dry) very mildly calcareous silty clay loam; dry soil has many fine distinct mottlings of brownish yellow (10YR 6/6 dry); moist soil is dark grayish brown (2.5Y 4/2 moist) mottled with yellowish brown (10YR 5/6 moist); hard, firm; moderate, coarse plates of laminated lacustrine material that separate to very fine blocks; large nests of calcium sulphate crystals; some pipestem-shaped iron concretions. Gradual boundary.
2129	Cg2	46 to 60 inches. Colors as in the horizon above in the very weakly calcareous silty clay loam; very hard, firm; moderate coarse plates of laminated lacustrine deposits that separate out in very fine blocks.

Remarks: The profile was too wet for a reliable estimate of the kind and degree of structure. However, in the re-examination of the envelope samples of each horizon, clods of the soil were hard, breaking to very fine blocks. The very fine blocks are very hard or extremely hard.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-9-55

SOIL TYPE Bearden clay loam **LOCATION** Pembina County, North Dakota

SOIL NOS. S54NDak-34-2-(1-6) **LAB. NOS.** 2130-2135

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-8	A1p	0.3	1.2	1.6	5.8	14.1	47.0	30.0	39.5	25.4	-	cl
8-15	A1ca	0.2	0.5	0.6	3.0	18.3	48.1	29.3	49.0	19.7	-	cl
15-23	Cca1	-	0.2	0.5	1.4	3.3	57.2	37.4	21.3	40.2	-	sicl
23-30	Cca2	-	0.1	0.2	0.5	0.9	65.1	33.2	21.0	45.3	-	sicl
30-39	Cg1	0.2	0.4	0.4	0.8	1.2	65.7	31.3	16.5	50.8	-	sicl
39-60	Cg2	-	0.2	0.2	0.5	1.5	74.4	23.2	30.2	46.0	-	sil

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6K1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.6	8.7	3.42	.288	11.9	-	1.7	1				16.8
8.0	9.0	9.2	0.86	.085	10.1	0.21	4.5	14	-			12.3
8.0	8.7	8.9	0.51			0.43	9.0	28	-			14.6
8.0	8.8	8.9	0.36			0.54	10.0	26	-			13.6
8.0	8.8	8.9	0.33			0.57	10.0	23	-			14.7
8.0	8.7	8.9	0.29			0.73	10.0	17	-			13.3

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a Ca	Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
32.0				0.8	1.0	2	3.5	0.4				67.0
19.1				2.5	0.2	7	20.9	0.2	6.6	2.2	54.8	56.8
18.7				3.9	0.2	7	40.0	0.3				61.6
17.5				4.6	0.2	11	42.0	0.2	7.1	5.2	177.9	64.0
21.3				5.5	0.4	12	45.0	0.2				67.0
19.1				5.5	0.4	13	47.0	0.2	5.6	6.0	184.1	64.5

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Bearden clay loam
Soil No.: S54NDak-34-2
Area: Pembina County, North Dakota.
Location: 930 feet west and 65 feet south of northeast corner Sec. 18, T160N, R52W.
Vegetation or crop: Plowed ground.
Parent material: Glaciolacustrine silt and clay deposits.
Physiographic position: Outer edge of Pembina River delta.
Topography: Level.
Drainage: Somewhat poor.
Ground water: 39 inches.
Moisture: Moist to field capacity plus.

Described by: C. A. Mogen.
Date: June 3, 1954.

Mandan Lab.No.	Horizon	
2130	A1p	0 to 8 inches. Black (10YR 2/0.5 dry) to (10YR 2/1 moist) moderately calcareous clay loam; slightly hard, friable; moderately developed fine granules.
2131	A1ca	8 to 15 inches. Dark gray (10YR 4/0.5 dry) and gray (10YR 5/0.5 dry) to very dark gray (10YR 3/1 moist) gray, (10YR 5/1 moist) and black (10YR 2/1 moist) very strongly calcareous clay loam with a slight amount of segregated lime in threads; hard, friable; moderately developed very fine blocks.
2132	Cca1	15 to 23 inches. Light gray (2.5Y 7/2 dry) and gray brown (2.5Y 5/2 dry) to light olive brown (2.5Y 5/4 moist) and olive brown (2.5Y 4/3 moist) very strongly calcareous silty clay loam with a very slight amount of segregated lime; there are tongues of black (10YR 2/1 moist) and dark gray (10YR 4/1 moist); spots of light yellowish brown (2.5Y 6/4 moist); hard, friable; strong very fine blocks when dry, weakly developed when moist.
2133	Cca2	23 to 30 inches. Light gray (2.5Y 7/2 dry) to light olive brown (2.5Y 5/4 moist) strongly calcareous silty clay loam; many fine faint mottlings of light gray, brown and yellow; slightly hard, friable; strong, very fine blocks in the dry soil, weakly developed in the moist soil.
2134	Cg1	30 to 39 inches. Light brownish gray (2.5Y 6/2 dry) with common fine distinct mottlings of yellowish brown (10YR 5/8 dry) to grayish brown (2.5Y 5/2 moist) moderately calcareous silty clay loam with a moderate amount of segregated lime as very fine soft concretions; very hard, friable; compound structure of moderate fine and very fine blocks.
2135	Cg2	39 to 60 inches. Light gray (2.5Y 7/2 dry) and light yellowish brown (2.5Y 6/4 dry) to light brownish gray (2.5Y 6/2 moist) and light olive brown (2.5Y 5/4 moist) in a fine mottled pattern in moderately calcareous silt loam; extremely hard, friable; moderately developed fine plates and blocks.

Remarks: The clods and large peds of the horizons in this sample when dried are hard, slightly hard, or very hard breaking to the very fine blocks. The very fine blocks are very hard.

SOIL SURVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE *Brantford loam, sandy substratum phase with lighter-textured B horizon than typical **LOCATION** Griggs County, North Dakota

SOIL NOS. S59NDak-20-1-(1-7) **LAB. NOS.** 11685-11691

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	6.2a	23.9a	20.9a	18.2a	3.0	15.5	12.3	15.4	9.4	Tr.	cosl
6-12	B1	5.0	21.8	19.4	15.5	3.6	19.6	15.1	18.7	9.8	Tr.	cosl
12-18	B2	8.9b	27.7c	20.8c	11.5	2.1	14.6	14.4	10.4	9.6	8	cosl
18-26	D1	8.1b	30.9c	24.1c	12.6	1.5	10.6	12.2	7.1	7.8	12	cosl
26-36	D2ca	32.3d	26.8d	11.2d	6.0e	1.2e	12.9	9.6	6.1	9.8	40	cosl
36-42	D2	37.9d	30.2d	7.4d	2.6e	1.1e	12.1	8.7	5.4	8.8	34	lcos/cos
42-60	D3	1.6d	15.7d	28.8d	34.2e	2.9e	9.9	6.9	14.3	6.7	1	ls

pH 1:1	pH 1:5	pH 1:10	8C1a ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
7.1	7.3	7.4	2.14	0.187	11	0.5	0.6	< 1				8
7.4	7.6	7.6	0.86	0.097	9	0.7	0.6	< 1				7
7.6	7.8	7.9	0.39	0.051	8	0.7	0.6	< 1				8
7.7	8.0	8.0	0.22	0.032		0.6	0.6	< 1				8
8.2	8.7	8.8	0.15			0.6	0.6	10				7
8.2	8.8	9.0	0.06			0.7	0.5	10				7
8.2	8.8	9.1	0.04			0.5	0.4	6				6

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5R1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	←	←	←	←	→							
17.9	15.4	2.6	1.9	< 0.1	0.9	106	91	18.9	20.8	5.9	1.44	
14.0	11.5	3.2	1.4	0.1	0.4	108	92	15.2	16.6	3.6	1.56	
13.7	10.5	3.3	1.2	0.1	0.5	105	92	14.4	15.6	3.2		
11.3	9.0	2.8	1.0	0.1	0.5	110	92	12.4	13.4	3.2		
9.3				0.2	0.5							
10.6				0.2	0.6							
8.0				0.2	0.5							

milliequivalents per 100g. soil

a. Few Fe-Mn? concr.
b. Few shale fragments. (Count of 0.25 to 2 mm. separate yielded 9% shale in the B2; 14% shale in the D1 horizon.)
c. Trace shale fragments.
d. Few shale fragments. Trace carbonate concr. $CaCO_3$?
e. Trace carbonate concr. $CaCO_3$?

Soil type: *Brantford loam, sandy substratum phase with lighter-textured B horizon than typical.
Soil No.: S59NDak-20-1-(1-7)
Location: 285 feet west and 275 feet north of east quarter corner of Sec. 16, T146N, R60W, Griggs County, North Dakota; 60 feet from crest of low knoll on southeast facing slope of 2 percent.
Vegetation: Alfalfa and wild roses.
Climate: Subhumid; mean annual precipitation 18.5 inches, April through September 15 inches.
Parent material: Shaly glacial outwash.
Physiography: Undulating outwash plain.
Relief: Area 10 feet, site 6 feet.
Slope: 2 percent.
Aspect: Southeast.
Drainage: Well drained.
Moisture: Dry to 60 inches.
Root distribution: Numerous to 12 inches, common to 42 inches, and none 42 to 60 inches.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: H. W. Omodt.
Date August 20, 1959.

Horizon and Lincoln Lab. Number	
Ap 11685	0 to 6 inches. Black (10YR 2/1 moist) to dark gray (10YR 4/1 dry) loam; weak coarse and medium subangular blocky structure breaking to moderate fine granules; slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B1 11686	6 to 12 inches. Black to very dark brown (10YR 2/1.5 moist) to dark gray (10YR 4/1 dry) loam; moderate medium prismatic structure breaking to moderate fine and medium subangular blocks and moderate very fine granules; slightly hard, very friable, slightly sticky and plastic; common bleached quartz grains; clear wavy boundary.
B2 11687	12 to 18 inches. Very dark grayish brown (2.5Y 3/2 moist) sandy clay loam, grayish brown (2.5Y 5/2 dry), very dark grayish brown (1Y 3/2 moist); dark grayish brown (10YR 4/1.5 dry) coatings on ped surfaces; common distinct dark yellowish brown (10YR 3/4 moist) stains; moderate medium prismatic structure breaking to weak fine subangular blocks; hard, very friable, sticky and plastic; few bleached quartz grains; distinct clay films with sand grains bridged and coated; noncalcareous; clear wavy boundary.
D1 11688	18 to 26 inches. Dark grayish brown (2.5Y 4/2 moist) loamy coarse sand, grayish brown (2.5Y 5/2 dry); single grain structure; loose; krotovinas common; slightly calcareous with a few fine distinct segregations of lime; clear wavy boundary.
D2ca 11689	26 to 36 inches. Gray (5Y 5/1 moist) gravelly very coarse sand, light gray (5Y 6/1 dry); few fine prominent reddish brown (5YR 4/4 dry) iron stains; structureless; loose; strongly calcareous with shale lightly coated with lime; quartzitic gravel coated with lime on bottom side and common prominent soft white nodules of lime; clear wavy boundary.
D2 11690	36 to 42 inches. Gray (5Y 5/1 moist) gravelly coarse sand, light gray (5Y 6/1 dry); few fine distinct dark yellowish brown (10YR 4/4 dry) iron stains; single grain structure; loose; slightly calcareous; quartzitic pebbles lime-coated on bottom side and a few fine distinct nodules of lime; clear wavy boundary.
D3 11691	42 to 60 inches. Dark grayish brown (2.5Y 4/2 moist) coarse sand, light brownish gray (2.5Y 6/2 dry); single grain structure; loose; slightly calcareous with a few very weak lime-cemented aggregates. Finely cross-bedded strata in this horizon; a layer of quartzitic sand occurs at 42 to 44 inches.

SOIL SURVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE *Brantford loam, sandy substratum phase with lighter-textured B horizon than typical **LOCATION** Griggs County, North Dakota

SOIL NOS. S59NDak-20-2-(1-8) **LAB. NOS.** 11692-11699

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (19mm)	TEXTURAL CLASS
0-6	Ap	3.8	21.9	18.7	16.1	2.5	20.5	16.5	15.1	12.7	2	cosl
6-13	B21	4.3	20.9	20.9	21.3	2.3	12.2	18.1	12.5	8.6	6	cosl/sl
13-18	B22	7.1a	25.7a	28.3a	20.3a	1.7a	8.4	8.5	9.0	5.9	6	lcos
18-26	D1ca	23.4b	30.1c	9.9c	4.8a	1.1a	18.8	11.9	6.5	14.6	26	cosl
26-35	D2	16.2b	38.4c	19.3c	7.6a	0.9a	10.9	6.7	5.3	7.9	32	lcos
35-40	D3	19.6c	36.4c	22.3a	12.2a	1.1a	5.5	2.9	5.4	3.8	29	cos
40-48	D4	8.7c	19.3c	14.4a	39.1a	2.6a	10.2	5.7	20.2	7.1	4	lcos
48-60	D5	2.5b	9.2b	10.3c	49.1a	5.6a	15.3	8.0	33.8	10.8	2	fsl

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.8	7.2	7.3	1.84	0.174	11	0.6	1.2	< 1				8
7.2	7.5	7.6	0.70	0.072	10	0.6	0.6	< 1				11
7.7	8.1	8.2	0.34	0.040	8	1.1	0.7	2				6
8.1	8.7	8.9	0.18	0.028		0.4	0.7	8				9
8.2	8.8	9.0	0.11			0.6	0.6	8				7
8.4	8.4	8.5	0.03			0.7	0.4	11				4
8.3	8.4	8.6	0.05			0.6	0.4	7				7
7.9	8.2	8.5	0.39			0.5	0.4	2				11

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 5N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→							
15.8	13.5	3.4	2.1	< 0.1	0.6	111	89	17.5	19.6	4.0	1.47	
14.5	11.2	3.5	1.9	0.1	0.5	106	89	15.3	17.2	3.2	1.47	
9.5	9.1	2.5	0.9	0.1	0.4	127	93	12.1	13.0	3.6		
11.2				0.1	0.6							
7.0				0.1	0.4							
4.6				0.1	0.2							
8.7				0.2	0.4							
15.2				0.3	0.6							

a. Trace carbonate concr. $CaCO_3$?

b. Common shale fragments. Trace carbonate concr. $CaCO_3$? (Count of 0.25 to 2 mm. separate yielded 8% shale in B22; 24% shale in D1ca horizon.)

c. Few shale fragments. Trace carbonate concr. $CaCO_3$?

Soil type: *Brantford loam, sandy substratum phase with lighter-textured B horizon than typical
Soil No.: S59NDak-20-2-(1-8)
Location: 800 feet east and 310 feet north of southwest corner of Sec. 3, T146N, R60W, Griggs County, North Dakota.
Vegetation: Fallow.
Climate: Subhumid; mean annual precipitation 18.5 inches, growing season precipitation 15 inches.
Parent material: Shaly glacial outwash.
Physiography: Undulating outwash plain.
Relief: Area 10 feet, site 6 feet.
Slope: 2 percent.
Aspect: Northeast.
Drainage: Well drained to somewhat excessive.
Moisture: Moist to 60 inches.
Root distribution: Numerous to 6 inches, common to 20 inches, and few to 30 inches.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 20, 1959.

Horizon and Lincoln Lab. Number	
Ap 11692	0 to 6 inches. Black (10YR 2/1 moist) loam, dark gray (10YR 4/1 dry); moderate medium subangular blocky structure breaking to moderate fine granules; soft, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B21 11693	6 to 13 inches. Very dark grayish brown (2.5Y 3/2 moist) sandy clay loam, grayish brown (2.5Y 5/2 dry); moderate medium prismatic structure breaking to moderate medium blocks and moderate fine granules; slightly hard, friable, slightly sticky and slightly plastic; distinct clay films with sand grains bridged and coated; krotovinas common; noncalcareous; clear wavy boundary.
B22 11694	13 to 18 inches. Very dark grayish brown (2.5Y 3/2 moist) sandy clay loam, grayish brown (2.5Y 5/2 dry); moderate medium and coarse prismatic structure breaking to weak fine blocks and moderate fine granules; slightly hard, friable, slightly sticky and slightly plastic; faint clay films with sand grains bridged and coated; krotovinas common; noncalcareous; clear wavy boundary.
Mlca 11695	18 to 26 inches. Very dark grayish brown (2.5Y 3/2 moist) coarse sand, grayish brown (2.5Y 5/2 dry); single-grain structure; loose; strongly calcareous with fine distinct soft white nodules of lime; gradual smooth boundary.
D2 11696	26 to 35 inches. Very dark grayish brown (2.5Y 3/2 moist) coarse sand, grayish brown (2.5Y 5/2 dry); single-grain structure; loose; slightly calcareous with few fine faint segregations of lime; clear wavy boundary.
D3 11697	35 to 40 inches. Dark grayish brown (2.5Y 4/2 moist) coarse sand, light brownish gray (10YR 6/2 dry); single-grain structure; loose; mostly quartzitic sand; slightly calcareous; clear smooth boundary.
D4 11698	40 to 48 inches. Dark grayish brown (2.5Y 4/2 moist) coarse sand, light brownish gray (2.5Y 6/2 dry); single-grain structure; cross-bedded; slightly calcareous; clear wavy boundary.
D5 11699	48 to 60 inches. Gray (5Y 5/1 moist) sand, light gray (5Y 7/1 dry); single-grain structure; loose; calcareous.

Note: A strata of dark yellowish brown (10YR 4/4 moist) iron-stained sand occurs at 13 to 14 inches and extends across the end of the pit. Too thin to sample. Cross-bedded sand with discontinuous lenses of very dark gray (5Y 3/1 moist), gray (5Y 5/1 dry), organic material occurs at 48 to 60 inches.

SOIL SURVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE *Brantford loam, gravel substratum phase **LOCATION** Nelson County, North Dakota

SOIL NOS. S59NDak-32-1-(1-7) **LAB. NOS.** 11700-11706

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	2.3	10.8	11.1	10.7	3.7	38.4	23.0	22.6	23.4	3	l
7-13	B2	4.8	12.5	15.2	11.7	3.1	32.1	20.6	23.1	15.8	3	l
13-17	B3	10.0a	13.6b	14.1b	10.1	2.3	22.5	27.4	10.2	17.5	29	scl
17-31	D1ca	24.8c	25.5e	12.1d	5.2d	1.2d	15.8	15.4	5.4	12.9	52	cosl
31-38	D2	11.3c	36.8e	22.0d	9.0d	1.6d	10.4	8.9	7.0	7.6	11	lcos
38-44	D3	20.4c	23.2c	18.2c	13.2d	1.6d	13.2	10.2	8.1	10.0	40	cosl
44-60	D4	15.1c	24.6e	20.0d	20.3d	2.1d	10.7	7.2	10.6	7.8	26	lcos

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.4	6.6	6.8	3.50	0.300	12	0.9	0.4					13
7.1	7.2	7.5	1.38	0.124	11	0.8	0.5	< 1				11
7.5	7.6	8.0	0.85	0.108	8	0.7	0.6	< 1				18
8.0	8.5	8.6	0.47	0.058	8	0.7	0.7	14				11
8.2	8.4	8.6	0.04			0.6	0.6	13				7
8.1	8.3	8.6	0.07			0.6	0.7	11				9
8.4	9.0	9.0	0.04			0.6	0.6	8				7

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→							
23.4	18.4	4.1	7.2	0.1	0.8	100	76	23.4	30.6	4.5		
19.4	15.4	4.3	2.6	0.1	0.5	105	89	20.3	22.9	3.6	1.50	
23.5	18.8	6.4	2.2	0.2	0.8	111	92	26.2	28.4	2.9		
14.0				0.2	0.5							
9.0				0.2	0.3							
12.2				0.3	0.4							
9.1				0.2	0.4							

a. Few shale fragments.
b. Trace shale fragments.
c. Few shale fragments. Trace carbonate concr. $CaCO_3$? (Count of 0.25 to 2 mm. separate yielded 8% shale in B2; 16% shale in D1ca horizon.)
d. Trace carbonate concr. $CaCO_3$?
e. Trace shale fragments. Trace carbonate concr. $CaCO_3$?

Soil type: *Brantford loam, gravel substratum phase
Soil No.: S59NDak-32-1-(1-7)
Location: 400 feet east and 20 feet south of fifth telephone pole north of southwest corner of Sec. 16, T150N, R60W, Nelson County, North Dakota.
Vegetation: Wheat.
Climate: Subhumid; mean annual precipitation 18.5 inches, growing season precipitation 15 inches.
Parent material: Shaly glacial outwash.
Physiography: Nearly outwash plain between till plain and Sheyenne River Valley.
Relief: 1 foot in 100 feet.
Slope: Less than 1 percent.
Drainage: Well drained.
Root distribution: Numerous to 14 inches, common to 31 inches, and few to 60 inches.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 20, 1959.

Horizon and Lincoln Lab. Number	
Ap 11700	0 to 7 inches. Black (10YR 2/1 moist) silt loam, dark gray (10YR 4/1 dry); weak to moderate medium subangular blocky structure breaking to moderate fine and very fine granules; slightly hard, very friable, slightly sticky and slightly plastic; few bleached quartz grains; noncalcareous; abrupt smooth boundary.
B2 11701	7 to 13 inches. Very dark grayish brown (2.5Y 3/2 moist) clay loam, grayish brown (2.5Y 5/2 dry); very dark grayish brown (10YR 3/2 moist) to dark grayish brown (10YR 4/2 dry) coatings on ped surfaces; strong medium prismatic structure breaking to moderate medium blocks; hard, very friable, sticky and plastic; common very thin plates of weathered shale; distinct clay films with sand grains bridged and coated; noncalcareous; clear wavy boundary.
B3 11702	13 to 17 inches. Dark grayish brown (2.5Y 4/2 moist) sandy clay loam, grayish brown (2.5Y 5/2 dry); few fine distinct dark yellowish brown (10YR 4/4) iron stains; weak medium prisms breaking first to weak fine medium subangular blocks and then to strong very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; abundant shale weathered to very thin plates; patches of distinct clay films with sand grains bridged and coated; noncalcareous; clear wavy boundary.
D1ca 11703	17 to 31 inches. Light gray (5Y 6/1 dry) gravel; few fine distinct dark yellowish brown (10YR 4/4 dry) iron stains; single grain; loose; strongly calcareous with lime-coated gravel and common prominent soft white nodules of lime; clear smooth boundary.
D2 11704	31 to 38 inches. Light brownish gray (10YR 6/2 dry) gravelly coarse sand; few fine prominent yellowish red (5YR 4/6 dry) stains; single-grain structure; loose; slightly calcareous with some lime-coated shale pebbles and a few very weakly lime-cemented aggregates; clear smooth boundary.
D3 11705	38 to 44 inches. Light gray (5Y 6/1 dry) gravelly coarse sand; common fine distinct yellowish brown (10YR 5/5 dry) iron stains; single-grain structure; loose; quartzitic gravel lime-coated on lower side; occasional large (3 inches in diameter) segregations of lime; noncalcareous between segregations; clear smooth boundary.
D4 11706	44 to 60 inches. Light gray (5Y 6/1 dry) gravelly coarse sand; few fine prominent dark reddish brown (2.5YR 3/4 dry) iron stains; single grain; loose; noncalcareous.

SOIL URVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE *Brantford silt loam, gravel substratum phase **LOCATION** Nelson County, North Dakota

SOIL NOS. S59NDak-32-2-(1-7) **LAB. NOS.** 11707-11713

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	4.6	12.3	10.3	9.4	3.4	35.7	24.3	19.7	22.7	3	l
7-14	B2	5.2	12.8	10.4	7.2	2.4	31.1	30.9	13.7	22.0	17	cl
14-18	B3	4.2a	11.1a	10.6a	7.3	2.1	31.0	33.7	8.9	26.1	34	cl
18-26	D11ca	25.7b	20.8b	5.5b	2.9c	1.0c	22.8	21.3	5.7	19.0	46	scl
26-33	D12ca	29.2b	30.2b	7.2b	3.0c	1.0c	15.9	13.5	4.4	13.4	49	cosl
33-46	D2	25.7b	28.8b	8.2c	5.4c	1.9c	16.8	13.2	6.9	13.8	62	cosl
46-60	D3	33.2b	34.4b	12.2c	2.8c	0.5c	8.9	8.0	2.9	7.0	63	lcos

pH 1:1	8C1a pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.2	6.6	6.7	3.84	0.325	12	0.8	0.4					14
6.8	6.9	7.2	1.16	0.139	8	0.9	0.4	< 1				18
7.0	7.4	7.4	0.75	0.097	8	0.7	0.4	< 1				21
7.9	8.2	8.8	0.62	0.087	7	0.6	0.6	10				13
8.0	8.5	9.0	0.16			0.7	0.6	14				10
8.1	8.8	9.1	0.07			1.0	0.6	17				9
8.2	8.8	8.8	0.04			0.9	0.6	19				7

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→							
26.4	18.9	4.4	8.2	0.1	1.1	93	75	24.5	32.7	4.3		
25.4	18.6	6.2	3.9	0.3	0.7	102	87	25.8	29.7	3.0		
28.2	20.6	7.4	3.2	0.4	0.9	104	90	29.3	32.5	2.8		
19.4				0.3	0.6							
14.0				0.3	0.4							
11.1				0.3	0.3							
8.5				0.2	0.3							

a. Few shale fragments. (Count of 0.25 to 2 mm. separate yielded 14% shale in B2; 24% shale in D11ca horizon.)

b. Few shale fragments. Trace carbonate concr. $CaCO_3$?

c. Trace carbonate concr. $CaCO_3$?

Soil type: *Brantford silt loam, gravel substratum phase
Soil No.: S59NDak-32-2-(1-7)
Location: 575 feet east and 75 feet north of southwest corner of Sec. 17, T150N, R60W, Nelson County, North Dakota.
Vegetation: Durum wheat.
Climate: Subhumid; mean annual precipitation 18.5 inches, growing season precipitation 15 inches.
Parent material: Shaly glacial outwash.
Physiography: Nearly level outwash plain.
Relief: Area 4 feet, site 1 foot.
Slope: Less than 1 percent.
Drainage: Well drained.
Moisture: Dry to 18 inches.
Root distribution: Numerous to 14 inches, common to 26 inches, and few to 40 inches.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 20, 1959.

Horizon and Lincoln Lab. Number	
Ap 11707	0 to 7 inches. Black (10YR 2/1 moist) silt loam, dark gray (10YR 4/1 dry); moderate fine subangular blocky structure breaking to moderate fine granules; slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B2 11708	7 to 14 inches. Very dark grayish brown (2.5Y 3/2 moist) clay loam, grayish brown (2.5Y 5/2 dry); moderate medium prismatic structure breaking to moderate fine and medium blocks; hard, friable, sticky and plastic; faint continuous clay films with patches of distinct clay films; sand grains coated; noncalcareous; clear wavy boundary.
B3 11709	14 to 18 inches. Very dark grayish brown (2.5Y 3/2 moist) sandy clay loam, grayish brown (2.5Y 5/2 dry); weak medium prismatic structure breaking to strong fine subangular blocks; slightly hard, friable, sticky and slightly plastic; distinct patches of clay films; noncalcareous; clear wavy boundary.
D11ca 11710	18 to 26 inches. Very dark grayish brown (2.5Y 3/2 moist) shale gravel with sandy clay loam "fines"; single-grain structure; loose with "fines"; sticky and slightly plastic; slightly calcareous with few fine prominent soft white nodules of lime and quartzitic pebbles lime-coated on bottom side; clear smooth boundary.
D12ca 11711	26 to 33 inches. Fine gravel and coarse sand; single-grain structure; loose; slightly calcareous; few fine prominent soft white nodules of lime and quartzitic pebbles lime-coated on lower side; clear smooth boundary.
D2 11712	33 to 46 inches. Light gray (5Y 6/1 moist) fine gravel and coarse sand; common fine distinct dark brown (7.5YR 4/4 moist) iron stains; single-grain structure; loose; cross-bedded strata of sand and gravel; slightly calcareous; few quartzitic pebbles lime-coated on bottom; clear smooth boundary.
D3 11713	46 to 60 inches. Light gray (5Y 6/1 moist) gravel and coarse sand; common fine distinct, 7.5YR 4/4, moist, iron stains; single-grain structure; loose; cross-bedded strata of sand and gravel; slightly calcareous; few quartzitic pebbles lime-coated on bottom.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Cavour Loam **LOCATION** Burke County, North Dakota

SOIL NOS. S49NDak-7-1 **LAB. NOS.** 52-58

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-5	Ap	1.8	4.5	6.8	13.9	8.6	40.6	23.8	32.7	24.5	1.8	l
5-6½	A2	1.8	4.6	7.1	14.6	8.0	42.5	21.4	30.5	28.5	0.3	l
6½-16	B2	1.5	4.1	6.0	11.9	7.5	36.6	32.4	30.2	20.4	0.6	cl
16-24	B3	0.2	2.6	8.0	18.4	10.3	32.4	28.1	35.0	18.0	0.1	cl
24-36	Cca1	2.0	4.4	5.6	13.4	9.6	34.9	30.1	30.6	22.4	2.1	cl
36-48	Cca2	1.7	4.4	5.6	13.4	9.6	34.6	30.7	31.0	21.8	2.8	cl
48-72	C1	2.8	4.8	5.5	13.6	9.8	34.5	29.0	31.7	21.0	4.5	cl

8C1b SATURATED PASTE	pH 8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.9	7.1	7.4	3.36	.298	11.3	-	0.4	-	-			
6.5	6.9	7.0	1.83	.163	11.2	-	0.3	-	-			
6.6	6.7	7.6	1.25	.122	10.2	-	1.5	-	-			
8.0	8.2	8.7	0.53	.048	11.0	0.30	5.7	-	-			
8.1	8.3	8.8	0.29	.034	8.5	0.33	6.0	9	-			
8.1	8.4	9.0	0.27	.030	9.0	0.33	6.0	8	-			
8.0	8.3	8.6	0.24	.030		0.48	8.1	7	2			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS 5B1a EXTRACTABLE 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil					milliequivalents per liter				
24.1	15.2	6.4	0.6	2.7	2	-	1.8			50.2
17.0	8.7	5.0	0.8	1.0	5	1.0	1.3			38.3
25.4	8.8	13.6	2.6	0.9	10	8.3	3.6			44.6
19.3			0.6	1.6	3	67.2	7.5			49.1
17.4			1.0	0.6	6	58.8	6.8			51.7
17.6			4.2	0.4	24	47.4	6.8			57.2
17.3			5.2	0.9	30	55.2	8.8			53.4

Soil type: Cavour loam
Soil No.: S49NDak-7-1
Location: Roadside cut, 100 yards east of northwest corner Sec. 18, T162N, R91W, Burke County, North Dakota.
Vegetation or crop: Redtop and introduced species (not virgin site).
Parent material: Glacial till.
Physiography: Till plain; depressional, incipient drainage way.
Relief: Quite level with short gentle slopes.
Slope: Less than 2 percent.
Drainage: Moderately well; internal drainage slow.
Described by: B. L. Matzek.
Date: September 22, 1949.

Horizon and Mandan Lab. Number	
Ap 52	0 to 5 inches. Dark gray or very dark gray (10YR 4/1 dry, 2.5/1 moist) loam.
A2 53	5 to 6½ inches. Dark gray (10YR 4/1 dry or moist) friable loam with moderately fine platy structure.
B2 54	6½ to 16 inches. Dark gray or very dark gray (10YR 4/1 dry, 3/1 moist) clay loam with hard, well-developed medium columnar structure.
B3 55	16 to 24 inches. Dark grayish brown or very dark grayish brown (1Y 4/2 dry, 3/2 moist) clay loam with moderately developed, medium columnar structure.
Cca1 56	24 to 36 inches. Very dark grayish brown mottled with light olive brown and gray (2.5Y 3/2, 5/4, and 5/1, moist) massive clay loam till with moderate amounts of segregated and disseminated lime.
Cca2 57	36 to 48 inches. No change apparent.
C1 58	48 to 72 inches. Similar to above but less lime and less mottling.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Cavour loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-5-(1-8) **LAB. NOS.** 8681-8688

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	1.5a	6.3a	8.1a	18.7a	11.7a	36.7	17.0	37.8	20.2	-	l
2-6	A12	2.6a	6.2a	8.3a	22.5a	15.1a	31.2	14.1	43.7	14.7	Tr.	fsl
6-10	A2	3.2a	8.1a	10.3a	23.7a	13.8a	30.9	10.0	41.6	15.5	Tr.	fsl
10-16	B2	1.6a	5.8a	8.0a	18.5a	11.0a	26.8	28.3	33.2	14.2	Tr.	cl/scl
16-21	B3ca	3.2b	6.4b	7.6b	16.1b	9.7b	27.8	29.2	29.1	16.8	Tr.	cl
21-30	Cca1	1.0b	3.2b	4.6b	12.6b	9.8b	33.6	35.2	29.8	20.8	Tr.	cl
30-40	Cca2	1.0b	3.2b	4.4b	12.1b	10.4b	36.7	32.2	31.8	22.3	Tr.	cl
40-60	Ccs	1.5c	3.7c	4.8c	12.3c	10.4b	36.7	30.6	31.6	22.4	Tr.	cl 1/

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUF)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6K1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.9	7.0	5.22	0.398	13.1	<0.20	0.7	<1				12.3
6.3	6.8	6.9	1.50	0.147	10.2	<0.20	0.6	<1				6.4
6.9	7.4	7.4	0.82	0.086	10	<0.20	2.4	<1	<1			4.0
8.1	8.6	8.8	0.72	0.070	10	0.56	10.0	<1	<1			12.6
8.4	8.6	8.8	0.41	0.036	11	0.82	15+	3	9			11.9
8.8	9.1	9.2	0.30	0.020	15	0.82	15+	13	3			12.5
8.8	9.2	9.3	0.22			0.94	15+	11	2			12.5
8.5	8.8	8.9	0.26			0.94	15+	5	62			13.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
19.9	12.1	4.5	5.0	0.2	1.8	<1	1.2	1.3				95.8
11.3	4.9	2.8	4.1	0.6	1.1	4	3.2	0.6				45.2
7.5	2.2	2.9	1.8	2.2	0.4	21	19.0	0.2				34.3
20.9	2.8	11.6	0.5	12.3	0.6	29	90.0	0.3	3.5	4.2	126.2	69.5
18.6				13.4	0.5	25	136.5	0.5	1.9	4.2	241.5	63.5
17.1				14.8	0.4	36	125.5	0.4	3.0	4.4	220.8	68.2
16.9				15.3	0.4	34	129.2	0.4	3.5	3.2	238.6	73.5
17.2				15.6	0.4	29	138.5	0.4	1.9	3.2	254.8	76.7

a. Few smooth and irregular light brown to dark brown concr. (Fe-Mn?)
b. Few smooth and irregular light brown to dark brown concr. (Fe-Mn?); few $CaCO_3$ concr.
c. Common $CaCO_4$ concr.
1/ Dispersion problem.

Soil type: Cavour loam
Soil No.: S58NDak-7-5-(1-8)
Location: 0.2 mile south and 220 feet west of north quarter corner of Sec. 16, T160N, R90W, Burke County, North Dakota.
Vegetation: Native grassland pasture.
Physiography: Till plain.
Parent material: Calcareous firm clay loam glacial till.
Topography: Gently undulating till plain with 5 to 10 feet of local relief. Sampled on about a 2 percent south facing slope with 3 to 6 inch truncated microrelief.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Permeability: Very slow below 10 inches.
Drainage: Moderately well drained with medium surface runoff.
Moisture: Dry to 16 inches, moist and saline below.
Root distribution: Mostly in A, few to 30 inches.
Stoniness: Few stones in area; gypsum in B3cs and parent material.
Described by: Robert L. Howey.
Date: July 31, 1958.

Horizon and Lincoln Lab. Number	
A11 8681	0 to 2 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; soft, very friable, slightly sticky and slightly plastic; weak subangular blocky to moderate fine crumb structure. Clear, smooth boundary.
A12 8682	2 to 6 inches. Gray (10YR 5/1 dry) to very dark gray (10YR 3/1 moist) loam; hard, friable, slightly sticky and slightly plastic; weak medium prismatic to weak platy structure. Clear, wavy boundary.
A2 8683	6 to 10 inches. Gray (10YR 6/1 dry) to dark gray (10YR 4/1 moist) loam; hard, friable, slightly sticky and slightly plastic; weak medium prisms to moderate medium plates. Abrupt, wavy boundary.
B2 8684	10 to 16 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam with continuous organic-stained dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) clay skins on all peds; extremely hard, firm, very sticky and very plastic; strong coarse columnar to strong medium blocky structure. Clear, wavy boundary.
B3cs 8685	16 to 21 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam; hard, firm, very sticky and very plastic; weak medium prisms (slightly calcareous inside) to weak angular blocks; clear, wavy boundary.
Ccal 8686	21 to 30 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) strongly calcareous (without segregation) clay loam; hard, firm, very sticky and very plastic; massive and apparently sodium-dispersed.
Cca2 8687	30 to 40 inches. Same as above; separated for sampling only. Gradual boundary.
Ccs 8688	40 to 60 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) moderately calcareous clay loam; very hard, firm, very sticky and very plastic; massive with many distinct gypsum nests and common small prominent black lignite fragments.

Note: This profile sampled on microrelief high about 10 feet east of S58NDak-7-4 which is the thin solum extreme. Variations between the two occur in a broad wavy pattern of round caps covered with a distinct A2 in the dry soil of virgin prairie.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Cavour loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-1 **LAB. NOS.** 1-7

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	2.7	5.4	7.0	18.2	12.8	35.3	18.6	40.8	18.8	1.2	l
6-10	A2	2.4	5.6	8.3	25.6	14.7	25.5	17.9	43.3	12.8	0.8	fsl
10-18	B2	3.6	8.0	11.5	26.9	12.8	19.6	17.6	40.2	9.0	4.2	fsl
18-21	B3	4.4	7.0	7.5	17.8	11.1	28.3	24.0	35.1	15.2	0.9	scl
21-25	Ccal	1.9	5.5	5.8	15.6	12.8	34.9	23.5	37.4	20.4	1.9	l
25-45	C1	1.6	3.7	4.9	14.0	12.4	38.1	25.2	37.9	21.8	1.9	l
45-64	C2	1.9	3.8	4.6	14.2	13.0	37.7	24.8	38.7	21.4	2.3	l

pH 8C1b SATURATED PASTE	8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST. % SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.2	6.4	6.8	3.03	.260	11.6	-	0.4	-	-			
6.0	6.5	6.7	0.78	.090	8.7	-	0.4	-	-			
6.5	6.9	7.4	0.44	.055	8.0	-	0.4	1	-			
7.6	8.4	8.9	0.42	.053	7.9	-	1.2	4	-			
7.9	8.2	8.6	0.29	.035	8.3	0.35	8.5	16	2			
8.4	8.8	9.1	0.24	.026		0.53	11.5	14	-			
8.2	8.8	9.2	0.23	.023		0.43	11.0	8	-			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS 5B1a EXTRACTABLE 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				←	milliequivalents per liter	→			
21.4	11.4	4.3	0.5	1.4	2	0.9	1.3				46.8
13.7	7.0	4.6	0.3	1.1	2	2.6	1.1				34.9
12.9		6.0	0.9	1.1	7	3.1	1.9				32.1
15.1		8.8	2.2	0.6	15	9.7	2.2				44.4
11.5		12.2	1.4	0.9	12	58.6	5.9				49.3
13.1		17.1	2.8	1.2	21	92.5	5.2				55.9
14.0		14.3	0.7	1.9	5	75.2	6.0				45.2

Soil type: Cavour loam
Soil No.: S49NDak-38-1
Location: 100 feet east and 1/4 mile north of southwest corner southwest quarter Sec. 7, T159N, R86W, Renville County, North Dakota.
Vegetation or crop: Pasture 1939-49; flax 1949.
Parent material: Glacial till.
Physiography: Ground moraine plain with shallow potholes.
Relief: Very gently undulating.
Slope: Less than 2 percent.
Drainage: Surface good; internal imperfect.
Described by: B. L. Matzek.
Date: September 9, 1949.

Horizon and Mandan Lab. Number	
Ap 1	0 to 6 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) loam with crumb structure.
A2 2	6 to 10 inches. Light gray or gray brown (10YR 7/1 dry, 5/2 moist) fine sandy loam with soft friable consistence and fine platy structure.
B2 3	10 to 18 inches. Light gray or grayish brown (10YR 7/1 dry, 5/2 moist) fine sandy loam with medium-sized well-developed columns with well-rounded tops. Consistence hard, dry and plastic when moist.
B3 4	18 to 21 inches. Olive brown (2.5Y 4/4 dry, 3/4 moist) slightly calcareous loam with weakly developed columns.
Ccal 5	21 to 25 inches. Light olive brown (2.5Y 5/4 dry) strongly calcareous loam with weak irregular blocky structure breaking to fine granular.
C1 6	25 to 45 inches. Light olive brown (2.5Y 5/4 dry) strongly calcareous loam with irregular blocky structure and some mottles apparently caused by iron stains.
C2 7	45 to 64 inches. Grayish brown or olive brown (2.5Y 5/2 dry, 4/4 moist) moderately calcareous, massive, plastic loam till; some mottles are evident.

Remarks: This profile is deeper than usual and the B2 seems to be too light in color; 2.5Y 4/2 coated with 3/2, moist, would be more typical. In the field the B2 was called a heavy clay loam, but mechanical analyses revealed it to be fine sandy loam.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Cavour loam **LOCATION** Ward County, North Dakota

SOIL NOS. S58ND-51-2-(1-10) **LAB. NOS.** 8697-8706

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	1.3	4.4	5.2	13.7	11.5	43.7	20.2	38.3	24.4	Tr.	l
2-7	A12	1.6	3.9	4.3	11.7	9.7	45.1	23.7	32.0	29.3	Tr.	l
7-10	A2	2.2	5.2	6.4	15.0	10.4	44.7	16.1	34.7	28.4	1.6	l
10-14	B2	1.2	2.8	3.9	9.8	7.4	36.9	38.0	24.4	25.2	Tr.	cl
14-17	B3cs	0.5	2.1	3.1	7.2	5.5	39.2	42.4	19.3	29.3	Tr.	c
17-25	Cca	1.4a	2.3a	2.8a	8.6a	6.4a	40.4	38.1	21.1	30.7	Tr.	cl
25-34	Ccacs	0.4a	0.6a	0.9a	3.9a	4.8a	53.6	35.8	21.1	39.8	Tr.	sicl 1/
34-40	C1	0.6a	1.1a	1.6a	4.8a	5.9a	54.6	31.4	24.5	38.9	Tr.	sicl 1/
40-49	Ccs	1.7a	3.7a	4.4a	12.5a	11.4a	41.3	25.0	34.2	25.8	3.1	l 1/
49-60	C	1.6a	2.1a	2.9a	9.1a	9.3a	47.4	27.6	30.2	31.9	0.9	l 1/

pH 1:1	pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	6.8	6.8	5.13	0.386	13.3	<0.20	0.8					13.9
6.2	6.4	6.7	2.96	0.236	12.5	<0.20	0.6					11.0
6.3	6.7	6.9	1.07	0.100	10.7	<0.20	1.5					5.7
6.5	6.7	6.8	1.06	0.100	10.6	0.53	11.0	<1	2			14.4
7.9	8.1	8.2	0.86	0.082	10	1.22	15+	1	8			16.4
8.5	8.8	8.9	0.45	0.039	12	0.82	15+	17	9			13.2
8.5	8.8	8.9	0.22			1.03	15+	14	36			13.2
8.5	9.0	9.1	0.20			1.12	15+	11	2			12.4
8.4	8.7	8.8	0.23			0.86	15.0	7	56			11.5
8.5	8.8	8.9	0.20			1.02	15.0	8	20			12.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLES 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
23.4	15.0	5.5	4.6	0.1	1.6	<1	0.8	1.2				79.8
20.0	10.3	4.9	6.4	0.2	1.4	1	0.9	0.7				63.5
11.5	5.1	3.6	3.6	1.3	0.6	8	8.8	0.4				41.6
26.8	8.2	13.1	2.8	9.0	0.6	15	76.5	0.3	3.7	1.0	159.2	63.7
28.0	9.0	17.6	0.5	15.4	0.5	22	123.2	0.2	3.0	0.5	275.3	74.1
17.4				12.2	0.2	26	119.2	0.2	3.3	0.5	241.4	64.7
17.0				14.8	0.3	34	134.2	0.2	2.1	0.7	260.8	67.4
17.8				15.7	0.4	34	131.8	0.3	1.4	0.7	246.4	72.7
14.5				14.2	0.3	39	129.2	0.3	1.4	0.5	221.9	66.2
16.2				14.6	0.4	31	125.5	0.4	2.1	1.0	212.2	75.9

1/ Dispersion problem
a. Few $CaCO_3$ concr.

Soil type: Cavour loam
Soil No.: S58NDak-51-2-(1-10)
Location: 260 feet north and 105 feet east of the southwest corner of Sec. 28, T160N, R89W, Ward County, North Dakota.
Vegetation: Native grassland pasture.
Physiography: Till plain.
Parent material: Calcareous firm clay loam till.
Topography: Gently undulating till plain with 5 to 10 feet of local relief. Sampled on a 1 percent southeasterly slope with 3- to 6-inch truncated microrelief.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Drainage: Moderately well drained with medium surface runoff.
Permeability: Very slow below 10 inches.
Moisture: Dry to 14 inches, moist and saline below.
Root distribution: Matted in A, few to 25 inches.
Stoniness: Few stones in area; gypsum in B3cs and parent material.
Described by: Robert L. Howey.
Date: August 1, 1958.

Horizon and Lincoln Lab. Number	
A11 8697	0 to 2 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; weak medium subangular blocky to moderate fine crumb structure. Clear boundary.
A12 8698	2 to 7 inches. Gray (10YR 5/1 dry) to very dark gray (10YR 3/1 moist) loam; slightly hard, friable, slightly sticky and plastic; weak medium prisms to weak subangular blocks and crumbs. Clear boundary.
A2 8699	7 to 10 inches. Light gray (10YR 6/1 dry) to dark gray (10YR 4/1 moist) loam; slightly hard, friable, slightly sticky and plastic; weak medium prismatic to moderate fine platy structure. Abrupt, wavy boundary.
B2 8700	10 to 14 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam with continuous dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) organic-stained clay skins on ped surfaces; very hard, firm, very sticky and very plastic; moderate medium columnar prisms (with flat caps frosted with silica) to strong medium angular blocks. Clear, wavy boundary.
B3cs 8701	14 to 17 inches. Light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) clay loam with grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) clay skins on most ped surfaces; hard, firm, very sticky and very plastic; moderate medium prisms (with gypsum nests and threads) to moderate fine angular blocks. Clear, wavy boundary.
Cca 8702	17 to 25 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous clay loam without lime segregation but with few fine distinct salt segregates; hard, friable, very sticky and very plastic; weak subangular blocky structure. Gradual boundary.
Ccacs 8703	25 to 34 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous clay loam without significant segregated lime but with many distinct gypsum nests; hard, firm, very sticky and very plastic; sodium-dispersed structureless material. Gradual boundary.
C1 8704	34 to 40 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) moderately calcareous clay loam; hard, firm, very sticky and very plastic; weak blocky structure or massive structureless. Gradual boundary.
Ccs 8705	40 to 49 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) weakly calcareous clay loam with many large distinct nests of gypsum; hard, firm, sticky and plastic; weak blocky structure. Gradual boundary.
C 8706	49 to 60 inches. Same as above except with much less gypsum.

Note: This profile taken on microrelief high, about 5 feet east of thin solum phase S58NDak-51-1 taken on microrelief low. Variations between the two occur in a broad wavy pattern of round caps covered with a distinct A2 in virgin sod.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Cresbard loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-7 **LAB. NOS.** 71-78

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-6	Ap	3.1	7.8	7.7	13.1	10.0	37.2	21.2	34.1	20.8	1.1	l
6-8	A2	5.2	10.9	10.2	14.6	9.0	37.9	12.3	33.8	21.2	2.8	l
8-14	B2	1.0	6.9	6.9	8.0	5.6	34.4	37.3	23.2	21.3	0.2	cl
14-20	Cca1	1.1	5.7	4.5	3.4	3.1	45.9	36.5	20.5	30.2	0.6	sicl
20-23	Cca2	4.9	11.6	12.7	8.2	3.6	36.0	23.0	22.5	20.4	6.5	l
23-34	Ccs1	1.9	4.9	5.4	11.8	9.6	42.3	24.0	31.5	27.8	5.5	l
34-46	Ccs2	1.9	3.5	4.2	11.7	9.1	46.4	23.2	32.1	31.0	1.9	l
46-64	Ccs3	2.7	4.0	5.1	14.0	7.4	46.1	20.7	34.2	28.9	2.8	l

8C1b SATURATED PASTE	pH 8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.7	6.9	7.3	3.18	.266	12.0	-	0.7	-	-			
7.2	7.4	7.6	0.95	.089	10.7	-	0.4	-	-			
7.0	7.1	7.8	0.89	.107	8.3	-	0.4	-	-			
7.9	8.3	8.8	0.52	.062	8.4	-	2.6	19	-			
7.9	8.3	8.9	0.33	.037	8.9	-	4.0	17	-			
8.1	8.4	8.6	0.23	.028		0.33	7.8	16	13			
8.0	8.3	8.3	0.21	.024		0.47	11.0	8	84			
7.9	8.2	8.4	0.18	.021		0.69	17.0	9	19			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE Ca	Mg		EXCHANGEABLE 6P2a Na	5B1b 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
23.6				0.1	1.0	-	1.4	0.9				43.8
9.7				0.1	0.6	1	0.6	2.0				30.4
27.8				0.2	0.7	-	0.6	1.5				52.0
16.2				0.2	0.6	1	5.9	3.3				51.1
10.6				0.6	0.5	6	15.1	5.3				35.7
11.6				2.4	0.7	21	47.4	8.6				40.9
12.4				1.2	0.9	10	89.9	9.0				44.2
13.1				1.8	0.6	14	111.4	11.2				45.4

Soil type: Cresbard loam
Soil No.: S49NDak-38-7
Location: 1/8 mile east of northwest corner Sec. 7, T160N, R86W, Renville County, North Dakota.
Vegetation or crop: Oats stubble with considerable foxtail.
Parent material: Water-reworked glacial till.
Physiography: Undulating water-reworked till plain.
Relief: Gently undulating.
Slope: 1 percent.
Drainage: Moderately well; internal drainage slow.
Described by: B. L. Matzek.
Date: September 23, 1949.

Horizon and Mandan Lab. Number	
Ap 71	0 to 6 inches. Dark gray or very dark gray (10YR 4/1 dry, 2.5/1 moist) loam.
A2 72	6 to 8 inches. Gray or dark gray (10YR 6/1 dry, 4/1 moist) loam with weak, fine platy structure.
B2 73	8 to 14 inches. Very dark gray brown or very dark brown (10YR 3/2 dry, 2/2 moist) plastic clay loam with well-developed medium prismatic structure.
Ccal 74	14 to 20 inches. Light olive brown or olive brown (2.5Y 5/3 dry, 4/3 moist) strongly calcareous silty clay loam with weak medium columnar structure.
Cca2 75	20 to 23 inches. Light gray or grayish brown (2.5Y 7/2 dry, 5/2 moist) strongly calcareous silty clay loam.
Ccs1 76	23 to 34 inches. Light olive brown or olive brown (2.5Y 5/4 dry, 4/4 moist) moderately calcareous loam with some gray streaks and some gypsum.
Ccs2 77	34 to 46 inches. Similar to above layer but with less lime and a high gypsum content.
Ccs3 78	46 to 64 inches. Light olive brown or olive brown (2.5Y 5/4 dry, 4/4 moist) weakly calcareous loam with moderate gypsum content.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Cresbard loam **LOCATION** Ward County, North Dakota

SOIL NOS. S58ND-51-3-(1-9) **LAB. NOS.** 8707-8715

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	1.7	4.5	5.2	13.9	12.7	41.0	21.0	37.4	24.3	Tr.	l
7-10	A21	1.4	4.7	5.8	14.1	11.8	40.0	22.2	36.6	23.1	Tr.	l
10-13	A22	1.6	5.9	7.7	18.8	15.1	32.4	18.5	40.1	17.5	1.5	l
13-18	B2	1.4	4.0	4.9	12.7	10.6	33.3	33.1	29.6	21.2	Tr.	cl
18-21	B3	1.0	3.5	4.2	11.3	10.1	37.3	32.6	30.0	24.0	Tr.	cl
21-27	Ccacs	0.6a	2.5a	3.1a	9.7a	10.2a	43.1	30.8	29.4	29.6	2.3	cl
27-40	Cca	1.7a	3.8a	4.5a	12.7a	11.1a	41.8	24.4	33.9	26.4	5.8	l
40-50	C1	1.6a	3.5a	3.7a	9.4a	8.3a	44.4	29.1	25.7	32.3	2.0	cl
50-61	C	1.2a	3.4a	4.1a	10.8a	9.4a	44.2	26.9	29.0	30.7	1.9	l/cl

pH 1:1	pH 1:5	pH 1:10	8C1a ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
5.9	6.1	6.4	2.33	0.206	11.3	<0.20	1.0					8.8
5.8	6.0	6.3	1.24	0.112	11.1	<0.20	0.7					8.4
6.1	6.7	6.7	0.66	0.068	10	<0.20	0.9					6.6
7.1	7.3	7.5	0.74	0.077	10	<0.20	3.4	<1	<1			12.5
7.7	7.9	8.1	0.59	0.058	10	0.48	9.0	<1	1			12.4
8.2	8.4	8.6	0.34	0.032	11	0.50	9.5	14	26			10.6
8.4	8.8	9.0	0.20			0.50	9.0	11	1			9.4
8.4	8.8	9.0	0.21			0.48	8.7	11	1			11.6
8.3	8.7	9.0	0.19			0.45	8.0	8	1			11.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
18.4	8.8	5.1	6.4	0.1	1.5	<1	1.0	1.2				49.2
15.7	6.2	5.9	5.5	0.2	0.6	1	1.3	0.3				43.7
12.5	3.6	5.6	3.2	0.6	0.3	4	3.6	0.1				39.7
23.7	5.2	12.2	1.9	2.8	0.4	8	17.2	0.2				59.5
22.4	7.0	21.3	<0.1	4.6	0.3	10	37.0	0.4	1.9	1.2	140.5	63.5
14.8				4.1	0.2	10	45.2	0.3	1.6	2.0	144.4	57.5
13.4				4.9	0.3	15	49.3	0.3	2.3	2.0	134.6	58.7
16.1				5.5	0.4	14	49.3	0.3	1.4	2.0	123.0	65.1
15.8				6.0	0.5	20	46.0	0.4	1.4	2.2	113.6	62.4

a. Few $CaCO_3$ concr.

Soil type: Cresbard loam
Soil No.: 858NDak-51-3-(1-9)
Location: 0.1 mile west and 200 feet north of the center of Sec. 22, T160N, R89W, Ward County, North Dakota.
Vegetation: Summer-fallowed cropland.
Physiography: Till plain.
Parent material: Calcareous firm loam glacial till.
Topography: Nearly level spot in gently undulating till plain.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Drainage: Well drained with slow runoff.
Moisture: Moist throughout because of fallow.
Permeability: Moderate in A horizon, slow in B horizon.
Root distribution: Little evidence of rooting in or below the Ccacs horizon.
Stoniness: Few stones in area: gypsum nests in Cca horizon.
Described by: Robert L. Howey.
Date: August 1, 1958.

Horizon and Lincoln lab. Number	
Ap 8707	0 to 7 inches. Dark gray (10YR 4/1 dry) to very dark brown (10YR 2/2 moist) loam; soft, very friable, slightly sticky and slightly plastic; weak subangular blocky to moderate fine and very fine crumb structure. Abrupt smooth boundary.
A21 8708	7 to 10 inches. Grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3/2 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; weak medium prisms to weak angular blocks. Clear boundary.
A22 8709	10 to 13 inches. Gray (10YR 6/1 dry) to dark grayish brown (10YR 4/2 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; weak prisms, plates and blocks. Abrupt and wavy boundary.
B2 8710	13 to 18 inches. Light brownish gray (10YR 6/2 dry) to brown (10YR 4/3 moist) clay loam with continuous organic-stained grayish brown (10YR 5/2 dry) to dark brown (10YR 3/3 moist) clay skins on all peds; very hard, firm, sticky and plastic; moderate fine prisms to strong medium and fine angular blocks. Prisms are flat-topped and frosted with silica. Clear boundary.
B3 8711	18 to 21 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) noncalcareous clay loam with continuous organic-stained grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay skins on all peds; hard, firm, sticky and plastic; moderate medium prismatic to angular blocky structure. Clear wavy boundary.
Ccacs 8712	21 to 27 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) strongly calcareous loam without significant segregated lime but with many gypsum nests distinct when moist; hard, friable, very sticky and plastic; weak subangular blocky structure. Gradual boundary.
Cca 8713	27 to 40 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) strongly calcareous loam with some fine nodular segregation; hard, friable, sticky and plastic; weak subangular blocky structure. Gradual boundary.
C1 8714	40 to 50 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) moderately calcareous loam with a slight amount of nodular segregated lime; hard, firm, sticky and plastic; weak natural angular blocky structure. Gradual boundary.
C 8715	50 to 61 inches. Same as above except without segregated lime and with a few gypsum nests.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Cresbard loam **LOCATION** Ward County, North Dakota

SOIL NOS. S58ND-51-4-(1-9) **LAB. NOS.** 8724-8732

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	2.0a	4.4a	5.8a	15.7a	12.8a	39.4	19.9	39.1	21.8	-	1
7-10	A21	1.6a	4.9a	7.3a	18.3a	14.0a	32.4	21.5	39.5	16.5	2.8	1
10-12	A22	1.6a	3.9a	6.0a	15.7a	12.6a	34.7	25.5	36.5	19.3	Tr.	1
12-17	B2	1.3a	3.5a	5.0a	12.8a	9.4a	34.0	34.0	28.6	21.8	Tr.	cl
17-20	B3	1.6b	3.3b	4.1b	11.2b	9.8b	39.0	31.0	30.1	24.9	1.3	cl
20-32	Ccacs	0.9b	2.7b	3.4b	10.0b	8.9b	43.5	30.6	28.2	30.0	Tr.	cl
32-40	Cca	1.4b	3.4b	5.1b	13.4b	10.3b	41.9	24.5	32.6	26.8	0.9	1
40-50	C1	1.6b	3.3b	4.5b	10.6b	9.8b	44.2	26.0	30.8	29.0	2.7	1
50-62	C2	1.6b	3.4b	4.1b	11.1b	10.1b	45.0	24.7	30.8	30.6	Tr.	1

	pH	8C1a	ORGANIC MATTER 6A1a	6B1a		8A2	ELECTRICAL CONDUCTIVITY	6E1a	6F1a	MOISTURE TENSIONS		4B2
1:1	1:5	1:10	ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	EC×10³ MILLIMHOS PER CM 3A1a	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
5.8	6.1	6.3	2.76	0.242	11.4	<0.20	1.0					9.4
6.2	6.5	6.7	0.88	0.097	9	<0.20	0.7					8.0
6.3	6.6	6.8	0.66	0.075	9	<0.20	1.0					9.5
6.5	6.8	6.9	0.67	0.075	9	0.22	3.6	<1	<1			13.2
7.8	8.1	8.3	0.62	0.072	9	0.58	10.5	2	2			12.1
8.4	8.6	8.7	0.25	0.042	6	0.58	11.2	15	45			11.0
8.4	8.8	8.9	0.17			0.57	11.5	10	13			10.0
8.4	8.8	9.0	0.18			0.57	10.8	9	2			10.3
8.2	8.6	8.8	0.18			0.70	10.0	8	3			10.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
19.6	9.7	4.8	6.9	0.1	1.9	<1	0.9	1.6				51.7
14.4	6.2	6.8	3.2	0.2	0.6	1	1.6	0.3				40.9
16.1	5.0	9.5	3.2	0.6	0.5	2	3.5	0.3				44.7
22.4	5.1	16.6	2.3	2.6	0.7	7	17.5	0.5				60.1
20.0	12.6		<0.1	4.6	0.5	8	45.8	0.7	2.1	2.9	167.1	63.0
13.2				4.9	0.4	13	55.9	0.7	1.2	2.2	176.6	57.1
13.4				5.1	0.5	15	57.5	0.8	1.2	2.2	178.3	53.5
14.7				5.1	0.6	14	55.9	0.8	1.4	2.7	170.7	56.0
14.7				4.6	0.6	12	52.5	0.8	1.4	2.4	156.8	55.3

a. Trace irregular light brown concr. (Fe?)
b. Trace irr gular light brown concr. (Fe?); few CaCO3 concr.

Soil type: Cresbard loam
Soil No.: S58NDak-51-4-(1-9)
Location: 0.2 mile north and 240 feet west of south quarter corner of Sec. 26, T160N, R90W, Ward County, North Dakota.
Vegetation: Summer-fallowed cropland.
Physiography: Gently undulating till plain.
Parent material: Firm calcareous loam glacial till.
Topography: Slightly convex slope with 4 to 6 feet of local relief.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Slope: 1 percent facing south.
Drainage: Well drained.
Permeability: Moderately slow.
Moisture: Moist throughout due to summer fallow.
Root distribution: Previous rooting evident to 40 inches.
Stoniness: Few stones in area.
Described by: Robert L. Howey.
Date: August 4, 1958.

Horizon and Lincoln Lab. Number	
Ap 8724	0 to 7 inches. Dark gray (10YR 4/1 dry) to very dark brown (10YR 2/2 moist) noncalcareous loam; slightly hard, friable, slightly sticky and slightly plastic; weak cloddy to moderate fine crumb structure. Abrupt and smooth boundary.
A21 8725	7 to 10 inches. Grayish brown (10YR 5/2 dry) to dark brown (10YR 4/3 moist) noncalcareous loam; slightly hard, friable, sticky and plastic; weak medium prisms frosted with silica breaking to weak medium angular blocks. Clear and wavy boundary.
A22 8726	10 to 12 inches. Gray (10YR 6/1 dry) to dark gray brown (10YR 4/2 moist) noncalcareous loam; slightly hard, friable, sticky and plastic; weak medium prisms frosted with silica breaking to weak medium plates and weak medium blocks. Abrupt and wavy boundary.
B2 8727	12 to 17 inches. Pale brown (10YR 6/3 dry) to dark yellowish brown (10YR 4/4 moist) noncalcareous clay loam with brown (10YR 5/3 dry) to dark brown (10YR 3/3 moist) continuous organic-stained clay skins on all ped surfaces; hard, firm, sticky and plastic; moderate fine prisms breaking to strong medium and fine angular blocks. Clear, wavy boundary.
B3 8728	17 to 20 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) noncalcareous clay loam with gray brown (2.5Y 5/2 dry) to dark brown (10YR 4/3 moist) continuous organic-stained clay skins on vertical ped surfaces; hard, firm, sticky and plastic; weak medium prisms to weak medium angular blocks. Clear, wavy boundary.
Ccacs 8729	20 to 32 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) strongly calcareous loam without segregated lime but with many coarse nests of gypsum distinct when moist; hard, friable, sticky and plastic; weak medium subangular blocky structure. Gradual boundary.
Cca 8730	32 to 40 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) moderately calcareous loam with some nodular lime and a few coarse lignite spots; hard, friable, sticky and plastic; weak medium subangular blocky structure. Gradual boundary.
C1 8731	40 to 50 inches. Light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) moderately calcareous loam with a few coarse nests of gypsum distinct when moist; hard, firm, sticky and plastic; weak medium angular blocky structure.
C2 8732	50 to 62 inches. Same as above, separated for sampling.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE* Des Lacs loam **LOCATION** Burke County, North Dakota

SOIL NOS. S49NDak-7-3 **LAB. NOS.** 65-70

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-8	Ap	1.0	3.4	5.6	16.6	13.9	39.2	20.3	40.9	23.0	0.4	l
8-18	B2	1.6	4.6	7.0	18.6	13.6	36.3	18.3	42.1	19.6	0.5	l
18-22	B31	2.8	6.7	9.6	22.8	15.8	28.9	13.5	46.0	12.8	3.2	fsl
22-32	B32	2.5	6.0	8.2	27.6	21.5	22.2	11.9	52.7	10.1	3.3	fsl
32-46	Cca	0.8	1.6	2.1	6.8	14.8	54.3	19.7	46.4	27.4	0.5	sil
46-60	D	2.4	4.4	5.3	13.9	11.0	40.2	22.8	35.5	24.7	4.2	l

pH 8C1b SATURATED PASTE	8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST. % SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.7	6.8	7.2	3.10	.259	12.0	-	0.7	-	-			
6.6	7.0	7.1	1.01	.100	10.1	-	0.3	-	-			
6.6	6.9	7.3	0.62	.065	9.5	-	0.4	-	-			
7.7	8.4	8.8	0.41	.045	9.1	-	0.6	-	-			
8.2	8.8	9.3	0.39	.044	8.9	-	0.6	16	-			
8.3	9.0	9.4	0.28	.028	10.0	-	0.8	14	-			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a CATIONS EXTRACTABLE 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →						← milliequivalents per liter →					
23.0	16.3	5.4	0.2	1.2	-	0.9	1.3				45.3
15.9	10.4	4.3	0.2	1.0	1	0.5	-				37.4
12.4	7.9	4.4	0.1	0.5	-	1.0	1.0				30.9
10.0			0.2	0.2	2	1.2	0.9				32.9
11.4			0.4	0.3	4	4.0	-				40.4
13.1			0.9	0.5	7	4.2	2.6				42.3

Soil type: *Des Lacs loam
Soil No.: S49NDak-7-3
Location: 1/8 mile east of southwest corner Sec. 4, T162N, R89W, Burke County, North Dakota.
Parent material: Water-reworked till over till.
Vegetation or crop: Fallow.
Physiography: Nearly level reworked till plain.
Relief: Nearly level.
Slope: Less than 1 percent.
Drainage: Moderately well.
Moisture: Moist throughout.
Other features: Slight wind erosion.
Described by: B. L. Matzek.
Date: September 20, 1949.

Horizon and Mandan Lab. Number	
Ap 65	0 to 8 inches. Dark gray or very dark gray (10YR 4/1 dry, 3/1 moist) loam.
B2 66	8 to 18 inches. Dark grayish brown or very dark grayish brown (10YR 4/2 dry, 3/2 moist) loam with weakly developed medium prismatic structures.
B31 67	18 to 22 inches. Dark brown (10YR 4/3 moist) fine sandy loam.
B32 68	22 to 32 inches. Olive brown (2.5Y 4/4 moist) fine sandy loam.
Cca 69	32 to 46 inches. Light yellowish brown (2.5Y 6.5/4 moist) strongly calcareous silt loam containing some segregated lime.
D 70	46 to 60 inches. Light olive brown mottled with dark grayish brown (2.5Y 5/4 mottled, 4/2 moist) loam till with moderate lime content.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Eckman loam, till substratum **LOCATION** Wells County, North Dakota

SOIL NOS. S53NDak-52-1 **LAB. NOS.** 1843-1848

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	Ap	1.2	4.2	5.0	14.1	18.4	39.1	18.0	48.9	17.6	0.6	1
5-14	B2	2.0	4.2	4.6	13.6	18.8	37.5	19.3	49.2	15.9	1.4	1
14-29	Cca1	2.8	4.1	4.1	14.1	17.3	35.5	22.1	41.1	21.3	2.9	1
29-35	Cca2	4.6	5.1	5.0	15.7	16.9	34.5	18.2	43.7	18.2	3.7	1
35-47	Cca3	4.8	5.8	5.4	15.6	18.6	35.9	13.9	46.9	17.7	3.9	1
47-60	C	4.8	6.1	5.5	15.8	18.6	34.9	14.3	48.0	15.9	4.6	1

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	7.0	7.1	2.45			<0.20	1.4	-				9.9
7.5	7.9	8.0	1.03			<0.20	0.6	-				9.4
8.4	9.2	9.4	0.43			<0.20	0.7	21				7.0
8.4	9.2	9.4	0.20			<0.20	0.7	16	-			7.3
8.3	9.2	9.4	0.11			<0.20	0.8	12	-			6.3
8.2	9.2	9.4	0.11			<0.20	0.8	13	-			6.8

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg		EXCHANGEABLE 6P2a Na	5B1b 6Q2a K	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
20.3	15.2	4.3		-	0.9	-	0.3	0.8				44.8
17.6	12.9	5.5		0.1	0.6	-	0.3	0.2				42.5
9.1				0.4	0.3	4	1.2	0.2				38.8
10.1				0.4	0.2	4	2.0	0.2				36.9
9.7				0.5	0.2	5	2.9	0.2				33.4
10.0				0.5	0.2	5	3.5	0.2				32.5

Soil type: Eckman loam, till substratum
Soil No.: S53NDak-52-1
Area: Wells County, North Dakota.
Location: 800 feet west and 75 feet north of S1/4 corner Sec. 20, T149N, R73W.
Vegetation: Summer fallow.
Parent material: Friable, stony, loam textured till (Mankato).
Physiographic position: Upland, till plain, (ground moraine) on a 100-foot plain slope that is the lower part of a slightly undulating 400-foot long, 2½ percent southeast slope, which breaks 65 feet southeast of sample site into a concave 1/2 percent slope. The stones in the B2 are coated with a carbonate crust, 1/16- to 1/4-inch thick.
Topography: Gently undulating.
Slope: 1½ percent.
Drainage: Well drained.
Ground water: Very deep.
Permeability: Moderate.
Moisture: Moist.
Salt or alkali: Saline substratum.
Root distribution: Deep.
Described by: C. A. Mogen.
Date: September 16, 1953.
Mandan

Lab.No.	Horizon	
1843	Ap	0 to 5 inches. Dark gray to black (10YR 4/1; 2/1 moist) noncalcareous loam; soft; cloddy to moderately developed fine granular structure; very friable. This rests abruptly on
1844	B2	Brown to dark yellowish brown, moist, with coatings of dark grayish brown to very dark grayish brown, moist (10YR 5/3 to 4/4 moist, coatings 10YR 4/2 to 3/2.7 moist) noncalcareous loam; hard moderately developed medium and coarse prisms separating out into moderately developed medium-sized blocks; friable. This changes in a clear wavy boundary to
1845	Cca1	14 to 29 inches. White with many fine faint mottlings of light gray, dry, to light yellowish brown mottled with white, moist, (2.5Y 8/2 and 7/2 dry; 6/3 and 8/2 moist) strongly calcareous loam; hard; massive structure that is porous; friable. This grades into
1846	Cca2	29 to 35 inches. Light yellowish brown with many fine distinct mottlings of white, dry, to light olive brown, moist, (2.5Y 6/3 and 8/2 dry; 5/4 moist) strongly calcareous loam; hard; moderately developed medium and fine blocky structure; compact in place; friable when moist. The moist soil has a fine network of 2.5Y 7/4 and 8/4 and a few fine prominent veins of dark red. This grades into
1847	Cca3	35 to 47 inches. Light yellowish brown with streaks of white, dry, to olive brown streaked with pale yellow and white, moist, (2.5Y 6/3 and 8/2 dry; 2.5Y 4/4, 7/4 and 8/2 moist) strongly calcareous loam; hard; moderately developed medium and fine blocky structure; friable when moist; compact in place. There are a few fine prominent dark red mottlings in the moist soil. This grades into
1848	C	47 to 60 inches. Light yellowish brown, dry, to olive brown streaked with white and with a few fine distinct mottlings of yellowish brown, moist, (2.5Y 6/3 dry; 2.5Y 4/4 and 8/2 and 10YR 5/8 moist) moderately calcareous loam; hard; moderately developed medium and fine blocky structure; friable when moist; compact in place.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Eckman loam, till substratum **LOCATION** Wells County, North Dakota

SOIL NOS. S53NDak-52-2 **LAB. NOS.** 1849-1854

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	1.4	3.0	4.4	16.3	23.9	33.9	17.1	53.2	15.2	0.7	l
5-12	B2	2.6	4.4	5.3	17.8	19.9	31.8	18.2	47.5	15.8	1.4	l
12-15	B3ca	2.9	5.1	5.9	21.0	19.4	26.1	19.6	45.0	14.5	3.6	vfsl
15-26	Cca	1.6	2.2	2.8	10.7	11.0	35.8	35.9	26.2	27.7	1.3	cl
26-42	C1	3.3	5.0	5.4	17.4	17.6	35.7	15.6	45.5	19.2	2.8	l
42-60	C2	3.3	5.1	5.6	17.6	17.8	35.6	15.0	45.5	19.4	3.5	l

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.1	7.5	7.6	2.08			<0.20	0.9	-				9.5
7.3	7.8	7.8	1.16			<0.20	0.5	-				9.3
7.5	8.3	8.5	0.96			<0.20	2.6	4				9.2
8.2	8.7	9.0	0.69			0.29	11.0	28	2			10.5
8.2	9.3	9.5	0.19			<0.20	3.6	9	-			6.7
8.2	9.2	9.5	0.17			<0.20	3.0	8	-			6.6

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	6O2b Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5B1b	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6L1a SO_4	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
19.6	14.9	4.1		0.1	1.2	-	0.3	1.0				43.9
18.0	13.3	4.6		0.1	0.7	-	0.3	0.4				43.3
15.3		7.3		0.4	0.3	3	5.2	0.4				44.8
12.3				1.9	0.2	15	55.0	0.4	0.5	19.5	187.3	51.9
11.0				1.7	0.2	15	22.0	0.4				35.2
11.1				1.6	0.2	14	18.4	0.4				34.0

Soil type: Eckman loam, till substratum
Soil No.: S53NDak-52-2
Area: Wells County, North Dakota.
Classification: Chernozem.
Location: 80 feet northwest of southeast corner Sec. 30, T149N, R73W.
Vegetation: Wheat stubble.
Parent material: Friable, slightly stony, loam-textured Mankato till.
Physiographic position: Upland, ground moraine, 100 feet from crest of knoll on an undulating broad-based knoll with very complex slopes. Slope for 50 feet north of site is 3 percent to north.
Topography: Gently undulating.
Slope: 1 percent.
Drainage: Well drained.
Moisture: Dry.
Stoniness: Common.
Root distribution: Deep.
Described by: C. A. Mogen.
Date: September 16, 1953.

Mandan Lab.No.	Horizon	
1849	Ap	0 to 5 inches. Dark gray to black (10YR 4/1.5 dry; 2/1.5 moist) noncalcareous loam; slightly hard, slightly cloddy or weak fine granular structure; very friable.
1850	B2	5 to 12 inches. Brown with yellowish brown and dark grayish brown coatings, dry, to dark yellowish brown with dark grayish brown and very dark grayish brown coatings, moist, (10YR 5/3, 5/5 and 4/2 dry; 4/4, 4/2 and 3/2 moist) noncalcareous loam; moderately developed coarse and medium-sized prisms separating out to weakly developed medium-sized blocks; friable when moist. This changes clearly into
1851	B3ca	12 to 15 inches. Brown with a few fine distinct mottlings of white, dry, to dark grayish brown with mottlings of white, moist, (10YR 5/3 and 9/2 dry; 4/2 and 8/2 moist) moderately calcareous very fine sandy loam with a slight amount of segregated lime; slightly hard; moderately developed coarse and medium-sized prismatic structure; prisms separating into weakly developed medium-sized blocky aggregates; friable when moist. This changes in a clear smooth boundary to
1852	Cca	15 to 26 inches. Pale brown with many fine distinct mottlings of very pale brown, dry, to light olive brown and pale yellow, moist, (10YR 6/3 and 8/3 dry; 2.5Y 5/4 and 7/3 moist) strongly calcareous clay loam with a moderate amount of segregated lime; lime concentration is in thick vertical masses or tongues 6 to 8 inches in diameter of very strongly calcareous soil material that is a very pale yellow with many fine faint mottlings of light yellowish brown; soft; porous, massive structure; very friable. This changes very gradually and in a wavy boundary to
1853	C1	26 to 42 inches. Light yellowish brown and pale yellow, dry, to olive brown and pale yellow, moist, (2.5Y 6/3 and 8/3 dry; 4/3 and 8/4 moist) moderately calcareous loam with a slight amount of segregated lime; slightly hard; moderately developed medium and fine blocks; friable. This grades into
1854	C2	42 to 60 inches. Light brownish gray with a few fine prominent mottlings of reddish yellow, dry, to olive brown mottled with yellowish red, moist, (2.5Y 6/2 and 5YR 6/8 dry; 2.5Y 4/3 and 5YR 4/8 moist) moderately calcareous loam with a very slight amount of segregated lime; slightly hard; moderately developed fine and medium-sized blocky structure; friable.

Remarks: A thick lime seam 1/4 inch across extends from 30 to 50 inches. A few stones and pebbles are distributed throughout.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Embden very fine sandy loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-6 **LAB. NOS.** 882-887

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (>19mm)	TEXTURAL CLASS
0-6	Ap	0.1	1.2	6.0	36.9	32.4	15.5	7.9	68.5	5.7	-	vfsl
6-14	A3	-	0.9	4.7	33.5	34.1	17.4	9.4	69.8	6.2	-	vfsl
14-28	B	-	0.7	4.7	33.7	35.3	16.0	9.6	70.5	5.4	-	vfsl
28-38	Ccag1,2	-	0.6	4.1	30.1	33.7	16.6	14.9	67.0	4.7	-	vfsl
38-53	C1	-	0.4	2.7	23.9	50.0	14.3	8.7	80.6	2.4	-	vfsl
53-60	C2	-	0.5	2.3	22.1	53.5	14.9	6.7	84.0	2.1	-	lvfs

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
7.1	7.5	7.6	1.90	0.164	11.6	-	0.6	-	-	28.7	14.9	6.7
7.4	7.7	7.8	1.05	0.097	10.8	-	0.6	-	-	25.6	13.2	5.8
7.8	8.4	8.6	0.50	0.053	9.4	-	0.6	-	-	23.9	12.3	5.0
8.1	9.0	9.3	0.30	0.032	9.4	-	0.6	16	-	23.4	13.1	5.3
8.1	9.0	9.2	0.10	0.014		-	0.7	12	-	21.9	9.0	3.4
8.2	9.0	9.2	0.04	0.009		-	0.6	10	-	23.0	7.6	3.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K			8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
13.7	10.5	2.8		0.1	0.6	1	0.6	0.6				43.2
11.6	9.2	2.6		0.1	0.3	1	0.6	-				36.9
9.4	9.8	2.1		0.1	0.2	1	0.6	-				34.4
5.0				0.1	0.1	2	0.9	-				30.6
4.8				0.1	0.1	2	1.5	0.2				30.0
4.8				0.1	0.1	2	1.7	-				31.4

Note: Horizons Ccag1 and Ccag2 were combined for laboratory analysis (lab. No.885).

Soil type: Rubden very fine sandy loam
Soil No.: S51NDak-5-6
Location: 150 feet northwest of corner of southeast quarter of northeast quarter Sec. 31, T162N, R80W, Bottineau County, North Dakota.
Vegetation: Summer fallow.
Parent material: Coarse-textured lacustrine material which has been reworked by wind.
Physiographic position: Upland delta.
Topography: Nearly level.
Slope: 1 percent.
Drainage: Moderate.
Moisture: Moist.
Stoniness: None.
Root distribution: Many and common to considerable depth.
Described by: C. A. Mogen.
Date: September 11, 1951.

Horizon and Mandan Lab. Number	
Ap 882	0 to 6 inches. Dark gray or very dark brown (10YR 4/1 dry, 2/2 moist) soft, noncalcareous very fine sandy loam having a weak medium crumb to single grain structure, grading to
A3 883	6 to 14 inches. Dark gray or very dark brown (10YR 4/1 dry, 2/2 moist) soft, noncalcareous very fine sandy loam having a weak crumb to single grain structure, grading to
B 884	14 to 28 inches. Grayish brown or very dark grayish brown (10YR 5/2 dry, 3/2 moist) loose, noncalcareous very fine sandy loam. This is underlain distinctly by
Ccag1 885	28 to 33 inches. Very pale brown or brown to grayish brown (10YR 7/3 dry, 5/3 to 5/2 moist) mottled with light brownish gray (10YR 6/2) strongly calcareous very fine sandy loam; loose consistence. This grades to
Ccag2 885	33 to 38 inches. Very pale brown or pale brown to light yellowish brown (10YR 7/3 to 8/3 dry, 6/3 to 6/4 moist) mottled with light brownish gray (10YR 6/2) strongly calcareous very fine sandy loam; loose consistence. This grades to
C1 886	38 to 53 inches. Brown to light yellowish brown or brown to yellowish brown (10YR 5/3 to 6/4 dry, 5/3 to 5/4 moist) loose, moderately calcareous very fine sandy loam, grading to
C2 887	53 to 60 inches. Very pale brown or light yellowish brown (10YR 7/4 dry, 6/4 moist) loose, weakly calcareous very fine loamy sand; faintly mottled with white or light gray (5Y 8/2 dry, 7/2 moist), distinct mottlings of yellowish brown (10YR 5/6).

Remarks: A gravel lag exists at a depth of about 70 inches. The Ccag1 and Ccag2 horizons were combined for laboratory analysis.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Exline clay loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-7-(1-8) **LAB. NOS.** 4487-4494

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	A1	0.1	0.6	1.4	20.0	20.0	31.9	26.0	50.5	15.9	-	l
6-10	B21	-	0.4	1.2	19.4	19.3	29.4	30.3	48.3	14.7	-	cl
10-17	B22	0.1	0.4	1.2	20.3	19.1	28.7	30.2	49.3	14.4	-	cl
17-24	B3ca	0.1	0.3	1.2	18.1	16.7	24.3	39.3	40.4	14.9	-	cl
24-30	IIC1	-	0.1	0.5	20.2	29.4	30.3	19.5	63.5	13.1	-	l
30-40	IIC2	-	-	0.2	6.5	20.7	51.6	21.0	51.3	26.4	-	sil
40-48	IIC3ca	0.2	0.1	0.2	5.2	12.8	64.6	16.9	50.5	30.9	Tr.	sil
48-60	IIC4	-	0.1	0.1	0.9	26.9	60.8	11.2	73.9	14.5	-	sil

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.2	8.1	8.3	2.43	.211	11.5	<0.20	1.0	-				12.2
7.4	8.0	8.6	1.03	.107	9.6	<0.20	1.0	-				12.9
7.9	8.9	8.9	0.82	.079	10.4	<0.20	3.2	3				12.6
8.2	8.8	8.9	0.62	.068	9.1	0.46	10.4	26				12.2
8.3	9.1	9.3	0.20			0.31	5.9	22				6.5
8.0	8.9	9.2	0.19			0.37	7.1	24				7.3
7.9	8.9	9.1	0.15			0.31	6.9	18				7.8
8.1	9.0	9.2	0.08			<0.20	2.0	9				6.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6F1a Na	6Q1a K	6N1a Ca	6O1a Mg	4A3a Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
22.9	17.5	8.3		0.3	1.3	1	1.8	0.8	4.6	4.4		56.2
23.7	11.0	12.3		1.5	1.0	5	7.3	0.3	1.2	2.8		60.2
21.1	16.9	13.3		3.6	0.7	10	23.1	0.3	4.9	10.2	1.40	64.2
14.6				6.5	0.3	16	79.4	0.3	19.4	50.5		53.2
7.9				3.5	0.2	20	47.2	0.1	5.9	18.7	1.52	40.6
11.8				4.0	0.2	16	45.7	0.1	34.8	43.8		46.4
12.4				3.5	0.2	14	35.9	0.1	31.4	36.6		46.6
10.0				2.4	0.2	18	14.6	0.1	1.8	4.3	1.53	42.4

Soil type: Exline clay loam
Soil No.: S56NDak-41-7-(1-8)
Location: 600 feet north and 75 feet east of west quarter corner of Sec. 10, T132N, R53W, Sargent County, North Dakota.
Vegetation: Native and tame grasses.
Parent material: Glacial lacustrine deposits.
Physiographic position: Lake plain.
Topography: Nearly level.
Drainage: Somewhat poor.
Ground water: 56 inches.
Described by: Wesley M. Larsen.
Date: July 11, 1956.

Horizon and Lincoln Lab. Number	
A1 4487	0 to 6 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) clay loam; fine granular structure; sticky and plastic; smooth boundary.
B21 4488	6 to 10 inches. Very dark gray (5Y 3/1 dry) to black (5Y 2/1 moist) clay; strong medium columnar structure; very firm, very sticky and very plastic; noncalcareous; clear wavy boundary.
B22 4489	10 to 17 inches. Very dark grayish brown (2.5Y 3/2 moist) clay; strong medium columnar structure; very firm, very sticky and very plastic. This horizon is limy around the columns and in larger root holes.
B3ca 4490	17 to 24 inches. Light gray (5Y 7/2 moist) to pale yellow (5Y 7/3 moist) silt loam with tongues of olive (5Y 4/3 moist); fine and very fine blocky structure; friable, slightly sticky and plastic; very strongly calcareous; abrupt smooth boundary.
IIC1 4491	24 to 30 inches. Light olive brown (2.5Y 5/6 moist) loam; friable, slightly sticky and slightly plastic; moderately calcareous; abrupt smooth boundary.
IIC2 4492	30 to 40 inches. Olive (5Y 5/3 moist) clay loam; weak blocky structure; sticky and plastic; strongly calcareous; clear smooth boundary.
IIC3ca 4493	40 to 48 inches. Light olive brown (2.5Y 5/4 moist) clay loam with common lime concretions of white (5Y 8/2 moist) and iron concretions of dark reddish brown (5YR 3/4 moist); weak angular blocky structure; sticky and plastic; strongly calcareous; smooth boundary.
IIC4 4494	48 to 60 inches. Gray (5Y 5/1 moist) very fine sandy loam; dark reddish brown (5YR 2/2 and 3/4 moist) iron concretions which are nearly round with a long vertical axis; nonsticky and nonplastic; moderately calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Exline clay loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-9-(1-7) **LAB. NOS.** 4502-4508

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	A1p	-	0.4	1.6	24.0	16.2	32.0	25.8	49.4	17.8	-	l
5-9	B2	0.1	0.2	0.9	15.8	10.2	35.9	36.9	35.7	23.0	-	cl
9-14	B3ca	-	0.1	0.6	10.0	6.2	34.2	48.9	22.2	26.4	-	c
14-26	Cca	0.1	0.2	0.3	8.8	4.4	33.9	52.3	15.2	30.8	-	c
26-39	D1	0.1	0.1	0.5	54.1	28.6	10.9	5.7	84.3	3.4	-	lfs
39-53	D2	-	-	0.8	78.9	13.8	3.8	2.7	80.5	1.9	-	fs
53-60	D3	-	-	0.4	77.7	15.8	3.3	2.8	87.2	2.4	-	fs

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.2	8.4	2.05	.168	12.2	<0.20	0.9	-				12.1
7.9	8.7	9.0	1.13	.096	11.8	<0.20	1.4	-				17.7
8.4	8.9	8.9	0.84	.073	11.5	0.22	3.3	6				17.8
8.4	9.0	9.1	0.46	.049	9.4	0.26	5.2	32				15.3
8.3	9.1	9.1	0.08			<0.20	1.7	5				3.6
8.0	8.9	8.8	0.05			<0.20	1.0	4				2.2
8.3	8.9	9.2	0.06			<0.20	0.7	4				2.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
23.9	11.8	12.1		1.9	0.8	7	7.2	0.2	1.6	1.2		47.2
30.4	11.1	17.9		5.2	0.5	14	11.6	0.1	0.6	1.7		74.1
29.2				7.5	0.3	18	27.5	0.1	1.5	5.9		82.2
22.8				7.6	0.2	20	40.0	0.1	3.0	12.2		74.4
5.6				1.1	0.1	14	11.2	-	1.4	2.5		31.1
3.5				0.4	0.1	6	5.1	0.1	1.6	2.2		31.6
4.2				0.5	0.1	10	4.0	0.1	1.0	1.2		33.9

Soil type: Exline clay loam
Soil No.: S56NDak-41-9-(1-7)
Location: 760 feet north and 80 feet east of southwest corner of Sec. 4, T132N, R53W, Sargent County, North Dakota.
Vegetation: Soybean crop.
Topography: Nearly level.
Parent material: Glacial lacustrine deposits.
Physiographic position: Lake plain.
Drainage: Somewhat poor.
Ground water: Below 60 inches.
Described by: Wesley M. Larsen.
Date: July 11, 1956.

Horizon and Lincoln Lab. Number	
A1p 4502	0 to 5 inches. Black (10YR 2/1 moist) clay loam; fine crumb structure; sticky and plastic; abrupt smooth boundary.
B2 4503	5 to 9 inches. Black (5Y 2/1 moist) clay; moderate coarse columnar structure with rounded caps; very firm, very sticky and very plastic; calcareous; wavy boundary.
B3ca 4504	9 to 14 inches. Olive gray (5Y 4/2 moist) silty clay; medium angular blocky structure; firm, very sticky and very plastic; continuous clay skins on all faces; very strongly calcareous; smooth boundary.
Cca 4505	14 to 26 inches. Olive (5Y 5/3 moist) silty clay; medium angular blocky; firm, very sticky and very plastic; patches of clay on vertical faces; strongly calcareous; wavy boundary.
D1 4506	26 to 39 inches. Olive yellow (2.5Y 6/6 moist) with many prominent mottles of brown and dark brown (7.5YR 4/4 and 3/2 moist) fine sandy loam; very friable; noncalcareous; smooth boundary.
D2 4507	39 to 53 inches. Reddish brown and dark reddish brown (5YR 4/4 and 3/4 moist) mottled with yellowish brown (10YR 5/6 moist) fine sand; noncalcareous; smooth boundary.
D3 4508	53 to 60 inches. Light olive brown (2.5Y 5/4 moist) and pale olive (5Y 6/4 moist) fine sand with thread-like horizontal stains of dark yellowish brown (10YR 4/4 moist); noncalcareous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Fargo clay **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-5 **LAB. NOS.** 876-881

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
0-6	A1	0.1	0.3	0.3	0.9	2.6	32.3	63.5	13.6	21.9	-	c
6-15	A1g	0.1	0.3	0.3	0.9	2.9	30.8	64.7	14.5	19.8	-	c
15-29	Bcag	0.1	0.2	0.3	1.0	2.8	32.0	63.6	15.2	20.3	-	c
29-37	Ccag	-	0.1	0.2	0.6	2.3	30.5	66.3	13.3	20.0	-	c
37-44	Ccag2	0.1	0.2	0.2	1.0	3.6	36.5	58.4	17.7	23.2	-	c
44-62	Ccag3	-	0.2	0.3	1.1	4.3	38.7	55.4	18.3	25.5	-	c

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.2	8.6	3.65	0.340	10.7	-	0.6	2	-			31.5
7.9	8.6	9.0	2.52	0.242	10.4	-	0.6	3	-			30.2
8.4	9.0	9.5	2.51	0.232	10.8	-	0.8	5	-			30.5
8.6	9.4	9.6	1.38	0.128	10.8	-	1.2	9	-			29.9
8.6	9.5	9.8	0.84	0.081	10.4	-	1.4	11	-			25.4
8.7	9.4	9.7	0.28	0.053		0.21	2.0	11	-			24.2

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE Ca	Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil			→		←	milliequivalents per liter			→		
44.1			0.9	3.0	2	3.5	0.6					107.2
42.4			3.2	2.0	8	5.9	0.2					113.3
39.8			6.6	2.2	16	9.1	0.2					137.4
38.5			9.0	2.1	23	12.4	0.2					154.5
32.5			8.9	1.7	27	13.5	0.2					183.1
30.5			8.8	1.4	29	18.9	0.2	5.8	0.2	15.7		162.9

Soil type: Fargo clay
Soil No.: S51NDak-5-5
Location: 150 feet west of North Dakota Highway 14 in southeast quarter or northeast quarter Sec. 36, T162N, R78W, Bottineau County, North Dakota.
Vegetation: Fair barley.
Parent material: Fine-textured glacial lacustrine clay.
Physiographic position: Glacial lake.
Topography: Flat or nearly level.
Slope: 0 or less than 1 percent.
Drainage: Somewhat poor to poor.
Moisture: Moist.
Stoniness: None.
Root distribution: Common to 4 feet.
Described by: C. A. Mogen.
Date: September 11, 1951.

Horizon and Mandan Lab. Number	
A1 876	0 to 6 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) plastic, slightly hard, sticky, noncalcareous clay having a moderate granular structure. Boundary between this horizon and the one immediately underneath is gradual and tongued.
A1g 877	6 to 15 inches. Dark gray or black to very dark gray (10YR 4/1 dry, 2/1 to 3/1 moist) slightly plastic, moderately hard, sticky, noncalcareous clay having a strong medium granular structure, grading to
Bcag 878	15 to 29 inches. Dark gray or very dark gray (10YR 4/1 dry, 3/1 moist) moderately plastic, very hard, moderately calcareous clay having a compound weak coarse prismatic to moderate coarse granular structure. This grades irregularly to
Ccag 879	29 to 37 inches. Dark gray or very dark gray (10YR 4/1 dry, 3/1 moist) moderately plastic, very hard, moderately calcareous clay having a strong medium blocky structure. This grades to
Ccag2 880	37 to 44 inches. Grayish brown or dark grayish brown (2.5Y 5/2 dry, 4/2 moist) weakly plastic, moderately hard, calcareous clay having a moderate medium blocky structure. This grades to
Ccag3 881	44 to 62 inches. Olive gray to olive (5Y 5/2 to 5/3 dry, 4/2 to 4/3 moist), weakly plastic, moderately hard, moderately calcareous clay, having a weak to moderate medium blocky structure; a few gypsum crystals are in evidence.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Fargo clay **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-4 **LAB. NOS.** 870-875

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	Ap	0.4	0.5	0.4	1.2	3.5	38.8	55.2	18.0	25.0	-	c
5-20	Acag	0.1	0.2	0.4	1.0	3.3	35.2	59.8	15.0	24.2	-	c
20-29	Bcag	-	0.1	0.2	0.7	2.2	29.8	67.0	11.5	21.0	-	c
29-38	Ccag	-	0.1	0.1	0.3	0.9	20.1	78.5	6.3	14.8	-	c
38-52	Ccsg	-	0.1	0.2	0.4	0.5	28.6	70.2	3.2	26.2	-	c
52-60	Cg	0.3	0.3	0.3	0.5	0.5	51.8	46.3	2.7	49.9	-	sic

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.3	8.6	3.05	0.301	10.1	-	0.6	3	-			23.3
7.9	8.6	8.7	1.72	0.161	10.7	-	0.6	4	-			24.0
8.4	9.0	9.2	0.90	0.085	10.6	-	0.6	10	-			24.3
8.5	9.2	9.6	0.56	0.058	9.6	-	0.8	10	-			26.7
7.8	8.0	8.0	0.42	0.044	9.5	0.43	5.5	10	66			26.3
7.9	8.2	8.4	0.44	0.038	11.6	0.45	7.5	15	36			19.2

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE Ca	Mg	EXCHANGEABLE 6P2a Na	5B1b 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil			→		←	milliequivalents per liter			→		
38.3			-	2.5	-	1.3	0.4					76.1
36.4			0.9	1.2	2	2.8	-					77.8
35.8			3.1	0.8	9	6.1	-					105.7
39.1			4.9	0.8	12	8.0	-					134.1
32.9			3.2	0.8	10	33.0	0.4					99.8
26.4			3.2	0.5	12	41.3	0.4	3.7	0.8	109		79.4

Soil type: Fargo clay
Soil No.: S51NDak-5-4
Location: 100 feet north of road and 1000 feet west of section line southeast quarter of southeast quarter Sec. 23, T162N, R78W, Bottineau County, North Dakota.
Vegetation: Fair barley.
Parent material: Fine-textured lacustrine glacial material.
Physiographic position: Glacial lake.
Topography: Flat.
Slope: Less than 1 percent.
Drainage: Somewhat poor.
Moisture: Moist to wet.
Root distribution: Numerous roots to 3 feet.
Stoniness: None.
Described by: C. A. Mogen.
Date: September 11, 1951.

Horizon and Mandan Lab. Number	
Ap 870	0 to 5 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) firm, sticky, weakly calcareous clay having a moderate medium granular structure. This grades very irregularly to
Acag 871	5 to 20 inches. Light brownish gray or dark grayish brown (2.5Y 6/2 dry, 4/2 moist) very plastic, very hard clay having moderate medium prismatic to weak medium blocky structure; streaked with very dark grayish brown or very dark brown (10YR 2/2 moist, 2/5Y 3/2 dry). This grades to
Bcag 872	20 to 29 inches. Light brownish gray or dark grayish brown (2.5Y 6/2 dry, 4/2 moist) very plastic, very hard, moderately calcareous clay having a compound moderate coarse prismatic and moderate coarse blocky structure; streaked with very dark grayish brown black or very dark brown (2.5Y 3/2 dry, 10YR 2/2 moist). This grades to
Ccag 873	29 to 38 inches. Light olive gray or olive gray (5Y 6/2 dry, 4/2 moist) very plastic, very hard, moderately calcareous clay having a compound weak coarse prismatic and moderate coarse blocky structure; grades to
Ccsg 874	38 to 52 inches. Light olive gray or olive gray (5Y 6/2 dry, 4/2 moist) very plastic, very hard, weakly calcareous clay; fine weak lamination breaking to moderate medium blocky structure; distinct mottlings of pale olive or olive (5Y 6/4 dry, 5/4 moist); moderately gypsiferous. This changes distinctly to
Cg 875	52 to 60 inches. Mottled light gray and pale yellow or olive, light olive gray and pale olive (5Y 7/2 to 7/4 dry, 5/4 to 6/2 to 6/4 moist) laminated silty clay loam and silty clay; plastic, moderately hard, weakly calcareous, weakly gypsiferous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Fargo clay, till substratum **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-8 **LAB. NOS.** 894-899

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-8	Ap	1.9	2.1	1.9	2.7	3.7	36.2	51.5	18.4	23.0	1	c
8-12	A3	0.7	1.2	1.2	2.3	3.7	36.7	54.2	16.2	25.6	Tr.	c
12-22	B	0.7	1.4	1.2	1.9	3.0	37.3	54.5	15.2	26.3	Tr.	c
22-30	Ccag	1.5	1.7	1.4	2.5	2.3	40.1	50.5	10.9	33.0	1	sic
30-42	D1	6.2	7.6	7.5	14.6	9.4	32.3	22.4	29.9	19.8	13	l
42-60	D2	4.1	5.3	5.2	9.5	7.8	41.6	26.5	27.1	27.8	6	l

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS.
7.6	8.0	8.4	3.04	0.278	10.9	-	0.6	1	-			22.6
7.4	8.2	8.1	2.04	0.179	11.4	-	0.6	-	-			25.0
7.6	7.8	7.9	1.56	0.141	11.1	-	2.6	2	-			22.7
7.8	8.4	8.5	0.89	0.092	9.7	0.28	5.5	21	3			18.3
8.0	8.7	8.9	0.25	0.028	8.9	0.21	4.7	16	-			8.6
8.0	8.7	8.8	0.23	0.030		0.24	5.0	16	-			11.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →					
39.2			0.1	1.9	-	0.6	0.2				70.1
39.8	27.4	14.1	0.2	0.9	-	1.3	-				72.9
37.0			0.5	0.7	1	3.5	0.2				74.7
26.3			1.2	0.3	4	15.9	0.2	3.7	2.2	78.6	66.5
11.0			0.8	0.2	7	17.8	-				40.6
15.2			1.6	0.4	10	23.3	0.2	3.7	2.5	68.1	51.0

Soil type: Fargo clay, till substratum
Soil No.: S51NDak-5-8
Location: 50 feet north of Highway 5, southwest quarter of southeast quarter Sec. 26, T162N, R78W, Bottineau County, North Dakota.
Vegetation: Good wheat crop.
Parent material: Moderately fine-textured glacial lacustrine material; shallow over till.
Physiographic position: Glacial lake.
Topography: Nearly level.
Slope: Less than 1 percent.
Drainage: Moderate.
Moisture: Moderate to 22 inches, less moist below.
Stoniness: None.
Root distribution: Many to a depth of 30 inches.
Described by: C. A. Mogen.
Date: September 12, 1951.

Horizon and Mandan Lab. Number	
Ap 894	0 to 8 inches. Dark gray or black (10YR 4/1 dry, 2/1 moist) friable, slightly plastic, noncalcareous clay having a moderate medium granular structure. This grades to
A3 895	8 to 12 inches. Dark grayish brown or black to very dark brown (10YR 4/2 dry, 2/1 to 2/2 moist) firm, moderately plastic clay having a moderate medium to fine granular structure. This is underlain distinctly but irregularly by
B 896	12 to 22 inches. Dark grayish brown or very dark grayish brown (2.5Y 4/2 dry, 3/2 moist) firm, moderately plastic, moderately hard, noncalcareous clay having a compound weak medium prismatic and moderate medium blocky structure. This is distinctly underlain by
Ccag 897	22 to 30 inches. Light gray to white or light yellowish brown (2.5Y 7/2 to 8/2 dry, 6/4 moist) friable, slightly hard, strongly calcareous silty clay having a weak fine crumb to granular structure. This is underlain distinctly by
D1 898	30 to 42 inches. Pale yellow or light olive brown (2.5Y 7/4 dry, 5/4 moist) friable, slightly hard, moderately calcareous loam mottled with white or light brownish gray (2.5Y 8/2 dry, 6/2 moist). This layer contains a moderate amount of gravel. It is underlain distinctly by
D2 899	42 to 60 inches. Light yellowish brown or olive brown (2.5Y 6/4 dry, 4/4 moist) firm, moderately plastic, moderately hard, moderately calcareous loam having subangular medium blocky structure; faintly mottled with light gray or grayish brown (2.5Y 7/2 dry, 5/2 moist) and strong brown (7.5YR 5/6).

Remarks: The D is glacial till. The D1 horizon is water-modified till which is gravelly.

SOIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE Fargo silty clay, till substratum **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-9 **LAB. NOS.** 900-904

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	0.9	1.3	1.0	2.3	5.2	41.3	48.0	21.8	26.2	-	sic
6-13	B	0.3	0.8	0.9	2.0	4.6	40.5	50.9	18.9	27.4	-	sic
13-21	Ccag	1.6	1.5	1.1	2.2	3.0	40.1	50.5	12.5	31.9	1	sic
21-31	D1	3.9	5.6	4.9	9.4	7.9	36.3	32.0	27.1	22.6	5	cl
31-60	D2	6.3	6.1	5.2	9.1	7.8	39.8	25.7	27.9	25.1	4	l

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.0	7.4	7.6	3.40	0.299	11.4	-	0.7	-	-			21.1
7.3	8.0	8.4	1.40	0.159	8.8	-	0.5	1	-			21.2
7.9	8.8	8.8	0.97	0.101	9.6	-	0.5	19	-			17.5
8.3	9.3	9.4	0.28	0.038	7.4	-	0.6	20	-			11.2
8.3	9.2	9.2	0.22	0.026		-	1.5	18	-			11.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6F1a Na	6G1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		← milliequivalents per liter →					
37.5	26.5	10.8		0.2	2.2	-	0.9	0.4				68.9
34.7		13.0		0.1	1.2	-	0.2	0.2				70.3
25.5				0.3	0.8	1	0.6	-				63.0
15.1				0.4	0.4	3	3.5	-				46.0
13.8				1.0	0.4	7	8.7	-				47.3

Soil type: Fargo silty clay, till substratum
Soil No.: S51NDak-5-9
Location: 75 feet east of road and 1000 feet south of Highway 5, northwest quarter of northwest quarter of Sec. 36 T162N, R78W, Bottineau County, North Dakota.
Vegetation: Good wheat crop.
Parent material: Shallow, moderately fine-textured glacial lacustrine material.
Physiographic position: Glacial lake.
Topography: Nearly level.
Slope: Less than 1 percent.
Drainage: Moderate.
Moisture: Moderate to 14 inches, dry to 31 inches, and moist below 31 inches.
Stoniness: None.
Root distribution: High amount of roots to 14 inches; moderate amount below.
Described by: C. A. Mogen.
Date: September 12, 1951.

Horizon and Mandan Lab. Number	
Ap 900	0 to 6 inches. Dark gray or black (10YR 4/1 dry, 2/1 moist) firm, slightly plastic, sticky, noncalcareous silty clay having a moderate medium granular structure. This is underlain distinctly by
B 901	6 to 13 inches. Light yellowish brown or light olive brown (2.5Y 4/2 dry, 3/2 moist) firm, moderately plastic, moderately hard noncalcareous silty clay having a compound moderate medium prismatic and moderate coarse granular structure; mottled with very dark gray or black (10YR 3/1 dry, 2/1 moist). Distinctly but irregularly underlain by
Ccsg 902	13 to 21 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) friable, slightly plastic, slightly hard, moderately calcareous silty clay having a compound weak medium prismatic and moderate coarse granular or medium blocky structure; materials are streaked with light brownish gray or dark grayish brown (2.5Y 6/2 dry, 4/2 moist). This changes to
D1 903	21 to 31 inches. Pale yellow or light yellowish brown (2.5Y 7/4 dry, 6/4 moist) firm, slightly plastic, moderately calcareous clay loam having a moderate medium blocky structure; profusely mottled with white or light gray (2.5Y 8/2 dry, 7/2 moist). This changes gradually to
D2 904	31 to 60 inches. Grayish brown or dark grayish brown (2.5Y 5/2 dry, 4/2 moist) firm, slightly plastic, slightly hard, moderately calcareous loam; moderate subangular structure; mottled with pale yellow or light olive brown (2.5Y 7/4 dry, 5/4 moist); small distinct mottlings of strong brown (7.5YR 5/6).

Note: The D1 horizon contains some gravel. This is water-modified till; good till occurs below 31 inches. Tonguing in the upper horizon is common, also found in the Fargo soils. The A3 horizon is absent in this profile but generally is present.

OIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Fargo silty clay **LOCATION** Cass County, North Dakota

SOIL NOS. S53NDak-9-3 **LAB. NOS.** 1772-1777

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	A1p	0.2	0.5	0.5	1.1	2.8	41.1	53.8	16.2	28.5	-	sic
7-12	AB	0.1	0.4	0.3	0.8	1.8	35.4	61.2	13.2	24.5	-	c
12-24	B2	0.1	0.3	0.3	0.8	1.2	32.9	64.4	8.4	26.2	-	c
24-36	B3g	0.2	0.2	0.2	0.8	1.0	36.8	60.8	9.0	29.2	-	c
36-54	Cg	0.1	0.2	0.2	0.5	0.8	36.2	62.0	7.1	30.3	-	c
54-60	Cgca	0.1	0.1	-	0.3	0.5	39.0	60.0	8.6	31.1	-	c

8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5			6.2	0.471	13.2	<0.20	0.9	-				27.5
6.6			2.84	0.248	11.4	<0.20	0.6	-				27.1
6.8			1.22	0.117	10.4	<0.20	0.6	-				27.3
7.8			0.78	0.074	10.5	<0.20	0.7	12				23.7
7.9			0.56	0.055	10.2	<0.20	0.9	17				23.6
8.0			0.39	0.048	8.1	<0.20	1.2	17				23.6

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1a	6P2a Na	6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
56.8	31.9	14.6		0.3	3.9	6.1	0.4	1.5				87.4
53.9	28.3	16.4		0.3	3.4	5.5	0.6	0.8				81.5
47.9	23.3	19.1		0.6	1.9	3.0	0.6	0.4				84.5
							1.3	0.1				80.7
							3.0	-				82.7
							4.8	0.1				85.7

Soil type: Fargo silty clay
Soil No.: S53NDak-9-3
Area: Cass County, North Dakota
Location: 370 feet west and 280 feet north of southeast corner Sec. 2, T141N, R50W.
Vegetation: Wheat, rank straw.
Parent material: Lacustrine clay.
Physiographic position: Glacial Lake Agassiz plain; on slight rise 12 to 18 inches above bottom of adjacent shallow, flat-bottomed depression. Depression is Grano clay in which no wheat but weeds are growing.
Topography: Level (relief six to eighteen inches).
Drainage: Somewhat poor.
Permeability: Slow.
Moisture: Moist.
Stoniness: Free.
Root distribution: Many through B2.
Described by: C. A. Mogen.
Date: August 11, 1953.

Mandan Lab. No.	Horizon	
1772	A1p	0 to 7 inches. Very dark gray (10YR 3/1 dry) to black (10YR 1.5/0.5 moist) silty clay; strong fine granular structure; hard when dry, friable when moist.
1773	AB	7 to 12 inches. Dark gray (2.5Y 4/1 dry) to black (2.5Y 2/1 moist) clay; moderate coarse prisms separating into moderate very fine blocks; very hard when dry, firm when moist. The surfaces of the moist aggregates glisten.
1774	B2	12 to 24 inches. Dark gray (2.5Y 4/0.5 dry) to very dark gray (2.5Y 3/1 moist) clay; moderate coarse prisms separating into moderate very fine blocks; very hard when dry, firm when moist. Moist aggregates glisten.
1775	B3g	24 to 36 inches. Gray (2.5Y 5/1 dry) to dark grayish brown (2.5Y 4/2 moist) moderately calcareous clay; compound structure of weak coarse prisms and moderately developed very fine blocks; very hard when dry; friable to firm when moist. Moist aggregates glisten.
1776	Cg	36 to 54 inches. Gray (5Y 6/1 dry) to olive gray (5Y 4/2 moist) moderately calcareous clay with a very slight amount of segregated lime; moderate very fine blocks; very hard when dry, friable to firm when moist. Moist aggregates glisten.
1777	Cgca	54 to 60 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) mottled with olive (5Y 4/4 moist) and light gray (5Y 7/2 moist) in common medium-sized distinct mottlings, strongly calcareous clay with a moderate amount of segregated lime; weak very fine blocks; very hard when dry; friable to firm when moist.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Fargo silty clay loam **LOCATION** Cass County, North Dakota

SOIL NOS. S53NDak-9-4 **LAB. NOS.** 1778-1784

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-8	A1p	0.3	0.6	0.8	2.4	7.3	51.9	36.7	39.4	21.4	-	sicl
8-15	B21	0.2	0.8	0.9	2.7	8.3	50.3	36.8	42.6	17.8	-	sicl
15-22	B22	0.3	0.9	1.0	2.8	5.7	49.8	39.5	35.5	21.9	-	sicl
22-32	Cg1	0.3	0.5	0.6	1.4	2.1	54.0	41.1	21.2	35.9	-	sic
32-42	Cgca1	0.2	0.2	0.3	1.0	1.1	49.5	47.7	12.9	38.4	-	sic
42-50	Cgca2	0.1	0.1	0.1	0.4	0.7	43.4	55.2	8.2	36.2	-	sic
50-60	Cg2	-	0.1	0.2	0.4	0.5	41.9	56.9	6.8	35.9	-	sic

8C1b pH SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.0			2.56	0.216	11.8	<0.20	0.4	-				17.6
6.9			1.06	0.094	11.3	<0.20	0.4	-				17.8
7.3			0.59	0.062	9.5	<0.20	0.4	-				18.4
8.1			0.45	0.051	8.8	<0.20	0.5	17				17.3
8.2			0.38	0.046	8.3	<0.20	0.8	21				19.8
8.2			0.37	0.040	9.2	<0.20	1.2	20				24.5
8.1			0.28	0.037	7.6	<0.20	1.4	18				24.7

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1a	6P2a Na	6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION
←	milliequivalents per 100g. soil				→		← milliequivalents per liter				→	%
38.0	20.2	12.2		0.3	1.0	4.3	-	0.4				62.0
32.3	14.2	14.8		0.4	0.8	2.1	0.4	0.1				59.8
32.5	13.9	16.3		0.6	0.7	1.0	1.1	0.4				64.3
							1.5	0.4				67.3
							3.5	0.1				74.4
							5.9	0.4				83.3
							6.7	0.4				87.1

Soil type: Fargo silty clay loam
Soil No.: 853NDak-9-4
Area: Cass County, North Dakota.
Location: NW NE NW Sec. 22, T141N, R50W, 1/4 mile east and 260 feet south and 80 feet east of northwest corner.
Vegetation: Oat stubble.
Parent material: Lacustrine clay.
Physiographic position: Bed of Glacial Lake Agassiz on level position 80 feet west of shallow depression.
Topography: Level (relief six to twelve inches).
Slope: 1/2 percent.
Drainage: Somewhat poor.
Permeability: Moderately slow.
Moisture: Moist.
Stoniness: Free.
Described by: C. A. Mogen.
Date: August 11, 1953.
Mandan

Lab.No.	Horizon	
1778	A1p	0 to 8 inches. Very dark gray (10YR 3.5/1 dry) to black (10YR 2/1 moist) silty clay loam; strong fine granules; hard when dry, friable when moist, sticky and plastic when wet.
1779	B21	8 to 15 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) silty clay loam; compound structure of weak coarse prisms and strong very fine blocks; very hard when dry, firm when moist, sticky and very plastic when wet. Faces of aggregates glisten in moist soil. Clear wavy boundary.
1780	B22	15 to 22 inches. Grayish brown (2.5Y 5/2 dry) streaked with dark gray (10YR 4/1 dry) to very dark gray (2.5Y 3/1 moist) streaked with black (10YR 2/1 moist) silty clay loam; compound structure of weak coarse prisms and strong very fine blocks; very hard when dry, firm when moist, sticky and very plastic when wet. Faces of aggregates glisten in moist soil. Clear wavy boundary.
1881	Cg1	22 to 32 inches. Light olive gray (3.5Y 6/2 dry) streaked with dark gray (10YR 4/1 dry) to olive gray (3.5Y 4/2 moist) streaked with black (10YR 2/1 moist) strongly calcareous silty clay with a very slight amount of segregated lime in the threads; moderate fine blocks; hard when dry, friable when moist, sticky and plastic when wet. Clear wavy boundary.
1782	Cgca1	32 to 42 inches. Light olive gray and white (3.5Y 6/2 and 10YR 9/2 dry) to olive gray and white (3.5Y 5/2 and 10YR 8/2 moist) strongly calcareous silty clay with a moderate amount of segregated lime; moderate very fine blocks; hard when dry, friable when moist, sticky and plastic when wet. Gradual boundary.
1783	Cgca2	42 to 50 inches. Light gray (5Y 7/2 dry) and pale yellow (5Y 7/3 dry) with a few fine distinct mottlings of brownish yellow and white (10YR 6/8 and 9/2 dry) to olive (5Y 5/3 moist) mottled with yellowish brown and white (10YR 5/8 and 8/2 moist) strongly calcareous silty clay with a moderate amount of segregated lime; strong very fine blocks; hard when dry, friable to firm when moist, sticky and plastic when wet. Gradual boundary.
1784	Cg2	50 to 60 inches. Pale yellow (5Y 7/3 dry) with many fine prominent mottlings of brownish yellow (10YR 6/8 dry) to olive (5Y 5/3 moist) mottled with yellowish brown (10YR 5/8 moist) moderately calcareous silty clay; strong very fine blocky structure; hard when dry, friable to firm when moist, sticky and plastic when wet.

Note: Profile differs from sample 853NDak-9-3 in having a friable, more calcareous, upper C horizon. In this respect it approaches Bearden silty clay loam.

SOIL SURVEY LABORATORY Mandan, North Dakota[1/] 9-9-55

SOIL TYPE Fargo silty clay **LOCATION** Walsh County, North Dakota

SOIL NOS. S54NDak-50-1-(1-7) **LAB. NOS.** 2136-2142

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	0.4a	0.6	0.5	1.1	1.6	56.1	39.7	21.4	36.9	-	sicl
6-12	AB	0.3	0.4	0.2	0.3	1.2	50.6	47.0	24.0	27.9	-	sic
12-17	B21	0.1	0.6	0.3	0.6	1.2	52.1	45.1	23.9	29.7	-	sic
17-25	Cca1	0.1	0.2	0.2	0.5	0.8	55.5	42.7	12.5	44.1	-	sic
25-34	Cca2	0.1	0.2	0.2	0.3	0.7	53.1	45.4	9.1	45.0	-	sic
34-41	C1	0.5	0.3	0.2	0.7	2.1	56.5	39.7	13.2	45.9	-	sicl
41-60	C2	0.3	0.3	0.4	1.0	1.3	49.7	47.0	10.3	41.2	-	sic

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.6	8.5	8.6	3.52	.282	12.5	-	0.7	1				19.2
7.5	8.3	8.3	1.27	.116	10.9	-	0.6	-				19.3
7.6	8.4	8.5	0.93	.093	10.0	-	0.7	1				18.7
7.8	8.8	9.0	0.78			-	0.9	24				15.5
7.9	8.9	9.1	0.61			-	1.0	27				15.3
8.0	9.0	9.2	0.42			-	0.8	20				15.7
8.0	9.0	9.1	0.34			-	0.7	12				19.7

5A1a CATION EXCHANGE CAPACITY (NH_4Ac)	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6F1a Na	6G1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
42.0		15.8		0.2	1.3	-	0.4	0.3				75.3
38.1	23.5	15.1		0.1	1.0	-	0.4	0.2				77.8
32.6		16.0		0.2	1.0	1	0.4	0.2				75.2
23.3				0.2	0.6	1	0.7	0.3				63.0
21.5				0.3	0.6	1	1.1	0.3				65.5
21.7				0.3	0.6	1	0.9	0.2				67.1
26.0				0.4	0.6	1	0.9	0.2				80.5

1/ Mechanical analyses by Beltsville Laboratory.
a. Organic matter in sand fractions.

Soil type: Fargo silty clay
Soil No.: 854NDak-50-1
Area: Walsh County, North Dakota.
Location: 120 feet north, and 90 feet east of S1/4 corner Sec. 15, T157N, R51W.
Vegetation or crop: Disked grain stubble.
Parent material: Glaciolacustrine clay.
Physiographis position: Bed of glacial Lake Agassiz.
Topography: Level.
Drainage: Somewhat poor.
Ground water: 38 inches.
Permeability: Slow.
Moisture: Moist.
Stoniness: Free.
Described by: C. A. Mogen.
Date: June 3, 1954.

Mandan Lab.No.	Horizon	
2136	A1p	0 to 6 inches. Black (10YR 2/1 dry) to (10YR 1/1 moist) noncalcareous silty clay; hard, friable; moderately developed very fine granules.
2137	AB	6 to 12 inches. Black (10YR 2/0.5 dry) to (1.5/0.5 moist) silty clay; slightly hard clods of the dry soil separate to extremely hard strong very fine blocks; moist soil is firm. Gradual boundary.
2138	B21	12 to 17 inches. Dark gray (2.5Y 4/1 dry) to very dark gray (2.5Y 3/1 moist) silty clay; clods of the dry soil are slightly hard breaking to strong very fine blocks which are extremely hard; firm when moist. Clear, very wavy boundary.
2139	Cca1	17 to 25 inches. Light brownish gray (2.5Y 6/2 dry) strongly calcareous silty clay with a slight amount of segregated lime; dry soil is mottled light gray (2.5Y 7/2 dry) and light yellowish brown (2.5Y 6/4 dry); moist soil is light olive brown (2.5Y 5/4 moist) mottled with grayish brown (2.5Y 5/2 moist); clods of the dry soil are slightly hard breaking to the extremely hard strong very fine blocks; moist soil is firm; tongues of the A1 extend to 34 inches. Gradual boundary.
2140	Cca2	25 to 34 inches. Light brownish gray (2.5Y 6/2 dry) strongly calcareous silty clay in which there is a slight amount of segregated lime in small soft concretions; dry soil is mottled with grayish brown (2.5Y 5/2 dry) and white (2.5Y 8/2 dry); the moist soil is grayish brown (2.5Y 5/2 moist) mottled with light olive brown (2.5Y 5/4 moist) and white (2.5Y 8/2 moist); clods of the dry soil are slightly hard breaking to the extremely hard strong very fine blocks; firm when moist. Gradual boundary.
2141	C1	34 to 41 inches. Light brownish gray (2.5Y 6/2 dry) with many fine faint mottlings of light yellowish brown (2.5Y 6/4 dry) to olive brown (2.5Y 4/4 moist) mottled with grayish brown (2.5Y 5/2 moist) moderately calcareous silty clay with a slight amount of segregated lime in small soft rounded concretions; clods of the dry soil are hard, breaking to very fine blocks; moist soil is firm; clear boundary.
2142	C2	41 to 60 inches. Light gray (5Y 7/1 dry) with common fine distinct mottlings of light yellowish brown (10YR 6/4 dry) to dark grayish brown (2.5Y 4/2 moist) mottled with yellowish brown (10YR 5/6 moist) mildly calcareous silty clay; clods of the dry soil are hard, breaking to strong fine and very fine blocks; firm when moist.

Remarks: This profile contains large pendants of the AB and B horizons; one extends to 30 inches. These are 12 to 18 inches across at the upper part, tapering to about 2 inches across at 30 inches or in their lower part.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-9-55

SOIL TYPE Fargo silty clay **LOCATION** Walsh County, North Dakota

SOIL NOS. S54NDak-50-2-(1-7) **LAB. NOS.** 2143-2149

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	0.8a	0.6	0.6	1.2	1.6	53.7	41.5	18.3	37.7	-	sic
6-11	B21	0.5	0.5	0.3	0.8	1.4	43.9	52.6	17.5	28.3	-	sic
11-18	B22	0.1	0.6	0.6	1.4	1.5	48.8	47.0	13.4	37.8	-	sic
18-32	C1	0.2	0.6	0.7	1.6	1.8	48.6	46.5	12.7	38.7	-	sic
32-43	Cca1	0.2	0.4	0.5	1.3	1.4	47.1	49.1	10.5	38.7	-	sic
43-49	Cca2	0.1	0.2	0.4	1.0	1.4	45.2	51.7	7.6	39.5	0.2	sic
49-60	C	0.2	0.5	0.5	1.1	1.3	49.3	47.1	7.4	43.9	-	sic

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a.	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.6	8.5	8.7	3.32	.257	12.9	0.25	0.7	1	-			19.8
7.7	8.5	8.6	0.89	.096	9.3	-	0.7	-				20.4
7.7	8.6	8.8	0.57	.055	10.4	0.62	1.9	9	-			16.7
7.8	8.7	8.8	0.55			0.43	3.0	17	-			15.9
7.9	8.8	9.0	0.40			0.21	2.0	17	-			16.8
7.9	8.9	9.1	0.44			-	1.4	16				18.2
8.0	8.9	9.1	0.36			-	1.3	15				19.7

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
40.4		16.2		0.3	1.8	-	0.9	0.4				72.3
35.5	19.8	18.0		0.5	1.3	1	1.4	0.2				79.3
28.3				0.9	1.0	2	4.0	0.4				72.9
24.8				1.4	1.0	4	8.0	0.7				65.8
25.3				1.4	1.0	4	6.3	0.4				71.1
26.5				1.3	1.0	4	4.5	0.4				77.0
26.1				1.4	0.9	4	4.0	0.3				82.4

1/ Mechanical analyses by Beltsville Laboratory.
a. Organic matter in sand fraction.

Soil type: Fargo silty clay
Soil No.: 854NDak-50-2
Area: Walsh County, North Dakota.
Location: 0.2 mile west, 330 feet south of northeast corner Sec. 33, T157N, R51W.
Vegetation or crop: Grain stubble--summer fallow.
Parent material: Glaciolacustrine clay.
Physiographic position: Bed of Glacial Lake Agassiz.
Topography: Level to very slightly depressed.
Slope: 1 percent.
Drainage: Somewhat poor.
Ground water: 40 inches.
Permeability: Slow.
Moisture: Moist to above field capacity.
Stoniness: Free.
Described by: C. A. Mogen.
Date: June 3, 1954.

Mandan Lab.No.	Horizon	
2143	A1p	0 to 6 inches. Black (10YR 2/1 dry) to (10YR 1.5/1 moist) silty clay; hard friable; moderately developed very fine granules. Abrupt boundary.
2144	B21	6 to 11 inches. Dark gray (5Y 4/1 dry) streaked with black (10YR 2/1 dry) to very dark gray (5Y 3/1 moist) streaked with black (5Y 1.5/1 moist) silty clay; clods of the dry soil are hard, breaking to strong very fine blocks; firm when moist. Clear wavy boundary with as much as 7 inches of relief between trough and crest of the waves.
2145	B22	11 to 18 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay; clods of the dry soil are slightly hard, breaking to extremely hard, strong very fine blocks; firm when moist. Clear wavy boundary.
2146	C1	18 to 32 inches. Light olive gray (5Y 6/2 dry) with common fine faint mottlings of pale olive (5Y 6/3 dry) to dark grayish brown (2.5Y 4/2 moist) moderately calcareous silty clay with a very slight amount of segregated lime in small soft concretions; clods of the dry soil are slightly hard, breaking to strong very fine blocks; firm when moist.
2147	Cca1	32 to 43 inches. Light olive gray (5Y 6/2 dry) moderately calcareous silty clay with a slight amount of segregated lime in small soft concretions; dry soil has many fine faint mottlings of pale olive (5Y 6/4 dry) and white (5Y 9/1 dry); the moist soil is dark grayish brown (2.5Y 4/2 moist) with many fine faint mottlings of olive brown (2.5Y 4/4 moist) and light gray (2.5Y 7/2 moist); clods of the dry soil are hard, breaking to moderate very fine blocks; firm when moist.
2148	Cca2	43 to 49 inches. Pale olive (5Y 6/3 dry) and light olive gray (5Y 6/2 dry) with a few medium-sized prominent mottlings of white (5Y 9/1 dry) to olive brown (2.5Y 4/3 moist) mottled with grayish brown (2.5Y 5/2 moist) and light gray (2.5Y 7/2 moist), mildly calcareous silty clay with a very slight amount of segregated lime; clods of the dry soil are hard, breaking to moderate very fine blocks; firm when moist.
2149	C	49 to 60 inches. Pale yellow (5Y 7/3 dry) with many fine prominent mottlings of brownish yellow (10YR 6/6 dry) to light yellowish brown (2.5Y 6/4 moist) and grayish brown (2.5Y 5/2 moist) with prominent mottlings of yellowish brown (10YR 5/6 moist) very mildly calcareous silty clay; very hard, firm; well developed medium-sized platy structure.

Remarks: This profile was sampled in a broad, flat, low area within a nearly level plain having repeated swells and swales with maximum relief about 12 inches. The soils on the swells have A1, Cca horizon profiles in which the A1 is calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Farland silt loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-13-(1-7) **LAB. NOS.** 8562-8568

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-4	A1	0.1a	0.9a	2.0a	12.0a	15.0a	48.6	21.4	46.5	24.7	-	l
4-12	B21	0.1a	0.4a	1.2a	6.1a	13.6a	50.9	27.7	42.8	25.9	-	cl
12-21	B22	<0.1	0.4b	1.0b	5.6b	12.6b	47.1	33.3	38.0	25.7	-	sicl
21-28	B23	0.1c	0.4c	1.6b	8.6b	15.3b	44.4	29.6	42.0	23.6	-	cl
28-45	Cca	0.2d	0.1d	0.2b	1.5b	3.3b	55.4	39.3	17.1	42.7	-	sicl
45-51	C1	0.3d	0.8d	1.0d	5.9b	13.8b	47.8	30.4	39.8	26.0	Tr.	cl
51-67	C2	0.6e	0.8e	0.6e	8.5f	17.5f	43.6	28.4	45.5	22.5	Tr.	cl

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
5.6	5.9	6.1	3.58	0.341	10.5	<0.20	0.5					10.6
6.4	6.6	6.8	1.91	0.169	11.3	<0.20	0.5					10.7
6.8	7.3	7.4	1.08	0.093	11.6	<0.20	0.5	<1				12.2
7.8	8.5	8.6	1.04	0.084	12.4	<0.20	1.0	<1				10.8
8.8	9.6	9.8	0.76			<0.20	1.4	11				15.5
8.9	9.6	9.8	2.61			<0.20	2.7	5	<1			14.4
8.7	9.6	9.7	1.52			0.22	4.0	4	<1			12.9

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
21.3	11.2	3.8	10.6	<0.1	1.4	<1	0.4	0.7				66.7
20.9	11.4	6.0	6.5	0.1	1.2	<1	0.5	0.6				51.5
22.9	12.1	9.7	3.7	0.3	0.6	1	1.3	0.2				52.7
21.1	11.4	10.0	1.8	1.4	0.3	5	5.3	0.2				54.5
21.5				4.8	0.3	18	10.7	0.1				95.4
25.9				6.4	0.2	19	21.1	0.1				69.8
21.9				6.5	0.2	20	29.3	0.2	5.1	2.0	29.0	74.0

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth brown concr. (Fe?)
c. Many smooth brown concr. (Fe?)
d. Many shale fragments.
e. Many shale fragments; also, few $CaCO_3$ concr.
f. Few smooth brown concr. (Fe?); also few $CaCO_3$ concr.

Soil type: Farland silt loam
Soil No.: S58NDak-45-13-(1-7)
Location: 850 feet north and 200 feet east of west quarter corner of Sec. 26, T141N, R93W, Stark County, North Dakota.
Vegetation: Blue grama and threadleaf sedge.
Parent material: Alluvium.
Physiography: Medium height terrace in broad valley of Knife River.
Slope: 2 percent north facing.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate.
Salt or alkali: None.
Described by: K. E. Larson.
Date: July 23, 1958.

Horizon and Lincoln Lab. Number	
A1 8562	0 to 4 inches. Very dark gray brown (2.5Y 3/2 dry) to black (2.5Y 2/2 moist) silt loam; medium moderate crumb and fine weak angular blocky structure; hard, friable, slightly sticky and plastic; noncalcareous; clear and smooth boundary.
B21 8563	4 to 12 inches. Dark gray brown (2.5Y 4/2 dry) to black (2.5Y 2/2 moist) silt loam; medium moderate prisms that break to fine and medium moderate angular blocks; hard, friable, slightly sticky and plastic; clay skins on top and vertical faces of prisms; noncalcareous; gradual and smooth boundary.
B22 8564	12 to 21 inches. Dark grayish brown (2.5Y 4/2 dry and moist) silty clay loam; medium moderate prisms that break to fine and medium moderate angular blocks; hard, friable, sticky and plastic; clay skins on all faces of peds, 10YR 2/2; noncalcareous; clear and smooth boundary.
B23 8565	21 to 28 inches. Olive (5Y 4/3 dry) to dark gray brown (2.5Y 4/2 moist) silty clay loam; medium moderate prisms that break to fine moderate angular blocks; very hard, friable, sticky and plastic; clay skins on top and vertical faces of prisms; noncalcareous; abrupt and wavy boundary.
Cca 8566	28 to 45 inches. Olive (5Y 4/3 dry) to olive gray (5Y 4/2 moist) silty clay loam; medium strong angular blocks; very hard, friable, sticky and plastic; very strongly calcareous with many lime nodules of 2.5Y 8/2; abrupt and wavy boundary.
C1 8567	45 to 51 inches. Olive gray (5Y 5/2 dry) to olive gray (5Y 4/2 moist) silt loam; coarse and medium moderate angular blocks; slightly hard, friable, slightly sticky and plastic; strongly calcareous with few lime threads of 2.5Y 8/2; abrupt and wavy boundary.
C2 8568	51 to 67 inches. Olive gray (5Y 5/2 dry) to olive gray (5Y 5/2 moist) silt loam; coarse and medium moderate angular blocks; slightly hard, friable, slightly sticky and plastic; calcareous with few threads of lime.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Farland silt loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-20-(1-9) **LAB. NOS.** 8600-8608

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-3	A1	0.1a	0.6a	1.9a	6.2a	8.1a	57.9	25.2	37.9	31.4	-	sil
3-7	B21	0.2a	0.4a	1.2a	4.2a	6.6a	53.8	33.6	30.4	32.4	-	sicl
7-15	B22	0.1a	0.3a	1.3a	5.3a	7.8a	49.7	35.5	31.5	29.1	-	sicl
15-25	B23	<0.1	0.2a	0.8a	7.8a	12.8a	45.0	33.4	37.3	26.1	-	cl
25-31	Cca1	<0.1	0.2b	1.0b	7.4b	10.0b	50.5	30.9	36.1	28.8	-	sicl
31-39	Cca2	<0.1	0.1b	1.5b	5.6b	5.8b	52.7	34.3	26.8	34.5	-	sicl
39-47	Cca3	<0.1	0.2b	1.6b	5.7b	6.8b	49.3	36.4	26.7	32.6	-	sicl
47-54	C1	<0.1	0.2b	1.2b	5.1b	7.0b	53.3	33.2	29.6	33.6	-	sicl
54-60	C2	<0.1	0.3b	2.0b	6.4b	6.8b	44.2	40.3	23.8	30.6	-	sic

pH 1:1	pH 1:5	pH 1:10 (8C1a)	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.0	6.3	6.4	4.28	0.354	12.1	<0.20	0.4					13.3
6.1	6.3	6.6	2.37	0.194	12.2	<0.20	0.4					13.8
6.5	6.8	7.1	1.43	0.132	10.8	<0.20	0.5	<1				14.6
7.3	7.9	7.9	0.98	0.093	10	<0.20	0.6	<1				13.5
8.4	9.0	9.3	0.82			<0.20	0.8	5				12.2
8.7	9.3	9.5	0.77			<0.20	0.9	5				14.2
8.7	9.4	9.6	0.60			<0.20	0.9	5				14.9
8.6	9.4	9.6	0.63			<0.20	1.5	4				14.4
8.2	8.8	9.1	0.81			0.24	3.8	2	<1			16.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
22.6	12.5	5.0	8.8	<0.1	1.1	<1	0.4	0.5				76.9
24.8	14.1	7.2	6.1	0.1	0.9	<1	0.4	0.4				56.1
25.3	14.0	9.0	4.2	0.1	0.8	<1	0.7	0.3				55.2
24.0	13.2	11.0	1.9	0.6	0.5	2	2.2	0.2				54.2
19.7				1.1	0.3	4	4.7	0.2				53.2
20.4				2.2	0.3	9	5.8	0.1				62.8
21.1				3.0	0.3	12	7.1	0.1				68.6
20.8				3.2	0.4	12	11.1	0.2				68.0
23.9				4.1	0.5	10	22.5	0.4				71.9

a. Few smooth and irregular brown to black concr. (Fe-Mn?)
b. Few smooth and irregular brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Farland silt loam
Soil No.: 858NDak-45-20-(1-9)
Location: 1350 feet west and 220 feet north of south quarter corner of Sec. 28, T141N, R93W, Stark County, North Dakota.
Vegetation: Blue grama, western wheatgrass, threadleaf sedge.
Parent material: Stream alluvium.
Physiography: Broad, flat, medium height terrace.
Permeability: Moderate.
Slope: 1 percent.
Drainage: Well.
Erosion: None.
Root distribution: Numerous to 30 inches, few to 60 inches.
Described by: K. E. Larson.
Date: July 25, 1958.

Horizon and Lincoln Lab. Number	
A1 8600	0 to 3 inches. Very dark grayish brown (10YR 3/2 dry) to black (10YR 2/1 moist) silt loam; fine weak plates breaking to fine moderate crumbs; slightly hard when dry; friable when moist; slightly sticky and slightly plastic; noncalcareous; abrupt, smooth boundary.
B21 8601	3 to 7 inches. Dark gray (10YR 4/1 dry) to very dark brown (10YR 2/2 moist) silt loam; medium moderate prisms that break to medium moderate angular blocks; prisms coated with clay on all surfaces, 10YR 2/1 dry; hard when dry; friable when moist; slightly sticky and plastic; noncalcareous; gradual smooth boundary.
B22 8602	7 to 15 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark gray (10YR 3/1 moist) silty clay loam; medium moderate prisms that break to medium moderate angular blocks; prisms have clay skins on all surfaces, 10YR 2/2; hard, friable, sticky and plastic; noncalcareous; gradual, smooth boundary.
B23 8603	15 to 25 inches. Olive gray (5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay loam; medium strong prisms to medium strong blocks; clay skins of 2.5Y 3/1 on vertical surfaces; hard, firm, sticky and plastic; noncalcareous; clear and smooth boundary.
Cca1 8604	25 to 31 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay loam; coarse weak prisms that break to coarse and medium strong angular blocks; patches of clay skins on vertical surfaces of prisms; hard, firm, sticky and plastic; very strongly calcareous with common fine distinct lime threads, 2.5Y 8/2; gradual smooth boundary.
Cca2 8605	31 to 39 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay loam; coarse strong angular blocks; hard, firm, sticky and plastic; very strongly calcareous with common fine distinct lime threads and nodules, 2.5Y 8/2; gradual smooth boundary.
Cca3 8606	39 to 47 inches. Identical to Cca2 with the exception of very hard dry consistence (split for laboratory purposes).
C1 8607	47 to 54 inches. Olive (5Y 5/3 dry) to olive brown (2.5Y 4/3 moist) silty clay loam; coarse and medium strong angular blocks; very hard, friable, sticky and plastic; strongly calcareous with common fine distinct lime threads; clear and wavy boundary.
C2 8608	54 to 60 inches. Olive gray (5Y 5/2 dry) to olive brown (2.5Y 4/3) silt loam; medium strong blocks; very hard, friable, sticky and plastic; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. October 1961

SOIL TYPE Forman loam **LOCATION** Barnes County, North Dakota

SOIL NOS. S59NDak-2-1 **LAB. NOS.** 11951-11957

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	3.7	5.8	6.4	18.8	12.9	30.2	22.2	38.6	14.9	Tr.	l
5-13	B21	2.6	4.9	5.6	16.5	12.6	29.9	27.9	35.5	16.2	Tr.	cl
13-19	B22	2.7	5.1	5.6	16.4	13.1	31.7	25.4	36.7	17.5	-	l
19-28	Cca	2.9a	4.3a	4.7a	14.4a	11.4a	35.1	27.2	34.5	20.3	Tr.	cl/l
28-39	Ccs	3.2a	4.6a	4.7a	14.4a	11.6a	36.3	25.2	35.7	20.5	3	l
39-49	C21	2.4a	4.7a	5.2a	15.7a	12.6a	37.2	22.2	38.1	20.9	Tr.	l
49-60	C22	2.1a	4.6a	5.2a	16.5a	13.0a	36.5	22.1	38.5	20.8	Tr.	l

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1c $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	4A1h Bulk Density O.D. g/cc		4B2 15-Bar H_2O %
6.3	6.5	7.0	2.21	0.183	12	1.0	0.6	<1				9.8
6.7	6.9	7.3	1.02	0.101	10	1.4	0.4	<1		1.57		11.5
7.4	7.8	7.9	0.74	0.079	9	1.1	0.4	<1				10.2
8.3	8.9	9.1	0.34	0.039	9	0.8	1.5	19		1.60		8.8
8.0	8.4	8.5	0.25			0.8	6.7	14	10			9.9
8.1	8.6	8.8	0.16			1.0	6.7	11	<1			9.7
8.0	8.4	8.6	0.16			1.0	10.0	9	9	1.69		9.8

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
20.2	12.2	6.2	5.0	0.1	0.8	<1	0.4	0.5				44.0
19.7	10.7	8.6	3.1	0.1	0.6	<1	0.4	0.2				48.2
18.0	8.8	10.0	1.9	0.2	0.5	1	0.6	0.2				45.9
13.0		11.5	<0.1	0.8	0.4	5	5.3	0.3				48.2
13.3		13.9	<0.1	2.4	0.3	9	26.2	0.6	5.3	2.0	101	46.8
13.6		11.8	<0.1	3.1	0.4	10	33.8	0.5	4.4	2.4	93.2	50.1
13.1		13.5	<0.1	3.4	0.4	10	46.0	0.6	7.2	3.4	151	45.0

a. Trace Carbonate Concr. $CaCO_3$?

Soil type: Forman loam
Soil No.: S59NDak-2-1
Location: 80 feet north and 135 feet west of east quarter corner of Sec. 5, T137N, R60W, Southwestern Barnes County, North Dakota.
Vegetation: Grain stubble.
Parent material: Glacial till.
Physiography: Gently undulating till plain with 8-to 10-foot relief and 4 percent slopes. Site is midway up the side of a ridge 10 feet high. Well-drained soils occupy an abnormally large share of the landscape compared to other till plain areas of comparable topography and relief.
Relief: 8 to 10 feet.
Drainage: Well drained.
Slope: Area 4 percent; 5 percent southeast at site.
Erosion: Moderate.
Stoniness: Common small pebbles throughout the profile; large stones rare.
Described by: C. E. Redmond.
Date: August 26, 1959.

Horizon and Lincoln Lab. Number	
Ap 11951	0 to 5 inches. Loam, dark gray (10YR 4/1 dry) to black (10YR 2/1 moist); weak coarse subangular blocky structure breaking to weak medium crumbs; hard, friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary. (Approximately 30 percent of the volume of this horizon is composed of B horizon material which has been mixed with the A in plowing. This material has the color and texture of the material in the B21 horizon.)
B21 11952	5 to 13 inches. Clay loam, brown (10YR 5/3 dry) to between brown and dark brown (10YR 4/3 moist); strong medium prismatic structure breaking to strong fine and medium angular blocks; hard, firm, sticky and slightly plastic; noncalcareous; patches of thin to moderately thick clay films on ped surfaces; clear irregular boundary. (Thin tongues of black (10YR 2/1 moist) A1 horizon extend down between the prisms, making up 10 to 15 percent of the volume of the horizon. The colors in this horizon have a hue slightly redder than 10YR; this is especially true near the top of the horizon.)
B22 11953	13 to 19 inches. Clay loam, light olive brown (2.5Y 5/3 dry) to olive brown (2.5Y 5/3 moist); strong coarse prismatic structure breaking to strong coarse angular blocks; very hard, firm, sticky and slightly plastic; noncalcareous; continuous thin and discontinuous moderate clay films on ped surfaces; clear irregular boundary. (The colors of this horizon have a hue slightly redder than 2.5Y.)
Cca 11954	19 to 28 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/4 moist) with many coarse prominent white lime and gypsum concentrations and a few fine prominent reddish brown mottlings; moderate coarse prismatic structure breaking to moderate medium angular blocks; very hard, friable, sticky and slightly plastic; moderately calcareous but strongly calcareous in and around lime concentrations; patches of thin clay films on vertical ped surfaces; gradual wavy boundary.
Ccs 11955	28 to 39 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/4 moist) with many coarse prominent white clusters of gypsum crystals and a few fine prominent reddish brown mottlings; weak coarse prismatic structure breaking to weak thin plates which break to moderate very fine subangular blocks; very hard, friable, sticky and slightly plastic; moderately calcareous; gradual boundary. (Gypsum crystals occur in clusters up to one inch in diameter.)
C21 11956	39 to 49 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with common fine prominent strong brown (7.5YR 5/6 dry) to dark brown (7.5YR 4/4 moist) mottlings and a few fine prominent white threads of gypsum; weak very coarse prismatic structure breaking to moderate medium plates which break to weak fine subangular blocks; very hard, friable, sticky and slightly plastic; weakly calcareous; gradual boundary.
C22 11957	49 to 60 inches. Loam, light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) with common medium prominent yellowish red (5YR 4/6 and 5/6 dry) to dark reddish brown (5YR 3/4 and 4/4 moist) mottlings, and common medium prominent white clusters of gypsum crystals; very weak, very coarse prismatic structure breaking to moderate thick plates which break to moderate fine subangular blocks; hard, friable, slightly sticky and slightly plastic; weakly calcareous.

OIL SURVEY LABORATORY Linc ln, Nebr. October 1961

SOIL TYPE Forman loam **LOCATION** Barnes County, North Dakota

SOIL NOS. S59NDak-2-2 **LAB. NOS.** 11958-11963

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	3B Carbonate Clay % <0.002
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	Ap	3.5	5.9	6.0	14.6	10.2	38.6	21.2	36.8	19.5	Tr.	
5-14	B21	3.0	6.0	7.2	18.2	11.2	26.5	27.9	32.6	14.9	Tr.	
14-24	B22	2.5	6.0	7.0	19.0	12.6	27.0	25.9	34.3	15.6	Tr.	
24-38	Cca-ca	3.1a	5.9a	6.8a	17.0a	11.9a	31.3	24.0	34.0	18.6	Tr.	3
38-53	C21	2.3a	5.5a	5.9a	16.3a	12.6a	33.9	23.5	37.0	18.7	6	2
53-60	C22	2.3a	5.9a	6.0a	16.9a	13.0a	34.5	21.4	37.3	19.6	7	<1

pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1c $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	4A1h Bulk Density O.D. g/cc		4B2 15-Bar H_2O %
6.8	7.0	7.1	3.40	0.258	13	0.8	0.7	<1				10.6
6.7	7.2	7.2	0.82	0.076	11	1.1	0.4	<1		1.61		9.0
7.1	7.5	7.5	0.43	0.047	9	0.8	0.4	<1		1.64		7.2
7.9	8.3	8.4	0.24			0.8	4.5	10	5	1.75		6.7
8.2	8.6	8.9	0.19			1.0	6.2	12	<1			9.5
8.1	8.6	8.8	0.16			1.0	7.5	11	<1			9.3

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	5B1a 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
20.7	15.4	5.9	4.6	0.1	1.6	<1	0.3	1.0				51.3
15.2	7.4	7.8	3.1	0.3	0.5	2	0.3	0.2				40.6
12.5	4.9	7.7	1.7	0.1	0.4	1	0.6	0.2				35.4
10.1		9.0	<0.1	0.9	0.3	5	10.2	0.4	6.5	1.7	63.3	37.0
13.5		16.2	<0.1	3.1	0.4	13	29.8	0.5	5.1	10.0	74.0	43.1
13.2		12.7	<0.1	3.4	0.4	14	37.0	0.5	4.4	14.4	90.5	44.7

a. Trace Carbonate Concr. $CaCO_3$?

Soil type: Forman loam
Soil No.: S59NDak-2-2
Location: 1100 feet east and 145 feet north of southwest corner of Sec. 9, T138N, R60W, Southwestern Barnes County, North Dakota.
Vegetation: Grain stubble.
Parent material: Glacial till.
Physiography: 4 percent undulating till plain with 6-foot relief. Site is on gentle slope; area contains more well-drained soils than one would expect on this landscape.
Relief: 6 feet.
Drainage: Well drained.
Slope: Area 4 percent; 3 percent north at site.
Erosion: Slight.
Stoniness: Common to many throughout the profile.
Described by: C. E. Redmond.
Date: August 26, 1959.

Horizon and Lincoln Lab. Number	
Ap 11958	0 to 5 inches. Loam, dark gray (10YR 4/1 dry) to black (10YR 2/1 moist); weak fine and medium subangular blocky structure breaking to weak fine crumbs; hard, friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary. (A small amount of B21 material was incorporated in the Ap by plowing.)
B21 11959	5 to 14 inches. Clay loam, brown (7.5YR 5/3 dry, grading with depth to 10YR 5/3 dry) to between brown and dark brown (7.5YR 4/2 moist, grading with depth to 10YR 4/3 moist); strong medium prismatic structure breaking to strong fine angular blocks; very hard, firm, sticky and slightly plastic; noncalcareous; discontinuous thin clay films on ped surfaces; clear wavy boundary.
B22 11960	14 to 24 inches. Clay loam, grayish brown (2.5Y 5/2 dry) becoming light gray (2.5Y 7/2 dry) when rubbed, to dark grayish brown (2.5Y 4/2 moist) with a few fine distinct yellowish brown (10YR 5/6 dry) to dark yellowish brown mottlings; strong medium prismatic structure breaking to strong medium and fine angular blocks; very hard, firm, sticky and slightly plastic; noncalcareous; continuous moderate clay films on ped surfaces; clear very irregular boundary. (Colors in this horizon have a hue slightly redder than 2.5Y.)
Ccacs 11961	24 to 38 inches. Clayloam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with many coarse distinct white (N 8/0 dry to 2.5Y 8/2 moist) concentrations of gypsum and lime and a few fine prominent reddish brown mottlings; moderate coarse and very coarse prismatic structure breaking to moderate medium subangular blocks; very hard, firm, sticky and slightly plastic; moderately calcareous, very high in gypsum; gradual boundary.
C21 11962	38 to 53 inches. Loam, light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/4 moist) with a few medium prominent reddish yellow (5YR 6/8 dry) to yellowish red (5YR 5/6 moist) mottlings; weak coarse prismatic structure breaking to moderate thick plates which break into moderate fine subangular blocks; very hard, friable, slightly sticky and slightly plastic; weakly calcareous; gradual boundary.
C22 11963	53 to 60 inches. Loam, between light brownish gray and light gray (2.5Y 6.5/2 dry) to between light olive brown and olive brown (2.5Y 4.5/4 moist) with common fine distinct yellowish red mottlings; moderate medium platy structure breaking to moderate fine subangular blocks; very hard, friable, sticky and slightly plastic; weakly calcareous.

Note: The depth to lime varies from 20 to 30 inches around the pit. In the deeper areas a noncalcareous B3 horizon, similar to the B22 in color and structure, occurs between the B22 and Ccs.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Forman loam **LOCATION** Dickey County, North Dakota

SOIL NOS. S53NDak-11-1 **LAB. NOS.** 1869-1876

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-2	A11	0.6	2.7	3.4	9.1	9.9	48.1	26.2	37.1	26.3	0.3	l
2-4	A12	1.1	2.6	3.7	10.5	11.5	43.9	26.7	38.1	23.6	0.5	l
4-7	AB	1.1	2.9	3.4	9.3	11.0	43.2	29.1	38.6	21.4	1.0	cl
7-14	B2	0.9	1.7	1.9	5.1	8.5	49.2	32.7	35.6	25.2	0.3	sicl
14-29	Cca1	1.8	1.9	1.7	5.2	11.9	46.4	31.1	36.4	25.3	1.5	cl
29-39	Cca2	3.7	3.3	3.0	9.0	13.7	36.9	30.4	39.7	16.8	1.9	cl
39-48	C2	2.6	3.5	3.3	9.2	12.9	40.9	27.6	39.3	20.3	1.2	cl
48-60	C3	2.6	3.1	3.5	9.2	12.0	42.2	27.4	39.2	20.8	2.2	cl

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.0	7.0	5.23			<0.20	0.8	-				18.9
6.0	6.3	6.3	3.60			<0.20	0.4	-				15.4
6.1	6.5	6.6	2.61			<0.20	0.4	-				14.1
6.6	6.9	7.0	1.37			<0.20	0.4	-	-			13.6
7.6	8.4	8.6	0.54			<0.20	0.6	13	-			10.9
7.9	8.7	8.9	0.21			<0.20	0.6	16	-			11.6
8.1	8.8	9.1	0.12			<0.20	0.7	11	-			11.2
8.2	9.0	9.2	0.09			<0.20	0.8	13	-			11.7

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	6O2b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter				→	
31.1	25.4	6.8		0.2	1.4	1	0.3	0.8					78.1
28.8	19.1	5.6		0.1	1.0	-	0.3	0.4					64.3
27.2	18.6	6.1		0.1	0.8	-	0.3	0.2					55.5
26.3	18.4	7.6		0.1	0.8	-	0.6	0.2					53.2
20.1		10.6		0.1	0.4	-	0.9	0.2					51.8
18.8		18.0		0.4	0.3	2	1.7	0.2					50.8
17.2				0.9	0.3	5	4.1	0.2					47.9
17.4				1.0	0.4	6	5.2	0.2					50.7

Soil type: Forman loam
Soil No.: S53NDak-11-1
Area: Dickey County, North Dakota.
Location: 0.3 mile west and 1/4 mile north of southeast corner Sec. 5, T129N, R60W.
Vegetation: Native grasses.
Parent material: Friable loam till Mankato.
Physiographic position: Upland slope to glacial channel.
Topography: Sloping gently.
Slope: 8 percent.
Drainage: Well.
Stoniness: Some.
Described by: C. A. Mogen.
Date: September 18, 1953.

Mandan Lab.No.	Horizon	
1869	A11	0 to 2 inches. Dark gray to black (10YR 4/1 2/1 moist) noncalcareous loam; soft; weakly developed fine platy structure. This rests abruptly on
1870	A12	2 to 4 inches. Dark gray to black (10YR 4/1 crushing to 4/1.5 dry; 2/1 moist) noncalcareous loam; slightly hard; moderately developed medium-sized prismatic structure, separating out into moderately developed medium-sized blocks; very friable. This grades into
1871	AB	4 to 7 inches. Dark gray crushing to grayish brown, dry, to very dark gray crushing to very dark grayish brown, moist, (10YR 4/1.5 with 4/1 coatings crushing to 5/2 dry; 3/1.5 with 3/1 coatings crushing to 3/2.7 moist) noncalcareous clay loam; hard; compound structure of strongly developed medium and fine prisms and medium and fine blocks; friable. This grades into
1872	B2	7 to 14 inches. Brown with dark gray coatings crushing to pale brown, dry, to dark grayish brown with very dark gray coatings crushing to dark grayish brown (10YR 5/3 with 4/1 coatings crushing to 6/3 dry; 4/2 with 3/1 coatings crushing to 4.5/2.5 moist) noncalcareous silty clay loam; hard; compound structure of strongly developed medium and fine prisms and medium and fine blocks; friable. This changes clearly into
1873	Ccal	14 to 29 inches. Light olive brown with common fine distinct mottling of white, dry, to olive brown mottled with light gray, moist, (2.5Y 5/3 and 8/2 dry; 4/3 and 7/2 moist) strongly calcareous clay loam with a moderate amount of segregated lime; hard; massive structure; friable. This grades into
1874	Cca2	29 to 39 inches. Light yellowish-brown with many medium-sized distinct mottlings of white, dry, to light olive brown mottled with light gray and with a few fine prominent mottlings of yellowish red, moist, (2.5Y 6/3 and 8/2 dry; 5/4 and 7/2 and 5YR 4/8 moist) moderately calcareous clay loam with a slight amount of segregated lime; hard; moderately developed medium and fine blocky structure; friable. Grades into
1875	C2	39 to 48 inches. Light yellowish brown with very fine distinct mottlings of pale yellow and white and a few fine prominent mottlings of yellowish red, dry, to light olive brown mottled with pale yellow and yellowish red, moist, (2.5Y 6/4, 8/4 and 8/2 and 5YR 5/8 dry; 2.5Y 5/4 and 7/4 and 5YR 4/8 moist) moderately calcareous clay loam; hard; moderately developed medium and fine blocky structure; friable. This grades into
1876	C3	48 to 60 inches. Light gray with many fine distinct mottlings of olive yellow and very dark grayish brown, dry, to light brownish gray mottled with light olive brown and with common fine distinct mottlings of very dark brown (2.5Y 7/2, 6/6 and 10YR 3/2 dry; 2.5Y 6/2 and 5/6 and 10YR 2/2 moist) moderately calcareous clay loam; hard; moderately developed medium and fine blocky structure; friable.

SOIL SURVEY LABORATORY Lincoln, Nebr. October 1961

SOIL TYPE Forman silt loam **LOCATION** Ransom County, North Dakota

SOIL NOS. 859N Dak-37-3 **LAB. NOS.** 11932-11941

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	3B Carbonate Clay % <0.002
0-6	Ap	1.5	3.1	3.3	8.9	7.5	41.7	34.0	29.1	25.0	-	
6-9	B1	1.7	2.5	2.8	7.3	6.9	40.5	38.3	26.2	25.3	-	
9-13	B21	0.6	2.7	3.1	8.2	7.4	37.9	40.1	26.3	23.6	-	
13-17	B22	1.1	2.7	2.9	7.1	6.6	38.3	41.3	22.3	26.5	-	
17-20	B3ca	1.4a	2.9a	2.9a	7.2a	6.8a	42.6	36.2	24.5	29.0	-	<1
20-28	Cca	1.0a	2.5a	2.6a	7.2a	7.3a	45.4	34.0	24.4	32.4	-	6
28-35	C2	2.7a	3.5a	2.9a	7.5a	7.0a	45.5	30.9	23.1	33.6	Tr.	6
35-43	C3	1.1a	3.1a	2.6a	7.3a	7.7a	49.9	28.3	25.9	35.9	Tr.	3
43-53	C4	1.6a	2.7a	2.4a	6.8a	6.6a	53.9	26.0	26.7	37.7	Tr.	2
53-60	C	2.6a	4.0a	3.7a	9.3a	8.1a	48.6	23.7	26.7	35.2	10	1

pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free Iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1c $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.4	6.6	6.7	3.72	0.292	13	0.9	0.4	<1				15.3
6.5	6.7	6.8	2.77	0.224	12	0.9	0.4	<1				16.8
6.8	7.0	7.0	1.57	0.158	10	1.1	0.4	<1				16.8
7.2	7.6	7.7	1.08	0.110	10	1.2	0.5	<1				17.2
7.9	8.4	8.6	0.87	0.094	9	1.0	0.7	10				15.4
8.0	8.6	8.8	0.56	0.061	9	0.9	2.6	21				13.3
8.1	8.6	8.8	0.29			0.8	5.6	27	<1			13.1
8.1	8.6	8.8	0.20			0.8	6.5	21	<1			13.4
8.1	8.5	8.7	0.16			1.0	7.5	18	<1			12.6
8.0	8.5	8.7	0.16			1.1	8.0	16	<1			12.0

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6F2a Na	6Q2a K	5B1a	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil					→		← milliequivalents per liter				→	
29.6	21.0	8.6	7.1	0.1	1.3		<1	0.3	0.4				57.8
29.4	19.4	9.9	5.2	0.2	0.8		1	0.5	0.2				61.3
28.9	18.1	11.5	3.9	0.2	0.7		1	0.6	0.2				56.1
28.3	17.4	12.7	2.7	0.3	0.7		1	0.7	0.2				59.0
22.5		11.8	<0.1	0.4	0.5		1	1.2	0.2				58.6
18.6		12.8	<0.1	1.6	0.3		6	8.0	0.1				54.6
16.6		17.6	<0.1	3.0	0.2		10	24.2	0.2	3.7	4.6	73.0	54.2
15.9		19.2	<0.1	3.8	0.3		12	31.6	0.2	6.5	6.8	79.9	56.8
15.6		17.4	<0.1	4.1	0.4		13	36.8	0.3	4.2	8.8	98.1	55.2
14.4		15.5	<0.1	4.0	0.4		12	40.8	0.4	5.3	10.5	104	52.9

a. Trace Carbonate Concr. $CaCO_3$?

Soil type: Forman silt loam
Soil No.: S59NDak-37-3
Location: 310 feet north and 165 feet west of southeast corner of Sec. 18, T133N, R55W, Southern Ransom County, North Dakota.
Vegetation: Millet.
Parent material: Glacial till.
Physiography: 4 percent undulating till plain; on slope to a shallow drainage way.
Relief: 6 feet.
Drainage: Well drained.
Slope: 3 percent northwest.
Erosion: Slight.
Described by: C. E. Redmond.
Date: August 22, 1959.

Horizon and Lincoln Lab. Number	
Ap 11932	0 to 6 inches. Silt loam, very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist); weak medium subangular blocky structure breaking to weak fine crumbs; hard, friable, slightly sticky and plastic; noncalcareous; abrupt smooth boundary.
B1 11933	6 to 9 inches. Clay loam, very dark grayish brown (10YR 3/2 dry) to very dark brown (10YR 2/2 moist) with thick tongues of very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist); strong medium and coarse blocky structure; very hard, firm, very sticky and plastic; noncalcareous; clear broken boundary.
B21 11934	9 to 13 inches. Clay loam, grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3/2 moist) with tongues of very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist); strong medium prismatic structure breaking to strong very fine angular blocks; very hard, firm, very sticky and plastic; noncalcareous; thick clay films on ped surfaces; diffused boundary.
B22 11935	13 to 17 inches. Clay loam, dark grayish brown and grayish brown (2.5Y 4/2 and 5/2 dry) to dark and very dark grayish brown (2.5Y 3/2 and 4/2 moist) with tongues of very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist); strong medium prismatic structure breaking to strong fine angular blocks; very hard, firm, sticky and plastic; continuous moderate and patchy thick clay films on ped surfaces; noncalcareous but containing small rounded pebbles which have lime coatings; clear irregular boundary.
B3ca 11936	17 to 20 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) with common fine distinct white (N 8/0 dry) to faint light gray (2.5Y 7/2 moist) lime concentrations; moderate medium prismatic structure breaking to moderate medium blocks; hard, friable, sticky and slightly plastic; thin clay films on ped surfaces; weakly calcareous becoming moderately calcareous with depth; clear wavy boundary.
Cca 11937	20 to 28 inches. Silt loam, light gray (2.5Y 7/2 dry) to light olive brown (2.5Y 5/4 moist); weak coarse prismatic structure breaking to weak fine blocks; hard, friable, slightly sticky and plastic; patchy light clay films on vertical ped surfaces; strongly calcareous with the lime segregated into distinct white blotches; gradual boundary.
C2 11938	28 to 35 inches. Loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with common medium faint white (2.5Y 8/2 dry) to light brownish gray (2.5Y 6/2 moist) mottlings; weak medium platy structure breaking to weak very fine blocks; very hard, friable, slightly sticky and slightly plastic; moderately calcareous; gradual boundary.
C3 11939	35 to 43 inches. Loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) with common medium very faint light gray (2.5Y 7/2 dry) and a few very fine prominent reddish brown mottlings; weak thin platy structure breaking to weak fine blocks; hard, friable, slightly sticky and plastic; weakly calcareous; gradual boundary.
C4 11940	43 to 53 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with a few fine prominent reddish brown and common medium distinct light gray (N 7/0 dry, 2.5Y 7/2 moist) mottlings; moderate medium platy structure breaking to moderate fine blocks; hard, friable, sticky and plastic; weakly calcareous; gradual boundary.
C 11941	53 to 60 inches. Loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with common coarse faint light gray (N 7/0 dry, 6/0 moist) and a few fine prominent reddish brown mottlings; weak medium platy structure breaking to moderate fine blocks; friable, slightly sticky and slightly plastic; weakly calcareous. This horizon contains some gypsum and some unidentified black specks.

Note: There is a great deal of tonguing in this profile. Approximately 50 percent of the B21 and 20 percent of the B22 are composed of tongues of A material. These tongues retain the dark color of the A, but have structure similar to that of the surrounding B material. The maximum depth of tonguing is 22 inches.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Forman loam **LOCATION** Sargent County, North Dakota

SOIL NOS. 856ND-41-2-(1-7) **LAB. NOS.** 4449-4455

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-8	A1p	3.0	5.6	4.2	10.3	9.5	35.5	31.9	31.4	19.3	3.2	cl
8-14	B2	2.3	6.2	5.9	11.5	10.1	31.7	32.3	30.5	17.4	2.6	cl
14-17	B3	3.2	5.4	5.2	11.5	10.6	36.1	28.0	30.2	22.8	6.4	cl
17-26	Cca1	4.2	5.9	5.7	11.3	10.2	35.1	27.6	28.5	23.1	7.8	cl
26-37	Cca2	4.7	6.8	6.0	10.9	9.7	33.4	28.5	27.8	21.4	7.3	cl
37-44	Cca3	3.5	6.4	6.3	11.4	9.8	33.6	29.0	28.6	21.1	6.2	cl
44-60	C	4.2	6.7	6.2	11.8	10.1	33.8	27.2	29.9	20.6	9.8	cl
60+												

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.0	7.5	7.7	3.47	.325	10.7	<0.20	1.6	-				15.4
7.0	7.2	7.4	2.30	.195	11.8	<0.20	1.1	-				13.9
7.6	8.4	8.6	0.94	.101	9.3	<0.20	0.9	17				9.8
7.8	8.7	8.7	0.51	.054	9.4	<0.20	0.8	22				7.9
7.9	8.5	8.8	0.18			<0.20	2.8	28				8.2
7.8	8.4	8.6	0.16			<0.20	3.5	23	-			8.6
7.7	8.0	8.2	0.16			<0.20	4.5	23	29			8.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	4A3a Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
29.4	24.3	8.0		-	2.3	-	0.6	1.8	8.8	5.0		58.9
25.5	20.8	7.8		-	1.0	-	0.5	0.5	5.8	4.0	1.24	54.0
16.2				-	0.4	-	0.5	0.3	4.4	3.1		46.9
12.9				0.1	0.3	1	0.6	0.2	3.5	3.8	1.35	41.4
12.2				0.3	0.3	1	3.6	0.3	12.1	24.0		46.3
13.3				0.7	0.3	3	7.5	0.3	16.8	25.9		45.8
11.4				0.9	0.3	4	11.1	0.4	23.3	34.5		44.4
											1.84	

Soil type: Forman loam
Soil No.: S56NDak-41-2-(1-7)
Location: 1250 feet east and 150 feet south of northwest corner of Sec. 18, T130N, R55W, Sargent County, North Dakota.
Vegetation: Plowing.
Parent material: Glacial till.
Physiographic position: Top of a low ridge which slopes 3 percent to east and 1 percent to west.
Topography: Gently undulating, 1 to 3 percent slopes.
Drainage: Well drained.
Stoniness: Stones throughout the profile.
Root distribution: Good through 37 inches.
Described by: Wesley M. Larsen.
Date: July 12, 1956.

Horizon and Lincoln Lab. Number	
Alp 4449	0 to 8 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) loam; weak fine crumb structure; slightly hard, very friable; abrupt smooth boundary from tillage; tongues of this horizon extend through B3 horizon; abundant, clear, very fine and fine quartz sand.
B2 4450	8 to 14 inches. Brown coated with very dark grayish brown (10YR 4.5/3 and 3/2 dry to 3.5/3 and 3/2 moist) clay loam with many thick tongues of A1 material; moderate medium prisms and blocks with distinct continuous clay skins on all ped faces; very hard, friable, sticky and plastic; diffused smooth boundary.
B3 4451	14 to 17 inches. Grayish brown coated with dark grayish brown (2.5Y 5/2 and 10YR 3.5/2 dry) to dark grayish brown coated with very dark grayish brown (2.5Y 4/2 and 10YR 3/2 moist) clay loam; moderate coarse prismatic and blocky structure with many patches of clay skins on vertical surfaces; very hard, firm, sticky and plastic; mildly to moderately calcareous on insides of prisms and blocks.
Cca1 4452	17 to 26 inches. Light yellowish brown with many small white soft concretions of lime (2.5Y 6/3 and 8/2 dry) to light olive brown and white (2.5Y 5/4 and 8/2 moist) clay loam; weak coarse prismatic with patches of clay on vertical surfaces; hard, friable, sticky and plastic; very strongly calcareous; diffused boundary.
Cca2 - Cca3 4453 - 4454	26 to 37 and 37 to 44 inches. Same color and structure as above but in a very strongly calcareous loam with decreasing amount of segregated lime; hard, friable, slightly sticky and slightly plastic; diffused boundary.
C 4455	44 to 60 inches. Light yellowish brown (2.5Y 6/3 dry) with common fine distinct mottles of white to light olive brown mottled with grayish brown and white (2.5Y 5/4, 5/2 and 8/2 moist) loam; strongly calcareous with common fine soft lime segregations and many small nests of gypsum crystals; weak coarse prisms breaking to weak fine blocks; hard and friable.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Forman loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-5-(1-7) **LAB. NOS.** 4473-4479

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4	A1	1.4	3.9	4.1	10.0	9.2	43.1	28.3	34.7	23.9	Tr.	cl
4-8	B21	2.2	4.2	6.0	15.0	10.2	32.0	30.4	34.0	17.4	Tr.	cl
8-17	B22	1.6	3.5	4.2	14.2	14.3	33.2	29.0	39.6	17.0	Tr.	cl
17-22	B3ca	4.2	4.7	4.4	11.2	11.1	39.1	25.3	34.0	23.7	5.6	l
22-33	Cca	4.8	5.4	5.3	10.6	8.5	38.5	26.9	29.0	24.3	8.8	l
33-44	C1	5.9	5.3	5.4	10.8	8.6	36.8	27.2	29.4	22.4	11.2	cl
44-60	C2	5.2	5.5	5.6	10.6	8.9	37.4	26.8	30.1	22.7	8.3	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.8	7.1	7.2	6.10	.479	12.7	<0.20	1.0	-				17.4
6.3	6.8	7.0	2.79	.244	11.4	<0.20	0.7	-				13.6
7.0	7.6	7.8	1.27	.122	10.4	<0.20	1.0	-				10.8
7.7	8.5	8.7	0.73	.070	10.4	<0.20	0.7	20				8.2
7.9	8.8	8.9	0.35	.042	8.3	<0.20	0.7	23				8.5
8.2	9.1	9.1	0.20			<0.20	0.8	22				9.0
8.3	9.0	9.2	0.20			<0.20	0.8	19				9.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil →						← milliequivalents per liter →					
31.3	23.9	6.7		-	2.0	-	0.5	1.4	5.5	3.3		84.3
26.2	18.1	6.6		-	1.5	-	0.4	0.8	3.7	2.7		57.7
20.9	17.5	6.8		0.1	0.7	-	0.7	0.4	5.8	4.1		50.6
14.2				-	0.3	-	0.6	0.3	3.8	3.1		44.1
13.6				0.1	0.3	1	0.7	0.2	2.0	4.1		49.9
13.4				0.2	0.3	1	1.7	0.1	0.8	5.3		45.6
13.3				0.6	0.3	3	3.2	0.2	0.4	3.9		50.0

Soil type: Forman loam
Soil No.: S56NDak-41-5-(1-7)
Location: 485 feet west and 560 feet south of north quarter corner of Sec. 16, T130N, R55W, Sargent County, North Dakota.
Vegetation: Native grasses.
Parent material: Glacial till.
Physiographic position: The top of a broad ridge with side slopes of 6 to 10 percent to the northwest and southeast.
Topography: Gentle slope of 2 percent.
Drainage: Well drained.
Root distribution: Abundant to 4 inches, plentiful to 20 inches, and few through 60 inches. Concentration of roots between prisms with good distribution through peds.
Described by: Wesley M. Larsen.
Date: July 10, 1956.

Horizon and Lincoln Lab. Number	
A1 4473	0 to 4 inches. Very dark gray to black (10YR 3/1 dry to 2/1 moist) friable loam with a moderate fine fine crumb structure; slightly hard when dry; abundance of clear quartz sand throughout; abrupt smooth boundary but with many tongues extending through B horizons.
B21 4474	4 to 8 inches. Dark grayish brown to very dark grayish brown coated with very dark gray to black (10YR 4/2 coated with 3/2 and 3/1 dry to 3/2 coated with 2/2 and 2/1 moist) clay loam; compound moderate medium prismatic and blocky structure with distinct continuous clay skins on prism faces and less distinct on faces of blocks from inside prisms; hard, friable; many prisms coated with A1 soil material; clear quartz sand common on prism faces; clear wavy boundary.
B22 4475	8 to 17 inches. Light olive brown with coats of dark grayish brown and very dark gray (2.5Y 5/3 and 10YR 4/2 and 3/1 dry) to olive brown with coats of very dark grayish brown, very dark brown, black (2.5Y 4/3 and 10YR 3/2, 2/2 and 2/1 moist) clay loam; moderate medium prismatic and blocky structure with distinct continuous clay skins on prism faces, less distinct on faces of blocks; hard, friable, sticky and plastic; clear wavy boundary.
B3ca 4476	17 to 22 inches. Light olive brown to olive brown with many fine distinct white mottles (2.5Y 5/3 dry to 4/3 moist and 8/1) clay loam; weak medium prisms with continuous thin clay skins; hard, friable, sticky and plastic; strongly calcareous with many fine threads and films of soft segregated lime; diffuse boundary.
Cca 4477	22 to 33 inches. Light yellowish brown to light olive brown (2.5Y 6/3 dry to 4.5/3 moist) very strongly calcareous clay loam with common threads and nodules of white (2.5Y 8/2) soft segregated lime; soft segregated lime coating gravels and gravel sockets; hard, friable, sticky and plastic; diffuse boundary.
C1 - C2 4478 - 4479	33 to 44 and 44 to 60 inches. Light yellowish brown to light olive brown (2.5Y 6/4 dry to 5/4 moist) moderately calcareous loam with a small amount of segregated lime decreasing with depth; weak medium and fine blocky structure; hard, friable, slightly sticky and slightly plastic.

SOIL SURVEY LABORATORY Lincoln, Nebr. October 1961

SOIL TYPE Forman silt loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S59N Dak-41-1 **LAB. NOS.** 11942-11950

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	3.5	4.8	4.4	11.3	8.6	37.7	29.7	29.9	22.7	Tr.	cl
5-9	B21	2.2	4.2	4.3	11.4	9.0	35.0	33.9	30.3	20.1	Tr.	cl
9-13	B22	1.6	3.8	3.8	11.0	9.0	36.7	34.1	28.9	23.2	-	cl
13-24	Cca	3.3a	5.0a	4.7a	11.3a	8.1a	36.2	31.4	27.3	23.2	-	cl
24-29	C2	3.7a	6.8a	6.2a	13.4a	8.5a	33.7	27.7	27.8	21.3	3	cl
29-33	C3	2.5a	6.0a	5.6a	12.4a	8.4a	37.2	27.9	28.8	23.3	4	cl
33-41	Ccs	0.8a	1.8a	1.7a	4.0a	5.7a	58.6	27.4	29.9	36.6	3	sicl/sil
41-50	C5	1.6a	3.6	3.6	9.9	9.7	46.7	24.9	33.4	28.6	4	l
50-60	C6	2.1	5.2	5.0	11.9	9.7	41.5	24.6	33.8	24.0	3	l

pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free Iron Fe_2O_3%	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1c $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	4A1h Bulk Density O.D. g/cc		4B2 15-Bar H_2O %
7.2	7.5	7.6	3.47	0.274	13	0.9	0.6	<1				14.5
7.4	7.5	7.8	1.43	0.141	10	1.0	0.5	<1		1.56		13.7
7.7	8.2	8.5	1.15	0.122	9	1.1	0.6	<1				14.2
8.2	8.8	9.0	0.46	0.051	9	0.8	0.8	24				8.7
8.2	8.8	8.9	0.30			0.7	2.6	23	<1	1.68		7.7
8.0	8.5	8.5	0.22			0.8	6.0	24	2			8.8
7.9	8.4	8.6	0.24			0.9	7.8	30	5			10.4
7.9	8.5	8.7	0.20			1.0	8.0	23	4	1.82		9.5
7.9	8.3	8.5	0.16			1.1	8.4	20	12			10.2

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
28.6	24.0	7.4	3.2	0.1	1.3	<1	0.4	0.5				58.0
25.2	18.8	7.8	2.4	0.1	0.8	<1	0.4	0.2				54.2
23.8	23.7	8.5	0.7	0.2	0.7	1	0.4	0.2				54.9
14.1		9.1	<0.1	0.2	0.3	1	1.1	0.1				44.1
11.0		10.0	<0.1	0.8	0.2	4	7.0	0.2				41.1
11.5		11.9	<0.1	1.7	0.3	8	19.2	0.3	3.5	1.0	91.6	43.9
13.5		15.4	<0.1	2.5	0.3	8	27.8	0.3	3.0	1.0	120	51.7
12.6		14.0	<0.1	2.4	0.3	7	32.3	0.4	2.8	1.5	126	46.7
11.7		12.4	<0.1	2.3	0.3	8	32.3	0.6	3.0	1.5	135	43.6

a. Trace Carbonate Concr. $CaCO_3$?

Soil type: Forman silt loam
Soil No.: S59NDak-41-1
Location: North Sargent County, North Dakota.
Vegetation: Millet.
Parent material: Glacial till.
Physiography: Knoll on 4 percent undulating till plain.
Relief: 8 feet.
Drainage: Well drained.
Slope: 4 percent southwest.
Erosion: Slight.
Described by: C. E. Redmond.
Date: August 26, 1959.

Horizon and Lincoln Lab. Number	
Ap 11942	0 to 5 inches. Silt loam, very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist); weak coarse and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B21 11943	5 to 9 inches. Clay loam, grayish brown (10YR 5/2 dry) to dark grayish brown (10YR 4/2 moist) with tongues of dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist); strong coarse prismatic structure breaking to strong fine angular blocks; very hard, firm, sticky and slightly plastic; noncalcareous; continuous moderate and discontinuous thick clay films on ped surfaces; diffused boundary.
B22 11944	9 to 13 inches. Clay loam, grayish brown (2.5Y 5/2 dry) to dark grayish brown (10YR 4/2 moist) with tongues of gray (10YR 5/1 dry) to very dark gray (10YR 3/1 moist); strong medium prismatic structure breaking to strong fine angular blocks; very hard, firm, sticky and plastic; noncalcareous but becoming weakly calcareous with depth and containing a few rounded calcareous pebbles; continuous moderate with patches of thick clay films on ped surfaces; clear wavy boundary.
Cca 11945	13 to 24 inches. Silt loam, light brownish gray and light gray (2.5Y 6/2 and 7/2 dry) to grayish brown and light grayish brown (2.5Y 5/2 and 6/2 moist) with common medium and fine distinct light yellowish brown (10YR 6/4 dry) to brown (10YR 5/3 moist) and a few medium prominent reddish brown mottlings and with common medium distinct light gray (N 7/0 dry, 6/0 moist) lime concentrations; moderate medium prismatic structure breaking to moderate medium and fine subangular blocks; very hard, friable, slightly sticky and plastic; strongly calcareous with the lime segregated into distinct white blotches; gradual boundary.
C2 11946	24 to 29 inches. Loam, light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/4 moist) with a few fine prominent reddish yellow (7.5YR 6/8 dry) to yellowish brown (7.5YR 5/6 moist) mottlings and common medium distinct white (N 8/0 dry) to light gray (2.5Y 7/2 moist) lime concentrations; moderate medium prismatic structure breaking to moderate medium subangular blocks; very hard, friable, slightly sticky and slightly plastic; moderately calcareous; clear wavy boundary.
C3 11947	29 to 33 inches. Clay loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with a few fine prominent yellowish red (5YR 5/6 dry, 4/6 moist) mottlings and many medium and coarse faint light gray (N 7/0 dry, 6/0 moist) and common medium distinct white (N 8/0 dry) to light gray (N 7/0 moist) lime concentrations; weak medium platy structure breaking to weak fine subangular blocks; very hard, friable, sticky and plastic; moderately calcareous; gradual boundary.
Ccs 11948	33 to 41 inches. Clay loam, white and light yellowish brown (2.5Y 8/2 and 6/3 dry) to grayish brown and light olive brown (2.5Y 5/2 and 5/4 moist) with common fine distinct yellowish brown (10YR 5/6 dry) to dark yellowish brown (10YR 4/4 moist) and a few medium prominent yellowish red (5YR 5/8 dry, 4/8 moist) mottlings; weak thick platy structure breaking to weak fine subangular blocks; very hard, friable, sticky and plastic; weakly calcareous; many gypsum crystals; gradual boundary.
C5 11949	41 to 50 inches. Silt loam, light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/4 moist) with many coarse distinct light gray (2.5Y 7/2 dry) to faint grayish brown (2.5Y 5/2 moist) and common medium faint light yellowish brown (10YR 6/4 dry) to yellowish brown (10YR 5/4 moist) mottlings; moderate medium platy structure breaking to moderate very fine angular blocks; very hard, friable, sticky and plastic; weakly calcareous; gradual boundary.
C6 11950	50 to 60 inches. Clay loam, light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/4 moist) with common medium distinct yellowish brown (10YR 5/6 dry) to dark yellowish brown (10YR 4/4 moist) mottlings and many coarse distinct light gray (N 7/0 dry) to gray (N 5/0 moist) lime and gypsum concentrations; moderate thick platy structure breaking to moderate fine angular blocks; hard, friable, sticky and slightly plastic; weakly calcareous.

Note: A discontinuous B3ca, 1 to 3 inches thick, occurs intermittently around the pit; it has clay loam texture, moderate medium prismatic structure breaking to moderate medium angular blocks, and is weakly to moderately calcareous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Gardena loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-7 **LAB. NOS.** 888-893

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-7	Ap	0.1	0.5	1.2	9.4	24.0	41.2	23.6	51.1	21.4	-	l
7-21	B2	-	0.2	1.0	10.4	31.6	34.0	22.8	54.6	19.2	-	l
21-27	B3	-	0.3	1.1	9.4	25.0	43.2	21.0	63.7	11.7	-	l
27-36	Ccag	-	0.3	1.0	11.1	39.6	26.1	21.9	64.6	10.5	-	scl
36-43	C1g	0.6	0.7	1.3	8.9	44.4	29.0	15.1	70.4	10.1	Tr.	vfsl
43-60	C2g	0.3	0.6	0.6	1.4	2.0	62.2	32.9	8.0	57.2	Tr.	sicl

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4	7.8	8.0	3.59	0.301	11.9	-	0.6	-	-			13.0
6.8	7.7	7.5	1.06	0.108	9.8	-	0.4	-	-			10.5
7.2	7.6	7.9	0.58	0.068	8.5	-	0.4	-	-			9.0
7.8	8.7	9.0	0.58	0.046	12.6	-	0.4	14	-			8.0
8.0	8.8	9.1	0.23	0.029		-	0.5	12	-			6.1
8.2	9.0	8.8	0.25	0.033		-	0.8	27	-			13.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE 6N2b Ca	602b Mg	CATIONS EXCHANGEABLE 6P2a Na	5B1b 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →					
28.4	22.6	5.9	0.1	1.7	-	0.9	0.9				53.0
20.2	13.6	5.7	0.1	0.6	-	1.3	0.2				42.8
17.6	13.2	5.4	0.1	0.4	-	0.9	0.2				42.9
14.0			0.1	0.4	1	0.6	0.2				39.3
9.9			0.1	0.3	1	0.6	0.2				35.0
18.6			0.3	0.4	2	1.3	-				59.2

Soil type: Gardena loam
Soil No.: S51NDak-5-7
Location: 500 feet east of section line of northwest quarter of northwest quarter Sec. 35, T162N, R80W; 100 feet south of North Dakota Highway 5, Bottineau County, North Dakota.
Vegetation: Summer fallow.
Parent material: Moderately coarse to medium-textured glacial lacustrine material.
Physiographic position: Upland delta.
Topography: Nearly level; crest of low rise.
Slope: Less than 2 percent.
Drainage: Moderate.
Moisture: Moist.
Stoniness: None.
Described by: C. A. Mogen.
Date: September 11, 1951.

Horizon and Mandan Lab. Number	
Ap 888	0 to 7 inches. Dark gray or black to very dark gray (10YR 4/1 dry, 2/1 to 3/1 moist) soft, loose, noncalcareous loam having a weak fine crumb structure. This is underlain distinctly by
B2 889	7 to 21 inches. Dark grayish brown or very dark grayish brown (10YR 4/2 dry, 3/2 moist) friable, soft, noncalcareous loam having a moderate medium prismatic structure; structural aggregates are coated with very dark gray or very dark brown (10YR 3/1 dry, 2/2 moist). This grades distinctly but irregularly to
B3 890	21 to 27 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) friable, soft, noncalcareous loam having a weak fine prismatic to weak medium crumb or granular structure. This is underlain distinctly by
Ccag 891	27 to 36 inches. Light gray to white or light yellowish brown and light brownish gray (2.5Y 7/2 to 8/2 dry, 6/4 to 6/2 moist) friable, loose, moderately calcareous sandy clay loam having a soft crumb structure. This is underlain distinctly by
C1g 892	36 to 43 inches. Light gray to pale yellow or light olive brown streaked with light brownish gray (2.5Y 7/2 to 8/4 dry, 5/4 to 6/2 moist) soft, loose, moderately calcareous very fine sandy loam; abruptly underlain by
C2g 893	43 to 60 inches. Pale yellow or light yellowish brown (2.5Y 8/4 dry, 6/4 moist) friable, slightly hard, moderately calcareous silty clay loam; finely but distinctly laminated; mottled with white or light gray to light brownish gray (2.5Y 8/2 dry, 6/2 to 7/2 moist).

Remarks: In many places an A3 horizon is present and the B horizon is thinner.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Gardena very fine sandy loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-1 **LAB. NOS.** 438-443

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-9	A1p	0.4	1.8	3.5	21.7	27.4	29.3	16.0	61.7	12.0	-	vfsl
9-16	B2	0.1	1.4	2.6	21.0	27.9	29.7	17.3	63.3	11.4	-	vfsl
16-25	C1ca	-	0.5	1.3	14.6	23.9	34.6	25.1	56.3	14.7	-	l
25-38	C2	0.3	0.8	1.6	17.8	43.8	22.7	13.0	74.4	7.7	-	vfsl
38-65	C3	-	0.5	1.3	22.2	47.9	21.4	6.6	83.7	4.8	-	vfsl
65-84	D	6.0	6.9	6.7	12.4	11.1	35.5	21.3	34.2	19.6	-	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.5	7.8	8.0	2.68	.232	11.6	-	0.6	-	-			10.1
8.0	8.4	8.5	1.16	.119	9.7	-	0.7	-	-			8.2
8.5	9.2	9.4	0.44	.054	8.1	-	2.8	28	-			8.1
8.8	9.5	9.6	0.16	.020		-	2.3	15	-			5.1
8.8	9.6	9.6	0.04	.010		-	0.9	13	-			3.5
8.2	8.8	9.1	0.06	.018		-	3.8	16	-			10.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
21.4	17.2	6.6		-	1.4	-	-	0.9				44.6
17.6	13.2	7.8		-	0.4	-	1.5	-				40.5
8.8				1.1	0.2	12	18.1	0.3				37.5
6.3				1.1	0.2	17	16.9	-				31.9
5.3				0.5	0.2	9	7.2	-				34.6
12.4				0.9	0.4	7	18.4	0.7				41.9

Soil type: Gardena very fine sandy loam
Soil No.: S50NDak-38-1
Location: Southeast quarter of southwest quarter, Sec. 28, T163N, R84W, Renville County, North Dakota.
Vegetation: Quackgrass at edge of wheat field.
Parent material: Medium-textured glaciofluvial material very deep over till.
Physiographic position: Nearly level upland drift plain with numerous depressions.
Topography: Nearly level to very gently undulating.
Slope: One percent.
Erosion: None apparent.
Drainage: Moderately well.
Ground water: Very deep.
Moisture: Field capacity.
Salt: Free.
Stoniness: Free.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 18, 1950.

Horizon and Mandan Lab. Number	
Alp 438	0 to 9 inches. Dark gray, dry, and very dark gray to black, moist (10YR 4/1 between 2/1 and 3/1), noncalcareous, heavy-textured very fine sandy loam having a moderately developed, fine crumb structure; soft when dry; very friable when moist. This changes gradually into
B2 439	9 to 16 inches. Between gray and grayish brown, dry, and between very dark gray and very dark grayish brown, moist (10YR between 5/1, 5/2 dry, 3/1, 3/2 moist), noncalcareous very fine sandy loam; weakly developed, medium-sized prismatic structure; prisms readily crumble into moderately developed fine granules. This changes clearly into
C1ca 440	16 to 25 inches. Light gray, dry, and light olive brown, moist (2.5Y 7/2, 5/3), very strongly calcareous loam; weakly developed granular structure; slightly hard when dry; very friable when moist. There is a large amount of segregated lime in large diffused splotches.
C2 441	25 to 38 inches. Pale yellow, dry, and light olive brown, moist (2.5Y between 7/2 and 7/4 dry, 5/4 moist), strongly calcareous very fine sandy loam; weak granular structure; slightly hard when dry; very friable when moist. There is a slight amount of segregated lime appearing mostly as white threads throughout the soil mass.
C3 442	38 to 65 inches. Light gray prominently mottled with yellow and yellowish brown, dry, and grayish brown mottled with brownish yellow and yellowish brown, moist (2.5Y 7/2 with 10YR 7/6 and 5/8 dry, 2.5Y 5/2 with 10YR 6/6 and 5/8 moist) moderately calcareous light-textured very fine sandy loam; somewhat stratified; slightly hard when dry; very friable when moist. This overlies
D 443	65 to 84 inches. Light gray prominently mottled with some strong brown and faintly mottled with a pale yellow, dry, and grayish brown mottled with dark brown and light olive brown, moist (2.5Y 7/2 with 7.5YR 5/6 and 2.5Y 7/3 dry, 2.5Y 5/2 with 7.5YR 4/4 and 2.5Y 5/3 moist), moderately calcareous loam till; very hard when dry; firm when moist; weak granular or fine blocky structure; contains numerous fine and medium-sized angular gravels of quartz and granite.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Gardena loam **LOCATION** Wells County, North Dakota

SOIL NOS. S53NDak-52-3 **LAB. NOS.** 1855-1860

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	1.3	3.5	4.5	12.9	18.6	41.3	17.9	50.3	17.7	0.4	l
7-12½	B2	0.5	2.3	3.2	11.2	20.9	43.2	18.7	54.5	16.8	0.3	l
12½-17	B3	0.5	1.5	2.2	8.4	21.1	49.8	16.5	59.1	17.6	0.2	l
17-32	Cca	0.9	1.6	3.6	19.4	27.4	31.1	16.0	57.3	15.2	0.5	vfsl
32-46	C	2.0	3.2	4.6	18.6	26.6	31.8	13.2	60.5	10.8	0.1	vfsl
46-60	D	4.2	5.0	5.8	13.7	13.6	34.3	23.4	36.1	20.2	2.5	l

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	7.0	7.0	1.77			<0.20	1.2	-				8.8
7.1	7.3	7.3	1.04			<0.20	0.7	-				9.1
7.5	7.7	7.9	0.92			<0.20	0.6	1				8.2
7.9	8.4	8.6	0.45			<0.20	0.6	12	-			6.2
8.0	8.6	8.9	0.21			<0.20	0.6	9	-			5.3
8.3	9.0	9.2	0.12			<0.20	0.8	9	-			9.2

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5B1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →						← milliequivalents per liter →					
19.6	13.7	4.0	-	1.1	-	0.3	0.8				42.7
18.0	13.3	4.3	0.1	0.6	-	0.3	0.2				41.7
16.7		4.2	0.1	0.4	-	0.6	0.2				43.7
10.2		4.8	0.1	0.3	1	0.6	0.2				36.5
8.7			0.1	0.2	1	1.2	0.2				32.3
14.6			0.9	0.3	6	4.9	0.2				42.1

Soil type: Gardena loam
Soil No.: S53NDak-52-3
Area: Wells County, North Dakota.
Location: 1300 feet west and 200 feet north of southeast corner Sec. 28, T149N, R73W.
Vegetation: Summer fallow.
Parent material: Water-sorted, stratified till.
Physiographic position: Upland, ground moraine, 30 feet from crest of low rise on 60-foot long slope.
Topography: Gently undulating (relief two to six feet).
Slope: 1/2 percent.
Drainage: Well drained.
Permeability: Moderately rapid.
Moisture: Moist.
Salt or alkali: Free.
Stoniness: Patchy; slightly to moderately stony in small 1/4-acre areas. There are a very few stones and pebbles in the stratified drift.
Described by: C. A. Mogen.
Date: September 16, 1953.
Mandan

Lab.No.	Horizon	
1855	Ap	0 to 7 inches. Dark gray to black (10YR 4/1.5 dry; 2/1.5 moist) noncalcareous loam; slightly hard; moderately developed fine granular structure; very friable. This rests abruptly on
1856	B2	7 to 12½ inches. Dark grayish brown with some dark gray coatings, dry, to very dark grayish brown, moist, (10YR 4/2 and 4/1.5 dry; 3/2.7 moist) noncalcareous loam; slightly hard; moderately developed medium and coarse prisms separating out into weakly developed medium-sized blocky aggregates; very friable. This grades into
1857	B3	12½ to 17 inches. Brown to very dark grayish brown (10YR 5/3 dry; 3.5/2 moist) noncalcareous loam; slightly hard; moderately coarse prismatic structure; prisms separate out into weak coarse blocks; very friable. This changes clearly into
1858	Cca	17 to 32 inches. Light gray with many fine faint mottlings of white, dry, to olive brown mottled with light brownish gray, moist, (2.5Y 7/2 and 8/2 dry; 4.5/3 and 7/2 moist) strongly calcareous very fine sandy loam with a slight amount of segregated lime in threads; slightly hard; porous, massive structure; very friable when moist. This grades into
1859	C	32 to 46 inches. Light yellowish brown with common fine faint mottlings of white, dry, to light olive brown mottled with light brownish gray, moist, (2.5Y 6/3 and 8/2 dry; 5/4 and 6/2 moist) moderately calcareous very fine sandy loam; slightly hard; porous, massive structure; very friable. This rests on
1860	D	46 to 60 inches. Grayish brown with common fine distinct mottlings of white and with a very few very fine prominent mottlings of yellowish red, dry, to olive brown mottled with yellowish red, moist, (2.5Y 5/2 and 8/2 and 5YR 4/8 dry; 2.5Y 4/3 and 5YR 4/8 moist) moderately calcareous loam; moderately developed medium and fine blocky structure.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Gardena loam **LOCATION** Wells County, North Dakota

SOIL NOS. S53NDak-52-4 **LAB. NOS.** 1861-1868

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	0.6	2.1	3.1	10.4	20.5	44.6	18.7	52.0	19.8	0.2	1
6-11	B21	0.8	2.8	3.6	11.4	22.8	40.6	18.0	55.6	15.4	0.4	1
11-15	B22	1.1	2.2	2.8	10.8	24.8	40.7	17.6	59.0	13.7	0.5	1
15-24	B3	0.5	1.9	2.6	10.8	31.6	38.5	14.1	65.2	12.3	0.4	1
24-30	Bca	3.2	3.8	4.8	15.8	21.7	32.2	18.5	49.8	14.6	2.4	1
30-40	Dca	2.6	3.4	4.3	17.2	19.9	33.0	19.6	47.3	17.5	1.9	1
40-50	D1	2.5	4.0	5.2	18.9	19.3	35.1	15.0	48.9	18.3	2.5	1
50-60	D2	3.1	4.5	5.4	19.2	18.8	34.7	14.3	47.4	18.7	2.9	1

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.8	7.0	2.46			<0.20	0.7	-				10.3
6.8	7.0	7.0	1.02			<0.20	0.4	-				8.5
6.7	7.0	7.1	0.69			<0.20	0.4	-				8.0
7.0	7.1	7.1	0.61			<0.20	0.4	1	-			7.2
7.7	8.3	8.5	0.56			<0.20	0.8	9	-			7.7
7.9	8.7	8.8	0.27			<0.20	1.8	18	-			7.0
8.3	9.3	9.4	0.17			<0.20	1.3	12	-			7.1
8.3	9.4	9.4	0.13			<0.20	1.8	10	-			7.1

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	6O2b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6F1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		← milliequivalents per liter				→	
22.4	15.8	4.6		-	1.3	-	0.6	0.8				45.7
16.9	11.1	4.6		-	0.6	-	0.6	0.2				39.2
16.0	10.3	4.8		-	0.5	-	0.6	0.2				37.7
13.7		5.0		0.2	0.3	1	0.6	0.2				36.8
12.6		6.8		0.2	0.3	1	1.2	0.2				38.0
10.3		9.8		0.5	0.2	5	5.2	0.2				36.5
10.8				1.6	0.2	15	9.8	0.2				36.3
11.2				2.1	0.2	19	14.1	0.2				37.7

Soil type: Gardena loam
Soil No.: S53NDak-52-4
Area: Wells County, North Dakota.
Location: 520 feet west, 90 feet north of southeast corner Sec. 30, T149N, R73W.
Vegetation: Wheat stubble.
Parent material: Water-sorted over unsorted drift.
Physiographic position: Upland, ground moraine, 50 feet from base of 400-foot long undulating slope.
Topography: Gently undulating (relief five to twenty feet).
Slope: 3 percent.
Drainage: Well drained.
Permeability: Moderate.
Moisture: Dry.
Stoniness: Few.
Described by: C. A. Mogen.
Date: September 17, 1953.

Mandan Lab.No.	Horizon	
1861	Ap	0 to 6 inches. Dark gray to black (10YR 4/1; 2.5/1 moist) noncalcareous loam; slightly hard; moderately developed fine granular structure; very friable. This changes in a clear smooth boundary to
1862	B21	6 to 11 inches. Dark grayish brown to very dark grayish brown coated with very dark brown, moist, (10YR 4/2 dry; 3/2 and 2.5/2 moist) noncalcareous loam; slightly hard; moderately developed coarse and medium-sized prismatic structure; prisms separate into weak coarse and medium-sized blocks; very friable. This grades in a smooth boundary to
1863	B22	11 to 15 inches. Brown with some dark grayish brown coatings, dry, to dark grayish brown with some very dark grayish brown coatings, moist, (10YR 5/3 and 4/2 dry; 4/2 and 3.5/2 moist) noncalcareous loam; slightly hard; moderately developed coarse and medium-sized prisms; prisms separate into weakly developed coarse and medium-sized blocks; very friable. This changes in a clear smooth boundary to
1864	B3	15 to 24 inches. Pale brown to dark grayish brown (10YR 6/3 dry; 4/2 moist) noncalcareous loam; slightly hard; moderate to weakly developed coarse prismatic structure; prisms separate out into weakly developed coarse blocks; very friable. This changes in a clear wavy boundary to
1865	Bca	24 to 30 inches. Pale brown with stripes of white, dry, to light olive brown striped with pale yellow, moist, (1Y 6/3 and 9/2 dry; 2.5Y 5/4 and 9/4 moist) moderately calcareous loam with a slight amount of segregated lime; slightly hard; weakly developed coarse prismatic and coarse blocky structure; very friable.
1866	Dca	30 to 40 inches. Pale yellow streaked with white, dry, to light yellowish brown streaked with pale yellow, moist, (2.5Y 7/3 and 9/2 dry; 6/3 and 9/4 moist) strongly calcareous loam with a moderate amount of segregated lime in threads and seams; slightly hard; porous, massive structure; friable.
1867	D1	40 to 50 inches. Light yellowish brown with many streaks of white, dry, to olive brown streaked with pale yellow, moist, (2.5Y 6/3 and 9/2 dry; 4/4 and 8/4 moist) moderately calcareous loam; slight amount of segregated lime; hard; moderately developed medium and fine blocky structure; friable.
1868	D2	50 to 60 inches. Light yellowish brown with many fine distinct mottlings of light gray and very few very fine prominent mottlings of reddish brown, dry, to olive brown mottled with gray and reddish brown, moist, (2.5Y 6/3 and 7/0 dry; 4/3 and 6/0 moist) moderately calcareous loam; hard; moderately developed medium and fine blocky structure; friable.

SOIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE Glyndon loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-3 **LAB. NOS.** 1816-1821

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-7	Ap	0.2	0.3	0.7	7.3	37.2	34.3	20.0	64.2	12.5	-	l
7-10	Cca1	-	0.1	0.4	5.2	36.9	33.5	23.9	61.0	13.2	-	l
10-19	Cca2	-	-	0.4	3.6	40.3	33.0	22.7	63.8	12.2	-	l
19-30	Cca3	-	-	0.2	1.7	21.1	54.5	22.5	52.7	24.2	-	sil
30-43	C1	-	-	-	0.9	36.4	49.6	13.1	73.4	13.3	-	l
43-60	Cg	-	-	-	0.8	36.8	50.7	11.7	75.5	12.8	-	sil

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.9	8.6	8.9	1.83			<0.20	0.8	7				10.5
8.2	9.0	9.2	0.78			<0.20	0.8	15				12.2
8.5	9.4	9.6	0.32			<0.20	1.0	20				10.4
8.9	10.0	10.1	0.18			<0.20	1.3	18	-			11.0
9.0	10.0	10.1	0.11			<0.20	1.2	12	-			7.5
8.9	9.9	10.0	0.11			<0.20	1.1	9	-			7.0

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE Ca	602b Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5B1b	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
17.1		12.4	0.2	1.3		1	0.3	1.0				44.0
12.6			0.4	1.4		3	1.2	1.0				44.3
8.4			0.7	1.0		8	5.5	0.8				36.1
9.6			3.8	0.8		40	13.0	0.2				50.3
9.3			3.6	0.7		39	12.3	0.4				49.2
10.1			3.6	0.7		36	11.2	0.2				47.7

Soil type: Glyndon loam
Soil No.: 853NDak-5-3
Area: Bottineau County, North Dakota.
Location: 450 feet north and 75 feet west of SE corner Sec. 20, T159N, R75W.
Vegetation: Disked grain stubble.
Parent material: Glacial lacustrine (delta) deposits of silt and sands.
Physiographic position: Delta plain on the east side of Glacial Lake Souris.
Topography: Very gently undulating (relief one to four feet).
Slope: 1/2 percent.
Drainage: Moderately well drained.
Ground water: 72 inches.
Permeability: Moderate.
Moisture: Dry to 19 inches.
Salt or alkali: Probably saline below 10 inches.
Described by: C. A. Mogen.
Date: September 15, 1953.

Mandan Lab.No.	Horizon	
1816	Ap	0 to 7 inches. Dark gray and light gray, dry, to very dark gray, moist, (10YR 4/1 and 7/2; 3/1 moist) strongly calcareous silt loam or loam; cloddy and weak fine granular structure; slightly hard and very friable.
1817	Cca1	7 to 10 inches. Light gray, dry, to dark gray with common fine distinct mottlings of light gray, moist, (2.5Y 6/1 and 7/1, dry, to 4/1 and 6/1, moist) very strongly calcareous loam; slightly hard; weak coarse prisms and weak very coarse platy structure; compact in place, very friable when moist.
1818	Cca2	10 to 19 inches. Light brownish gray to light olive brown (2.5Y 6/2; 5/3 moist) very strongly calcareous loam; slightly hard; weak, very coarse prismatic structure; very friable when moist.
1819	Cca3	19 to 30 inches. Pale yellow to light olive brown (2.5Y 7/3; 5.5/4 moist) strongly calcareous fine textured silt loam; hard; weak to very coarse prismatic structure; very friable.
1820	C1	30 to 43 inches. Light yellowish brown to light olive brown (2.5Y 6/4; 5/4 moist) moderately calcareous loam; hard; porous, massive structure; very friable.
1821	Cg	43 to 60 inches. Pale yellow with many fine distinct mottlings of white, dry, to light yellowish brown mottled, with light gray and yellowish brown, moist, (2.5Y 7/4, 8/2 and 8/0 and 10YR 6/4 dry to 2.5Y 6/0 and 10YR 5/8 moist) mildly calcareous silty loam; hard weak platy to moderately defined laminated structure; very friable.

Remarks: Weakly developed coarse prisms are visible in this dry soil. Streaks and tongues of A1 horizon sift down between the prisms into the Cca horizon. In the moist soil there is no visible macro structure--only a weak fine crumb or fine granular structure in A1 and Cca.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Glyndon loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-4 **LAB. NOS.** 1822-1828

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	A1p	0.1	0.2	0.8	10.6	38.3	32.4	17.6	67.1	11.3	-	l
7-11	A12	-	0.1	0.8	9.7	40.9	31.6	16.9	69.1	10.3	-	l
11-16	A1ca	-	0.2	0.8	11.1	39.3	28.8	19.8	66.0	10.0	-	l
16-20	Cca	-	0.2	0.7	9.3	34.4	31.6	23.8	60.6	12.0	-	l
20-32	Ccs	-	0.1	0.4	3.3	42.4	33.8	20.0	66.7	11.9	-	l
32-42	C1	-	0.1	0.1	0.6	8.7	66.8	23.7	43.7	32.2	-	sil
42-60	Cg	-	-	-	1.3	53.2	35.5	10.0	81.9	7.7	-	vfsl

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.2	7.7	7.7	2.78			<0.20	0.7	1				11.3
7.3	7.8	7.8	1.37			<0.20	0.6	-				9.4
7.7	8.4	8.6	0.86			<0.20	0.6	8				8.9
7.8	8.4	8.6	0.79			<0.20	0.7	16	-			9.3
7.6	7.9	8.0	0.32			<0.20	2.6	18	19			6.7
7.7	8.4	8.6	0.20			<0.20	2.0	19	-			8.7
8.0	8.8	8.9	0.08			<0.20	1.0	9	-			5.3

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
24.6		4.3		0.1	1.1	-	-	0.8				51.4
19.0	17.4	3.4		0.2	0.4	1	-	0.2				47.0
12.9		2.9		0.2	0.3	2	0.3	0.2				42.0
11.2		2.8		0.2	0.3	2	0.6	0.4				40.8
8.0		2.1		0.4	0.2	5	1.5	0.4				35.2
12.6		8.1		0.4	0.3	3	2.3	0.4				44.0
9.1		7.0		0.5	0.3	5	2.6	0.2				38.2

Soil type: Glyndon loam
Soil No.: S53NDak-5-4
Area: Bottineau County, North Dakota.
Location: 220 feet west and 400 feet north of southeast corner Sec. 20, T159N, R75W.
Vegetation: Disked grain stubble.
Parent material: Lacustrine deposited silts and sands.
Physiographic position: Delta plain on the east side of Glacial Lake Souris.
Topography: Very gently undulating (relief one to four feet).
Slope: 1 percent.
Drainage: Moderately well drained.
Ground water: 72 inches.
Permeability: Moderate.
Moisture: Dry to 20 inches.
Salt or alkali: Saline substratum 20 to 42 inches.
Described by: C. A. Mogen.
Date: September 15, 1953.

Mandan Lab.No.	Horizon	
1822	Alp	0 to 7 inches. Dark gray to black (10YR 4/1; 2/1 moist) noncalcareous loam; weakly developed fine granular structure; soft when dry, very friable when moist.
1823	A12	7 to 11 inches. Dark gray and grayish brown mottled, dry, to very dark gray, moist, (10YR 4/1 and 5/2 dry to 3/1 moist) noncalcareous loam; soft; weak coarse prismatic structure; compact in place; very friable.
1824	Alca	11 to 16 inches. Brown with many fine faint mottlings of dark gray with common distinct mottlings of white to very dark grayish brown mottled with light brownish gray (10YR 5/3, 4/1 and 9/1 dry; 3/2 and 6/2 moist) moderately calcareous loam with a moderate amount of segregated lime; soft; weak coarse prismatic structure; very friable when moist.
1825	Cca	16 to 20 inches. Light yellowish brown to dark grayish brown (2.5Y 6.5/3; 4/2 moist) very strongly calcareous loam; slightly hard; weak coarse prismatic structure; very friable.
1826	Ccs	20 to 32 inches. Pale yellow to light olive brown (2.5Y 7/4; 5/4 moist) very strongly calcareous loam; moderate amount of crystalline gypsum visible. Soft; porous, massive structure; friable.
1827	C1	32 to 42 inches. Pale yellow with common very fine distinct mottlings of white and brownish yellow, dry, to light olive brown mottled with light gray and yellowish brown, moist, (2.5Y 7/4, 8/0 and 10YR 6/8 dry; 2.5Y 5/4, 6/0 and 10YR 5/8 moist) strongly calcareous fine textured silt loam; soft; porous, massive structure; very friable.
1828	Cg	42 to 60 inches. Pale yellow mottled with light gray in bands and with tubes of brownish yellow, dry, to olive mottled with light gray and yellowish brown (5Y 7/3, 7/0 and 10YR 6/6 dry; 5Y 5/3, 6/0 and 10YR 5/8 moist) very weakly calcareous, very fine sandy loam; soft; weakly developed medium-sized laminated structure; very friable.

Remarks. When dry the weakly coarse prismatic zone from 7 to 16 inches appears to represent a weakly developed B horizon; however, these prisms include two inches of 10YR 2/1 and have no secondary structure.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Glyndon very fine sandy loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-5 **LAB. NOS.** 1829-1835

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	-	0.2	1.5	11.8	42.1	28.2	16.2	69.0	9.4	-	vfsl
6-9	A12	-	0.2	1.5	12.2	42.9	26.0	17.2	69.2	7.8	-	vfsl
9-20	Cca	-	0.2	1.0	6.8	34.8	25.0	32.2	54.4	9.8	-	cl
20-32	C1	-	-	0.3	2.5	53.2	24.0	20.0	71.9	7.3	-	scl
32-39	C2	-	0.2	0.1	1.1	50.2	32.4	16.0	74.1	9.3	-	l
39-48	Cg1	-	-	0.2	1.1	51.0	36.6	11.1	77.8	10.6	-	vfsl
48-60	Cg2	-	-	0.2	1.3	55.1	33.8	9.6	82.5	7.4	-	vfsl

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS.
7.5	7.9	8.0	2.70			<0.20	0.8	1				10.4
7.8	8.3	8.3	1.21			<0.20	0.6	1				9.7
8.3	9.1	9.3	0.39			<0.20	0.7	27				13.2
8.4	9.2	9.3	0.14			<0.20	0.8	17	-			7.6
8.2	9.0	9.2	0.11			<0.20	0.9	16	-			6.6
8.3	9.2	9.2	0.08			<0.20	1.0	15	-			6.1
8.2	9.1	9.1	0.04			<0.20	1.0	12	-			5.0

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE Ca	602b Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5B1b 5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter	→			
23.1		8.1	0.1	0.8	-	0.3	0.4			47.0
19.6		9.3	0.2	0.5	1	0.6	0.2			42.6
9.3			0.3	0.2	3	1.5	0.2			46.4
7.2			0.6	0.2	8	4.4	0.2			39.4
8.4			0.9	0.2	11	6.7	-			41.2
8.0			1.2	0.2	15	8.4	-			39.0
7.8			0.9	0.2	12	7.2	0.2			39.8

Soil type: Glyndon very fine sandy loam
Soil No.: S53NDak-5-5
Area: Bottineau County, North Dakota.
Location: 960 feet west and 260 feet south of northeast corner Sec. 30, T159N, R75W.
Vegetation: Summer fallow.
Parent material: Lacustrine silt and sands.
Physiographic position: Delta plain, Glacial Lake Souris near foot of long slope into somewhat poorly drained low flat of high lime soils.
Topography: Very gently undulating (relief two to five feet).
Slope: 1 percent.
Drainage: Moderately well.
Ground water: 72 inches.
Permeability: Moderate.
Moisture: Moist.
Described by: C. A. Mogen.
Date: September 15, 1953.

Mandan Lab.No.	Horizon	
1829	Alp	0 to 6 inches. Very dark gray to black (10YR 3/1; 2/1 moist) noncalcareous and moderately calcareous very fine sandy loam; weak fine granular structure; slightly hard when dry, very friable when moist.
1830	A12	6 to 9 inches. Very dark gray to black (10YR 3/1; 2/1 moist) noncalcareous very fine sandy loam; slightly hard; weak coarse prismatic to weak fine granular structure; very friable. This changes clearly into
1831	Cca	9 to 20 inches. Light gray with many fine faint mottlings of gray and white and with tongues of dark gray, dry, to grayish brown tongued with very dark gray, moist, (2.5Y 7/2, 5/1, 8/1 and 4/1 dry; 2.5Y 5/2 and 3/1 moist) very strongly calcareous clay loam; slightly hard; very weakly developed coarse prismatic structure; friable when moist. This changes clearly into
1832	C1	20 to 32 inches. Pale yellow with many fine distinct mottlings of light gray, dry, to light yellowish brown mottled with light brownish gray, moist, (2.5Y 7/4 and 7/2 dry; 6/4, 6/5 and 6/2 moist) strongly calcareous sandy clay loam; slightly hard; massive structure; very friable. This grades into
1833	C2	32 to 39 inches. Olive yellow with many fine faint mottlings of light gray and with a few fine distinct mottlings of white, dry, to light olive brown mottled with light brownish gray, moist, (1Y 6/6, 7/2 and 9/1 dry; 5/5 and 6/2 moist) moderately calcareous loam; slightly hard; massive or weak fine blocky structure; very friable. Changes clearly into
1834	Cg1	39 to 48 inches. Light yellowish brown with many fine distinct mottlings of white and olive yellow, dry, to light olive brown mottled with light olive gray and yellowish brown, moist, (2.5Y 6/4, 8/0 and 6/6 dry; 2.5Y 5/6, 5Y 6/2 and 10YR 5/8 moist) moderately calcareous very fine sandy loam; hard; moderately developed medium-sized laminated structure; very friable when moist.
1835	Cg2	48 to 60 inches. Light gray with many medium-sized prominent mottlings of brownish yellow, dry, to light olive gray mottled with yellowish brown, moist, (5Y 7/2 and 10YR 6/8 dry; 5Y 6/2 and 10YR 5/8 moist) moderately calcareous very fine sandy loam; slightly hard; weakly developed medium-sized platy and laminated structure; compact in place; very friable.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Glyndon loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-6 **LAB. NOS.** 1836-1842

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	A1p	0.2	0.3	2.0	13.0	40.4	27.0	17.1	66.5	9.3	-	vfsl
6-10	A1ca	-	0.5	1.8	11.4	37.1	26.2	23.0	60.7	10.0	-	scl
10-23	Cca	-	0.1	1.3	8.7	37.7	26.8	25.4	58.8	11.4	-	scl
23-33	C1	-	-	0.2	1.3	41.5	38.2	18.8	68.6	12.0	-	l
33-41	C2	-	-	0.1	0.9	50.3	37.1	11.6	77.9	10.2	-	l
41-52	Cg1	-	-	0.1	1.0	48.2	39.9	10.8	78.2	10.6	-	l
52-60	Cg2	-	-	0.2	0.6	18.9	66.3	14.0	66.5	19.0	-	sil

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.9	8.4	8.5	2.10			<0.20	1.0	2				9.8
8.3	8.9	9.0	0.96			<0.20	0.8	13				10.6
8.6	9.2	9.3	0.35			<0.20	1.0	22				11.3
8.2	8.9	9.2	0.17			<0.20	0.9	19	-			6.6
8.1	8.8	9.0	0.08			<0.20	0.9	13	-			5.2
8.0	8.7	8.9	0.08			<0.20	0.8	12	-			5.1
7.9	8.5	8.8	0.11			<0.20	0.7	15	-			6.9

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a EXTRACTABLE CATIONS Ca	602b Mg	EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5B1b 5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil					milliequivalents per liter				
18.7		9.7	0.1	0.9	-	0.3	0.8			47.3
12.8			0.2	0.5	2	1.2	0.2			45.4
8.9			0.4	0.2	4	2.9	0.2			41.1
7.6			0.4	0.2	5	4.1	-			35.4
7.1			0.4	0.2	6	3.2	0.2			37.3
8.0		4.5	0.3	0.2	4	2.0	0.2			38.6
10.5		4.9	0.3	0.2	3	1.7	0.2			42.9

Soil type: Glyndon loam
Soil No.: S53NDak-5-6
Area: Bottineau County, North Dakota.
Location: 1040 feet west and 240 feet south of northeast corner Sec. 30, T159N, R75W.
Vegetation: Summer fallow.
Parent material: Lacustrine silt and sands.
Physiographic position: Delta plain, east edge Glacial Lake Souris, 150 feet back from bottom of 500-foot long slope into lower-lying plain of somewhat poorly drained high lime soils.
Topography: Very gently undulating (relief two to five feet).
Slope: 1 percent.
Drainage: Moderately well drained.
Ground water: 72 inches.
Permeability: Moderate.
Moisture: Moist.
Described by: C. A. Mogen.
Date: September 15, 1953.

Mandan Lab.No.	Horizon	
1836	A1p	0 to 6 inches. Dark gray to black (10YR 4/1; 2/1 moist) moderately calcareous loam; weak fine granular structure; soft and very friable. This changes abruptly to
1837	A1ca	6 to 10 inches. Gray and light gray mottled, dry, dark grayish brown and light brownish gray mottled, moist, (10YR 5/1 and 7/1 dry; 10YR 4/2 and 6/2 moist) strongly calcareous sandy clay loam; slightly hard and very friable. This changes in a clear irregular boundary to
1838	Cca	10 to 23 inches. Light yellowish brown with streaks of light gray, dry, to grayish brown streaked with dark grayish brown, moist, (2.5Y 6/3 and 7/2 dry; 5/2 and 4/2 moist) very strongly calcareous sandy clay loam; soft; very weakly developed, very coarse prisms; very friable. This changes in a clear wavy boundary to
1839	C1	23 to 33 inches. Pale yellow with a few fine distinct mottlings of white, dry, to light olive brown mottled with light gray, moist, (2.5Y 7/4 and 8/0 dry; 1Y 5/6 and 6/0 moist) moderately calcareous loam; soft; massive structure; very friable. This changes in a clear wavy boundary to
1840	C2	33 to 41 inches. Pale yellow with many fine faint mottlings of white, dry, to olive yellow mottled with light brownish gray and yellowish brown, moist, (2.5Y 7/4, 7/6 and 8/2 dry; 2.5Y 6/6, 6/2 and 10YR 5/8 moist) moderately calcareous loam; massive structure; soft and very friable. This grades into
1841	Cg1	41 to 52 inches. Light yellowish brown and white, dry, to light olive brown mottled with light olive gray, moist, (2.5Y 6/4 and 5Y 8/2 dry; 2.5Y 5/5 and 5Y 6/2 moist) moderately calcareous loam; soft; massive structure; very friable. This grades into
1842	Cg2	52 to 60 inches. Pale yellow with medium-sized prominent mottlings of white and brownish yellow, dry, to pale olive mottled with light gray and yellowish brown, moist, (5Y 7/3, 8/1 and 10YR 6/8 dry; 5Y 6/3, 6/1 and 10YR 5/8 and 3/4 moist) moderately calcareous silt loam; soft; weakly developed medium-sized laminated structure; very friable.

Remarks: Tongues of dark soil extending into the Cca horizon are evidence of dry-season cracking in this soil, but the moist soil has no macro structure.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Glyndon loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-2 **LAB. NOS.** 856-863

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-3	Ap	0.3	1.1	2.6	9.4	23.0	46.3	17.3	54.5	20.3	Tr.	l
3-9	A1ca	0.2	0.7	1.8	6.4	22.2	50.0	18.7	55.9	20.5	l	sil
9-15	Cca1	0.1	0.6	1.2	5.6	23.0	50.5	19.0	56.0	21.7	Tr.	sil
15-27	Cca2	-	0.3	0.7	3.6	25.6	54.6	15.3	61.8	21.2	-	sil
27-38	C1	-	0.1	0.2	0.6	1.6	82.9	14.6	23.9	60.9	-	sil
38-50	C2	-	0.2	0.4	1.5	8.5	76.5	12.9	37.1	49.0	-	sil
50-60	C3	0.1	0.1	0.1	0.2	0.1	80.3	19.1	13.5	67.0	-	sil

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	6B1a ORGANIC MATTER NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.2	8.5	2.76	0.262	10.5	-	1.0	3	-			14.2
7.6	8.2	8.4	2.14	0.215	10.0	-	2.0	8	-			11.7
7.8	8.4	8.7	0.92	0.101	9.1	-	3.6	25	2			10.5
8.3	8.7	8.8	0.58	0.056	10.4	0.36	10.0	21	4			6.8
8.5	9.0	9.1	0.36	0.043	8.4	0.67	15.0	31	3			8.6
8.3	8.8	9.0	0.36	0.042	8.6	0.65	15.0	23	1			8.2
8.3	8.7	8.8	0.18	0.023		0.49	11.0	23	1			9.9

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE Ca	Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil			→		←	milliequivalents per liter			→		
22.0			0.1	1.0	-	-	0.9					57.3
17.9			0.1	0.5	-	0.6	0.6					54.0
9.6			0.5	0.2	5	10.9	0.4					46.7
8.1			0.9	0.2	11	27.2	0.4	4.7	1.2	189		40.4
11.2			1.6	0.2	14	46.0	0.2					49.9
11.3			1.5	0.4	13	52.0	0.6	6.4	4.2	295		46.7
12.8			2.7	0.5	21	43.9	0.4					56.1

Note: Laboratory No. 860 was skipped.

Soil type: Glyndon loam
Soil No.: S51NDak-5-2
Location: Along road in new road cut, southwest quarter of southwest quarter of Sec. 2, T161N, R81W, Bottineau County, North Dakota.
Vegetation: Stubble of annual weeds.
Parent material: Medium-textured glacial lacustrine material.
Physiographic position: Upland delta.
Topography: Nearly level.
Slope: Less than 1 percent.
Drainage: Moderate.
Moisture: Moist.
Stoniness: None.
Root distribution: Numerous roots to 12 inches.
Described by: C.A. Mogen.
Date: September 9, 1951.

Horizon and Mandan Lab. Number	
Ap 856	0 to 3 inches. Gray to dark gray or very dark gray to dark gray (10YR 5/1 to 4/1 dry, 3/1 to 4/1 moist) very friable, soft, moderately calcareous loam having a crumb structure. This changes to
Alca 857	3 to 9 inches. Gray to dark gray or very dark gray (10YR 5/1 to 4/1 dry, 3/1 moist) soft, very friable silt loam having a crumb structure; moderately calcareous, grading to
Ccal 858	9 to 15 inches. Light gray or pale olive (2.5Y 7/2 dry, 5Y 6/3 moist) very friable, soft, strongly calcareous silt loam having a moderately developed fine crumb structure. This changes irregularly to
Cca2 859	15 to 27 inches. Pale yellow or light yellowish brown (2.5Y 8/4 dry, 6/4 moist) friable, soft, silt loam having a crumb or granular structure; strongly calcareous. This changes distinctly to
C1 861	27 to 38 inches. Pale yellow or light yellowish brown to light olive brown (2.5Y 7/4 dry, 5/4 to 6/4 moist) friable, soft, moderately calcareous silt loam having a moderate finely laminated structure. This grades to
C2 862	38 to 50 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) friable, slightly hard, moderately calcareous silt loam having a compound weakly laminated and subangular blocky structure. This grades to
C3 863	50 to 60 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) friable, slightly hard, moderately calcareous silt loam mottled with light gray or grayish brown (2.5Y 7/2 dry, 5/2 moist); faintly mottled with light olive brown (2.5Y 5/6); medium lamina.

Note: Laboratory number 860 was skipped.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Glyndon very fine sandy loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-1 **LAB. NOS.** 1801-1807

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5½	A1p	0.3	0.3	0.8	29.1	42.2	16.1	11.2	76.2	6.2	-	vfsl
5½-10	A12	0.1	0.2	0.6	24.9	43.6	16.7	13.9	75.2	5.9	-	vfsl
10-17	A13	0.2	0.6	0.7	24.1	44.1	16.6	13.7	75.2	5.7	-	vfsl
17-29	Cca	-	-	0.2	9.1	58.3	17.4	15.0	78.2	6.1	-	vfsl
29-39	C11	-	-	0.1	7.7	62.6	19.4	10.2	83.8	5.7	-	vfsl
39-51	C12	-	0.1	0.1	4.9	62.6	22.5	9.8	84.0	5.7	-	vfsl
51-60	Cg	-	0.1	0.1	2.6	53.4	32.5	11.3	80.5	7.7	-	vfsl

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.1	8.0	1.87			<0.20	1.1	1				7.9
8.2	8.9	8.9	1.40			<0.20	1.8	1				8.9
8.4	9.0	9.1	0.58			<0.20	1.2	4				7.4
8.4	9.1	9.2	0.19			<0.20	1.4	12	-			6.8
8.3	9.1	9.2	0.14			<0.20	1.2	8	-			5.4
8.1	9.0	9.1	0.11			<0.20	1.0	7	-			5.7
8.0	8.8	9.0	0.17			<0.20	0.9	3	-			6.5

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE Ca	602b Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5B1b 5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →				
17.5		6.4	0.4	0.8	2	2.0	0.8			40.3
17.2			1.2	0.6	7	10.9	0.4			41.5
12.3			1.1	0.4	9	7.6	0.2			39.6
7.4			1.0	0.2	14	8.1	-			37.4
7.9			1.1	0.2	14	9.1	-			36.9
8.9			1.1	0.2	12	7.6	-			40.2
11.2		7.6	1.1	0.2	10	6.1	-			39.5

Soil type: Glyndon very fine sandy loam
Soil No.: S53NDak-5-1
Location: 430 feet west and 100 feet north of southeast Sec. 10, T159N, R75W, Bottineau County, North Dakota.
Vegetation: Flax stubble.
Parent material: Glacial lacustrine (delta) sand deposits.
Physiographic position: Delta plain, east edge Glacial Lake Souris.
Topography: Level (relief in inches).
Slope: 1/2 percent.
Drainage: Moderately well.
Ground water: Saturated soil at 56 inches plus.
Permeability: Moderately rapid.
Moisture: Moist below plow layer.
Described by: C. A. Mogen.
Date: September 14, 1953.

Mandan Lab. No.	Horizon	
1801	A1p	0 to 5½ inches. Very dark gray to black (10YR 3/1 to 2/1 moist) mildly calcareous very fine sandy loam; weak fine granular structure; soft when dry, very friable when moist.
1802	A12	5½ to 10 inches. Very dark gray to black (10YR 3/0.5 to 2/1 moist) mildly calcareous very fine sandy loam; weak medium-sized blocky structure; soft when dry, very friable when moist.
1803	A13	10 to 17 inches. Dark gray with common fine distinct mottlings of light gray, dry, to very dark gray mottled with grayish brown, moist, (10YR 4/1 and 7/1 to 3/1 and 5/2 moist) moderately calcareous very fine sandy loam; weak fine granular structure; slightly hard when dry, very friable when moist. This changes in a clear irregular boundary.
1804	Cca	17 to 29 inches. Pale yellow to light olive brown (2.5Y 7/3, 5.5/4 moist) very strongly calcareous very fine sandy loam; porous, massive to weak fine subangular blocky; soft when dry, very friable when moist. This changes in a clear very irregular boundary.
1805	C11	29 to 39 inches. Light yellowish brown with common fine faint mottlings of light brownish gray, dry, to light olive brown, moist, (2.5Y 6/4 and 6/2 dry, 5/4 moist) strongly calcareous very fine sandy loam; porous, massive structure; slightly hard when dry, very friable when moist. This grades into
1806	C12	39 to 51 inches. Light yellowish brown and light gray, dry, to light olive brown, moist, (2.5Y 6/4 and 7/2 dry, 5/4 moist) moderately calcareous very fine sandy loam; massive structure; slightly hard when dry, very friable when moist. This grades into
1807	Cg	51 to 60 inches. Light yellowish brown with many fine distinct mottlings of light gray, white and many fine prominent mottlings of brownish yellow and a few fine prominent mottlings of very dark brown, dry, (2.5Y 6/4, 7/2 and 8/0 and 10YR 6/8 and 2/2 dry to 2.5Y 5/4, 6/2 and 6/0 and 10YR 5/8 and 2/2 moist) moderately calcareous very fine sandy loam; slightly hard; weak medium laminated structure; very friable.

Remarks: There are irregular shaped masses or inclusions of light-colored material from the C horizon in the A12 and A13 horizons. These are sometimes called "Krotovinas".

SOIL SURVEY LABORATORY Mandan, North Dakota

SOIL TYPE Glyndon very fine sandy loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S53NDak-5-2 **LAB. NOS.** 1808-1815

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	A1p	0.2	0.3	1.0	32.1	41.6	13.8	11.0	77.0	5.2	-	vfsl
6-9	A12	-	0.2	0.7	30.7	42.2	14.0	12.2	77.2	5.7	-	vfsl
9-19	Cca11	-	0.2	0.6	24.9	39.6	17.0	17.7	71.0	7.3	-	vfsl
19-26	Cca12	-	0.2	0.5	23.5	39.1	15.6	21.1	68.8	6.9	-	scl
26-32	Cca2	-	0.1	0.3	23.3	46.3	13.4	16.6	75.3	6.1	-	vfsl
32-43	C1	-	-	0.1	37.7	44.2	8.0	10.0	86.0	3.3	-	lfs
43-49	C2	-	-	0.1	37.1	45.8	8.5	8.5	86.5	4.2	-	lfs
49-60+	Cg	-	-	0.1	38.9	46.5	8.2	6.3	89.1	3.8	-	lfs

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4	8.1	8.2	1.74			<0.20	0.8	-				7.2
7.8	8.3	8.4	1.40			<0.20	0.6	-				7.8
8.1	9.0	9.1	0.61			<0.20	0.8	10				7.8
8.5	9.4	9.5	0.38			<0.20	0.9	17	-			9.4
8.4	9.4	9.5	0.22			<0.20	1.0	14	-			6.5
8.5	9.3	9.4	0.08			<0.20	0.8	8	-			4.3
8.5	9.3	9.5	0.08			<0.20	0.7	6	-			4.3
8.5	9.3	9.4	0.05			<0.20	0.6	4	-			3.9

5A1a CATION EXCHANGE CAPACITY NH_4OAc	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg		EXCHANGEABLE 6P2a Na	6Q2a K	5B1b	5D1 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K			8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→			← milliequivalents per liter →					
16.7	14.9	4.9		0.2	1.0		1	0.3	1.2				39.9
16.6	15.0	4.1		0.2	1.0		1	0.3	0.8				38.4
9.5				0.1	1.3		1	0.3	1.8				36.0
7.1				0.1	1.5		1	0.6	3.3				34.0
6.7				0.2	1.4		3	0.6	3.5				33.8
5.6				0.1	0.7		2	0.6	2.0				33.7
6.4				0.1	0.7		2	0.6	1.6				35.1
6.4				0.2	0.5		3	0.6	0.8				36.3

Soil type: Glyndon very fine sandy loam
Soil No.: S53NDak-5-2
Area: Bottineau County, North Dakota.
Location: 900 feet south and 900 feet west of E1/4 corner Sec. 9, T159N, R75W.
Vegetation: Wheat stubble.
Parent material: Glacial lacustrine (delta) deposited sands.
Physiographic position: Delta plain east edge of Glacial Lake Souris, midway of long slope, 150 feet back from edge of small, shallow, poorly drained depression.
Topography: Very gently undulating (relief two to four feet).
Slope: 1 percent.
Drainage: Moderately well drained.
Permeability: Moderately rapid.
Moisture: Moist.
Described by: C. A. Mogen.
Date: September 14, 1953.

Mandan Lab.No.	Horizon	
1808	A1p	0 to 6 inches. Very dark gray to black (10YR 3/1 to 2/1 moist) mildly calcareous or noncalcareous very fine sandy loam; weak fine granular structure; soft when dry, very friable when moist.
1809	A12	6 to 9 inches. Very dark gray to black (10YR 3.5/0.5 to 2/1 moist) mildly calcareous or noncalcareous very fine sandy loam; weak medium blocky structure; soft when dry, very friable when moist.
1810	Ccal1	9 to 19 inches. Gray with many fine faint mottlings of light gray, dry, to dark gray mottled with gray, moist, (10YR 5/1 and 7/1; 4/1 and 6/1 moist) strongly calcareous very fine sandy loam; massive to very weak fine granular structure; soft when dry, very friable when moist.
1811	Ccal2	19 to 26 inches. Light gray to grayish brown with common fine faint mottlings of light brownish gray, moist, (2.5Y 7/2; 5/2 and 6/2 moist) strongly calcareous sandy clay loam; massive structure or very fine weak granular; soft when dry, very friable when moist.
1812	Cca2	26 to 32 inches. Light gray, dry, to light yellowish brown with common fine distinct mottlings of light gray, moist, (2.5Y 7/2; 6/4 and 7/2 moist) strongly calcareous very fine sandy loam; massive structure; soft when dry, very friable when moist.
1813	C1	32 to 43 inches. Light yellowish brown with common fine faint mottlings of light brownish gray, dry, to light olive brown, moist, (2.5Y 6/4 and 6/2; 5/6 moist) mildly calcareous loamy fine sand; massive structure; soft when dry, very friable when moist.
1814	C2	43 to 49 inches. Light yellowish brown with common fine distinct mottlings of white (1Y 6/4 and 8/2 dry to 5/4 and 7/2 moist) very mildly calcareous loamy fine sand; massive structure; soft when dry, very friable when moist. Changes clearly into
1815	Cg	49 to 60+ inches. Light gray with common fine prominent mottlings of brownish yellow, dry, (5Y 7/2 and 10YR 6/8 dry to 5Y 6/2 and 2.5Y 5/4 moist) very mildly calcareous loamy fine sand; single grain structure; soft when dry, very friable when moist.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Hamerly clay loam **LOCATION** Nelson County, North Dakota

SOIL NOS. S53NDak-32-1 **LAB. NOS.** 1663-1668

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	A1p	1.7	3.6	4.3	8.9	6.1	45.0	30.4	28.7	27.4	0.8	cl
7-16	Cca1	3.2	3.9	4.0	8.8	7.1	42.4	30.6	27.3	27.5	3.8	cl
16-24	Cca2	2.8	4.1	4.3	9.7	7.2	41.3	30.6	25.7	28.6	4.2	cl
24-34	C1	5.7	6.4	5.5	10.8	7.7	38.3	25.6	26.7	25.5	5.1	l
34-45	C2	4.1	6.3	6.2	12.4	9.1	38.7	23.2	30.1	24.9	4.8	l
45-60	C3	5.1	6.8	6.3	12.7	9.0	38.5	21.6	29.8	25.3	6.7	l

8C1b pH SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
8.0			3.21	0.270	11.9	<0.20	0.7	2				17.2
8.5			0.76	0.086	8.8	<0.20	0.6	19				15.6
8.4			0.53	0.060	8.8	<0.20	0.8	25				17.0
8.2			0.20	0.029		<0.20	0.8	18				14.0
8.0			0.14	0.024		<0.20	0.7	15				13.3
7.9			0.09	0.021		<0.20	0.6	14				13.3

	EXTRACTABLE CATIONS 5B1a Ca	6G2b Mg	6P2a Na	6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil					milliequivalents per liter					
		5.2	0.1	0.6	0.4	0.4	0.4				62.2
		24.4	0.1	0.3	-	0.4	0.1				56.9
		20.5	0.2	0.2	-	1.1	0.1				55.8
		13.4	0.2	0.3	-	0.6	-				49.2
		10.0	0.2	0.3	-	0.6	-				46.5
		7.9	0.2	0.3	-	0.4	-				43.8

Soil type: Hamerly clay loam
Soil No.: 853NDak-32-1
Location: 240 feet south and 180 feet west of the north quarter corner Sec. 3, T152N, R60W, Nelson County, North Dakota.
Crop: Cultivated, fallow after wheat.
Climate: Average annual precipitation about 18.5 inches; normal annual temperature 37° F.
Parent material: Friable, calcareous loam till, very probably of Mankato (late Wisconsin) age.
Physiography: Gently undulating till plain with much low, wet land. The soils are mainly those of the Hamerly and Aastad series, with some Flom and Parnell but little Barnes. This site is about 1½ feet higher than the bottom of a small undrained depression in which there is a Tetonka-Flom intergrade. Higher on the slope toward the southeast is a fair example of Aastad soil.
Slope: About 1½ percent, slightly concave, facing toward the northwest.
Drainage: Moderately well drained. Runoff is medium; permeability moderately slow, apparently affected by moderately high water table (although the profile is not wet now) and by upward capillary movement of water. The surface of the cultivated field shows grayish spots where the high-lime material has been plowed up.
Described by: W. M. Johnson, 1953.

Mandan Lab.No.	Horizon	
1663	Alp	0 to 7 inches. Very dark gray to black (10YR 3/0.5 dry; 2/0.75 moist) soft, friable clay loam. Has a "salted" appearance due to grains of light colored Cca horizon brought up and mixed by cultivation. Cloddy due to tillage but the clods break easily to moderate very fine granules. Plastic and slightly sticky when wet. Moderately calcareous. The lower boundary is abrupt and smooth.
1664	Ccal	7 to 16 inches. White to light brownish gray (2.5Y 8/2 dry; 6/2.5 moist) friable, soft, plastic, slightly sticky clay loam with numerous vertical "tongues" of grayish brown (dry). Moderate medium prisms break easily to weak medium blocks that may be crushed to very fine aggregates resembling granules. Very strongly calcareous, the carbonates being in disseminated form. Porous. Lower boundary is gradual and smooth.
1665	Cca2	16 to 24 inches. Light gray to grayish brown (2.5Y 7.5/2.5 dry; 5/2.5 moist) soft friable, plastic, slightly sticky, clay loam with a few conspicuous, somewhat darker "tongues" coming down from the horizons above. Weak coarse irregular blocks may be crushed to very fine granule-like peds. Very strongly calcareous, the lime being in disseminated form. Porous. The lower boundary is clear and wavy.
1666	C1	24 to 34 inches. Light brownish gray to olive brown (2.5Y 6/2.5 dry; 4/3 moist) soft, friable, plastic, slightly sticky, loam till, with few to common inconspicuous medium and fine light gray mottles. Very weak, very fine irregular blocky structure. Strongly calcareous. Porous. The lower boundary is gradual and slightly wavy.
1667	C2	34 to 45 inches. Light yellowish brown to olive brown (2.5Y 6.5/3 dry; 4/3.5 moist) soft, friable, plastic, slightly sticky, loam till with common fine and medium mottles of gray and a few fine spots of red. Moderate medium and very coarse platy structure. Strongly calcareous. Porous. Diffuse, smooth lower boundary.
1668	C3	45 to 60 inches. Light yellowish brown to olive brown (2.5Y 6.5/3 dry; 4/3 moist) soft, friable, loam till with common fine and medium mottles of gray and a few fine spots of red. Moderate very coarse platy structure. This material is rather high in weathered shale chips. Strongly calcareous, with lime both disseminated and segregated along cracks. Porous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Hamerly loam **LOCATION** Nelson County, North Dakota

SOIL NOS. S53NDak-32-2 **LAB. NOS.** 1669-1674

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-8	A1p	2.6	5.8	6.8	13.5	8.3	36.1	26.9	32.7	19.4	1.3	l
8-11	A12	2.8	6.0	6.3	12.4	7.6	35.3	29.6	30.1	20.1	1.5	cl
11-21	Cca1	3.5	4.7	4.8	11.0	6.1	31.4	38.5	23.9	20.0	3.5	cl
21-28	Cca2	4.2	5.6	5.5	11.6	7.3	37.5	28.3	26.2	25.5	3.2	cl
28-44	Ccs	4.9	7.6	6.4	12.0	8.0	35.6	25.5	27.6	23.1	3.9	l
44-60	C1	4.6	6.6	6.2	12.6	8.9	38.4	22.7	30.7	24.2	4.5	l

DEPTH INCHES	pH 8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
0-8	7.8			3.99	0.314	12.7	<0.20	0.7	1				14.6
8-11	7.9			2.22	0.212	10.5	<0.20	0.6	4				14.4
11-21	8.2			0.86	0.096	9.0	<0.20	0.7	32				11.9
21-28	8.0			0.64	0.073	8.8	<0.20	3.1	20	-			13.8
28-44	7.9			0.20	0.025		0.20	6.0	14	70			14.1
44-60	7.9			0.14	0.021		0.20	5.5	15	-			12.8

DEPTH INCHES	EXTRACTABLE CATIONS Ca	6G2b Mg	6P2a Na	6Q2a K	5B1a	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6I1a SO_4	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
0-8		5.6	0.1	0.8		0.4	0.2	0.5				54.8
8-11		7.1	0.1	0.6		-	0.2	0.4				54.9
11-21		8.7	0.1	0.3		-	0.4	0.1				46.6
21-28							6.7	0.8				50.1
28-44							21.1	1.0	1.6	2.5	92.5	47.8
44-60							21.5	0.4	1.6	2.0	78.4	45.6

Soil type: Hamerly loam
Soil No.: 853NDak-32-2
Location: 450 feet north and 75 feet east of the southwest corner Sec. 23, T153N, R60W, Nelson Couty, North Dakota.
Crop: Cultivated, fallow after wheat.
Climate: Average annual precipitation about 18.5 inches; normal annual temperature 37° F.
Parent material: Friable, calcareous loam glacial till, very probably of Mankato (late Wisconsin) age.
Physiography: Gently undulating till plain. This soil occurs in a ring or band around a shallow undrained depression. The dominant soils in the vicinity are Hamerly and Aastad, with varying but relatively small amounts of Barnes, Flom and Parnell.
Slope: About 1½ percent toward the southwest; very slightly concave.
Drainage: Moderately well drained; medium runoff. Medium to moderately slow permeability, affected by capillary rise of water from intermittent high water table.
Described by: W. M. Johnson, 1953.
Mandan

Lab.No.	Horizon	
1669	Alp	0 to 8 inches. Very dark gray to black (10YR 3/1 dry; 2/0.75 moist) slightly hard, friable loam. Cultivated soil is cloddy but the clods crush easily to moderate very fine granules. Slightly calcareous. Lower boundary is abrupt and smooth.
1670	A12	8 to 11 inches. Very dark gray to black (10YR 3/1 dry; 2/0.75 moist) soft, friable clay loam. Moderate medium prisms break easily to weak irregular medium blocks that in turn may be crushed to very fine granules. Moderately calcareous. Abrupt, very wavy or irregular boundary. Horizon varies in thickness from 1 to 6 inches.
1671	Ccal	11 to 21 inches. Light brownish gray to dark grayish brown (2.5Y 6/2 dry; 4/2 moist) soft, friable clay loam or light silty clay loam with abundant conspicuous fine white mottles (dry). Moderate medium prismatic structure. Porous. Very strongly calcareous. Gradual, wavy lower boundary.
1672	Cca2	21 to 28 inches. Light yellowish brown to olive brown (2.5Y 6/3 dry; 4.5/3 moist) soft, friable, plastic, slightly sticky, clay loam, with common fine white mottles. Moderate medium prismatic structure. Very strongly calcareous. Porous. The lower boundary is diffuse and wavy.
1673	Ccs	28 to 44 inches. Pale olive to olive (5Y 6/3 dry; 4.5/3 moist) soft, friable loam, with common fine mottles of gray, white and strong brown. Weak coarse prisms may be broken into moderate medium and coarse plates. Strongly calcareous. Very many "nests" of gypsum crystal from 1/2 to 1 inch in diameter. Porous. Diffuse, wavy lower boundary.
1674	C1	44 to 60 inches. Finely and inconspicuously mottled gray, yellowish brown, white and brown giving a mass effect of light brownish gray (2.5Y 6/2 dry; 4/3 moist) soft, friable loam till. Moderate medium and coarse platy structure. Strongly calcareous. Plastic and slightly sticky when wet. Porous.

Note: Grayish spots and rings in plowed fields show where tillage implements have brought up material from the Cca horizon. Pebbles and small stones are scattered over the soil surface.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Hamerly silt loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-4 **LAB. NOS.** 459-464a

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (>19mm)	TEXTURAL CLASS
0-5	Ap	5.1	6.3	7.0	13.4	12.0	32.5	23.6	36.0	16.0	2	l
5-10	A3	4.2	7.0	7.2	12.5	11.0	31.2	26.9	35.0	14.2	3	l
10-28	C1ca	3.8	6.1	6.4	11.5	9.3	30.8	32.3	28.9	17.6	6	cl
28-36	C21	3.8	6.2	6.7	13.0	9.9	33.3	27.2	31.6	19.1	6	cl
36-40	C22	4.8	7.8	7.8	13.1	9.4	32.9	24.1	30.5	19.2	7	l
40-48	C31cs	5.0	7.5	7.4	13.5	10.0	33.2	23.4	31.4	19.2	7	l
48-60	C32cs	4.6	7.2	7.3	13.4	10.5	42.4	14.6	31.6	29.0	9	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.5	8.7	2.96	.288	10.3	-	0.6	6	-			11.8
7.9	8.5	8.8	1.75	.190	9.2	-	0.7	9	-			12.2
8.1	8.9	9.2	0.46	.060	7.7	-	1.4	28	-			9.6
8.5	8.9	8.9	0.24	.031		0.64	15.0	17	6			10.0
8.2	8.7	8.8	0.12	.020		0.54	14.0	17	5			9.6
8.1	8.5	8.7	0.10	.017		0.59	13.5	17	19			10.0
8.0	8.4	8.6	0.13	.018		0.61	13.5	14	43			10.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE Ca	Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6L1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil					milliequivalents per liter					
22.8			-	1.6	-	0.2	0.8				48.8
19.9			-	0.8	-	0.4	0.4				47.8
11.8			0.2	0.5	2	5.6	0.5				41.2
13.7			2.3	0.8	17	104.2	2.1	2.8	2.9	58.6	42.6
12.2			2.1	0.7	17	98.0	2.2				40.1
12.0			2.0	0.7	17	93.2	1.9	3.3	2.5	51.6	42.7
12.0			2.2	0.6	18	86.8	1.6				44.7

Soil type: Hamerly loam
Soil No.: S50NDak-38-4
Location: Northeast quarter of northeast quarter, Sec. 17, T161N, R85W, Renville County, North Dakota.
Vegetation: Quackgrass fallow.
Parent material: Glacial till.
Physiographic position: Crest of short rise between wet depressions on till plain.
Topography: Gently undulating.
Slope: 3 percent.
Erosion: Slight.
Drainage: Moderately well; restricted internal drainage due to capillary rise from fluctuating seasonal water table.
Moisture: Moist.
Stoniness: Few.
Described by: C. A. Mogen
Date: September 19, 1950.

Horizon and Mandan Lab. Number	
Ap 459	0 to 5 inches. Gray when dry, very dark gray when moist (10YR 5/1, 3/1), mildly calcareous loam having a moderately developed fine crumb structure; soft when dry; very friable when moist. This grades into
A3 460	5 to 10 inches. Grayish brown distinctly mottled with numerous fine spots of light gray and streaked with gray when dry, olive brown mottled with grayish brown and streaks of very dark gray, moist (2.5Y 5/2, 7/2, 10YR 5/1 dry, 2.5Y 3/3, 5/2, and 3/1 moist), strongly calcareous loam with a slight amount of segregated lime; weak medium prismatic structure; prisms readily separate into moderately developed medium-sized granules; slightly hard when dry; very friable when moist. This changes clearly into
C1ca 461	10 to 28 inches. Distinctly mottled in a fine- and medium-sized pattern of light brownish gray and white, dry, and light olive brown and light gray, moist (2.5Y 6/2 and 8/2 dry, 2.5Y between 5/2 and 5/4 with 7/2 moist), strongly calcareous clay loam with a large amount of segregated lime; weak to moderate medium-sized granular structure; hard when dry; friable when moist.
C21 462	28 to 36 inches. Light gray faintly mottled with very fine spots of light yellowish brown and white, dry, and light yellowish brown, moist (2.5Y 6/2, 6/4, and 8/2 dry, 2.5Y 4/3 moist), moderately calcareous clay loam with slight amount of segregated lime; hard when dry; friable when moist.
C22 463	36 to 40 inches. Light gray faintly mottled with a very few very small spots of yellowish red, moist soil is light olive brown (2.5Y 7/2, 5YR 4/6 dry, 2.5Y 5/3, 5YR 4/6 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; firm when moist.
C31cs 464	40 to 48 inches. Faintly mottled light gray and pale yellow when dry, light olive brown when moist (2.5Y 7/2 and 7/4 dry, 2.5Y 5/3 moist), mildly calcareous loam; moderate very thick platy; there is a large quantity of crystalline gypsum present.
C32cs 464a	48 to 60 inches. Faintly mottled light gray and white with very few very fine spots of reddish brown, dry, olive brown stained with dark reddish brown when moist (2.5Y 6/2 and 8/2, 5YR 4/4 dry, 2.5Y 4/3, 2.5YR 3/4 moist), mildly calcareous loam; moderate very thick platy; gypsum same as in the horizon above.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Hamerly loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-7 **LAB. NOS.** 480-486

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	3.7	5.4	6.4	13.2	12.2	33.9	25.2	37.2	16.7	4	l
6-16	C11ca	3.0	5.0	5.6	11.5	9.4	32.4	33.2	29.1	19.2	5	cl
16-26	C12ca	2.1	5.0	6.0	13.3	11.4	34.1	28.1	34.2	19.4	6	cl
26-36	C21	3.1	5.4	6.4	13.2	11.5	34.4	25.9	34.4	19.4	5	l
36-48	C22	3.8	5.5	6.0	12.9	11.5	35.2	25.1	34.8	19.9	6	l
48-60	C31cs											
60-72	C32cs	3.4	5.4	6.2	13.6	12.1	34.2	24.9	35.0	19.4	8	l

8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
pH			ORGANIC MATTER									
7.9	8.3	8.6	2.42	.233	10.4	-	0.6	4	-			11.7
8.0	8.8	9.1	0.69	.078	8.8	-	0.6	25	-			9.9
7.9	8.5	8.7	0.26	.037	7.0	0.28	6.5	18	-			9.6
8.0	8.5	8.8	0.19	.026		0.29	6.5	14	-			10.2
7.8	8.2	8.6	0.18	.022		0.33	7.3	13	8			10.1
7.7	8.2	8.2	0.20	.021		0.34	7.0	11	40			10.8
7.6	8.2	8.3	0.18	.022		0.26	6.2	11	28			11.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS Ca	Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				←	milliequivalents per liter	→				
23.2			0.1	1.1	-	0.4	0.2					49.4
13.3			0.2	0.3	2	0.9	-					43.3
13.4			0.8	0.5	6	10.2	1.9					43.0
14.4			1.0	0.7	7	13.5	2.3	2.6	2.2	22.6		43.8
13.8			0.8	0.6	6	13.8	2.1					43.5
13.4			0.7	0.6	5	13.1	2.0	3.1	3.1	24.4		45.8
13.8			0.6	0.5	4	10.2	1.7					46.3

Soil type: Hamerly loam
Soil No.: S50NDak-38-7
Location: Southeast quarter of southwest quarter, Sec. 33, T162N, R85W, Renville County, North Dakota.
Vegetation: Disked stubble field.
Parent material: Calcareous clay loam glacial till.
Physiographic position: Upland till plain; crest of rise between depressions.
Topography: Gently undulating.
Slope: 2 percent.
Drainage: Moderately well.
Stoniness: Slight.
Described by: C. A. Mogen.
Date: September 19, 1950.

Horizon and Mandan Lab. Number	
Ap 480	0 to 6 inches. Gray with some fine distinct mottlings of light gray, dry, and very dark gray mottled with grayish brown, moist (10YR 5/1 and 7/2 dry, 3/1 and 5/2 moist), mildly calcareous loam with a slight amount of segregated lime; moderately developed fine granular structure; hard when dry; very friable when moist.
C11ca 481	6 to 16 inches. Mottled white and light yellowish brown, dry, and mottled pale yellow and light olive brown, moist (2.5Y 8/2 and 6/3 dry, 7/4 and 5/4 moist), strongly calcareous light clay loam; moderate amount of segregated lime; moderately granular; hard when dry; friable when moist.
C12ca 482	16 to 26 inches. Light yellowish brown with numerous distinct fine mottlings of white and a very few very fine mottlings of yellowish brown, dry, and light olive brown mottled with light gray and yellowish brown, moist (2.5Y 6/3, 8/2, and 8/0, 10YR 5/8 dry, 2.5Y 5/3 and 7/2, 10YR 5/8 moist), moderately calcareous clay loam; weak granular structure; hard when dry; friable to firm when moist; slight amount of segregated lime. This grades into
C21 483	26 to 36 inches. Mottled light brownish gray, white and light olive brown with a very few very fine spots of red, dry, and mottled dark grayish brown, light gray and light olive brown, with stains of weak red, moist (mottlings are distinct and small), (2.5Y 6/2, 8/0 and 5/6, 2.5YR 4/8 dry, 2.5Y 4/2, 7/2 and 5/6, 2.5YR 4/2 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; firm when moist. This grades into
C22 484	36 to 48 inches. Light yellowish brown with numerous fine distinct mottlings of light gray and brownish yellow and with a very few fine spots of yellowish red, dry, and olive brown mottled with gray and yellowish brown, moist (2.5Y 6/3, 10YR 7/1 and 6/6, 5YR 5/8 dry, 2.5Y 4/3, 10YR 5/1 and 5/6, 5YR 4/8 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; firm when moist.
C31cs 485	48 to 60 inches. Faintly mottled light brownish gray and light yellowish brown with few distinct mottlings of brownish yellow and black, dry, and mottled grayish brown and light olive brown with spots of yellowish brown and black, moist (mottlings are small in size), (2.5Y 6/2 and 6/4, 10YR 6/6, 2.5Y 2/0 dry, 2.5Y 5/2 and 5/4, 10YR 5/6, 2.5Y 2/0 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; firm when moist. Contains a moderate amount of crystalline gypsum. This grades into
C32cs 486	60 to 72 inches. Similar to above layer but mottles are of medium size and are yellowish red, dry and moist (5YR 5/8 and 4/6).

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Hecla sand **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-1 **LAB. NOS.** 850-855

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	Ap	1.7	15.5	29.2	38.5	5.0	5.1	5.0	25.0	3.1	Tr.	s
7-12	A1	1.5	15.2	31.5	41.9	3.7	2.7	3.5	24.1	1.6	Tr.	s
12-18	AC1	1.0	12.7	27.5	44.8	5.8	3.7	4.5	29.8	1.6	Tr.	s
18-32	AC2	3.9	24.0	34.1	30.1	2.1	2.1	3.7	14.6	1.2	1	cs
32-42	Ccag1	0.9	11.5	28.3	52.8	1.9	2.4	2.2	25.7	0.8	1	fs
42-60	Ccag2	11.1	59.3	17.8	7.1	0.7	2.5	1.5	4.9	1.0	5	cs

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.4	7.9	7.9	0.93	0.089	10.4	-	0.5	-	-	12.0		5.0
7.6	8.0	8.1	0.45	0.042	10.7	-	0.4	-	-	6.2		3.1
7.6	8.1	8.0	0.44	0.044	10.0	-	0.4	-	-	6.8		3.0
7.8	8.3	8.2	0.25	0.029	8.6	-	0.3	-	-	5.1		2.6
8.2	9.1	9.2	0.07	0.008		-	0.3	5	-	4.0		1.9
8.2	9.2	9.2	0.03	0.003		-	0.3	11	-	3.1		1.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →				
8.4	7.5	1.4	-	0.3	-	-	0.4			29.2
4.7	4.1	0.7	-	0.2	-	0.2	0.2			25.8
5.5	5.0	1.1	-	0.1	-	-	0.2			25.9
4.3	4.9	0.9	-	0.1	-	-	0.2			24.7
2.1			0.1	0.1	5	0.2	-			25.7
1.6			0.1	0.1	6	0.2	0.2			22.3

Soil type: Hecla sand
Soil No.: S51NDak-5-1
Location: 200 feet southeast of northwest corner of northwest quarter of northwest quarter Sec. 20, T161N, R80W, Bottineau County, North Dakota.
Vegetation: Summer fallow.
Parent material: Coarse-textured lacustrine materials which have been reworked by wind.
Physiographic position: Upland delta.
Topography: Simple slope to pothole, 2 percent slope.
Drainage: Moderate.
Moisture: Moist.
Stoniness: None.
Described by: C. A. Mogen.
Date: September 10, 1951.

Horizon and Mandan Lab. Number	
Ap 850	0 to 7 inches. Dark gray or very dark brown (10YR 4/1 dry, 2/2 moist) loose sand, grading to
A1 851	7 to 12 inches. Grayish brown to dark grayish brown or very dark grayish brown to very dark brown (10YR 4/2 to 5/2 dry, 3/2 to 4/2 moist) loose sand, grading to
AC1 852	12 to 18 inches. Dark grayish brown to dark gray or very dark grayish brown to dark brown (10YR 4/2 to 4/1 dry, 3/2 to 4/3 moist) loose noncalcareous sand, grading to
AC2 853	18 to 32 inches. Grayish brown to brown or very dark grayish brown to dark brown (10YR 5/2 to 5/3 dry, 3/2 to 4/2 moist) loose noncalcareous coarse sand, grading to
Ccag1 854	32 to 42 inches. Pale brown or brown (10YR 6/3 dry, 5/3 moist) very weakly calcareous fine sand, grading to
Ccag2 855	42 to 60 inches. Light yellowish brown or yellowish brown (10YR 6/4 dry, 5/4 moist) coarse sand; very weakly calcareous; small black specks (10YR 2/1).

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Hecla loamy fine sand **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-12-(1-6) **LAB. NOS.** 4525-4530

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-8	A11	0.1	0.1	0.6	24.3	44.4	21.6	8.9	80.6	6.2	-	vfsl
8-20	A12	0.1	0.1	1.2	40.2	39.8	12.6	6.0	81.0	4.2	-	lfs
20-28	AC1	-	0.1	1.3	43.2	38.3	11.2	5.9	80.6	3.8	-	lfs
28-35	AC2	-	-	0.9	40.3	41.7	10.9	6.2	83.0	3.2	-	lfs
35-45	C1	-	-	1.4	43.1	38.9	10.3	6.3	79.7	3.1	-	lfs
45-58	C2	-	-	1.5	35.8	40.7	14.5	7.5	79.5	3.1	-	lfs

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
6.7	7.0	7.1	2.46	.205	12.0	<0.20	0.9	-				8.3
6.7	7.1	7.2	1.39	.126	11.0	<0.20	0.7	-		16.0	8.3	5.6
6.9	7.2	7.4	0.70	.083	8.4	<0.20	0.5	-		13.7	6.8	4.4
6.9	7.5	7.5	0.41			<0.20	0.5	-		12.3	6.1	3.9
7.1	7.6	7.7	0.26			<0.20	0.5	-		12.6	6.4	3.7
7.7	8.0	8.3	0.14			<0.20	0.7	-		16.2	7.7	4.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	5B1a 6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil →						← milliequivalents per liter →					
14.1	9.3	2.8		0.2	1.6	1	1.0	1.9	3.7	1.6		51.3
10.3	7.4	1.7		0.1	0.9	1	0.9	1.2	2.7	1.8		39.0
8.4	6.0	1.8		-	0.6	-	0.4	0.7	2.1	1.6		32.5
7.0	4.8	1.8		-	0.4	-	0.5	0.4	2.7	1.6		31.0
6.9	5.1	1.8		-	0.4	-	0.5	0.3	2.7	2.0		29.9
7.3	5.4	2.6		-	0.4	-	0.6	0.4	3.8	3.0		32.1

Soil type: Hecla loamy fine sand
Soil No.: 856NDak-41-12-(1-6)
Location: 1060 feet east and 75 feet north of south quarter corner of Sec. 34, T129N, R57W, Sargent County, North Dakota.
Vegetation: Tame grasses.
Parent material: Sandy lacustrine.
Physiographic position: Sandy area in glacial Lake Dakota.
Topography: Nearly level.
Relief: 3 to 5 feet.
Drainage: Moderate.
Moisture: Dry.
Described by: Wesley M. Larsen.
Date: July 12, 1956.

Horizon and Lincoln Lab. Number	
A11 4525	0 to 8 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) loamy fine sand.
A12 4526	8 to 20 inches. Dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist) very friable loamy fine sand.
AC1 4527	20 to 28 inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown and very dark brown (10YR 3/2 and 2/2 moist) noncalcareous very friable loamy fine sand; gradual boundary.
AC2 4528	28 to 35 inches. Same as horizon above.
C1 4529	35 to 45 inches. Brown (10YR 5/3 dry) to dark grayish brown (10YR 4/2 moist), very friable, noncalcareous loamy fine sand.
C2 4530	45 to 58 inches. Light yellowish brown (10YR 6/4 dry) to yellowish brown (10YR 5/4 moist), very friable, noncalcareous loamy fine sand.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Hecla loamy fine sand **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-13-(1-6) **LAB. NOS.** 4531-4536

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-12	A11	-	0.1	2.7	54.5	32.2	6.0	4.5	73.5	2.9	-	fs
12-22	A12	-	0.1	2.2	50.7	34.2	7.4	5.4	75.4	3.1	-	lfs
22-30	AC	-	0.1	2.4	53.8	33.6	5.1	5.0	75.0	2.3	-	fs
30-40	C1	-	0.1	2.2	54.8	34.2	3.7	5.0	76.0	1.3	-	fs
40-48	C2	-	0.1	2.5	55.8	33.1	3.9	4.6	74.9	1.4	-	fs
48-60	C3	-	-	1.4	43.7	40.0	8.7	6.2	78.5	2.9	-	lfs

8C1p pH SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.1	7.2	0.93	.076	12.2	<0.20	0.5	-		10.0	5.9	3.7
6.7	7.0	7.0	0.98	.087	11.3	<0.20	0.4	-		10.9	6.6	4.6
6.8	7.0	7.0	0.53	.060	8.8	<0.20	0.4	-		8.7	5.1	3.4
6.8	7.0	7.0	0.28			<0.20	0.4	-		7.4	4.4	3.0
6.8	7.2	7.0	0.20			<0.20	0.4	-		7.6	4.6	3.0
6.8	7.4	7.3	0.29			<0.20	0.5	-		11.7	6.4	3.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6Q2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6Q1a Mg		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter		→		
7.7	5.8	1.6		-	0.5	-	0.4	0.8	2.6	2.2		33.2
8.6	6.8	1.6		-	0.4	-	0.4	0.4	2.2	2.4		31.7
7.0	5.4	1.6		-	0.2	-	0.4	0.2	1.9	1.7		32.8
5.8	4.1	1.6		-	0.2	-	0.4	0.2	2.2	1.6		30.5
5.3	3.8	1.5		-	0.2	-	0.4	0.2	1.8	1.5		31.0
7.1	5.3	2.2		-	0.2	-	0.4	0.2	2.6	2.2		30.6

Soil type: Hecla loamy fine sand
Soil No.: 856NDak-41-13-(1-6)
Location: 200 feet east and 175 feet south of north quarter corner of Sec. 32, T129N, R57W, Sargent County, North Dakota.
Vegetation: Native grasses.
Topography: Top of low ridge.
Parent material: Sandy lacustrine material.
Moisture: Dry.
Physiographic position: Sandy portion of glacial Lake Dakota.
Relief: 5 to 10 feet, choppy.
Drainage: Moderate.
Root distribution: Abundant to 10 inches, plentiful to 48 inches, and few through 60 inches.
Described by: Wesley M. Larsen.
Date: August 8, 1956.

Horizon and Lincoln Lab. Number	
A11 4531	0 to 12 inches. Dark gray or very dark gray (10YR 4/1 dry, 3/1 moist) very friable loamy fine sand; smooth boundary.
A12 4532	12 to 22 inches. Same as horizon above.
AC 4533	22 to 30 inches. Grayish brown (10YR 5/2 dry) to dark gray (10YR 4/1 moist) very friable loamy fine sand; noncalcareous.
C1 4534	30 to 40 inches. Light brownish gray (10YR 6/2 dry) to grayish brown (10YR 5/2 moist) loose noncalcareous fine sand; wavy boundary.
C2 4535	40 to 48 inches. Same as horizon above.
C3 4536	48 to 60 inches. This horizon is the same color as the two above but contains many mottles of dark yellowish brown and yellowish brown (10YR 4/4 moist, 5/4 dry); very friable noncalcareous loamy fine sand.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE * Kenaston loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-2-(1-8) **LAB. NOS.** 8657-8664

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	Ap	2.7	5.5	6.0	13.5	10.1	35.4	26.8	33.1	19.7	2.5	l
5-9	B21	1.3	4.1	5.4	13.4	9.7	32.2	33.9	30.7	18.5	1.2	cl
9-13	B22	1.9a	3.9a	5.0a	12.4a	10.3a	34.8	31.7	31.6	20.6	1.1	cl
13-16	B3ca	2.0a	4.1a	4.8a	12.2a	9.7a	37.0	30.2	30.5	23.0	2.6	cl
16-23	Ccacs	2.0a	3.3a	3.7a	10.6a	9.6a	42.4	28.4	31.8	26.3	3.5	cl
23-31	Cca	1.5a	3.4a	4.3a	11.5a	9.9a	41.1	28.3	31.2	26.3	3.5	cl
31-43	C1	1.6a	3.1a	3.9a	11.1a	10.1a	44.8	25.4	33.5	27.8	2.1	l
43-61	C	2.6a	4.0a	5.2a	13.2a	10.2a	38.7	26.1	33.3	23.1	3.6	l

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.3	6.6	6.8	2.14	0.181	11.8	<0.20	0.7					10.9
6.3	6.7	7.0	1.05	0.092	11.4	<0.20	0.6					12.9
8.0	8.6	9.0	0.91	0.092	10	<0.20	1.4	2				12.4
8.2	8.7	8.9	0.58	0.053	11	0.26	5.0	11	<1			10.8
8.3	8.6	8.7	0.34	0.029	12	0.47	10.2	14	11			10.7
8.5	9.0	9.2	0.27	0.019	14	0.47	10.0	13	<1			11.3
8.5	8.9	9.1	0.23			0.66	11.4	10	<1			10.9
8.4	8.9	9.1	0.25			0.55	9.5	8	<1			11.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	8A1 6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
20.2	11.4	6.2	5.6	0.2	1.4	1	1.1	0.7				49.2
22.3	8.1	11.9	4.6	0.8	0.8	3	2.3	0.3				54.8
20.7		13.4	<0.1	1.7	0.5	6	6.9	0.2				56.4
17.0				3.3	0.4	10	28.6	0.4	4.4	8.1	56.3	57.2
14.0				5.9	0.4	15	66.1	0.5	2.8	7.9	147.5	57.2
15.3				7.4	0.6	20	72.4	0.6	2.1	7.9	130.7	61.4
15.4				8.2	0.6	23	79.0	0.6	2.3	10.1	151.4	58.6
16.2				8.0	0.6	22	73.2	0.6	2.1	9.6	116.7	61.0

a. Few smooth and irregular light brown to black concr. (Fe-Mn?); few $CaCO_3$ concr.

Soil type: *Kenaston loam
Soil No.: S58NDak-7-2-(1-8)
Location: 0.15 mile east and 80 feet south of northwest corner of Sec. 13, T161N, R89W, Burke County, North Dakota.
Vegetation: Summer-fallowed cropland.
Physiography: Till plain.
Parent material: Calcareous firm loam-clay loam glacial till.
Topography: Slightly undulating with less than 5 feet local relief. Slightly convex slope of less than 1 percent sampled.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Permeability: Moderate in solum, slow in parent material.
Drainage: Well drained with medium surface runoff into local depressions.
Moisture: Moist throughout due to fallow.
Root distribution: Little evidence of rooting below the Cca.
Stoniness: Few stones in area; gypsum nests observed in Cca horizon.
Described by: Robert L. Howey.
Date: July 31, 1958.

Horizon and Lincoln Lab. Number	
Ap 8657	0 to 5 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) noncalcareous loam; hard, friable, sticky and slightly plastic; weak medium subangular blocks to moderate very fine crumbs and granules. Abrupt and smooth tillage boundary with some B mixed in the Ap.
B21 8658	5 to 9 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) loam with strong continuous dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) clay skins; hard, friable, sticky and plastic; moderate medium and fine prisms to moderate medium fine angular blocks. Apparent color change.
B22 8659	9 to 13 inches. Same as above except ped coatings are 2.5Y 4/2 dry and 2.5Y 3/2 moist; clear, wavy boundary.
B3ca 8660	13 to 16 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous clay loam with moderate nodular segregation evident when dry; hard, friable, sticky and plastic; weak prisms to weak angular blocky structure. Clear, wavy boundary.
Ccacs 8661	16 to 23 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous clay loam with much segregated lime in small nodules; hard, friable, sticky and plastic; weak subangular blocky to crumb structure; also has small gypsum nests throughout.
Cca 8662	23 to 31 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) strongly calcareous clay loam with moderate nodular segregation; hard, friable, sticky and plastic; natural weak angular blocky structure. Gradual boundary.
C1 8663	31 to 43 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist), with common medium distinct gray mottles, moderately calcareous clay loam; hard, firm, sticky and plastic; weak angular blocky structure. Gradual, indefinite boundary.
C 8664	43 to 61 inches. Same as above; separated for sampling.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE *Kenaston loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-3-(1-8) **LAB. NOS.** 8665-8672

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	ABp	1.5	4.3	5.6	13.9	10.2	37.5	27.0	33.0	22.1	Tr.	cl/l
5-9	B21	2.6	6.3	6.7	14.6	9.3	30.8	29.7	28.9	18.8	3.8	cl
9-13	B22	3.2	5.0	5.4	13.1	9.3	34.4	29.6	29.5	21.2	0.7	cl
13-19	B3ca	1.1a	3.3a	4.2a	12.2a	10.4a	39.0	29.8	32.5	23.7	4.3	cl
19-28	Cca	1.8a	3.1a	4.1a	12.0b	9.9b	37.3	31.8	30.4	23.7	Tr.	cl
28-44	C1	2.4a	3.7a	4.4a	12.9b	11.1b	38.0	27.5	33.8	22.7	2.3	cl
44-54	C	2.0a	3.6a	4.6a	13.5a	11.3a	38.3	26.7	34.4	23.0	5.2	l
54-66	C	2.2a	3.5a	4.7a	13.8a	11.3a	38.0	26.5	34.0	23.1	2.2	l

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.1	7.4	1.91	0.188	10.2	<0.20	0.7	<1				11.2
7.1	7.4	7.4	1.03	0.083	12.4	<0.20	0.5	<1				11.3
7.7	8.1	8.4	0.96	0.087	11	<0.20	0.7	1				11.5
8.3	8.8	9.1	0.63	0.054	12	<0.20	0.8	10				10.5
8.3	8.8	9.1	0.37	0.028	13	<0.20	3.6	17	<1			10.7
8.4	8.9	9.1	0.29			0.29	5.8	8	<1			11.6
8.1	8.5	8.7	0.25			0.49	8.1	7	18			11.5
8.1	8.5	8.7	0.34			0.58	8.5	8	11			11.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
21.8	12.5	7.0	2.8	0.1	1.2	<1	0.7	0.6				51.6
21.3	12.3	8.5	1.8	0.1	0.5	<1	0.7	0.2				51.0
21.6	13.9	9.4	0.9	0.2	0.4	<1	1.2	0.2				52.4
17.2				0.5	0.3	2	2.8	0.2				52.8
15.4				2.2	0.3	8	17.7	0.4				55.6
17.0				3.6	0.5	9	34.5	0.6	2.8	2.7	74.2	61.7
16.8				4.1	0.5	9	43.7	0.7	2.8	2.4	127.6	59.7
16.8				4.3	0.5	10	43.0	0.8	2.6	2.7	117.5	61.3

a. Few smooth and irregular light brown to black concr. (Fe-Mn?); few $CaCO_3$ concr.

b. Few smooth and irregular light brown to black concr. (Fe-Mn?); common $CaCO_3$ concr.

Soil type: *Kenaston loam
Soil No.: S58NDak-7-3-(1-8)
Location: 0.3 mile west and 150 feet south of northeast corner of Sec. 5, T160N, R90W, Burke County, North Dakota.
Vegetation: Summer-fallowed cropland.
Parent material: Calcareous firm loam-clay loam glacial till.
Physiography: Till plain.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Topography: Gently undulating with less than 5 feet local relief. Slightly convex slope of less than 1 percent sampled.
Permeability: Moderate in solum, slow in parent material.
Drainage: Well drained with medium surface runoff into local depressions.
Moisture: Moist throughout due to fallow.
Root distribution: Little evidence of rooting below the Cca horizon.
Stoniness: Few stones in area; gypsum nests in parent material.
Described by: Robert L. Howey.
Date: July 31, 1958.

Horizon and Lincoln Lab. Number	
ABp 8665	0 to 5 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; cloddy to weak subangular blocky and very fine crumb structure. Abrupt smooth tillage boundary.
B21 8666	5 to 9 inches. Grayish brown (10YR 5/2 dry) to brown (10YR 4/3 moist) clay loam with dark grayish-brown (10YR 4/2 dry) to dark brown (10YR 3/3 moist) continuous organic-stained clay skins on all ped surfaces; hard, friable, sticky and plastic; moderate medium prisms to moderate medium fine angular blocks. Clear boundary.
B22 8667	9 to 13 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) noncalcareous clay loam with continuous dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) organic-stained clay skins on all peds; hard, friable, sticky and plastic; moderate medium prisms to moderate medium and fine angular blocky structure. Clear, wavy boundary.
B3ca 8668	13 to 19 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous clay loam with some fine nodular segregation; hard, friable, sticky and plastic; weak medium prisms to weak angular blocky structure. Clear, wavy boundary.
Cca 8669	19 to 28 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous clay loam with much segregated lime in nodules; hard, friable, sticky and plastic; weak very coarse prismatic to weak angular blocky structure; gradual boundary.
C1 8670	28 to 44 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) moderately calcareous clay loam with a slight amount of segregated lime in nodules and threads and with a few fine prominent lignite specks; hard, firm, sticky and plastic; weak angular blocky structure; gradual boundary.
C 8671	44 to 54 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) moderately calcareous clay loam without segregation but with a few large prominent gypsum nests and some lignite spots; hard, firm, sticky and plastic; weak angular blocky structure.
C 8672	54 to 66 inches. Same as above separated for sampling.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE *Kenaston loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-6-(1-9) **LAB. NOS.** 8733-8741

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	0.3	2.0	2.5	6.7	8.1	54.4	26.0	33.9	32.4	-	sil
2-8	A12	0.5	3.0	3.5	8.5	7.4	51.5	25.6	30.4	33.2	-	sil
8-12	A2	0.9	3.2	4.3	10.8	9.2	46.5	25.1	35.7	26.0	Tr.	l
12-18	B21	0.6	2.3	3.4	9.3	9.4	40.8	34.2	35.5	20.1	Tr.	cl
18-26	B22	0.5	1.6	2.1	6.8	9.4	47.7	31.9	37.2	24.1	-	cl/sicl
26-33	Cca1	1.6a	2.9a	3.7a	10.3a	9.5a	40.6	31.4	32.2	23.8	2.2	cl
33-42	Cca2	3.1a	5.7a	6.9a	17.3a	12.9a	34.7	19.4	38.1	19.2	4.9	l
42-50	D1	5.1a	8.6a	10.3a	24.4a	15.4a	29.8	6.4	46.4	11.8	8.6	fsl
50-66	D2	2.2a	4.6a	5.6a	14.9a	11.2a	34.5	27.0	33.5	20.4	6.3	cl/l

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC $\times 10^3$ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.3	6.5	6.7	9.43	0.734	12.8	<0.20	0.5					21.5
5.9	6.2	6.3	3.56	0.274	13.0	<0.20	0.4					13.4
6.0	6.3	6.5	1.39	0.138	10.1	<0.20	0.4					10.0
6.1	6.5	6.6	1.02	0.099	10.3	<0.20	0.4					13.0
6.7	7.1	7.2	0.80	0.085	9	<0.20	0.6	<1				12.1
8.3	8.8	9.1	0.54	0.060	9	<0.20	0.7	14				10.3
8.5	9.1	9.3	0.30			<0.20	0.9	13				6.8
8.8	9.2	9.4	0.31			<0.20	0.9	7				3.1
8.8	9.5	9.6	0.58			<0.20	1.3	10				10.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
37.0	24.9	7.1	9.8	<0.1	2.1	<1	0.4	0.8				112.8
26.3	15.1	5.6	9.8	<0.1	0.8	<1	0.4	0.2				73.7
20.1	11.0	5.9	5.1	0.1	0.4	<1	0.7	0.1				50.0
24.5	12.6	10.0	4.2	0.2	0.5	1	0.8	0.1				51.7
22.6	12.2	10.6	2.8	0.2	0.5	<1	1.3	0.2				53.3
16.6				0.5	0.3	2	2.2	0.2				50.9
10.7				0.6	0.2	5	3.6	0.2				39.9
5.9				0.6	0.1	8	5.0	0.1				27.8
15.4				3.1	0.3	16	9.4	0.1				66.9

a. Few $CaCO_3$ concr.

Soil type: *Kenaston loam
Soil No.: S58NDak-7-6-(1-9)
Location: 0.35 mile south and 225 feet east of northwest corner of Sec. 36, T136N, R90W, Burke County, North Dakota.
Vegetation: Native grassland pasture (silty range site); needle-and-thread, green needlegrass, western wheatgrass and blue grama plus fringed sagewort and scattered western snowberry.
Physiography: Till plain.
Parent material: Calcareous firm loam-clay loam glacial till.
Topography: Slight concave flat in the gently undulating till plain.
Elevation: About 1800 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Drainage: Well drained with slow runoff and extra moisture from higher ground.
Permeability: Moderate to 50 inches, slow below.
Moisture: Dry throughout profile.
Root distribution: Matted in surface 2 inches, observed through 42 inches.
Salt or alkali: None.
Stoniness: Few stones in area to 42 inches.
Described by: Robert L. Howey.
Date: August 5, 1958.

Horizon and Lincoln Lab. Number	
A11 8733	0 to 2 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) loam; soft, very friable, slightly sticky and slightly plastic; weak fine subangular blocky to moderate fine crumb structure. Clear, smooth boundary.
A12 8734	2 to 8 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; weak coarse and medium prisms to subangular blocky structure. Clear boundary.
A2 8735	8 to 12 inches. Gray (10YR 5/1 dry) to very dark grayish brown (10YR 3/2 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; weak prisms, plates and angular blocks. Weak silica frosting observed on prism surfaces. Abrupt, wavy boundary.
B21 8736	12 to 18 inches. Grayish brown (10YR 5/2 dry) to dark grayish brown (10YR 4/2 moist) clay loam with continuous organic-stained clay skin coatings of very dark grayish brown (10YR 3/2 moist) on all peds; very hard, firm, sticky, and plastic; moderate fine prisms to moderate medium and fine angular blocks with weak silica frosting on upper prism surface. Clear boundary.
B22 8737	18 to 26 inches. Light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) noncalcareous clay loam with continuous grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) clay skins on all ped surfaces; very hard, firm, sticky and plastic; moderate fine prismatic to moderate medium angular blocky structure. Clear, wavy boundary.
Ccal 8738	26 to 33 inches. Grayish brown and light gray (2.5Y 5/2 and 7/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous loam with moderately fine nodular segregated lime; hard, friable, sticky and plastic; weak moderate prisms and angular blocks. Gradual boundary.
Cca2 8739	33 to 42 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous loam with some fine nodular segregated lime; hard, friable, sticky and plastic; weak subangular blocky structure. Clear boundary.
D1 8740	42 to 50 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) moderately calcareous sandy loam with some gravel and stone; hard, friable, slightly sticky and nonplastic; structureless. Clear boundary.
D2 8741	50 to 66 inches. Olive gray (5Y 5/2 dry) (5Y 4/2 moist) moderately calcareous clay loam; hard, firm, sticky and plastic; natural weak angular blocky structure.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Kenaston loam **LOCATION** Burke County, North Dakota

SOIL NOS. S49NDak-7-2 **LAB. NOS.** 59-64

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	A1	2.4	7.3	7.8	14.9	9.2	37.5	21.0	37.8	17.4	2.9	l
6-12	B21	2.6	5.5	7.0	15.0	9.3	27.2	33.3	29.8	15.7	1.2	cl
12-17	B22	2.7	5.3	6.7	15.8	11.2	29.4	28.8	33.2	17.1	2.2	cl
17-34	Cca	2.6	5.2	6.2	15.1	11.0	32.1	27.8	33.2	19.3	6.3	cl
34-48	C1	2.6	5.0	5.9	14.4	10.8	35.3	25.9	34.2	20.9	4.0	l
48-64	C2	2.5	5.2	6.2	14.6	10.4	35.5	25.6	33.3	21.5	3.1	l

pH 8C1b SATURATED PASTE	8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS.
7.3	7.3	7.6	4.33	.347	12.5	-	0.6	-	-			
6.3	6.2	6.9	1.11	.112	9.9	-	0.4	-	-			
7.4	7.6	8.4	0.69	.076	9.1	-	0.8	-	-			
8.1	8.5	9.0	0.28	.035	8.0	-	6.5	13	-			
8.2	8.7	9.2	0.19	.028		0.33	7.7	8	-			
8.0	8.4	8.7	0.23	.028		0.46	9.5	7	8			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil →					← milliequivalents per liter →					
23.7	17.4	5.7	0.2	1.9	-	0.5	2.9				62.9
24.2	17.6	9.7	0.2	1.3	-	1.4	1.1				44.0
20.2			0.2	1.0	1	2.7	1.2				48.3
14.2			1.6	1.0	11	37.2	4.6				45.2
16.1			1.1	0.8	7	57.4	6.7				50.5
15.7			0.7	0.7	4	74.1	5.9				47.8

Soil type: *Kenaston loam
Soil No.: S49NDak-7-2
Location: Roadside cut, 1/4 mile north of southwest corner Sec. 23, T162N, R90W, Burke County, North Dakota.
Vegetation or crop: Native grasses, mainly blue grama.
Parent material: Glacial till. Both large and small rocks quite numerous.
Physiography: Ground moraine plain.
Relief: Gently undulating.
Slope: 1 to 2 percent.
Drainage: Well drained.
Described by: B. L. Matzek.
Date: September 22, 1949.

Horizon and Mandan Lab. Number	
A1 59	0 to 6 inches. Dark gray or very dark brown (10YR 4/1 dry, 2.5/2 moist) loam with well-developed fine granular structure.
B21 60	6 to 12 inches. Brown or dark brown (9YR 5/3 dry, 4/3 moist) clay loam with well-developed medium granular structure.
B22 61	12 to 17 inches. Yellowish brown or dark yellowish brown (1Y 5/4 dry, 4/4 moist) clay loam with well-developed prismatic structure.
Cca 62	17 to 34 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) strongly calcareous clay loam with gray streaks and irregular blocky structure.
C1 63	34 to 48 inches. Light olive brown mottled with yellowish brown (2.5Y 5/4 mottled, 10YR 5/8 moist) loam till with moderate lime content and some lignite.
C2 64	48 to 64 inches. Olive (5Y 4/3 moist) loam till with moderate disseminated lime content; some gypsum and lignite evident.

OIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE *Kenaston loam **LOCATION** Ward County, North Dakota

SOIL NOS. S49NDak-51-1 **LAB. NOS.** 45-51

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	4.3	8.8	8.9	18.1	11.3	29.9	18.7	35.6	16.9	5.7	l
5-11	B21	6.7	15.1	18.2	18.6	6.3	15.4	19.6	21.4	9.1	5.2	sl
11-18	B22	2.4	7.2	10.2	16.1	9.3	28.8	25.9	29.3	17.9	1.5	l
18-28	Cca	2.2	4.1	5.7	13.1	10.2	35.9	28.8	32.1	22.1	2.5	cl
28-40	C1	2.2	4.6	4.9	13.6	9.9	38.9	25.9	33.0	24.2	3.7	l
40-54	C2	2.9	4.3	5.2	13.9	11.2	38.6	23.8	35.8	23.0	4.0	l
54-60	D	2.5	4.3	5.1	14.0	11.9	38.4	23.9	37.0	22.0	2.5	l

8C1b SATURATED PASTE	pH 8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.7	7.8	7.9	3.28	.293	11.2	-	0.5	-	-			
6.9	7.3	7.4	1.10	.103	10.7	-	0.3	-	-			
7.2	7.6	8.1	0.87	.085	10.2	-	0.6	-	-			
8.3	8.4	8.8	0.58	.053	10.9	0.64	15.0	15	4			
8.3	8.6	8.9	0.41	.034	12.0	0.48	10.5	14	2			
8.0	8.1	8.5	0.31	.026	11.9	0.33	7.2	9	23			
7.9	8.0	8.3	0.32	.024	13.3	0.30	6.3	8	30			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS 5B1b EXTRACTABLE Ca	Mg	EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →				
21.0			0.1	1.1	-	0.3	0.5			61.6
15.7			0.1	0.6	-	0.5	1.3			37.2
18.4			0.1	0.2	-	0.9	0.5			43.4
13.7			0.6	1.1	4	81.3	10.2			45.2
14.2			1.0	1.2	7	62.2	7.2			44.2
14.6			0.3	0.5	2	56.4	8.7			44.7
14.2			0.7	0.4	5	48.7	10.2			43.3

Soil type: *Kenaston loam
Soil No.: S49NDak-51-1
Location: Roadside cut, 1/16 mile east of southwest corner Sec. 12, T160N, R89W, Ward County, North Dakota.
Vegetation or crop: Native grasses along fence line--buffalograss, blue grama and crested wheatgrass.
Parent material: Water-reworked glacial till.
Physiography: Till plain; above breaks into Des Lacs Valley.
Relief: Gently undulating.
Slope: 1 to 2 percent.
Drainage: Moderately well.
Described by: B. L. Matzek.
Date: September 22, 1949.

Horizon and Mandan Lab. Number	
Ap 45	0 to 5 inches. Dark grayish brown or very dark brown (10YR 4/2 dry, 2/2 moist) loam.
B21 46	5 to 11 inches. Dark yellowish brown (10YR 4/4 moist) coated with very dark grayish brown (10YR 3/2 moist) sandy loam with well-developed medium prismatic structure.
B22 47	11 to 18 inches. Yellowish brown or dark yellowish brown (10YR 5.5/4 dry, 4/4 moist) loam with moderately developed medium prismatic structure.
Cca 48	18 to 28 inches. Dark yellowish brown (10YR 4/4 moist) clay loam that is strongly calcareous with segregated and disseminated lime, and with moderate irregular blocky structure.
C1 49	28 to 40 inches. Light olive brown mottled with yellowish brown (2.5Y 5/4 and 10YR 5/8 moist) massive, moderately calcareous loam.
C2 50	40 to 54 inches. Similar to above but some gypsum present.
D 51	54 to 60 inches. Firm till, same color as C2.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Iefor sandy loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-22-(1-9) **LAB. NOS.** 8625-8633

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	0.2a	4.7a	16.8a	36.9a	7.0a	20.0	14.4	28.9	11.0	Tr.	fsl
6-9	A1	0.1a	4.4a	15.6a	32.8a	5.8a	24.0	17.3	27.1	13.7	-	fsl
9-15	B1	0.1a	3.5a	14.8a	33.5a	5.0a	23.1	20.0	23.7	15.9	-	scl/fsl
15-21	B21	0.1a	3.5a	12.6a	29.1a	4.1a	27.7	22.9	19.1	22.3	-	scl/l
21-26	B22	0.2a	6.6a	18.2a	38.7a	6.6a	16.7	13.0	24.6	11.4	-	fsl
26-28	B3	0.1b	2.3b	9.8b	34.2b	6.8b	27.4	19.4	26.6	21.6	-	fsl
28-38	Cca	0.3b	2.9b	9.3b	32.4b	7.1b	29.8	18.2	27.5	22.7	-	fsl/l
38-51	C1	0.2b	3.5b	8.8b	34.2b	7.4b	28.6	17.3	27.9	22.4	-	fsl
51-60	C2	<0.1a	3.3a	8.5a	35.3a	7.6a	27.7	17.6	28.2	21.9	-	fsl

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.1	7.5	7.4	1.23	0.109	11.3	<0.20	0.7	<1				6.0
7.2	7.5	7.5	0.92	0.083	11	<0.20	0.6	<1				6.7
7.1	7.4	7.4	0.77	0.072	11	<0.20	0.4	<1				7.5
7.3	7.6	7.6	0.63	0.062	10	<0.20	0.4	<1				9.2
7.6	7.8	7.8	0.33	0.033	10	<0.20	0.4	<1				5.7
8.3	8.8	9.1	0.25			<0.20	0.7	4				8.0
8.4	8.9	9.2	0.22			<0.20	0.9	9				7.5
8.5	9.0	9.2	0.06			<0.20	0.7	2				7.5
8.4	8.8	8.9	0.02			<0.20	0.7	<1				7.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
9.6	8.5	0.7	1.4	<0.1	0.3	99	0.5	0.3				34.3
10.0	8.6	1.2	1.8	<0.1	0.2	100	0.5	0.1				37.4
9.3	7.3	1.2	1.4	<0.1	0.1	92	0.4	0.1				39.9
9.1	7.3	1.7	0.9	<0.1	0.1	100	0.4	0.1				45.7
5.7	4.6	1.0	0.4	<0.1	0.1	100	0.5	0.1				33.3
5.7				0.1	0.1		1.1	0.1				49.6
4.8				0.1	0.1		1.9	0.1				51.7
5.2				0.2	0.1		2.0	0.1				50.1
5.2				0.2	0.1		2.5	<0.1				47.7

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: *Lefor sandy loam*
Soil No.: S58NDak-45-22-(1-9)
Location: 260 feet north and 345 feet east of south quarter corner of Sec. 9, T137N, R95W, Stark County, North Dakota.
Vegetation: Fallow.
Parent material: Sandy clay strata (bentonitic) of Golden Valley formation.
Physiography: Upland, gently rolling plain.
Slope: 5 percent northeast facing, convex.
Stoniness: None.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate.
Described by: A. F. Bahr.
Date: July 29, 1958.

Horizon and Lincoln Lab. Number	
Ap 8625	0 to 6 inches. Dark grayish brown (10YR 4/2 dry, 3/2 moist) to very dark grayish brown sandy loam; moderate cloddy structure breaking to fine weak crumbs; hard, friable, slightly sticky and slightly plastic; noncalcareous; abrupt, smooth boundary.
A1 8626	6 to 9 inches. Dark grayish brown (10YR 4/2 dry, 3/2 moist) to very dark grayish brown sandy loam; coarse weak prisms that break into medium weak angular blocks; hard, friable, slightly sticky and slightly plastic; noncalcareous; smooth and clear boundary.
B1 8627	9 to 15 inches. Light olive brown (2.5Y 5/3 dry, 10YR 4/2 moist) to dark grayish brown sandy clay loam; coarse weak prisms breaking to medium weak angular blocks with clay coats of 10YR 3/2 on top and vertical faces; hard, friable, sticky and slightly plastic; noncalcareous; smooth and clear boundary.
B21 8628	15 to 21 inches. Pale yellow (2.5Y 7/4 dry, 4/4 moist) to olive brown sandy clay loam; coarse moderate prisms that break to coarse and medium angular blocks; hard when dry; friable when moist; sticky and plastic when wet; continuous clay coatings on all surfaces of peds, 2.5Y 4/2; noncalcareous; clear and smooth boundary.
B22 8629	21 to 26 inches. Light yellowish brown (2.5Y 6/4 dry, 4/4 moist) to olive brown sandy clay loam; coarse moderate prisms that break to coarse weak angular blocks; continuous clay coats, 2.5Y 4/3, on top and vertical surfaces of prisms; slightly hard when dry; very friable moist; sticky and plastic; noncalcareous; clear, wavy boundary.
B3 8630	26 to 28 inches. Pale yellow (5Y 7/4 dry) to light olive brown (2.5Y 5/4 moist) sandy clay loam; coarse weak prisms that break to medium weak angular blocks; patchy coats on clay on vertical surfaces of prisms; hard when dry; friable when moist; sticky and plastic; noncalcareous; clear, wavy boundary.
Cca 8631	28 to 38 inches. Nearly white (5Y 8/2 dry) to light olive gray (5Y 6/2 moist) and light olive brown (2.5Y 5/4 moist) sandy clay loam; medium weak angular blocks; slightly hard when dry; friable when moist; sticky and plastic when wet; very strongly calcareous with few distinct lime nodules; a few vertical cracks extend through this horizon with dark coatings; gradual, smooth boundary.
C1 8632	38 to 51 inches. Nearly white (5Y 8/2 dry) to light yellowish brown (2.5Y 6/4 moist) sandy clay loam; few coarse prominent mottles of 10YR 5/6 moist; medium moderate plates; slightly hard dry; friable when moist; sticky and plastic wet; calcareous; gradual, smooth boundary.
C2 8633	51 to 60 inches. Nearly white (5Y 8/2 dry) to pale olive (5Y 6/3 moist) sandy clay loam; medium moderate plates; slightly hard, friable, sticky and plastic; calcareous.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-8-55

SOIL TYPE Maddock loamy fine sand **LOCATION** Richland County, North Dakota

SOIL NOS. S54NDak-39-1-(1-6) **LAB. NOS.** 2113-2118

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-3	A1	0.2	0.9	3.8	59.9	19.6	8.7	6.9	66.3	4.5	-	lfs
3-7	AC1	-	0.4	3.0	66.3	22.5	3.3	4.5	72.5	1.8	-	fs
7-12	AC2	-	0.3	3.7	68.7	18.2	4.9	4.2	69.7	1.6	-	fs
12-19	C1	-	0.3	4.6	70.5	18.9	1.7	4.0	66.7	1.3	-	fs
19-37	C2	-	0.2	3.8	73.8	16.8	1.7	3.7	66.8	1.5	-	fs
37-60	C3	-	0.1	5.1	71.5	18.1	1.4	3.8	66.3	0.8	-	fs

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	6B1a ORGANIC MATTER NITROGEN %	ORGANIC MATTER C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	4B1a MOISTURE TENSIONS 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
6.7	7.1	7.2	2.00	.154	13.0	-	0.5	-		17.5	10.5	5.6
6.4	6.6	6.8	0.85	.068	12.5	-	0.4	-		8.8	5.4	3.2
6.4	6.5	6.7	0.59	.048	12.3	-	0.4	-		7.6	4.5	3.2
6.4	6.6	6.8	0.31			-	0.4	-		5.6	3.6	2.0
6.2	6.6	6.5	0.15			-	0.3	-		6.0	3.9	2.0
6.3	6.6	6.6	0.09			-	0.3	-		5.8	3.8	1.8

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLES 6P1a Na	6Q1a K	3A1			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
11.8	9.0	2.2		0.1	0.5	1	0.6	0.6				46.0
10.1	4.8	0.8		0.1	0.3	1	0.6	0.3				38.0
5.6	4.1	0.8		0.1	0.2	2	0.3	0.3				35.2
4.8	3.3	0.9		0.1	0.2	2	0.6	0.3				34.0
4.2	2.9	0.7		-	0.1	-	0.4	0.2				33.6
4.0	3.0	0.8		0.1	0.1	2	0.6	0.2				29.2

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Maddock loamy fine sand
Soil No.: S54NDak-39-1
Area: Richland County, North Dakota.
Location: 1400 feet north, 200 feet east of southwest corner Sec. 5, T135N, R51W.
Vegetation or crop: Bluegrass meadow.
Parent material: Aeolian sand on Sheyenne River delta
Physiographic position: Crest of a low mound on Sheyenne River delta plain.
Topography: Hummocky (5 to 15 feet relief).
Slope: 1 percent north.
Drainage: Somewhat excessive.
Permeability: Rapid.
Moisture: Moist to 18 inches and below 48 inches.
Salt or alkali: Free.
Stoniness: Free.
Described by: C. A. Mogen.
Date: June 2, 1954.

Mandan Lab.No.	Horizon	
2113	A1	0 to 3 inches. Very dark gray (10YR 3.5/1 dry) to black (10YR 2/1 moist) loose loamy fine sand; having a weak fine crumb structure. Clear boundary.
2114	AC1	3 to 7 inches. Dark grayish brown (10YR 4/1.5 dry) to very dark grayish brown (10YR 2.5/2 moist) loose fine sand having a weak fine crumb structure; there are bands of black soil (10YR 2/1 moist). Gradual boundary.
2115	AC2	7 to 12 inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) loose fine sand having a weak fine crumb structure; bands of black (10YR 2/1 moist) of buried A1 horizons. Clear irregular boundary.
2116	C1	12 to 19 inches. Grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3/2 moist) loose fine sand; single grains. Gradual boundary.
2117	C2	19 to 37 inches. Light brownish gray (10YR 6/2 dry) to very dark grayish brown (10YR 3.5/2 moist) loose fine sand; single grains. Gradual boundary.
2118	C3	37 to 60 inches. Light brownish gray (10YR 6/2.5 dry) to dark grayish brown (10YR 4/2 moist) loose fine sand; single grains.

Remarks: The profile is noncalcareous through 60 inches. Area is bordered on east by semicircle of tree-covered stabilized dunes.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-8-55

SOIL TYPE Maddock loamy fine sand **LOCATION** Richland County, North Dakota

SOIL NOS. S54NDak-39-2-(1-5) **LAB. NOS.** 2119-2123

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-3	A1	0.4	0.7	1.9	57.0	24.3	8.3	7.4	75.8	4.1	-	lfs
3-8	AC	-	0.1	0.8	67.9	24.7	2.2	4.3	83.8	1.3	-	fs
8-20	C1	-	-	0.7	75.1	19.4	1.0	3.8	80.5	0.6	-	fs
20-37	C2	-	-	0.4	66.7	27.4	1.7	3.8	87.6	0.8	-	fs
37-60	C3	-	-	0.7	71.4	22.4	1.9	3.3	82.7	0.8	-	fs

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	6.6	6.7	2.13	.188	11.3	-	0.5	-		18.4	11.9	7.0
6.3	6.6	6.8	0.71	.064	11.1	-	0.4	-		8.6	5.4	3.2
6.3	6.5	6.5	0.31			-	0.4	-		6.0	3.6	2.0
6.2	6.7	7.0	0 13			-	0.3	-		6.7	3.8	2.0
6.3	6.6	6.7	0.08			-	0.3	-		5.4	3.2	1.6

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
12.4	9.0	1.8		0.1	0.5	1	0.4	0.4				52.4
5.9	4.1	1.0		0.1	0.1	2	0.6	0.2				40.0
4.3	2.9	0.7		0.1	0.1	2	0.6	0.1				36.0
4.3	2.9	0.7		0.1	0.1	2	0.4	-				31.3
3.6	2.4	0.8		0.1	-	3	0.6	-				31.2

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: Maddock loamy fine sand
Soil No.: S54NDak-39-2
Area: Richland County, North Dakota.
Location: 375 feet south, 65 feet west of northeast corner Sec. 33, T136N, R51W.
Vegetation or crop: Bluegrass and buckbrush.
Parent material: Aeolian sands on Sheyenne River delta.
Physiographic position: Crest of knoll.
Topography: Strongly undulating (5 to 10 feet relief).
Slope: 1 percent convex.
Drainage: Somewhat excessive.
Moisture: Moist.
Described by: C. A. Mogen.
Date: June 2, 1954.
Mandan

Lab.No.	Horizon	
2119	A1	0 to 3 inches. Very dark grayish brown (10YR 3/1.5 dry) to black (10YR 2/1 moist) loamy fine sand; soft, very friable; moderate fine crumb. Clear boundary.
2120	AC	3 to 8 inches. Dark grayish brown (10YR 4/1.5 dry) to very dark brown (10YR 2.5/2 moist) loose fine sand; weak fine crumb or single grain structure. Clear boundary.
2121	C1	8 to 20 inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) loose fine sand; single grains. Gradual boundary.
2122	C2	20 to 37 inches. Grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3/2 moist) loose fine sand; single grains. Gradual boundary.
2123	C3	37 to 60 inches. Colors as in the horizon above; loose fine sand.

Remarks: Profile is noncalcareous through 60 inches. There appear to be less than 50 percent of clear quartz grains, about 15 percent of dark minerals and approximately 35 percent of stained quartz grains.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Makoti silty clay loam **LOCATION** Mountrail County, North Dakota

SOIL NOS. S58ND-31-2-(1-8) **LAB. NOS.** 8649-8656

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	0.1	0.3	0.7	2.5	6.5	57.3	32.6	38.7	26.5	-	sicl
6-13	B21	0.1	0.3	0.7	2.4	5.8	53.8	36.9	35.1	25.8	-	sicl
13-18	B22	0.1a	0.2a	0.5a	1.7a	7.0a	52.5	38.0	36.6	23.8	-	sicl
18-24	B3ca	<0.1	0.3b	0.7b	2.6b	11.3b	53.9	31.2	43.0	23.6	-	sicl
24-38	Cca	<0.1	0.2b	0.5b	1.9b	6.4b	60.6	30.4	41.4	26.7	-	sicl
38-44	C1	0.1b	0.2b	1.8b	8.3b	9.3b	58.2	22.1	51.1	20.9	-	sil
44-60	C21	<0.1	0.1b	0.2b	0.4b	3.5b	64.4	31.4	37.3	30.8	-	sicl
60-68	C22	0.1b	0.4b	0.8b	1.0b	6.8b	60.2	30.7	38.9	28.7	-	sicl

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUF)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.2	6.5	6.8	2.64	0.224	11.8	<0.20	0.5					14.2
6.6	6.9	7.1	1.39	0.125	11.1	<0.20	0.5	<1				15.1
7.3	7.6	7.9	0.93	0.089	10	<0.20	0.6	<1				15.1
8.2	8.7	9.0	0.60	0.065	9	<0.20	0.6	15				11.4
8.6	9.1	9.3	0.38			<0.20	0.8	18				11.5
8.8	9.4	9.5	0.22			<0.20	1.0	14				9.5
8.5	9.1	9.2	0.31			<0.20	1.9	13				12.9
8.0	8.4	8.6	0.30			0.41	5.7	13	<1			13.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
26.6	15.9	7.9	5.1	0.1	1.6	<1	0.4	0.5				61.4
28.4	15.1	11.5	3.8	0.1	0.6	<1	0.4	0.1				63.5
29.1	14.5	15.9	1.4	0.2	0.6	1	0.7	0.1				62.1
19.4				0.2	0.4	1	0.9	0.1				59.8
17.0				0.9	0.4	4	3.3	0.1				59.0
14.0				1.6	0.3	8	6.4	0.2				54.4
18.9				2.5	0.5	10	10.7	0.3				62.7
18.8				2.7	0.6	8	18.7	0.8	4.0	7.4	76.4	63.2

a. Few smooth and irregular light brown to black concr. (Fe-Mn?)
b Few smooth and irregular light brown to black concr. (Fe-Mn?) few $CaCO_3$ concr.

Soil type: Makoti silty clay loam
Soil No.: S58NDak-31-2-(1-8)
Location: 110 feet south to 80 feet west of the center of Sec. 22, T151N, R88W, Mountrail County, North Dakota.
Vegetation: Summer-fallowed cropland.
Drainage: Moderately well with slow runoff.
Parent material: Moderately fine-textured glaciolacustrine deposit.
Physiography: Lake plain.
Topography: Broad, flat, level plain.
Elevation: About 2000 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Slope: Less than 1/2 percent.
Permeability: Moderately slow.
Moisture: Moist throughout but without water table.
Root distribution: Not limited.
Salt or alkali: No evidence.
Stoniness: None.
Described by: Robert L. Howey.
Date: July 30, 1958.

Horizon and Lincoln Lab. Number	
Ap 8649	0 to 6 inches. Dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist) noncalcareous silty clay loam; hard, friable, slightly sticky and plastic; cloddy to moderate medium to fine crumbs and very fine granules. Abrupt and smooth tillage boundary with a few fine tongues of A1 extending into the B21 horizon.
B21 8650	6 to 13 inches. Dark gray (10YR 4/1 dry) to very dark gray (2.5Y 3/1 moist) noncalcareous silty clay; hard, firm, sticky and plastic; weak medium prisms to moderate fine and very fine angular blocks with organic-stained clay skin coatings. Gradual, indefinite boundary.
B22 8651	13 to 18 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) and with shiny organic-stained clay skin coatings, 2.5Y 3/1, noncalcareous silty clay; hard, firm, sticky and plastic; weak medium prisms to moderate fine angular blocks. Clear and wavy boundary.
B3ca 8652	18 to 24 inches. Light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous (with some nodular segregation) silty clay loam; hard, friable, sticky and plastic; weak blocks to moderate fine crumbs. Gradual boundary.
Cca 8653	24 to 38 inches. Light gray (2.5Y 7/2 dry) to olive (5Y 5/3 moist) strongly calcareous (with moderate segregation) silty clay loam; hard, friable, sticky and plastic; weak subangular blocky structure. Clear boundary.
C1 8654	38 to 44 inches. Light gray and pale yellow (2.5Y 7/2 to 7/4 dry) to light olive brown (2.5Y 5/3 moist) moderately calcareous silt loam; hard, friable, slightly sticky and plastic; without developed structure. Gradual boundary.
C21 8655	44 to 60 inches. Light yellowish brown (2.5Y 6/4 dry) with many fine faint light brownish gray mottles to olive brown (2.5Y 4/3 moist) moderately calcareous silty clay loam; hard, friable, sticky and plastic; moderate medium platy structure. Gradual boundary.
C22 8656	60 to 68 inches. Light gray and pale olive (5Y 6/1 and 6/3 dry) with many large prominent yellowish brown (10YR 5/4 dry) mottles to dark gray (5Y 4/1 moist) with dark yellowish brown (10YR 3/4 moist) mottles between strata, moderately calcareous silty clay loam; hard, friable, sticky and plastic; natural platy to weak angular blocky structure.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Makoti silty clay loam **LOCATION** Mountrail County, North Dakota

SOIL NOS. S58ND-31-3-(1-8) **LAB. NOS.** 8716-8723

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	0.2a	0.7a	1.5a	5.6a	7.8a	49.9	34.3	36.7	24.2	-	sicl
6-13	B2	0.1a	0.4a	0.9a	4.9a	8.6a	48.8	36.3	39.1	21.3	-	sicl
13-17	B3ca	<0.1	0.3b	0.6b	4.0b	5.9b	52.8	36.4	36.9	24.3	Tr.	sicl
17-24	Cca1	<0.1	0.2b	0.3b	1.2b	5.2b	57.5	35.6	37.0	26.5	Tr.	sicl
24-29	Cca2	0.1b	0.1b	0.2b	0.7b	5.6b	62.8	30.5	41.9	27.0	-	sicl
29-36	Cca3	0.1b	0.2b	0.3c	0.7c	3.6c	60.8	34.3	35.1	29.7	Tr.	sicl
36-48	C1	0.1b	0.2b	0.3c	0.5c	4.2c	56.7	38.0	29.5	31.7	-	sicl
48-61	C	<0.1	0.3b	0.5c	1.0c	5.6c	57.8	34.8	33.9	30.1	-	sicl

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equiv. clast %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.1	7.3	2.41	0.206	11.7	<0.20	0.7	<1				14.2
7.0	7.2	7.4	1.12	0.105	10.7	<0.20	0.7	<1				14.2
8.0	8.5	8.7	1.00	0.098	10.2	<0.20	0.7	20				12.5
8.2	8.6	8.8	0.73	0.070	10	<0.20	0.7	24				11.0
8.3	8.8	9.0	0.51			<0.20	0.7	20				10.7
8.6	9.2	9.3	0.39			<0.20	0.8	18				11.8
8.5	9.1	9.3	0.32			<0.20	2.6	17	<1			14.4
8.1	8.6	8.8	0.30			0.41	6.5	14	<1			13.9

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
27.7	17.7	8.4	3.3	0.1	1.8	<1	0.5	0.5				62.6
26.9	17.2	9.7	2.4	0.1	0.8	<1	0.4	0.2				62.5
18.8				0.1	0.4	<1	0.6	0.2				61.8
17.3				0.2	0.4	1	0.9	0.2				59.1
17.3				0.6	0.5	3	2.3	0.2				56.1
18.0				1.6	0.5	7	5.0	0.2				58.8
21.2				3.4	0.5	11	15.3	0.2				71.4
20.6				4.5	0.6	11	32.3	0.4	2.1	4.4	70.8	70.8

a. Trace smooth and irregular light brown to black concr. (Fe-Mn?)
b. Trace smooth and irregular light brown to black concr. (Fe-Mn?); few $CaCO_3$ concr.
c. Common smooth and irregular light brown to black concr. (Fe-Mn?); few $CaCO_3$ concr.

Soil type: Makoti silty clay loam
Soil No.: S58NDak-31-3-(1-8)
Location: 0.45 mile south and 270 feet east of northwest corner of Sec. 4, T152N, R88W, Mountrail County, North Dakota.
Vegetation: Summer-fallowed cropland.
Parent material: Moderately fine-textured glaciolacustrine deposit.
Physiography: Lake plain.
Topography: Broad, flat, level plain.
Elevation: About 2000 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Slope: Moderately well drained with slow runoff.
Permeability: Moderately slow.
Moisture: Moist throughout but without water table.
Root distribution: Not limited.
Salt or alkali: None.
Stoniness: None.
Described by: Robert L. Howey.
Date: August 4, 1958.

Horizon and Lincoln Lab. Number	
Ap 8716	0 to 6 inches. Dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist) noncalcareous silty clay loam; slightly hard, friable, sticky and plastic; cloddy to moderate medium and fine crumbs. Abrupt and smooth boundary.
B2 8717	6 to 13 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) noncalcareous silty clay; hard, friable, sticky and plastic; weak medium prisms readily to moderate fine and very fine angular blocks; shiny slightly organic-stained clay skin surfaces on all peds. Clear, wavy boundary.
B3ca 8718	13 to 17 inches. Light brownish gray (2.5Y 6/2 dry) to dark grayish brown (2.5Y 4/2 moist) strongly calcareous (with some nodular segregation) silty clay loam; hard, friable, sticky and plastic; weak medium prisms (with broken thin coatings) and weak fine angular blocks. Gradual boundary.
Cca1 8719	17 to 24 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous (with moderate nodular segregation visible in dry soil) silty clay loam; hard, friable, sticky and plastic; weak prismatic to weak blocky structure. Gradual boundary.
Cca2 8720	24 to 29 inches. Light yellowish brown (2.5Y 6/3 dry) to olive brown (2.5Y 4/3 moist) strongly calcareous (with moderate nodular segregation) silt loam; slightly hard, friable, sticky and plastic with weak blocky to fine crumb structure. Gradual boundary.
Cca3 8721	29 to 36 inches. Light olive gray (5Y 6/2 dry), with many fine distinct yellowish brown mottles, to olive gray (5Y 4/2 moist), with dark yellowish brown mottling, strongly calcareous, with moderate nodular segregation, silty clay loam; hard, friable, sticky and plastic; weak blocky structure but with some vertical faces evident through this horizon. Gradual boundary.
C1 8722	36 to 48 inches. Gray (5Y 6/1 dry), with prominent yellowish brown (10YR 5/4) mottles occuring as seams between blocks, to olive gray (5Y 4/2 moist), with dark yellowish brown mottles, moderately calcareous, with some nodular segregation, silty clay loam; hard, friable, sticky and plastic; weak thick platy to weak blocky structure. Gradual boundary.
C 8723	48 to 61 inches. Gray (5Y 6/1 dry), with prominent yellowish brown (10YR 5/4) mottles between block and plates, to olive gray (5Y 4/2 moist), with dark yellowish brown mottles, moderately calcareous (without visible segregation) silty clay loam; hard, friable, sticky and plastic; natural moderate plates and angular blocks of stratified material.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Manning loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-1-(1-8) **LAB. NOS.** 8469-8476

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4½	Ap	1.0	4.8	10.9	32.1	11.3	23.9	16.0	43.0	8.8	Tr.	fsl
4½-11½	B21	1.4	4.3	10.7	35.2	12.1	20.3	16.0	43.8	6.9	2.2	fsl
11½-18½	B22	1.2	3.0	7.7	25.9	16.2	31.9	14.1	50.8	10.9	2.8	fsl
18½-24½	Cca	7.4	6.6	11.8	24.2	8.0	21.0	21.0	26.6	12.2	19.5	scl
24½-30½	D1	15.5a	9.7a	15.4a	31.9a	6.2a	10.8	10.5	22.5	6.3	44.7	cosl
30½-36	D2	37.0a	19.8a	15.5a	15.1a	2.0a	4.9	5.7	7.8	3.4	58.9	cos
36-39	D3	7.8a	13.2a	19.9a	35.7a	9.7a	8.2	5.5	32.5	3.9	33.5	ls
39-52	D4	<0.1	0.4b	2.6b	64.9b	15.4b	8.5	8.2	68.8	4.8	Tr.	lfs

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST. % SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.9	7.0	1.24	0.118	10.5	<0.20	0.6	<1				6.6
6.8	7.2	7.2	0.75	0.070	11	<0.20	0.4	<1				6.7
7.3	7.6	7.6	0.88	0.081	11	<0.20	0.4	<1				6.5
8.3	8.7	8.9	0.93	0.081	11	<0.20	0.5	15				7.9
8.4	8.9	9.1	0.51			<0.20	0.6	5				5.8
8.5	9.0	9.2	0.46			<0.20	0.6	2				5.1
8.6	9.1	9.3	0.16			<0.20	0.6	6				3.7
8.6	9.2	9.3	0.04			<0.20	0.5	2				5.2

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
13.2	9.3	2.6	3.2	<0.1	0.6	95	0.4	0.4				37.0
13.1	9.5	3.0	2.8	<0.1	0.2	100	0.3	0.1				34.9
13.4	10.6	3.3	1.8	<0.1	0.1	104	0.4	<0.1				42.0
11.2				<0.1	0.1		0.5	0.1				40.5
8.6				0.1	0.1		0.7	0.1				31.7
8.1				0.1	0.1		1.2	0.1				23.7
5.8				0.1	0.1		1.3	0.1				29.5
10.4				0.1	0.1		1.0	0.1				40.1

a. Common $CaCO_3$ concretions.
b. Few $CaCO_3$ concretions.

Soil type: Manning loam
Soil No.: S58NDak-45-1-(1-8)
Location: 600 feet east and 100 feet south of the south 1/4 corner Sec. 10, T139N, R97W, Stark County, North Dakota.
Vegetation: Crested wheatgrass.
Parent material: Alluvium over gravel beds.
Physiography: Broad, flat, high terrace.
Slope: 2 percent.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate to rapid.
Salt or alkali: None.
Root distribution: Numerous to 24 inches.
Described by: K. E. Larson.
Date: July 14, 1958.

Horizon and Lincoln Lab. Number	
Ap 8469	0 to 4½ inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) loam; medium, moderate crumb structure; slightly hard, very friable, slightly sticky and nonplastic consistence; noncalcareous; abrupt and smooth boundary.
B21 8470	4½ to 11½ inches. Olive brown (2.5Y 4/3 dry) to dark grayish brown (2.5Y 4/2 moist) loam; coarse, strong prisms that break to medium moderate angular blocks; patches of clay skins are visible on the vertical faces of prisms; slightly hard, very friable, slightly sticky and nonplastic consistence; nor calcareous; gradual and smooth boundary.
B22 8471	11½ to 18½ inches. Light brownish gray (2.5Y 6/2 dry) to dark grayish brown (2.5Y 4/2 moist) loam; coarse, strong prisms that break to medium moderate angular blocks; prisms have patches of clay skins on their vertical faces; slightly hard, very friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and wavy boundary.
Cca 8472	18½ to 24½ inches. Light brownish gray (2.5Y 6/2 dry) to dark gray brown (2.5Y 4/2 moist) loam; coarse, weak prisms that break to medium moderate angular blocks; slightly hard, very friable, slightly sticky and nonplastic consistence; very strongly calcareous with common medium and prominent lime nodules, 2.5Y 8/2; abrupt and smooth boundary.
D1 8473	24½ to 30½ inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) gravelly loam; single grain structure; slightly hard, very friable, slightly sticky and nonplastic consistence; strongly calcareous; abrupt and smooth boundary; 10 percent of gravel is greater than 3/4 inch in diameter.
D2 8474	30½ to 36 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) gravel; single grain structure; very friable, nonsticky and nonplastic consistence; calcareous; abrupt and wavy boundary; 20 percent of total gravel is greater than 3/4 inch in diameter.
D3 8475	36 to 39 inches. Light yellowish brown (2.5Y 6/4 dry) to dark grayish brown (2.5Y 4/2 moist) gravelly loam; single grain; extremely hard, very friable, slightly sticky and nonplastic consistence; strongly calcareous; abrupt and wavy boundary; 5 percent of gravel greater than 3/4 inch in diameter.
D4 8476	39 to 52 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) loamy fine sand; slightly hard, friable, nonsticky and nonplastic; weakly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Miranda loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-4-(1-8) **LAB. NOS.** 8673-8680

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-1	A2	1.3a	4.5a	5.5a	13.9a	10.6a	46.1	18.1	36.9	27.6	Tr.	l
1-5	B2	1.2a	4.1a	5.0a	12.6a	8.8a	34.9	33.4	28.6	21.9	Tr.	cl
5-8	B3cs	1.2b	3.8b	4.4b	12.0b	8.7b	33.0	36.9	27.9	20.5	Tr.	cl
8-13	Ccacs	1.4b	3.1b	3.8b	10.5b	9.0b	35.7	36.5	28.1	22.6	Tr.	cl
13-25	Cca1	1.4b	2.6b	3.5b	10.5b	9.3b	36.3	36.4	28.6	23.0	Tr.	cl
25-36	Cca2	1.0b	2.6b	3.2b	9.8b	10.8b	39.5	33.1	31.9	24.1	Tr.	cl
36-50	C1	1.6b	3.2b	4.1b	12.4b	10.9b	37.7	30.1	32.5	23.2	Tr.	cl
50-65	C2	1.6b	3.0b	4.0b	12.2b	11.1b	39.7	28.4	33.2	24.7	1.9	cl

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.1	6.5	6.8	4.57	0.362	12.6	<0.20	0.9					10.9
7.3	7.9	8.2	2.01	0.199	10.1	0.22	4.2	<1	<1			15.6
7.8	8.2	8.4	0.98	0.088	11	0.69	14.9	2	10			14.6
8.5	8.7	8.8	0.40	0.035	11	1.00	15+	8	15			14.2
8.8	9.0	9.1	0.28	0.018		1.00	15+	13	7			13.6
8.8	9.2	9.3	0.27			1.12	15+	12	3			13.0
8.8	9.0	9.2	0.24			1.12	15+	10	4			12.9
8.6	8.9	9.1	0.24			0.87	15+	7	10			13.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
16.7	4.8	3.7	8.3	1.7	1.9	7	6.6	0.8				70.3
26.4	3.9	12.3	4.2	8.6	1.6	21	40.0	0.6	5.6	2.9	37.9	78.0
24.4				14.4	1.1	18	143.2	1.0	3.5	2.4	211.2	69.8
19.8				15.2	0.6	20	172.5	0.8	3.5	2.9	274.1	65.6
17.7				16.5	0.4	25	183.2	0.6	1.4	2.7	286.2	66.2
18.2				17.7	0.3	40	123.2	0.3	2.8	2.7	231.3	84.1
17.8				17.6	0.4	38	123.2	0.3	2.6	2.7	225.6	87.4
17.5				16.8	0.4	34	131.8	0.4	2.1	3.2	247.8	82.2

a. Few smooth and irregular light to dark brown concr. (Fe-Mn?)
b. Few smooth and irregular light to dark brown concr. (Fe-Mn?); few $CaCO_3$ concr.

Soil type: Miranda loam
Soil No.: S58NDak-7-4-(1-8)
Location: 0.2 mile south and 230 feet west of north quarter corner of Sec. 16, T160N, R90W, Burke County, North Dakota.
Vegetation: Native grassland pasture.
Physiography: Till plain.
Parent material: Calcareous firm clay loam till.
Slope: 2 percent facing south.
Topography: Gently undulating with 5 to 10 feet local relief and slightly truncated microrelief of 3 to 6 inches.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Drainage: Moderately well drained with slow surface runoff.
Permeability: Very slow in B horizon.
Moisture: Moist and saline below 5 inches.
Root distribution: Matted in surface, few below 13 inches.
Stoniness: Few stones in area.
Described by: Robert L. Howey.
Date: July 31, 1958.

Horizon and Lincoln Lab. Number	
A2 8673	0 to 1 inch. Gray (10YR 5/1 dry) to very dark gray (10YR 3/1 moist) loam; soft, friable, slightly sticky and slightly plastic; moderate fine crumb structure. Abrupt and wavy boundary.
B2 8674	1 to 5 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) clay with continuous dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) organic-stained clay skins; extremely hard, firm, very sticky and very plastic; strong medium columns with round caps and frosted with silica to 3-inch depth; this breaks down to moderate medium and fine angular blocks. Clear and wavy boundary.
B3cs 8675	5 to 8 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam with continuous organic-stained clay skin coatings on all ped surfaces; very hard, firm, very sticky and plastic; moderate medium prisms which are very slightly calcareous inside and contain many gypsum nests; clear wavy boundary.
Ccacs 8676	8 to 13 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) strongly calcareous clay loam without significant segregated lime but with many distinct gypsum nests; very hard, firm, very sticky and plastic; weak subangular blocky or somewhat dispersed massive structure. Gradual boundary.
Ccal 8677	13 to 25 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) strongly calcareous clay loam with some segregated lime; very hard, firm, very sticky and very plastic; massive or weak subangular blocky structure.
Cca2 8678	25 to 36 inches. Same as above; separated for sampling only. Gradual boundary.
C1 8679	36 to 50 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) moderately calcareous clay loam; very hard, firm, very sticky and very plastic; apparently massive structureless till material containing many fine prominent lignite specks and large distinct gypsum nests.
C2 8680	50 to 65 inches. Same as above; separated for sampling only.

Note: Profile sampled in microrelief low about 10 feet west of S58NDak-7-5 identified as thick solum phase and taken on high of microrelief.

SOIL SURVEY LABORATORY Lincoln, Nebr. March, 1959

SOIL TYPE Miranda loam **LOCATION** Ward County, North Dakota

SOIL NOS. S58ND-51-1-(1-8) **LAB. NOS.** 8689-8696

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A2	1.4	2.3	3.1	10.6	9.7	48.4	24.5	33.4	30.7	-	l
2-6	B2	0.7	2.8	3.9	8.7	6.5	35.7	41.7	22.5	24.4	Tr.	c
6-10	B2cs	0.6	2.5	2.9	6.3	5.1	38.7	43.9	23.6	23.6	Tr.	c
10-15	B3cs	0.4a	1.4a	1.9a	5.1a	4.7b	45.7	40.8	20.5	32.8	Tr.	sic
15-24	Cca	0.5a	1.5a	2.5b	6.6b	5.3b	42.0	41.6	18.4	32.7	Tr.	sic
24-33	Ccacs	3.5a	4.5a	4.6b	10.5b	7.3b	36.8	32.8	23.3	26.7	6.3	cl 1/
33-46	Ccs	1.2c	2.0c	2.7c	7.6c	7.4c	49.6	29.5	27.4	34.1	Tr.	sicl 1/
46-60	C	2.3b	4.2b	4.9b	13.0b	11.9b	40.6	23.1	35.9	23.9	2.6	l

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC × 10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.2	6.5	6.7	6.00	0.450	13.3	<0.20	0.6					15.2
6.3	6.7	7.0	1.52	0.134	11.3	<0.20	1.6					15.9
7.5	7.7	7.7	0.89	0.067	13	0.86	13.5	<1	7			16.6
8.5	8.7	8.8	0.56	0.048	12	1.22	15+	10	9			14.3
8.6	8.9	9.0	0.38	0.030	13	1.14	15+	18	8			13.1
8.7	9.0	9.1	0.21			1.12	15+	11	20			11.9
8.5	8.8	8.9	0.18			1.03	15+	7	67			12.9
8.5	8.8	9.0	0.17			1.02	15+	7	23			10.6

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
26.2	14.8	5.7	7.4	0.3	2.1	1	1.4	1.2				89.2
29.5	14.1	9.2	4.2	2.8	1.4	7	10.0	0.4				63.2
28.0	7.6	23.7	0.9	12.1	0.9	18	94.2	0.6	5.4	1.0	206.2	73.9
21.0				15.4	0.4	25	136.5	0.3	2.3	0.2	259.5	75.1
18.0				14.8	0.3	28	136.5	0.3	2.8	0.7	257.9	71.4
16.4				14.9	0.3	30	150.8	0.3	1.2	1.0	283.8	66.1
15.8				20.6	0.3	67	148.2	0.3	2.1	0.7	265.7	67.5
14.2				13.7	0.4	31	143.2	0.4	0.7	1.5	236.5	64.7

a. Few smooth light brown concr. (Fe?); few $CaCO_3$ concr.
b. Few $CaCO_3$ concr.
c. Few $CaCO_3$ concr.; common $CaSO_4$ concr.
1/ Dispersion problem.

Soil type: Miranda loam
Soil No.: S58NDak-51-1-(1-8)
Location: 260 feet north and 100 feet east of southwest corner of Sec. 28, T160N, R89W, Ward County, North Dakota.
Vegetation: Native grassland pasture.
Physiography: Till plain.
Parent material: Calcareous firm clay loam glacial till.
Topography: Gently undulating with 5 to 10 feet of local relief. Sampled on a 1 percent southeasterly slope with 3-to 6-inch truncated microrelief.
Elevation: About 1900 feet above sea level.
Climate: About 15 inches annual precipitation; about 38 degrees F. mean annual temperature.
Drainage: Moderately well drained with slow surface runoff.
Permeability: Very slow in B horizon.
Moisture: Dry to 6 inches, moist and saline below.
Root distribution: Matted in A, few to 30 inches.
Stoniness: Few stones in area.
Described by: Robert L. Howey.
Date: August 1, 1958.

Horizon and Lincoln Lab. Number	
A2 8689	0 to 2 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; soft, friable, slightly sticky and slightly plastic; weak platy to moderate very fine crumb structure; abrupt, wavy boundary with a very thin light gray contact layer.
B2 8690	2 to 6 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) clay with continuous dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) organic-stained clay skin coatings on all ped surfaces; extremely hard, very firm, very sticky and very plastic; strong medium columns (with rounded caps slightly frosted with silica) to moderate medium fine angular blocks. Clear, wavy boundary.
B2cs 8691	6 to 10 inches. Grayish brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) clay loam with continuous organic-stained clay skins on all ped surfaces; hard, firm, very sticky and very plastic; moderate medium prisms to moderate angular blocks with gypsum in threads and seams.
B3cs 8692	10 to 15 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) clay loam; hard, firm, very sticky and very plastic with weak moderate prisms to weak angular blocks with many fine distinct gypsum nests. Clear, wavy boundary.
Cca 8693	15 to 24 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 5/3 moist) strongly calcareous clay loam without significant segregated lime; hard, friable, very sticky and very plastic; weak subangular blocky structure. Gradual boundary.
Ccacs 8694	24 to 33 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) strongly calcareous clay loam without segregated lime but with common distinct gypsum nodules; hard, firm, very sticky and very plastic; massive dispersed material without structure. Gradual boundary.
Ccs 8695	33 to 46 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) slightly calcareous clay loam with many gypsum nests and a few prominent black lignite fragments; hard, firm, very sticky and very plastic; apparently massive structureless till material.
C 8696	46 to 60 inches. Same as above but with less gypsum.

Note: This profile taken on microrelief low, about 5 feet west of thick solum phase S58NDak-51-2 sampled on microrelief high.

SOIL SURVEY LABORATORY Mandan, North Dakota 9-9-55

SOIL TYPE Morton clay loam **LOCATION** Hettinger County, North Dakota

SOIL NOS. S54NDak-21-3-(1-8) **LAB. NOS.** 2299-2306

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2½	A11	1.7	1.5	4.2	8.6	10.3	45.5	28.2	29.9	30.8	0.5	cl
2½-6	A12	0.8	1.5	4.8	9.3	12.0	44.5	27.1	32.8	29.2	-	cl
6-11½	B21	0.3	1.4	5.0	9.6	11.3	42.1	30.3	30.5	28.4	-	cl
11½-18	B22	0.5	1.3	4.2	7.2	6.5	46.1	34.2	20.1	36.3	-	cl
18-26	B3ca	0.4	0.5	1.3	2.5	2.7	58.5	34.1	10.0	52.6	-	sicl
26-33	Cca	-	0.2	0.4	0.9	0.9	61.7	35.9	6.1	57.0	-	sicl
33-45	Ccs	-	-	0.2	0.5	0.6	55.7	43.0	2.0	54.6	-	sic
45-60	C	-	-	-	-	0.4	40.8	58.8	1.0	40.2	-	sic

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.3	7.4	2.37	.262	9.0	-	0.8	-				12.3
7.0	7.4	7.5	1.62	.178	9.1	-	0.6	-				10.3
7.3	7.7	7.9	1.06	.123	8.6	-	0.6	-				10.4
7.6	8.3	8.6	0.72	.101	7.1	-	0.6	1				12.1
8.2	9.1	9.3	0.54	.066	8.2	-	1.2	17				12.2
8.2	8.8	9.0	0.31			0.59	10.0	19	-			12.6
8.3	8.7	8.8	0.16			0.95	15.0	13	43			16.5
8.2	8.5	8.7	0.11			0.81	12.0	7	47			20.6

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
23.9	17.3	5.1		-	1.1	-	0.6	0.8				61.7
21.8	15.7	4.6		0.1	0.6	-	0.4	0.2				53.8
21.0	14.6	5.7		0.1	0.3	-	0.4	0.1				52.3
22.4				0.4	0.2	1	2.0	-				56.8
17.6				2.2	0.2	9	9.2	-				63.0
16.7				9.6	0.3	20	85.0	0.1	8.1	4.5	147.5	74.3
17.9				14.0	0.2	13	141.0	0.2				82.3
20.6				15.6	0.2	22	111.0	0.2	8.6	3.8	190.1	99.8

Soil type: Morton clay loam
Soil No.: S54NDak-21-3
Area: Hettinger County, North Dakota.
Location: 0.15 mile east of northwest corner Sec. 17, T136N, R95W.
Vegetation or crop: Native grasses, good; green needle, needle-and-thread, blue grama, western wheatgrass, threadleaf sedge, silverleaf scurfpea, fringed sagewort, june grass.
Parent material: Stratified silt and clay of Fort Union formation.
Physiographic position: 150 feet from top of 500-foot long upland slope into stream valley of a narrow intermittent stream. Below pit the lower slope is a Morton-Rhoades complex.
Topography: Undulating (relief 10 to 20 feet).
Slope: 3 percent southeast.
Drainage: Well.
Permeability: Moderate.
Moisture: Dry to 33 inches; moist below 45 inches.
Stoniness: Free.
Described by: C. A. Mogen.
Date: July 20, 1954.

Mandan Lab.No.	Horizon	
2299	A11	0 to 2½ inches. Brown (10YR 5/3 dry) to very dark brown (10YR 2.5/2 moist) clay loam; soft, very friable; moderate fine granules.
2300	A12	2½ to 6 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2.5/2 moist) clay loam; hard, very friable; moderate, medium prisms. Very few igneous pebbles.
2301	B21	6 to 11½ inches. Dark grayish brown (10YR 4.5/2 dry) to very dark grayish brown (10YR 3/2 moist) clay loam; slightly hard, friable; compound structure of moderate medium prisms separating to weak medium blocks. Few igneous pebbles.
2302	B22	11½ to 18 inches. Pale brown (1Y 6/3 dry) to yellowish brown (1Y 5/4 moist) coated with dark grayish brown (1Y 4/2 moist) clay loam; very hard, friable; compound structure of moderate medium prisms separating to medium fine blocks; few igneous pebbles.
2303	B3ca	18 to 26 inches. Light yellowish brown (2.5Y 6/3 dry) and olive yellow (2.5Y 6/5 dry) to light olive brown (2.5Y 5/4 moist) coated with olive brown (2.5Y 4/3 moist) moderately calcareous silty clay loam with a slight amount of segregated lime; very hard, very friable; compound structure of moderate coarse and medium prisms separating to weak coarse and medium blocks. In this horizon there is a band, 3 inches thick, of yellow.
2304	Cca	26 to 33 inches. Pale yellow (5Y 7/3 dry) to light olive brown (2.5Y 5/4 moist) strongly calcareous silty clay loam with a moderate amount of segregated lime in threads and films; very hard, friable; compound structure of weak coarse prisms and weak fine blocks.
2305	Ccs	33 to 45 inches. Pale yellow (5Y 7/3 dry) with common medium-sized distinct mottlings of olive yellow (2.5Y 6/8 dry) to olive (5Y 4/3 moist) mottled with yellowish brown (10YR 5/8 moist) mildly calcareous silty clay; moderate amount of crystalline gypsum; very hard, friable; moderate fine blocks; 3 bands of yellow, each 3 inches thick.
2306	C	45 to 60 inches. Light gray (5Y 7/1 dry) mottled with light yellowish brown (2.5Y 6/4 dry) to olive brown (2.5Y 4/4 moist) mottled with olive gray (5Y 4/2 moist) mildly calcareous silty clay; very hard, firm; moderately developed fine and very fine blocks; slight amount of crystalline gypsum.

SOIL SURVEY LABORATORY Lincoln, Nebr. August 1960

SOIL TYPE Morton silt loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-16-(1-8) **LAB. NOS.** 11636-11643

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4	A1	0.5a	1.9a	7.0b	15.1	11.3	44.1	20.1	41.1	21.0	Tr.	l
4-13	B21	0.8a	1.9a	8.4b	17.9	11.1	34.3	25.6	35.5	17.5	Tr.	l
13-19	B22	0.6a	1.8a	7.4b	13.8b	11.3b	38.6	26.5	34.5	20.8	Tr.	l
19-27	B3	0.3a	1.1c	2.8b	4.6b	16.2b	48.9	26.1	40.6	26.4	Tr.	l
27-37	Cca1	0.2a	0.6d	2.4d	4.8d	5.4d	59.1	27.5	25.6	40.9	Tr.	sicl
37-46	Cca2	<0.1	0.1d	0.1d	0.5d	7.0d	72.0	20.3	46.5	32.8	-	sil
46-54	C1	<0.1	0.1d	0.1d	0.7d	21.0d	60.9	17.2	59.2	23.2	-	sil
54-60	C2	<0.1	0.1d	0.2d	0.7d	31.2d	50.9	16.9	66.6	16.0	-	sil

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM ms./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.4	6.8	6.7	3.20	0.244	13.1	1.8	0.5					9.3
6.7	7.1	7.1	1.04	0.092	11.3	2.5	0.4	<1				10.3
7.0	7.3	7.3	0.91	0.082	11	2.4	0.4	<1				10.2
7.4	7.7	7.7	0.76	0.076	10	2.0	0.4	<1				11.2
8.4	9.0	9.2	0.55			1.9	1.0	12				10.2
8.5	9.2	9.4	0.41			0.9	1.7	17				9.4
8.4	9.1	9.3	0.28			0.8	2.6	13				9.2
8.4	9.0	9.1	0.23			0.9	3.2	11				9.8

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	HCO_3^-	Cl^-	8A1 $SO_4^=$	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
19.4	11.9	4.8	5.1	<0.1	1.4	<1	0.3	0.8				56.1
19.8	10.0	8.1	3.6	<0.1	0.8	<1	0.3	0.4				49.6
19.9	9.4	9.9	3.2	0.1	0.5	<1	0.4	0.3				49.0
20.7	9.1	13.2	2.0	0.1	0.4	<1	0.6	0.2				56.5
16.4				0.9	0.3	4	4.7	0.2				56.4
15.4				1.7	0.2	7	9.8	0.2				63.7
16.2				2.1	0.3	7	14.5	0.4				62.0
16.6				2.4	0.3	8	16.4	0.5				63.3

a. Many Fe-Mn? concr.
b. Few Fe-Mn? concr.
c. Common Fe-Mn? concr.
d. Few Fe-Mn? concr. Few carbonate concr. $CaCO_3$?

Soil type: Morton silt loam
Soil No.: S58NDak-45-16-(1-8)
Location: 175 feet west and 190 feet north of east quarter corner of Sec. 1, T139N, R96W, Stark County, North Dakota.
Parent material: Residual silts and siltstones.
Vegetation: Blue grama and threadleaf sedge.
Physiography: Gently rolling uplands.
Slope: 3 percent north facing.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate.
Stoniness: None.
Described by: K. E. Larson.
Date: July 24, 1958.

Horizon and Lincoln Lab. Number	
A1 11636	0 to 4 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) silt loam; moderate medium crumb structure from weak fine angular blocks; slightly hard, friable, slightly sticky and slightly plastic; noncalcareous; clear smooth boundary.
B21 11637	4 to 13 inches. Brown (10YR 4/3 dry) to dark brown (10YR 3/3 moist) clay loam; moderate fine and medium prisms that break to moderate fine angular blocks; clay films on vertical and horizontal surfaces of the peds; hard, friable, slightly sticky and plastic; noncalcareous; gradual wavy boundary.
B22 11638	13 to 19 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) clay loam; moderate fine and medium prisms separating to moderate fine angular blocks; clay films on all faces of peds; prisms are coated with dark grayish brown or very dark grayish brown (10YR 4/2 dry, 3/2 moist); hard, friable, slightly sticky and plastic; few iron mottles of yellowish brown (10YR 5/8); noncalcareous; clear smooth boundary.
B3 11639	19 to 27 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) clay loam; strong coarse and medium prisms separating to moderate medium angular blocks; hard, friable, slightly sticky and plastic; clay skins on all faces of peds; noncalcareous; clear wavy boundary.
Ccal 11640	27 to 37 inches. Pale olive (5Y 6/4 dry) to olive (5Y 4/3 moist) clay loam; few fine prominent mottlings of reddish brown (5YR 5/3 dry); moderate coarse prisms that break to moderate medium angular blocks; hard, friable, slightly sticky and plastic; very strongly calcareous; gradual smooth boundary.
Cca2 11641	37 to 46 inches. Light gray (5Y 7/2 dry, crushed) silt loam, olive gray (5Y 4/2 moist, crushed), pale olive (5Y 6/3 dry) and light olive brown (2.5Y 5/4 dry) in bands; few large prominent mottlings of yellowish red, (5YR 5/8 dry); weak coarse and medium subangular blocks; friable, slightly sticky and slightly plastic; very strongly calcareous; clear smooth boundary.
C1 11642	46 to 54 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) silt loam; weak coarse subangular blocks that separate into weak coarse plates; hard, friable, slightly sticky and slightly plastic; few medium distinct mottles of light olive brown (2.5Y 5/6 dry); strongly calcareous; clear smooth boundary.
C2 11643	54 to 60 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) silt loam; weak medium subangular blocks that separate into weak medium plates; hard, friable, slightly sticky and slightly plastic; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. August 1960

OIL TYPE Morton silt loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-17-(1-8) **LAB. NOS.** 11644-11651

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-4	A1	0.2a	0.9c	2.8b	8.3	10.9	53.5	23.4	38.4	30.5	Tr.	sil
4-9	B21	0.4a	0.8c	2.6b	6.6	10.7	53.6	25.3	36.7	31.2	Tr.	sil
9-16	B22	0.5a	1.2c	3.3b	8.1	10.8	48.5	27.6	37.2	26.6	Tr.	cl
16-23	B23	0.5a	1.1c	3.5b	8.9	11.4	48.7	25.9	38.1	26.9	Tr.	l
23-31	B24	0.1a	1.0c	3.2b	7.1	6.0	51.2	31.4	23.2	37.4	Tr.	sicl
31-39	B3	0.4a	0.4e	0.6d	1.5d	2.6d	69.4	25.1	30.9	41.9	Tr.	sil
39-49	Cca	0.1e	0.2e	0.2e	0.4d	0.8d	70.2	28.1	19.0	52.2	Tr.	sicl
49-60	C1	0.1e	0.3e	0.2e	0.5d	0.8d	71.7	26.4	18.0	54.8	Tr.	sil

pH 1:1	pH 1:5	pH 1:10 (8C1a)	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	ORGANIC MATTER C/N	6C1a Free Iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	MOISTURE TENSIONS 1/3 ATMOS. %	MOISTURE TENSIONS 4B2 15 ATMOS. %
5.9	6.2	6.5	3.74	0.299	12.5	2.2	0.5					11.1
6.2	6.6	6.6	2.03	0.189	10.7	2.4	0.4					10.1
6.7	6.9	7.0	1.11	0.105	10.6	2.7	0.4	<1				10.0
6.8	7.2	7.2	0.78	0.080	10	2.8	0.4	<1				9.4
7.2	7.6	7.7	0.71	0.068	10	2.5	0.6	<1				11.1
8.0	8.4	8.6	0.51			2.5	6.2	12	1			9.3
8.1	8.5	8.6	0.43			2.2	8.5	14	7			11.1
8.1	8.4	8.6	0.39			2.8	9.8	11	10			11.5

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLES 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
20.8	12.4	5.1	8.0	<0.1	1.4	<1	0.2	0.6				63.9
18.9	10.6	5.8	7.5	<0.1	0.9	<1	0.2	0.3				54.9
18.2	9.2	7.9	4.8	<0.1	0.6	<1	0.3	0.2				49.8
17.2	7.6	8.8	3.1	0.1	0.4	<1	0.6	0.2				47.8
19.7	6.6	13.3	2.4	0.5	0.4	2	2.4	0.1				53.7
14.2				2.2	0.2	6	22.2	0.3	5.6	1.2	93.8	58.0
14.8				6.9	0.2	32	35.6	0.3	3.7	1.7	136.6	63.2
14.4				8.5	0.2	40	41.5	0.4	2.6	1.2	152.7	68.8

a. Many Fe-Mn? concr.
b. Few Fe-Mn? concr.
c. Common Fe-Mn? concr.
d. Few Fe-Mn? concr. Few carbonate concr. $CaCO_3$?
e. Common Fe-Mn? concr. Common carbonate concr. $CaCO_3$?

Soil type: Morton silt loam
Soil No.: S58NDak-45-17-(1-8)
Location: 0.2 mile east of northwest corner of Sec. 12, T140W, R95N, Stark County, North Dakota.
Parent material: Residual silts and siltstones of Tongue River member of Ft. Union formation.
Vegetation: Blue grama, green needlegrass, and western wheatgrass.
Physiography: Gently undulating residual upland.
Slopes: 3 percent.
Drainage: Well.
Erosion: None to slight.
Permeability: Moderate.
Root distribution: Numerous to 31 inches.
Described by: K. E. Larson.
Date: July 24, 1958.

Horizon and Lincoln Lab. Number	
A1 11644	0 to 4 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark brown (10YR 2/2 moist) silt loam; weak medium subangular blocky to moderate fine and medium crumb structure; slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; clear smooth boundary.
B21 11645	4 to 9 inches. Dark grayish brown (10YR 4/2 dry) silt loam; very dark brown (10YR 2/2 moist) crushing to very dark grayish brown (10YR 3/2 moist); continuous clay films on all faces; moderate medium prisms that break to moderate medium angular blocks; slightly hard, very friable, slightly sticky and plastic; noncalcareous; gradual smooth boundary.
B22 11646	9 to 16 inches. Brown (10YR 4.7/3 dry) to dark brown (10YR 3/3 moist) clay loam; moderate fine and medium prisms that break to moderate medium angular blocks; continuous clay films on faces of peds and with coatings of very dark brown (10YR 2/2 moist); hard, friable, sticky and plastic; noncalcareous; diffuse boundary.
B23 11647	16 to 23 inches. Olive brown (2.5Y 5/3 dry) to olive brown (2.5Y 4/3 moist) clay loam; moderate fine and medium prisms that break to moderate medium angular blocks; thin continuous clay films on faces of peds; hard, very friable, sticky and plastic; noncalcareous; gradual smooth boundary.
B24 11648	23 to 31 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) clay loam with common medium distinct, 2.5Y 5/4 dry, mottles; strong medium prisms to moderate fine angular blocks; patches of clay films on all faces, 2.5Y 3/2 moist; hard, friable, sticky and plastic; noncalcareous; clear smooth boundary.
B3 11649	31 to 39 inches. Pale olive (5Y 6/3 dry) to olive (5Y 4/3 moist) clay loam; weak coarse prisms that break to moderate medium subangular blocks; common fine distinct strong brown (7.5YR 5/8) mottles; patches of clay films on prism faces; hard, firm, sticky and plastic; highly calcareous with few prominent lime threads.
Cca 11650	39 to 49 inches. Pale olive (5Y 6/3 dry) to olive (5Y 4/3 moist) silt loam; moderate medium subangular blocks that break to weak coarse plates; hard, firm, slightly sticky and slightly plastic; very strongly calcareous with many prominent pale yellow lime nodules; common fine prominent mottles of 7.5YR 5/8.
C1 11651	49 to 60 inches. Pale olive (5Y 6/3 dry) to olive (5Y 4/3 moist) silt loam; moderate medium subangular blocks that break to moderate medium plates; common fine prominent yellowish red mottlings; slightly hard, friable, slightly sticky and slightly plastic; calcareous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Overly silty clay loam **LOCATION** Cass County, North Dakota

SOIL NOS. S53NDak-9-1 **LAB. NOS.** 1682-1687

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-9	A1	0.1	0.2	0.3	1.1	25.9	41.8	30.6	50.2	18.3	-	cl
9-12	AB	-	0.1	0.2	0.8	28.8	39.8	30.3	52.2	17.0	-	cl
12-20	B2g	0.1	0.2	0.3	0.9	26.3	39.0	33.2	45.5	20.6	-	cl
20-36	Cca	0.2	0.3	0.4	0.8	4.1	49.6	44.6	16.5	37.6	-	sic
36-48	C1	0.1	0.2	0.3	0.5	1.5	57.2	40.2	16.0	43.0	-	sic
48-60	C2	0.2	0.5	0.4	0.5	1.1	71.5	25.8	23.0	49.7	-	sil

pH 8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	ORGANIC MATTER C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	MOISTURE TENSIONS 1/3 ATMOS. %	4B2 15 ATMOS.
6.9			2.37	0.184	12.9	<0.20	0.5	-				15.4
6.6			1.21	0.111	10.9	<0.20	0.4	-				14.9
7.2			0.59	0.070	8.4	<0.20	0.7	1				14.4
8.3			0.50	0.061	8.2	<0.20	0.5	24				17.4
8.2			0.34	0.041	8.3	<0.20	0.5	19				18.8
8.0			0.20	0.027		<0.20	0.5	17				16.4

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6P2a Na	5B1a 6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil →					← milliequivalents per liter →					
31.6	17.7	10.5	0.1	0.3	3.0	0.6	-				56.4
29.7	13.5	13.1	0.1	0.2	2.8	0.4	-				53.3
		11.1	0.1	0.2	1.2	0.4	-				58.4
		20.2	0.1	0.2	-	0.2	-				67.8
		17.5	0.2	0.2	-	0.2	-				71.4
		14.8	0.3	0.2	-	0.6	-				67.8

Soil type: Overly silty clay loam
Soil No.: S53NDak-9-1
County: Cass County, North Dakota
Location: 220 feet west and 180 feet north of high line pole at southeast corner of field west of farm road; S1/4 corner Sec. 30, T140N, R51W.
Vegetation: Alfalfa.
Climate: Subhumid.
Parent material: Glacial lacustrine silty clay loam.
Physiographic position: Broad, level, plain or terrace of Lake Agassiz.
Topography: Very slightly undulating.
Slope: 1/2 percent.
Drainage: Somewhat poor.
Permeability: Moderately slow.
Moisture: Moist.
Stoniness: None.
Root distribution: Through 60 inches.
Described by: C. A. Mogen.
Date: June 13, 1953.
Mandan

Lab.No.	Horizon	
1682	A1	0 to 9 inches. Very dark gray to black (10YR 3/1 to 2/0.5 moist) noncalcareous silty clay loam; cloddy crushing readily into moderately defined fine granules; hard when dry, friable when moist, sticky and slightly plastic when wet. Broad V-shaped wedges of the A1 horizon extend to depths of 20 inches. Tongues and streaks of this granular structure extend into the Cca horizon in place. This changes in a clear irregular boundary to
1683	AB	9 to 12 inches. Very dark gray with many fine faint mottlings of dark gray, dry to black with many fine distinct mottlings of very dark gray, moist (10YR 3/1 and 4/1 dry; to 2/0.5 and 2.5Y 3/1 moist) noncalcareous heavy silty clay loam; weakly defined medium-sized blocky aggregates which readily crumble to moderately defined medium-sized granules; hard when dry, friable when moist, sticky and slightly plastic when wet. This changes in a clear irregular boundary to
1684	B2g	12 to 20 inches. Dark gray grading downward to grayish brown dry to very dark grayish brown grading downward to dark grayish brown moist (2.5Y 4/1, 5/2, 3/2 and 4/2 moist) noncalcareous fine textured silty clay loam; weakly defined medium-sized prisms, prisms separate out into a moderately defined fine subangular blocky aggregates; hard when dry, friable when moist, sticky and slightly plastic when wet. This changes in a clear wavy boundary to
1685	Cca	20 to 36 inches. Light gray with many fine faint mottlings of white to light brownish gray, moist (2.5Y 7/2 mottled with 9/2 to 6/2 moist) strongly calcareous silty clay loam with a moderate amount of segregated lime in threads and seams; weak fine granular structure; slightly hard when dry, friable when moist, sticky and slightly plastic when wet. This grades into
1686	C1	36 to 48 inches. Light gray with a few fine faint mottlings of white and olive yellow, dry to light brownish-gray with many fine distinct mottlings of yellowish brown, moist (2.5Y 7/2, 8/2 and 6/6 dry to 6/2, 7/2 and 10YR 5/8 moist) moderately calcareous fine textured silty clay loam; weak fine blocky structure; hard when dry, friable when moist, slightly sticky and slightly plastic when wet. This changes clearly to
1687	C2	48 to 60 inches. Horizon consists of stratified silt loam and silty clay. The silt is white mottled with pale olive, moist. The silty clay is olive gray mottled with yellow and yellowish brown, moist (5Y 8/2 and 6/3; 5/2 and 10YR 7/8 and 5/8 moist) moderately calcareous silt loam and silty clay loam; weakly to moderately defined finely laminated; hard when dry; friable when moist. The silt is non-sticky, non-plastic. The silty clay is slightly sticky and slightly plastic.

Note: Locally this soil is a dominant member in association with a somewhat poorly drained Calcium Carbonate Solonchak. In this association the Calcium Carbonate Solonchak occupies the slightly raised positions on nearly level to very slightly undulating landscape.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Overly clay loam **LOCATION** Cass County, North Dakota

SOIL NOS. S53NDak-9-2 **LAB. NOS.** 1656-1662

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	A1p	0.1	0.6	0.8	2.5	21.4	44.1	30.5	45.7	21.5	-	cl
7-11	A12	0.2	0.6	0.7	2.2	24.1	41.4	30.8	48.7	18.4	-	cl
11-18	B2	0.2	0.9	1.2	2.5	26.8	37.9	30.5	49.2	16.8	-	cl
18-25	Cca1	0.1	0.4	0.5	1.2	4.9	56.0	36.9	29.1	32.4	-	sicl
25-34	Cca2	0.3	0.3	0.4	0.5	1.9	62.6	34.0	26.9	37.9	-	sicl
34-44	C1	-	0.4	0.5	1.1	4.1	69.1	24.8	46.5	27.5	-	sil
44-50	C2	0.1	0.4	0.5	2.3	2.6	71.8	22.3	30.9	45.2	-	sil

8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6			3.00	0.212	14.2	<0.20	0.7	-				15.5
6.8			2.08	0.157	13.2	<0.20	0.5	-				15.7
7.4			0.62	0.068	9.1	<0.20	0.6	-				14.0
8.4			0.51	0.056	9.1	<0.20	1.4	32	-			15.1
8.2			0.30	0.043	7.0	0.24	5.0	26	-			16.3
8.1			0.20	0.028		0.22	6.5	19	-			13.7
8.1			0.22	0.029		0.21	4.7	19	-			15.1

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	6Q2a K	5B1a 6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6I1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
32.4	17.2	11.4		0.1	0.3	3.4	-	0.1				56.2
29.4	14.6	11.9		0.1	0.3	2.5	-	0.1				56.4
25.2	10.1	13.5		0.1	0.3	1.2	0.4	-				56.9
							2.2	-				64.2
							11.1	0.1	2.2	3.0	69.6	66.1
							12.6	0.1	2.7	2.8	79.9	58.7
							11.1	0.1	2.2	2.8	61.9	63.4

Soil type: Overly clay loam
Soil No.: 853NDak-9-2
Location: 0.45 mile west and 140 feet south of northeast corner Sec. 12, T139N, R52W, Cass County, North Dakota.
Crop: Cultivated, fallow following wheat.
Climate: Mean annual rainfall 23 inches; mean annual temperature 39° F.
Parent material: Calcareous lacustrine sediments of silty clay loam and silt loam texture, of late Wisconsin age (Glacial Lake Agassiz bed).
Drainage: Moderately well drained; runoff very slow; permeability medium.
Physiography: Level lake plain with very slight undulations and a moderate number of very shallow undrained depressions. Profile examined at a site that has some runoff; i.e., does not pond.
Described by: W. M. Johnson, 1953.

Mandan Lab.No.	Horizon	
1656	A1p	0 to 7 inches. Very dark gray to black (10YR 3/1 dry; 2/1 moist) soft, friable, moderate fine granular clay loam. The recently cultivated upper 2 inches tends to be cloddy. The lower boundary is clear and level.
1657	A12	7 to 11 inches. Very dark gray to black (10YR 3/1 dry; 1.5/0.5 moist) friable clay loam. Moderate medium prisms break to weak medium blocks. The blocks may be crushed to indistinct granule-like aggregates. Some of the prisms appear to have slightly shiny faces. Clear, irregular lower boundary. "Tongues" of dark-colored soil run down to 25 inches below the soil surface.
1658	B2	11 to 18 inches. Grayish brown to very dark grayish brown (2.5Y 4.5/2 dry; 3/2 moist) friable, clay loam. Some of the faces of aggregates have black films. Moderate medium prisms break to moderate very fine blocks. Plastic and slightly sticky when wet. Noncalcareous. Faces of aggregates are distinct planes but are not shiny. Clear, irregular ("tongued") lower boundary.
1659	Cca1	18 to 25 inches. White to light brownish gray (2.5Y 7.5/2 dry; 6.5/2 moist) friable, silty clay loam, with abundant, faint, medium to fine brown mottles and few fine black spots (moist). Weak medium prisms crush to fine granule-like aggregates. Very strongly calcareous. Calcium carbonate is in floury, disseminated form. Lower boundary is diffuse and wavy.
1660	Cca2	25 to 34 inches. White to light olive gray (5Y 7.5/2 dry; 6/2 moist) friable silty clay loam, with many, faint, medium and coarse mottles of brown and very dark brown (moist). Very weak prismatic structure. Very strongly calcareous, the lime being in disseminated form. Contains a very few hard shot concretions, very dark brown in color 1 to 2 mm. in diameter. Diffuse lower boundary.
1661	C1	34 to 44 inches. Light brownish gray to grayish brown (2.5Y 6.5/2 dry; 5/2 moist) friable, massive heavy silt loam or light silty clay loam. Has common medium and coarse mottles of dark grayish brown, brown, and light gray (moist). Strongly calcareous. Material in places shows faint coarse laminae. (Some soil scientists would probably call this horizon Cg). Diffuse lower boundary.
1662	C2	44 to 50 inches. Distinctly mottled light yellowish brown, light gray and strong brown, dry. Indistinctly laminated friable silt loam. There is a tendency toward vertical breakage, making weak very coarse blocks. Many tiny vertical tubules, probably root holes. Strongly calcareous.

Note: All horizons down to the Cca1 vary markedly in thickness within a linear distance of 3 feet, due to irregular boundaries. At the time the profile was examined, free water stood at a depth of 50 inches below the surface. This is presumably due to a temporary, perched water table held up by slowly permeable strata below.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Parnell silty clay loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-4-(1-8) **LAB. NOS.** 4465-4472

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	A11	0.5	1.0	1.3	2.7	4.3	54.6	35.6	23.0	37.4	-	sicl
5-10	A12	0.2	1.2	1.3	2.4	3.6	51.6	39.7	20.6	36.0	-	sicl
10-22	B21	0.3	0.6	0.7	1.6	3.1	46.2	47.5	16.8	33.5	Tr.	sic
22-33	B22	0.3	0.5	0.6	1.6	3.0	44.0	50.0	15.2	32.8	-	sic
33-44	B23	0.7	1.6	1.5	2.7	4.0	47.1	42.4	22.1	30.6	2.0	sic
44-50	Cg1	0.5	1.2	1.0	2.7	4.2	53.8	36.6	23.4	36.3	-	sicl a/
50-55	Cg2	-	0.1	0.2	0.6	1.9	50.9	46.3	18.3	34.9	-	sic b/
55-60	Cg3	1.4	3.0	3.0	5.9	10.2	52.5	24.0	40.1	25.9	Tr.	sil

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	6.7	7.1	6.54	.637	10.3	<0.20	1.0	-				21.7
6.9	7.3	7.7	3.06	.373	8.2	<0.20	0.8	-				18.9
7.0	7.6	7.7	1.16	.132	8.8	<0.20	0.6	-				19.6
7.1	7.5	7.9	0.72	.081	8.9	<0.20	0.6	-				20.0
7.0	7.6	7.9	0.61			<0.20	0.6	-				18.2
7.4	8.2	8.4	0.71			<0.20	0.7	13				17.8
7.3	8.1	8.4	1.22			<0.20	0.7	2				21.4
7.5	8.2	8.6	0.20			<0.20	0.8	4				11.1

5A1a CATION EXCHANGE CAPACITY ← NH4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter					
40.0	31.1	7.9		0.1	1.9	-	0.5	0.7	6.8	3.7		70.4
34.7	27.3	8.4		0.1	1.6	-	0.5	0.6	5.2	2.8		72.8
32.5	24.6	9.0		0.1	1.6	-	0.4	0.5	3.5	2.2		66.1
31.6	24.8	8.6		0.1	1.7	-	0.4	0.5	3.7	1.8		79.0
30.6	23.9	8.4		0.1	1.5	-	0.4	0.4	3.4	1.7		67.6
26.3		7.4		0.1	1.3	-	0.4	0.5	4.0	2.2		74.8
28.2		7.9		0.1	1.3	-	0.5	0.5	4.6	2.1		80.0
15.1		4.3		0.1	0.7	1	0.5	0.6	4.2	2.2		51.1

a/ Large number of small snail shells in sand fraction.
b/ A few shells in sand fraction.

Soil type: Parnell silty clay loam
Soil No.: S56NDak-41-4-(1-8)
Location: 430 feet east and 110 feet south of north quarter corner of Sec. 18, T130N, R55W, Sargent County, North Dakota.
Vegetation: Prairie cordgrass.
Parent material: Glacial lacustrine over glacial till.
Physiography: Enclosed depression, 10 feet deep.
Drainage: Very poor.
Ground water: 56 inches.
Described by: Wesley M. Larsen.
Date: July 11, 1956.

Horizon and Lincoln Lab. Number	
Ao	1 to 0 inch. Matted reed and rush remains (not sampled).
A11 4465	0 to 5 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) silty clay loam; weak medium platy, very friable. Abrupt smooth boundary.
A12 4466	5 to 10 inches. Black (N 2/0 moist) silty clay loam; weak angular blocky; friable. Abrupt smooth boundary.
B21 4467	10 to 22 inches. Black (N 2/0 moist) silty clay loam with a strong angular blocky structure; firm wavy boundary.
B22 4468	22 to 33 inches. Black (5Y 2/1 moist) silty clay; strong angular blocks; firm; continuous distinct clay skins on all faces; noncalcareous.
B23 4469	33 to 44 inches. Same as above but with a few pebbles. Clear boundary.
Cg1 4470	44 to 50 inches. Black (5Y 2/2 moist) silty clay loam with a weak angular blocky structure; firm; strongly calcareous. Smooth boundary.
Cg2 4471	50 to 55 inches. Olive gray (5Y 4/2 moist) silty clay; strong coarse angular blocks; firm; strongly calcareous; smooth boundary.
Cg3 4472	55 to 60 inches. Dark gray (5Y 4/1 moist) with many prominent mottles of dark reddish brown (2.5YR and 5YR 3/4 moist) silty clay loam; fine angular blocky; firm; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Parnell silty clay loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-8-(1-7) **LAB. NOS.** 4495-4501

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-8	A1	0.2	0.6	1.0	3.7	4.3	50.9	39.3	21.5	36.2	Tr.	sicl
8-11	AB	0.5	0.8	1.2	4.3	4.8	48.9	39.5	22.5	34.1	Tr.	sicl
11-20	B21	0.2	0.5	0.9	3.1	4.9	47.3	43.1	21.3	33.0	Tr.	sic
20-30	B22	0.3	0.6	0.9	3.0	4.9	44.2	46.1	20.4	30.7	Tr.	sic
30-39	B23	0.2	0.5	0.8	3.1	5.8	44.3	45.3	21.6	30.7	-	sic
39-46	Cgca	0.1	0.4	0.3	1.0	1.9	55.2	41.1	12.9	44.8	-	sic a/
46-60	Cg	0.3	0.5	0.2	0.3	1.1	61.2	36.4	13.2	49.3	-	sicl b/

8C1b SATURATED PASTE	pH 8C1a 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	ORGANIC MATTER C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	7.1	7.3	4.64	.412	11.3	<0.20	1.1	-				20.5
6.4	6.8	7.0	2.18	.237	9.2	<0.20	0.8	-				18.1
6.5	7.2	7.0	0.88	.107	8.2	<0.20	0.7	-				18.0
6.7	7.2	7.5	0.48	.070	6.8	<0.20	0.6	-				18.8
7.2	7.8	8.2	0.46			<0.20	0.8	-				19.3
7.6	8.3	8.4	0.46			<0.20	0.8	32				15.9
7.5	8.1	8.4	0.13			<0.20	0.9	16				17.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
35.6	28.2	8.6		0.1	1.9	-	0.4	1.2	7.6	4.4		76.3
30.8	23.3	8.2		0.1	1.6	-	0.4	0.8	4.6	3.0		62.6
28.1	20.2	8.6		0.1	1.5	-	0.4	0.7	3.6	2.3		63.5
29.1	21.1	9.1		0.1	1.7	-	0.3	0.6	3.2	2.3		67.0
29.8	26.2	9.2		0.1	1.8	-	0.3	0.9	4.9	2.7		67.9
18.4				0.1	1.0	1	0.4	0.6	5.0	2.5		69.6
21.8				0.1	1.2	-	0.5	0.7	5.2	2.7		63.6

a/ Snail shells in sand fraction.
b/ Shot (Mn?) in sand fraction.

Soil type: Parnell silty clay loam
Soil No.: S56NDak-41-8-(1-7)
Location: 410 feet north and 520 feet east of west quarter corner of Sec. 18, T132N, R54W, Sargent County, North Dakota.
Vegetation: Reeds and marsh grasses.
Parent material: Glacial lacustrine.
Physiographic position: Large enclosed depression.
Relief: 15 feet.
Drainage: Very poor.
Ground water: 56 inches.
Described by: Wesley M. Larsen.
Date: August 6, 1956.

Horizon and Lincoln Lab. Number	
A1 4495	0 to 8 inches. Black (10YR 2.5/1 dry to 2/1 moist) silty clay loam; hard, friable, sticky and plastic; noncalcareous; weak medium platy structure; smooth boundary.
AB 4496	8 to 11 inches. This horizon is the same as the one above except that it has a moderate medium angular blocky structure.
B21 4497	11 to 20 inches. Very dark gray (2.5Y 3/1 dry) to black (2.5Y 2/1 moist) silty clay; strong very fine angular blocky structure; firm, very sticky and very plastic; continuous distinct clay skins on all surfaces; wavy boundary.
B22 - B23 4498 - 4499	20 to 30 and 30 to 39 inches. Very dark gray (2.5Y 3/1 dry) to black (2.5Y 2/1 moist) silty clay loam; moderate medium angular blocky structure; sticky and plastic; noncalcareous; wavy boundary.
Cgca 4500	39 to 46 inches. Light gray (5Y 7/1 dry) to gray (5Y 5/1 moist) silty clay loam; weak angular blocky; firm, sticky and plastic; very strongly calcareous; clear smooth boundary.
Cg 4501	46 to 60 inches. Light gray and white (5Y 6/1 and 8/1 dry) to olive gray (5Y 5/2 moist) silty clay loam with many prominent mottles of strong brown (7.5YR 5/6 moist); weak angular blocky; firm, sticky and plastic; moderately calcareous with common large soft lime segregations.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Promise silty clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-7-(1-7) **LAB. NOS.** 8518-8524

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A1	<0.1	0.3a	0.4a	1.6a	3.6a	50.2	43.9	21.9	32.8	-	sic
2-6	B21	<0.1	0.2a	0.3a	1.4a	3.1a	45.5	49.5	18.3	31.1	-	sic
6-13	B22	<0.1	0.2a	0.3a	1.3a	3.1a	46.5	48.6	17.5	32.9	Tr.	sic
13-24	B3	<0.1	0.1b	0.2b	1.0b	2.5b	46.6	49.6	15.3	34.4	-	sic
24-32	C1	<0.1	0.1c	0.1c	1.2b	3.5b	50.1	45.0	18.0	36.4	Tr.	sic
32-45	C2cs	<0.1	<0.1	0.2c	1.0b	3.4b	48.4	47.0	18.4	34.0	Tr.	sic
45-62	C3	<0.1	<0.1	0.2c	1.2b	3.8b	49.0	45.8	19.4	34.2	-	sic

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6F1a CaCO₃ equivalent %	6F1a GYPSUM me./100g SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.7	7.1	7.2	2.84	0.259	11.0	<0.20	0.5	<1				17.6
7.9	8.7	8.9	1.43	0.127	11.2	<0.20	0.6	1				18.2
8.5	9.3	9.5	1.14	0.091	12.5	<0.20	0.7	3				18.1
8.5	9.3	9.6	0.99	0.075	13.2	<0.20	1.5	5				18.6
8.3	9.1	9.3	0.74			0.24	3.6	5	<1			16.5
8.0	8.4	8.5	0.69			0.43	5.7	4	8			15.8
8.1	8.7	9.0	0.65			0.36	5.5	4	<1			16.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6I1a $SO_4^=$	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
29.6	15.5	10.6	5.2	0.7	1.5	2	1.8	0.4				78.3
31.0	21.1	12.8	0.5	2.0	0.7	5	3.7	0.1				90.2
28.4				3.7	0.4	11	5.8	<0.1				99.7
26.8				6.2	0.4	17	12.0	0.1				134.7
24.1				6.1	0.3	16	26.0	0.2				84.6
24.7				6.3	0.4	14	40.6	0.3	3.0	0.5	90.4	72.2
24.5				6.1	0.4	13	35.6	0.2	2.3	0.7	64.4	77.6

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?); also, few $CaCO_3$ concr.
c. Common smooth light brown to black concr. (Fe-Mn?); also. few $CaCO_3$ concr.

Soil type: Promise silty clay
Soil No.: S58NDak-45-7-(1-7)
Location: 210 feet south and 215 feet west of northeast section corner of Sec. 13, T140N, R91W, Stark County, North Dakota.
Vegetation: Blue grama, western wheatgrass and sedges.
Parent material: Colluvium from Ft. Union shales.
Physiography: Broad, gently sloping fan.
Moisture: Moist to 32 inches.
Slope: 2 percent, southwest facing.
Drainage: Well.
Erosion: Slight.
Permeability: Slow.
Root distribution: Numerous to 32 inches.
Described by: Lloyd Shoesmith
Date: July 7, 1958.

Horizon and Lincoln Lab. Number	
A1 8518	0 to 2 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay; medium moderate crumb structure; hard, firm, very sticky and very plastic; noncalcareous; clear and smooth boundary.
B21 8519	2 to 6 inches. Olive gray (5Y 5/2 dry) to dark olive gray (5Y 3/2 moist) clay; medium weak prisms that break to medium weak angular blocks; very hard, firm, very sticky and very plastic; noncalcareous; patches of clay skins on vertical faces of the prisms; gradual and smooth boundary.
B22 8520	6 to 13 inches. Gray (5Y 5/1 dry) to olive gray (5Y 4/2 moist) clay; medium and coarse moderate prisms that break to medium moderate angular blocks; very hard, firm, very sticky and very plastic; calcareous; patches of clay skins on the vertical faces of the peds; clear and smooth boundary.
B3 8521	13 to 24 inches. Gray (5Y 5/1 dry) to olive (5Y 4/3 moist) clay; medium and coarse weak prisms that break to coarse moderate angular blocks; very hard, very firm, very sticky and very plastic; strongly calcareous; gradual and smooth boundary.
C1 8522	24 to 32 inches. Light brownish gray (2.5Y 6/2 dry) to olive gray (5Y 4/2 moist) clay; medium weak angular blocks; very hard, very firm, very sticky and very plastic; strongly calcareous; a few faint and fine lime nodules present, 2.5Y 8/2; gradual and smooth boundary.
C2cs 8523	32 to 45 inches. Olive gray (5Y 5/2 dry and 4/2 moist) clay; medium weak angular blocks; very hard, very firm, very sticky and very plastic; fragments of lignite and "scoria" present in the lower horizons. Pockets of gypsum crystals present; strongly calcareous; gradual and smooth boundary.
C3 8524	45 to 62 inches. Olive (5Y 5/3 dry) to olive gray (5Y 4/2 moist) clay; medium weak angular blocks; very hard, very firm, very sticky and very plastic; calcareous with occasional pockets of gypsum crystals visible.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Promise silty clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-8-(1-7) **LAB. NOS.** 8525-8531

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A1	0.8a	0.6a	0.4a	5.2b	9.8b	50.7	32.5	33.9	30.4	Tr.	sicl
2-11	B1	0.3c	0.3c	0.2b	3.1b	5.8b	37.6	52.7	20.8	25.0	Tr.	c
11-15	B2	0.4c	0.4c	0.4b	3.6b	5.8b	38.3	51.1	20.8	26.0	Tr.	c
15-25	Bca	0.1d	0.4d	0.3d	3.8e	6.2e	40.0	49.2	21.5	27.7	-	sic
25-31	Cca	0.4d	0.2d	0.2d	3.2e	6.1e	41.6	48.3	21.7	28.6	Tr.	sic
31-44	C1	<0.1	0.2d	0.1d	2.8e	6.6e	43.2	47.1	22.6	29.6	Tr.	sic
44-62	C2	0.2c	0.2c	0.1c	2.3e	4.6e	43.3	49.3	18.5	31.3	Tr.	sic

	pH	8C1a	ORGANIC MATTER 6A1a	6B1a		8A2	ELECTRICAL CONDUCTIVITY	6E1a	6F1a	MOISTURE TENSIONS		
1:1	1:5	1:10	ORGANIC CARBON %	NITROGEN %	C/N	EST% SALT (BUREAU CUP)	EC×10³ MILLIMHOS PER CM 8A1a	$CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.3	6.5	6.6	4.58	0.380	12.0	<0.20	1.1					15.1
7.8	8.3	8.4	1.29	0.114	11.3	<0.20	0.8	<1				17.6
8.6	9.1	9.3	1.13	0.089	12.7	<0.20	0.9	3				16.7
8.6	9.2	9.4	0.88	0.067	13	<0.20	1.7	8				15.2
8.3	8.9	9.1	0.71			0.22	3.5	6	<1			14.8
8.0	8.2	8.3	0.79			0.37	6.2	4	23			14.7
7.9	8.1	8.2	1.24			0.32	5.8	2	15			16.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
25.6	13.6	8.0	7.0	0.4	1.2	1	1.7	0.8				80.2
31.0	15.1	14.5	2.4	2.3	0.4	6	5.5	0.1				72.3
27.3				3.2	0.3	10	7.0	<0.1				71.5
23.6				3.8	0.3	12	12.3	0.1				76.7
23.2				4.0	0.3	12	21.1	0.1				63.6
23.6				4.0	0.2	9	28.6	0.2	3.0	1.0	86.6	67.0
26.3				4.1	0.2	8	27.9	0.2	1.4	0.5	79.2	70.7

a. Common smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?)
c. Many smooth light brown to black concr. (Fe-Mn?)
d. Many smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.
e. Few smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Promise silty clay
Soil No.: S58NDak-45-8-(1-7)
Location: 150 feet south and .45 mile west of northeast corner of Sec. 35, T139N, R91W, Stark County, North Dakota.
Vegetation: Native sod, blue grama and threadleaf sedge.
Parent material: Colluvium from Ft. Union shales.
Physiography: Long, gentle slope on a convex fan.
Permeability: Slow.
Slope: 2 percent, south facing.
Drainage: Well.
Erosion: Slight.
Root distribution: Numerous to 24 inches; few to 60 inches.
Moisture: Moist to 21 inches.
Described by: K. E. Larson.
Date: July 9, 1958.

Horizon and Lincoln Lab. Number	
A1 8525	0 to 2 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay; medium moderate crumb structure; slightly hard, friable, very sticky and very plastic; noncalcareous; gradual and smooth boundary.
B1 8526	2 to 11 inches. Olive gray (5Y 4/2 dry) to dark olive gray (5Y 3/2 moist) clay; medium moderate prisms that break to medium strong angular blocks; very hard, firm, very sticky and very plastic; noncalcareous; patches of clay skins on vertical faces of the prisms; clear and smooth boundary.
B2 8527	11 to 15 inches. Dark gray (5Y 4/1 dry) to dark olive gray (5Y 3/2 moist) clay; coarse moderate prisms that break to medium strong angular blocks; very hard, very firm, very sticky and very plastic; weakly calcareous; patches of clay skins on top and vertical faces of the prisms, 5Y 2/2 moist; clear and smooth boundary; few iron mottles of 7.5YR 6/8 from this horizon and those below.
Bca 8528	15 to 25 inches. Olive gray (5Y 5/2 dry) to dark olive gray (5Y 3/2 moist) clay; coarse moderate prisms that break to coarse and medium moderate angular blocks; patches of clay skins on vertical surfaces of the prisms; very hard, very firm, very sticky and very plastic; very strongly calcareous with many prominent lime threads of 2.5Y 8/2; abrupt and smooth boundary.
Cca 8529	25 to 31 inches. Olive gray (5Y 5/2 dry) to olive (5Y 4/3 moist) clay; medium moderate angular blocks; very hard, very firm, very sticky and very plastic; very strongly calcareous; fragments of lignite and "scoria" of 3-mm. or less in lower horizons.
C1 8530	31 to 44 inches. Olive gray (5Y 5/2 dry and 4/2 moist) clay; coarse moderate angular blocks; very hard, very firm, very sticky and very plastic; strongly calcareous with common, prominent and coarse lime nodules present, 2.5Y 8/2.
C2 8531	44 to 62 inches. Dark gray (5Y 4/1 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay; coarse moderate angular blocks; very hard, very firm, very sticky and plastic; strongly calcareous; a few nests of gypsum crystals visible in this horizon.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Promise silty clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-18-(1-6) **LAB. NOS.** 8587-8592

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	<0.1	0.2a	0.6a	2.7a	4.8a	46.2	45.5	18.5	34.1	-	sic
5-12	B21	<0.1	0.1a	0.4a	2.2a	3.7a	45.8	47.8	15.8	35.1	-	sic
12-20	B22	<0.1	<0.1	0.2a	1.0a	1.9a	44.4	52.5	9.4	37.5	-	sic
20-32	Ccs1	<0.1	<0.1	0.3a	1.3a	1.6a	41.8	55.0	7.3	36.8	-	sic
32-44	Ccs2	<0.1	<0.1	0.6b	2.1b	2.0b	43.5	51.8	10.7	35.8	-	sic
44-62	C	<0.1	<0.1	0.5b	2.7b	3.4b	52.7	40.7	17.2	40.3	-	sic

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
8.1	8.4	8.7	1.40	0.134	10.4	<0.20	0.7	2				18.8
8.2	8.8	9.1	1.06	0.101	10.5	<0.20	0.7	4				20.1
8.5	9.2	9.4	0.78	0.063	12	<0.20	0.8	5				19.4
8.0	8.3	8.5	0.65	0.044	15	0.34	5.2	4	24			19.1
8.0	8.3	8.5	0.59			0.48	7.0	4	11			19.7
8.4	9.3	9.6	0.42			0.30	4.2	6	<1			17.3

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS Ca	Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	8A1 6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
25.7				0.2	1.2	1	1.0	0.3				60.8
25.2				1.1	0.6	4	3.2	0.1				65.9
26.2				2.2	0.5	7	4.9	0.1				84.6
26.3				3.9	0.6	10	16.0	0.4	1.9	0.5	67.9	86.3
24.4				6.7	0.6	12	40.4	0.5	1.2	0.2	92.7	92.3
20.9				9.1	0.4	24	31.6	0.2	2.1	<0.1	40.5	127.3

a. Few irregular and smooth brown to black concr. (Fe-Mn?)
b. Few irregular and smooth brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Promise silty clay
Soil No.: S58NDak-45-18-(1-6)
Location: 215 feet north of south quarter corner of Sec. 35, T141N, R92W, Stark County, North Dakota.
Vegetation: Fallow.
Parent material: Alluvium from Knife River.
Physiography: Broad, flat valley.
Slope: 1 percent.
Drainage: Moderately well.
Erosion: Slight.
Permeability: Slow.
Root distribution: Numerous to 30 inches, few to 60 inches.
Described by: K. E. Larson.
Date: July 24, 1958.

Horizon and Lincoln Lab. Number	
Ap 8587	0 to 5 inches. Dark gray (5Y 4/1 dry) to black (2.5Y 2/2 moist) silty clay; very fine moderate crumb; hard, friable, very sticky and very plastic; slightly calcareous. (About 1 percent of delineated area is occupied by dispersed Ap layer.)
B21 8588	5 to 12 inches. Olive gray (5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay, with continuous clay skins of very dark gray (2.5Y 3/1); coarse weak prisms that break to fine moderate angular blocks; hard, friable, very sticky and very plastic; strongly calcareous.
B22 8589	12 to 20 inches. Description the same as B21 (split for laboratory purposes).
Ccs1 8590	20 to 32 inches. Olive gray (5Y 5/2 dry) to very dark gray brown (2.5Y 3/2 moist) silty clay; patches of clay skins on vertical surfaces of peds, 2.5Y 3/1; very coarse weak prisms that break to fine weak angular blocks; extremely hard, firm, very sticky and very plastic; strongly calcareous with few fine and faint lime nodules and many prominent nests of gypsum crystals, 2.5Y 7/2.
Ccs2 8591	32 to 44 inches. Description of Ccs2 same as Ccs1 with the exception of many fine distinct lime nodules.
C 8592	44 to 62 inches. Pale olive (5Y 6/3 dry) to olive (5Y 5/3 moist) silty clay; medium weak angular blocks; hard, friable, sticky and plastic; very strongly calcareous; a few gypsum crystals between peds and cracks.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Promise silty clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-19-(1-7) **LAB. NOS.** 8593-8599

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4	Ap	<0.1	0.2a	0.3a	1.4a	3.3a	42.1	52.7	16.8	29.4	-	sic
4-11	B21	0.1b	0.2b	0.3b	1.0b	2.3b	41.3	54.8	14.2	30.0	-	sic
11-18	B22	0.1b	0.1b	0.2b	0.7b	1.8b	42.0	55.1	12.7	31.5	Tr.	sic
18-28	Ccs1	<0.1	<0.1	0.1b	0.5b	1.1b	42.3	56.0	9.1	34.6	Tr.	sic
28-38	Ccs2	<0.1	<0.1	<0.1	0.5b	1.3b	40.9	57.3	9.0	33.5	-	sic
38-47	Ccs3	<0.1	<0.1	0.1b	1.1b	1.6b	52.1	45.1	11.0	43.5	-	sic
47-61	C1	<0.1	0.1b	1.3b	7.2b	9.3b	45.4	36.7	30.4	28.7	-	sicl

pH 1:1	pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
8.1	8.7	9.1	1.87	0.165	11.3	<0.20	1.0	2				24.0
8.4	9.4	9.6	1.33	0.094	14.1	<0.20	1.0	4				24.0
8.2	9.1	9.5	1.28	0.090	14.2	0.21	2.5	4	<1			26.7
7.9	8.1	8.3	0.94	0.050	19	0.58	8.2	6	25			22.4
7.9	8.1	8.2	0.90			0.58	8.5	4	23			21.8
8.0	8.2	8.4	0.82			0.53	9.5	4	48			19.1
8.1	8.6	9.0	0.60			0.44	9.0	4	9			14.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS Ca	Mg	H	6P2a Na	6Q2a K	5R1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
32.0				2.7	1.4	7	6.9	0.2				72.3
33.6				7.2	0.6	18	8.0	<0.1				136.4
31.7				10.4	0.8	23	20.5	0.1				148.4
31.7				11.3	0.8	17	58.5	0.6	3.5	1.0	105.9	99.6
29.8				11.7	0.8	18	60.0	0.6	3.0	0.2	112.1	107.1
24.4				10.0	0.6	20	66.9	0.7	1.9	1.0	122.3	78.6
19.1				8.6	0.5	20	63.8	0.7	2.1	0.5	118.3	74.1

a. Few smooth and irregular dark brown to black concr. (Fe-Mn?)
b. Few, smooth and irregular dark brown to black concr. (Fe-Mn?); also, few $CaCO_3$ concr.

Soil type: Promise silty clay
Soil No.: S58NDak-45-19-(1-7)
Location: 200 feet south and 45 feet west of north quarter corner, Sec. 7, T140 R92W, Stark County, North Dakota.
Vegetation: Alfalfa.
Parent material: River alluvium.
Physiography: Broad, flat valley of Knife River.
Slope: 1 percent.
Drainage: Moderately well.
Erosion: Slight.
Permeability: Slow.
Root distribution: Numerous to 18 inches.
Described by: K. E. Larson.
Date: July 24, 1958.

Horizon and Lincoln Lab. Number	
Ap 8593	0 to 4 inches. Dark gray (5Y 4/1 dry) to very dark gray (2.5Y 3/1 moist) silty clay; fine strong crumbs; very hard, firm, very sticky and plastic; moderately calcareous; abrupt and smooth boundary.
B21 8594	4 to 11 inches. Dark gray (5Y 4/1 dry) to very dark gray (5Y 3/1 moist) clay; coarse weak prisms that break to fine strong angular blocks; very hard, firm, very plastic and very sticky; clay skins continuous on top and vertical surfaces of peds; strongly calcareous; gradual and smooth boundary.
B22 8595	11 to 18 inches. Characteristics same as B21 with the exception of a clear and smooth boundary.
Ccs1 8596	18 to 28 inches. Dark gray (5Y 4/1 dry) to very dark gray (5Y 3/1 moist) clay; fine strong angular blocks; very hard, firm, very sticky and very plastic; patches of clay skins on vertical surface; nests of gypsum crystals (m2p, 2.5Y 5/2) and lime mottles (m3p, 5Y 7/2) in both Ccs1 and Ccs2 horizons; strongly calcareous; gradual and smooth boundary.
Ccs2 8597	28 to 38 inches. Same as above horizon (split for laboratory purposes).
Ccs3 8598	38 to 47 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay; fine moderate angular blocky; hard, firm, very sticky and very plastic; strongly calcareous; gradual and smooth boundary.
C1 8599	47 to 61 inches. Olive gray (5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay; fine moderate angular blocks; hard, firm, sticky and very plastic; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Regent silty clay loam **LOCATION** Dunn County, North Dakota

SOIL NOS. S58ND-13-1-(1-7) **LAB. NOS.** 8511-8517

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	0.5a	0.3b	0.3b	3.3b	7.2b	47.9	40.5	25.8	32.0	Tr.	sic
6-10	B1	0.1a	0.2a	0.3b	3.7b	7.5b	47.2	41.0	26.8	31.0	Tr.	sic
10-20	B2	0.2a	0.2a	0.2a	4.4b	9.5b	45.5	40.0	30.0	28.8	-	sic/sicl
20-34	Bca	0.4c	0.3c	0.2d	2.8d	7.4d	52.8	36.1	24.8	37.7	Tr.	sicl
34-45	C1	<0.1	0.1e	0.1e	1.0e	1.8e	55.4	41.6	8.0	50.0	-	sic
45-54	C2	<0.1	0.1e	<0.1	0.5e	0.8e	55.4	43.2	4.3	52.3	-	sic
54-62	C3	<0.1	<0.1	<0.1	0.4e	0.9e	54.0	44.7	4.7	50.5	Tr.	sic

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.1	6.5	6.6	2.11	0.219	9.6	<0.20	2.9		<1			15.0
6.6	7.1	7.1	1.52	0.145	10.5	<0.20	0.5	<1				15.1
7.1	7.5	7.5	1.11	0.109	10.2	<0.20	0.4	<1				14.4
8.3	8.9	9.1	0.83	0.084	10	<0.20	0.5	8				13.1
8.7	9.3	9.5	0.51			<0.20	0.7	11				15.8
8.7	9.5	9.7	0.38			<0.20	1.1	12				16.4
8.5	9.3	9.5	0.32			<0.20	2.0	8	<1			18.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
27.8	19.1	6.8	5.2	<0.1	1.8	<1	0.7	2.0				62.0
27.4	18.6	7.6	4.3	0.1	0.5	<1	0.4	0.1				64.3
25.7	16.7	8.6	2.8	0.1	0.4	<1	0.5	0.1				58.7
21.1				0.8	0.2	3	2.5	<0.1				56.4
19.9				2.8	0.2	12	5.1	<0.1				88.0
18.6				3.8	0.2	15	8.1	0.1				130.7
20.0				5.5	0.3	18	15.3	0.1				134.2

a. Many smooth and irregular light brown to black concr. (Fe-Mn?)
b. Few smooth and irregular light brown to black concr. (Fe-Mn?)
c. Common smooth light brown concr. (Fe?); also common $CaCO_3$ concr.
d. Few smooth light brown to black concr. (Fe-Mn?); also common $CaCO_3$ concr.
e. Common smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Regent silty clay loam
Soil No.: S58NDak-13-1-(1-7)
Location: 300 feet north and 220 feet west of southeast section corner of Sec. 32, T141N, R96W, Dunn County, North Dakota.
Vegetation: Alfalfa.
Parent material: Residual clay shale.
Physiography: Long upland slope in gently undulating terrain.
Slope: 4 percent, south facing.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate and slow.
Stoniness: Free.
Root distribution: Numerous to 34 inches, few to 54 inches.
Described by: K. E. Larson.
Date: July 16, 1958.

Horizon and Lincoln Lab. Number	
Ap 8511	0 to 6 inches. Dark grayish brown (2.5Y 4/2 dry) to black (10YR 2/1 moist) silty clay loam; coarse moderate plates and medium moderate crumb structure; very hard, friable, sticky and plastic; non calcareous; gradual and smooth boundary.
B1 8512	6 to 10 inches. Dark grayish brown (2.5Y 4/2 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay loam; medium moderate prisms that break to fine and medium moderate angular blocks; clay skins of 2.5Y 3/1 on top and vertical faces of peds; very hard, firm, sticky and very plastic; noncalcareous; clear and smooth boundary.
B2 8513	10 to 20 inches. Olive (5Y 4/3 dry) to dark grayish brown (2.5Y 4/2 moist) silty clay; medium moderate prisms that break to medium moderate angular blocks; hard, firm, sticky and very plastic; clay skins of 2.5Y 3/2 on top and vertical faces of peds; noncalcareous; abrupt and smooth boundary.
Bca 8514	20 to 34 inches. Pale olive (5Y 6/3 dry) to very dark grayish brown (2.5Y 3/2) silty clay; coarse weak prisms that break to coarse and medium moderate angular blocks; extremely hard, firm, sticky and very plastic; a few fine and distinct lime nodules of 2.5Y 8/2 when dry; very strongly calcareous; clear and wavy boundary.
C1 8515	34 to 45 inches. Olive (5Y 5/3 dry and 5Y 4/3 moist) silty clay; coarse weak prisms that break to medium moderate angular blocks; very hard, firm, sticky and very plastic; very strongly calcareous; gradual and smooth boundary.
C2 8516	45 to 54 inches. Pale olive (5Y 6/3 dry) to olive (5Y 4/3 moist) silty clay; coarse moderate angular blocks; extremely hard, very firm, and sticky and very plastic consistence; very strongly calcareous; clear and smooth boundary.
C3 8517	54 to 62 inches. Light olive gray (5Y 6/2 dry). Remainder of description same as C2.

SOIL SURVEY LABORATORY Mandan, North Dakota 9-9-55
Revised 4-24-56

SOIL TYPE Regent silt loam **LOCATION** Hettinger County, North Dakota

SOIL NOS. S54NDak-21-1-(1-7) **LAB. NOS.** 2285-2291

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	Ap	0.9	0.5	0.8	2.8	4.2	43.6	47.2	17.3	32.1	0.8	sic
7-10	AB	0.6	0.3	0.7	2.3	3.0	41.9	51.2	16.0	30.1	-	sic
10-20	B21	0.8	0.2	0.7	2.2	2.9	40.3	52.9	13.8	30.6	-	sic
20-29	B22	0.5	0.2	0.7	2.1	3.1	41.2	52.2	13.4	32.1	-	sic
29-37	Ccs1	-	0.1	0.4	1.2	1.5	60.9	35.9	7.0	56.1	-	sicl
37-52	Ccs2	-	0.1	0.2	0.5	0.5	50.3	48.4	4.4	46.7	-	sic
52-60	C	-	-	0.1	0.2	0.2	55.4	44.1	6.1	49.6	-	sic

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.4	8.5	1.65	.166	9.9	-	0.6	1				16.2
7.8	8.9	9.0	1.07	.110	9.7	-	0.6	3				17.5
8.2	9.5	9.6	0.92	.087	10.6	-	0.8	6				17.9
8.5	9.6	9.8	0.64	.054	11.8	-	1.4	7				18.0
7.9	8.3	8.6	0.54			0.43	8.0	10	20			16.7
8.0	8.7	9.0	0.39			0.71	10.0	10	6			16.9
8.1	8.7	9.3	0.38			0.71	10.0	10	3			16.4

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a Ca	Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
30.1				0.6	1.1	2	2.2	0.1				58.9
30.0				1.4	0.5	4	3.6	-				66.3
27.2				3.8	0.5	12	7.2	-				74.6
25.2				6.0	0.5	19	12.6	-				100.6
22.9				7.6	0.3	14	63.0	0.2	3.0	1.0	109.2	68.0
24.2				11.9	0.3	22	85.0	0.3				77.5
23.7				12.5	0.3	22	89.0	0.4	4.0	-	148.1	80.4

Soil type: Regent silt loam
Soil No., S54NDak-21-1
Area: Hettinger County, North Dakota.
Location: 120 feet south and 130 feet west of northeast corner Sec. 11, T134N, R97W.
Vegetation or crop: Summer fallow in strips 10 rods wide, alternate with wheat.
Parent material: Clay shales of Fort Union.
Physiographic position: 1/8 mile west of intermittent stream on 1/4-mile wide erosional terrace, 15 to 30 feet below the undulating higher plain where Morton and Regent soils occur.
Topography: Level.
Slope: 1 percent to east.
Drainage: Moderately well.
Permeability: Slow.
Moisture: Slightly moist.
Stoniness: Free.
Root distribution: Very deep.
Described by: C. A. Mogen.
Date: July 20, 1954.

Mandan Lab.No.	Horizon	
2285	Ap	0 to 7 inches. Olive gray (5Y 5/2 dry) to dark olive gray (5Y 3.5/2 moist) silt loam; slightly hard, friable, sticky; moderate fine granules and blocks.
2286	AB	7 to 10 inches. Olive gray (5Y 5/2 dry) to very dark gray (5Y 3.5/1 moist) and olive gray (5Y 4/2 moist) very slightly calcareous silty clay; very hard, friable, sticky and very plastic; moderate fine blocky structure. Gradual boundary.
2287	B21	10 to 20 inches. Olive gray (5Y 5/2 dry) to (5Y 4/2 moist) and dark gray (5Y 4/1 moist) moderately calcareous silty clay; extremely hard, firm, sticky and very plastic; weak coarse blocks separating to moderately developed fine and very fine blocks. Gradual boundary.
2288	B22	20 to 29 inches. Olive gray (5Y 5.5/2 dry) to (5Y 4/2 moist) moderately calcareous silty clay; extremely hard, firm, sticky and very plastic; compound structure of weak coarse blocks separating to moderate fine blocks. Clear boundary.
2289	Ccs1	29 to 37 inches. Gray (5Y 6/1 dry) and olive gray (5Y 5/2 dry) to dark gray (5Y 4/1 moist) with common medium-sized distinct mottlings of yellowish brown (10YR 5/8 moist) and light gray (10YR 7/2 moist) moderately calcareous silty clay loam; very hard, firm; weak coarse blocks separating to weak very fine blocks; moderate amount of crystalline gypsum. Clear boundary.
2290	Ccs2	37 to 52 inches. Light gray (5Y 6/1 dry) and pale olive (5Y 6/3 dry) to dark gray (5Y 4/1 moist) with a few medium-sized distinct mottlings of yellowish brown (10YR 5/4 moist) moderately calcareous silty clay; extremely hard, firm; moderately developed very fine blocks; slight amount of crystalline gypsum visible.
2291	C	52 to 60 inches. Light gray (5Y 7/1 dry) and pale yellow (5Y 7/3 dry) to gray (5Y 5/1 moist) with a very few faint mottlings of olive gray (5Y 5/2 moist) and white (5Y 8/1 moist) moderately calcareous silty clay with a slight amount of segregated lime and a slight amount of segregated gypsum crystals; extremely hard, firm; strongly developed very fine blocks.

Remarks: There are a few reddish brown angular stone fragments 1/4 to 1 inch in diameter and a few flat transparent pebbles on the surface of the soil and in the profile.

SOIL SURVEY LABORATORY Mandan, North Dakota 9-9-55

SOIL TYPE Regent silty clay **LOCATION** Hettinger County, North Dakota

SOIL NOS. S54NDak-21-2-(1-7) **LAB. NOS.** 2292-2298

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	Ap	0.6	0.4	0.9	2.5	4.5	46.0	45.1	23.4	28.5	-	sic
7-12	B	-	0.6	0.5	1.4	2.9	44.7	49.9	16.5	31.9	-	sic
12-22	Bca	-	-	0.6	1.0	1.6	46.3	50.5	11.8	36.7	-	sic
22-29	Cgcs	-	0.3	0.2	0.4	0.5	53.6	45.0	5.7	48.6	-	sic
29-40	Ccs	-	-	-	0.1	0.1	60.5	39.3	8.1	52.5	-	sicl
40-45	C1	-	-	-	0.2	0.5	66.1	33.2	15.4	51.4	-	sicl
45-60	C2	-	0.4	0.2	0.5	6.1	68.0	24.8	34.8	39.6	-	sil

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.5	8.5	8.7	1.25	.128	9.8	-	0.7	1				16.0
7.9	9.1	9.3	0.84	.083	10.1	-	0.6	3				17.0
7.9	9.1	9.3	0.60	.058	10.3	-	1.1	3				17.7
7.7	7.9	8.1	0.32			0.37	4.8	-	49			18.8
7.7	7.9	8.0	0.30			0.41	6.5	-	10			17.0
7.2	7.4	7.7	0.28			0.39	6.9	-	8			14.9
7.1	7.7	8.0	0.27			0.48	7.0	-	4			12.4

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO3	6K1a Cl	6L1a SO4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
29.0				0.5	1.0	1	2.0	0.1				61.4
29.2				1.6	0.4	4	4.0	-				66.6
29.4				2.7	0.4	7	7.6	-				76.5
30.2	49.5	11.9		3.6	0.3	6	25.0	0.2				73.5
27.7	24.0	13.6		6.6	0.2	12	42.0	0.2	5.1	-	83.6	75.4
23.3	20.8	10.8		7.2	0.2	14	51.0	0.2				76.2
20.4	16.6	9.0		6.6	0.1	14	55.0	0.2	3.5	1.0	87.6	68.6

Soil type: Regent silty clay
Soil No.: S54NDak-21-2
Area: Hettinger County, North Dakota.
Location: 140 feet north and 80 feet east of northwest corner Sec. 15, T134N, R96W.
Vegetation or crop: Summer fallow.
Parent material: Clay shale of Fort Union.
Physiographic position: Upland plain.
Topography: Very gently undulating.
Slope: 1 percent to north.
Moisture: Moist.
Permeability: Slow.
Stoniness: Free.
Described by: C. A. Mogen.
Date: July 20, 1954.

Mandan Lab.No.	Horizon	
2292	Ap	0 to 7 inches. Grayish brown (2.5Y 5/2 dry) to olive gray (5Y 4/2 moist) very slightly calcareous silty clay; slightly hard, friable, sticky and plastic; moderately developed fine granules.
2293	B	7 to 12 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) moderately calcareous silty clay with a slight amount of segregated lime; extremely hard, firm, sticky and plastic; moderately developed fine and very fine blocks.
2294	Bca	12 to 22 inches. Light olive gray (5Y 6/2 dry) to grayish brown (3.5Y 5/2 moist) with a few fine distinct mottlings of pale yellow (5Y 7/3 moist) moderately calcareous silty clay with a moderate amount of segregated lime in threads and films; extremely hard, firm, sticky and plastic; weak fine blocky structure.
2295	Cgcs	22 to 29 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) olive (5Y 5/3 moist) mildly calcareous silty clay with a moderate amount of crystalline gypsum; very hard, firm, slightly sticky and plastic; moderately developed fine blocky structure.
2296	Ccs	29 to 40 inches. Light gray (5Y 7/2 dry) with many fine distinct mottlings of light yellowish brown (2.5Y 6/4 dry) to olive gray (5Y 5/2 moist) with common fine distinct mottlings of light gray (5Y 7/2 moist) very slightly calcareous silty clay loam with a slight amount of gypsum crystals visible; very hard, firm, sticky and plastic; compound structure of moderate medium-sized plates separating to fine blocks.
2297	C1	40 to 45 inches. Pale yellow (5Y 7/3 dry) coated with yellowish brown (10YR 5/6 dry) to olive gray (5Y 5/2 moist) coated with dark yellowish brown (10YR 3/4 moist) noncalcareous silty clay loam; hard, friable; strong medium-sized plates.
2298	C2	45 to 60 inches. Light gray (5Y 7/2 dry) coated with brownish yellow (10YR 6/6 dry) to dark gray (5Y 4/1 moist) and olive (5Y 5/3 moist) coated with yellowish brown (10YR 5/8 moist) and with a few stains of dark reddish brown (5YR 3/4 moist) noncalcareous strata of silt loam, very fine sand and silty clay; hard, friable; strong medium plates.

SOIL SURVEY LABORATORY Mandan, North Dakota 9-9-55

SOIL TYPE Regent clay loam **LOCATION** Stark County, North Dakota

SOIL NOS. S54NDak-45-3-(1-8) **LAB. NOS.** 2307-2314

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2½	A11	1.8a	1.8	3.1	6.3	8.5	49.8	28.7	30.5	31.2	-	cl
2½-7	A12	0.7	1.8	3.4	6.3	7.7	45.7	34.4	28.6	28.2	-	sicl
7-11	B1	0.8	1.6	3.0	6.1	7.4	43.6	37.5	26.1	28.2	-	sicl
11-21	B21	0.6	1.7	3.0	5.2	6.8	39.7	43.0	25.4	23.8	-	c
21-26	B22	0.7	1.2	2.0	3.5	6.1	46.7	39.8	25.7	29.0	-	sicl
26-32	B3	0.4	1.4	2.8	4.7	6.1	48.8	35.8	25.9	31.4	-	sicl
32-53	Cca	-	-	-	0.2	0.2	45.9	53.7	2.1	44.2	-	sic
53-60	C	-	-	-	-	0.1	50.7	49.2	1.2	49.6	-	sic

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
5.6	6.1	6.3	4.63	.354	13.1	-	0.6	-				12.8
5.8	6.2	6.3	2.14	.192	11.1	-	0.5	-				11.7
6.0	6.5	6.6	1.38	.137	10.1	-	0.6	-				11.6
6.3	6.9	6.9	0.86	.088	9.8	-	0.4	-				13.0
6.6	7.2	7.4	0.72	.068	10.6	-	0.6	-				11.7
6.9	7.7	7.8	0.82			-	0.6	-				11.5
8.1	8.6	8.9	0.25			-	0.7	3				17.4
7.9	9.1	9.4	0.22			-	2.4	1				18.4

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
25.0	13.0	4.3		0.1	1.7	-	0.3	1.0				71.6
22.8	12.3	5.3		0.1	1.0	-	0.3	0.3				52.0
22.8	12.6	6.5		0.1	0.9	-	0.4	0.3				49.4
24.2	12.8	8.5		0.2	0.5	1	0.6	0.1				53.6
20.2	10.8	7.7		0.2	0.3	-	1.4	-				50.4
22.8	13.2	9.0		0.5	0.3	2	2.2	-				52.5
26.5				1.7	0.3	5	4.3	-				80.9
28.8				2.4	0.4	5	11.9	0.1				83.7

a. Organic matter in sand fraction.

Soil type: Regent clay loam
Soil No.: S54NDak-45-3
Area: Stark County, North Dakota.
Location: 0.2 mile north and 150 feet east of northwest corner Sec. 20, T138N, R95W.
Vegetation or crop: Native grasses; western wheatgrass, blue grama, buffalograss, bluegrass, junegrass, thread leaf sedge, fringed sagewort and silverleaf scurfpea.
Parent material: Stratified silt and clay of Fort Union formation.
Physiographic position: Side of gentle upland slope; 100 feet from shoulder 200 foot long east by southeast slope; the northwest slope is 2 percent and 3 percent and at 200 feet enters a shallow swale. A few small spots of solodized-Solonetz occur.
Topography: Undulating (relief 10 to 20 feet).
Slope: 4 percent to northwest.
Drainage: Well drained.
Moisture: Very dry to 48 inches; very slight moisture 48 to 72 inches; slight moisture 72 to 78 inches in silty clay overlying stratified dry silt and very fine sand to 96 inches over sandstone.
Described by: C. A. Mogen.
Date: July 21, 1954.

Mandan Lab.No.	Horizon	
2307	A11	0 to 2½ inches. Grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3.5/2 moist) clay loam; soft, very friable; weak fine plates. Clear boundary.
2308	A12	2½ to 7 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2.5/2 moist) silty clay loam; hard, friable; compound structure of moderate medium-sized prisms separating to weak medium blocks and further to moderately defined very fine subangular blocks. Gradual boundary.
2309	B1	7 to 11 inches. Dark grayish brown (10YR 4.5/2 dry) to very dark grayish brown (10YR 3/2 moist) silty clay loam; hard, friable; compound structure of moderate medium and medium prisms, separating to moderate medium and fine subangular blocks. Clear boundary.
2310	B21	11 to 21 inches. Brown (10YR 5/3 dry) to brown (10YR 4/3 moist) coated with very dark grayish brown (10YR 3/2 moist) clay; very hard, friable; moderate medium prisms separating into blocks. Gradual boundary.
2311	B22	21 to 26 inches. Light brownish gray (10YR 6/2 dry) to brown (10YR 5/3 moist) coated with very dark grayish brown (10YR 3.5/2 moist) silty clay loam; very hard, friable; moderate medium prisms separating into blocks. Clear boundary.
2312	B3	26 to 32 inches. Light brownish gray (2.5Y 6/2 dry) coated with very dark gray (10YR 3/1 dry) to dark grayish brown (2.5Y 4/2 moist) and light yellowish brown (2.5Y 6/4 moist) with stains or coatings of black (10YR 2/1 moist) silty clay loam; very hard, friable; weak coarse prisms; 3-inch thick layer of weathered carbonaceous material that is black (10YR 2/1 dry). Clear boundary.
2313	Cca	32 to 53 inches. Light brownish gray (2.5Y 6/2 dry) and white (2.5Y 9/1 dry) to olive gray (5Y 5/2 moist) and white (5Y 8/1 moist) strongly calcareous silty clay with a large amount of segregated lime in seams; very hard, friable; compound structure of weak coarse prisms separating into moderate fine blocks. In this horizon there is a heavy lime seam. Clear irregular boundary.
2314	C	53 to 60 inches. Light gray (5Y 7/2 dry) to olive gray (5Y 5/2 moist) with yellow mottlings; strongly calcareous silty clay; very hard, friable; strong very fine and fine blocks.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Regent silty clay loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-4-(1-8) **LAB. NOS.** 8496-8503

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1	0.4a	0.3a	0.6a	3.2a	9.6a	53.5	32.4	42.0	23.1	-	sicl
6-15	B2	0.1a	0.2a	0.4a	2.0a	8.4a	48.4	40.5	30.3	27.8	Tr.	sic
15-21	B3cacs	<0.1	0.1b	0.4b	2.1b	6.5b	54.1	36.8	24.1	37.8	-	sicl
21-31	B31ca	<0.1	0.1b	0.1b	0.8b	2.3b	55.8	40.9	14.6	44.0	-	sic
31-43	B32ca	<0.1	<0.1	0.1b	0.5b	1.6b	52.9	44.9	11.8	43.0	-	sic
43-52	C1	<0.1	<0.1	<0.1	0.2c	0.5c	54.5	44.8	2.3	52.8	-	sic
52-59	C2	<0.1	<0.1	<0.1	0.1c	0.3c	57.0	42.6	3.9	53.5	-	sic
59-64	C3	<0.1	<0.1	<0.1	0.1c	0.3c	52.6	47.0	2.8	50.2	-	sic

pH 8C1a 1:1	1:5	1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6K1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	7.0	7.1	1.56	0.141	11.1	<0.20	0.5	<1				12.5
7.9	8.3	8.4	0.90	0.084	11	<0.20	0.6	<1				13.8
7.8	8.1	8.3	0.52	0.046	11	0.22	3.2	11	11			10.9
8.1	8.5	8.8	0.39	0.033	12	0.32	4.0	15	1			12.0
8.3	8.9	9.1	0.33			0.37	5.4	9	<1			15.2
8.4	8.9	9.2	0.26			0.45	5.6	7	<1			16.7
8.3	8.8	9.0	0.25			0.70	8.5	7	2			16.4
8.3	8.8	9.0	0.24			0.98	9.0	7	2			18.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
22.0	10.3	9.2	3.9	0.2	1.2	1	0.9	0.3				56.2
24.5	16.0	9.9	0.9	0.3	0.4	1	1.3	0.1				62.8
18.0				0.3	0.2	<1	2.7	0.2				59.6
17.7				1.7	0.2	3	13.4	0.2	1.2	1.2	50.3	64.4
18.4				6.2	0.2	17	35.9	0.2	1.4	1.2	57.7	86.9
18.0				9.5	0.2	27	40.0	0.2	1.6	<0.1	59.8	117.8
20.2				11.4	0.2	22	59.1	0.3	1.4	1.0	110.0	116.8
19.7				12.8	0.2	27	60.6	0.3	1.2	0.2	111.5	122.8

a. Common smooth light brown to black concr. (Fe-Mn?)
b. Common smooth light brown to black concr. (Fe-Mn?); also Common $CaCO_3$ concr.
c. Common irregular black concr. (Mn?) also, few $CaCO_3$ concr.

Soil type: Regent silty clay loam
Soil No.: S58NDak-45-4-(1-8)
Location: 62 rods west and 50 rods north of southeast corner of northeast quarter, Sec. 2, T140N, R96W, Stark County, North Dakota.
Vegetation: Crested wheatgrass (cropland).
Parent material: Residual clay shale.
Physiography: Undulating upland.
Slope: 4 percent, southwest facing.
Drainage: Well.
Erosion: Slight.
Permeability: Moderately slow.
Stoniness: Free.
Root distribution: Numerous to 42 inches, few to 64 inches.
Moisture: Moist to 64 inches.
Described by: Lloyd Shoesmith and Donald Opdahl.
Date: July 16, 1958.

Horizon and Lincoln Lab. Number	
A1 8496	0 to 6 inches. Grayish brown (2.5Y 5/2 dry) to very dark gray brown (2.5Y 3/2 moist) silty clay loam; medium weak crumb structure; very hard, friable, sticky and plastic; noncalcareous; abrupt and smooth boundary.
B2 8497	6 to 15 inches. Olive brown (2.5Y 4/3 dry) to very dark grayish brown (2.5Y 3/2 moist) silty clay; medium moderate prisms that break to medium weak angular blocks; peds have clay skins on all faces of 2.5Y 2/2 color; very hard, friable, very sticky and very plastic; noncalcareous; abrupt and smooth boundary.
B3cacs 8498	15 to 21 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) silty clay; coarse weak prisms that break to medium weak angular blocks; clay skins on top and vertical faces of peds; very hard, friable, very sticky and very plastic; strongly calcareous with many distinct medium lime nodules; occasional nests of gypsum crystals.
B31ca 8499	21 to 31 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) silty clay; coarse weak prisms that break to medium weak angular blocks, which have clay skins on top and vertical faces; very hard, friable, very sticky and very plastic; very strongly calcareous with many prominent lime nodules of 2.5Y 7/2.
B32ca 8500	31 to 43 inches. Same description as B31ca.
C1 8501	43 to 52 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) silty clay; coarse weak prisms that break to medium weak angular blocks; peds coated on vertical faces with clay skins, 5Y 4/2 moist; very hard, firm, very sticky and very plastic; strongly calcareous; gradual wavy boundary.
C2 8502	52 to 59 inches. Pale olive (5Y 6/3 dry) to olive (5Y 4/3 and 5/3 moist) silty clay; medium weak plates; very hard, firm, very sticky and very plastic; strongly calcareous; abrupt and smooth boundary.
C3 8503	59 to 64 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 5/2 moist) silty clay; medium weak plates; very hard, firm, very sticky and very plastic; strongly calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Regent clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-9-(1-7) **LAB. NOS.** 8532-8538

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	3A1 0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-4	Ap	5.1	6.9a	3.8a	5.2a	3.3a	29.1	46.6	16.8	18.0	Tr.	c
4-8	B2	2.7b	6.0b	4.0b	5.0b	2.8b	29.0	50.5	15.2	18.8	Tr.	c
8-19	Bca	3.5	6.4	3.6c	3.9c	2.3c	29.2	51.1	13.3	19.9	Tr.	c
19-30	Cca	3.7	5.8	2.8c	3.4c	2.1c	31.7	50.5e	13.3	22.1	-	c
30-42	C11	2.1	5.5	3.5c	4.3c	2.7c	32.0	49.9e	15.7	20.9	-	c
42-52	C12	2.5	5.9	3.7c	4.5c	2.8c	32.2	48.4e	15.2	21.8	-	c
52-62	C2	3.0	6.6d	3.8d	4.2d	2.5d	30.4	49.5e	14.3	20.4	Tr.	c

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.4	8.5	1.14	0.113	10.1	<0.20	0.6	1				22.6
8.0	8.6	9.0	0.76	0.070	11	<0.20	0.5	3				24.3
8.1	9.0	9.1	0.63	0.059	11	<0.20	0.8	4				25.4
8.2	9.1	9.3	0.40	0.040	10	<0.20	0.9	3				26.5
8.3	9.2	9.4	0.43			<0.20	1.1	2				25.8
8.3	9.2	9.4	0.37			<0.20	1.3	3				24.4
8.1	9.0	9.3	0.37			0.20	1.5	4				24.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a Ca	6G2b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
40.7		4.4	<0.1	0.9	1.2	2	1.9	0.2				77.1
42.7				2.4	0.5	5	3.0	<0.1				92.7
41.5				3.8	0.4	8	4.9	<0.1				90.0
43.9				6.5	0.8	13	6.4	<0.1				95.6
42.8				6.7	1.1	14	7.6	0.1				83.9
41.7				6.1	1.1	13	8.9	0.1				86.0
41.4				6.2	1.2	14	7.5	0.1				85.1

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth black concr. (Mn?)
c. Few smooth black concr. (Mn?);also few $CaCO_3$ concr.
d. Few smooth dark brown to black concr. (Fe-Mn?);also few $CaCO_3$ concr.

e. Some difficulty was encountered in dispersing these samples for P.S.D.

Soil type: Regent clay
Soil No.: S58NDak-45-9-(1-7)
Location: 180 feet west and .35 mile south of northeast section corner of Sec. 31, T138N, R97W, Stark County, North Dakota.
Vegetation: Summer fallow.
Parent material: Bedded shale of the White River formation.
Physiography: Plain, long upland slope.
Slope: 4 percent, southwest facing.
Drainage: Well.
Erosion: Slight.
Permeability: Slow.
Root distribution: Few to 60 inches. Moisture: Moist to 60 inches.
Described by: K. E. Larson
Date: July 18, 1958.

Horizon and Lincoln Lab. Number	
Ap 8532	0 to 4 inches. Olive gray (5Y 4/2 dry) to black (5Y 2/2 moist) clay; medium moderate crumb; very hard, friable, very sticky and very plastic; noncalcareous; clear and smooth boundary; a few fine siliceous pebbles of 1- to 3-mm. size throughout profile.
B2 8533	4 to 8 inches. Gray (5Y 5/1 dry) to dark olive gray (5Y 3/2 moist) clay; medium weak prisms that break to fine and medium moderate angular blocks; very hard, friable, very sticky and very plastic; calcareous; clear and smooth boundary.
Bca 8534	8 to 19 inches. Olive gray (5Y 5/2 dry and 5Y 4/2 moist) clay; medium weak prisms that break to fine and medium moderate angular blocks; very hard, very sticky and very plastic, friable; calcareous; clear and wavy boundary.
Cca 8535	19 to 30 inches. Light gray (2.5Y 7/2 dry) to light brown gray (2.5Y 6/2 moist) clay; medium weak angular blocks that have patchy coats of clay of 5Y 3/1; very hard, firm, very sticky and very plastic; strongly calcareous with few faint and fine lime threads and nodules; gradual and smooth boundary.
C11 8536	30 to 42 inches. Gray (10YR 5/1 dry) to light olive brown (2.5Y 5/3 moist) clay; coarse and medium weak angular blocks; very hard, firm, very sticky and very plastic; many prominent and medium mottles of 10YR 6/2 dry; strongly calcareous with a few fine distinct lime nodules; clear and wavy boundary.
C12 8537	42 to 52 inches. Light brownish gray (10YR 6/2 dry) to light olive brown (2.5Y 5/3 moist) clay; description same as C11.
C2 8538	52 to 62 inches. Light gray (5Y 7/2 dry) to gray (5Y 5/1 moist) sandy clay; coarse and medium weak angular blocks; very hard, firm, very sticky and very plastic; strongly calcareous with few prominent lime nodules of 2.5Y 8/2 dry.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Regent clay **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-10-(1-7) **LAB. NOS.** 8539-8545

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	1.7	2.0	1.9a	4.8a	4.6a	32.0	53.0	18.6	20.7	2.1	c
5-11	B2	1.0b	1.8c	1.6c	4.1c	3.9c	32.2	55.4	17.6	20.7	1.4	c
11-23	Bca	0.8b	1.7c	1.5c	3.5c	3.5c	33.2	55.8	15.9	22.7	1.4	c
23-30	Cca	0.8b	1.3c	1.3c	3.6c	4.0c	35.4	53.6	16.9	24.6	Tr.	c
30-40	C11	0.8b	1.3c	1.1c	3.1c	3.5c	37.0	53.2d	15.3	26.9	Tr.	c
40-52	C12	0.9b	1.3c	1.0c	2.4c	2.7c	36.7	55.0d	13.4	27.4	Tr.	c
52-60	C2	0.6b	0.9c	0.6c	1.4c	1.7c	36.3	58.5	9.9	28.9	Tr.	c

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.3	8.5	1.25	0.119	10.5	<0.20	0.7	1				23.0
8.0	8.9	9.1	0.76	0.069	11	<0.20	0.7	3				24.0
8.2	9.0	9.3	0.60	0.052	12	<0.20	0.8	4				25.5
8.2	9.2	9.4	0.36	0.033	11	<0.20	1.0	4				25.1
8.2	9.2	9.4	0.18			0.20	1.7	3				24.3
8.1	9.0	9.3	0.14			0.31	2.4	2	<1			23.0
7.9	9.0	9.3	0.14			0.27	2.1	1	<1			24.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS Ca	602b Mg	6H1a H	6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
40.3		3.8	0.5	1.0	1.7	2	1.3	0.2				81.4
43.0				3.3	0.7	7	2.4	<0.1				86.0
42.7				6.2	0.6	13	5.7	<0.1				98.0
43.4				8.5	0.8	18	6.9	<0.1				100.3
46.0				8.9	1.0	17	12.0	0.1				90.6
46.2				8.2	1.1	15	15.6	0.2				86.7
45.6				8.3	1.2	15	13.9	0.2				91.4

a. Few smooth dark brown to black concr. (Fe-Mn?)
b. Few $CaCO_3$ concr.
c. Few smooth dark brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

d. Some difficulty was encountered in dispersing these samples for P.S.D.

Soil type: Regent clay
Soil No.: S58NDak-45-10-(1-7)
Location: 120 feet north and 60 rods east of west quarter corner Sec. 6, T137N, R97W, Stark County, North Dakota.
Vegetation: Summer fallow.
Parent material: Residual bedded shale of White River formation.
Physiography: Long upland slope.
Slope: 4 percent, south facing.
Drainage: Well.
Erosion: Slight.
Permeability: Slow.
Stoniness: None.
Moisture: Moist to 60 inches.
Described by: K. E. Larson.
Date: July 18, 1958.

Horizon and Lincoln Lab. Number	
Ap 8539	0 to 5 inches. Gray (5Y 5/1 dry) to dark olive gray (5Y 3/2 moist) clay; medium moderate crumb and fine weak angular blocky structure; friable, very sticky and very plastic; noncalcareous; small siliceous rock fragments on surface; clear and smooth boundary.
B2 8540	5 to 11 inches. Olive gray (5Y 5/2 dry) to dark gray (5Y 4/1 moist) clay; medium weak prisms that break to fine moderate angular blocks; very hard, friable, very sticky and very plastic; calcareous; gradual wavy boundary.
Bca 8541	11 to 23 inches. Gray (5Y 6/1 dry) to olive gray (5Y 5/2 moist) clay; medium weak prisms breaking to fine and medium moderate angular blocks; extremely hard, firm, very sticky and very plastic; strongly calcareous; clear and smooth boundary.
Cca 8542	23 to 30 inches. Light gray (5Y 7/2 dry) to dark gray (5Y 4/1 moist) clay, with clay lenses of olive gray (5Y 5/2); medium moderate angular blocks; very hard, firm, very sticky and very plastic; slickensides visible in this horizon; strongly calcareous with few lime threads; clear and smooth boundary.
C11 8543	30 to 40 inches. Light gray (5Y 7/2 dry) to pale olive (5Y 6/3 moist) clay; medium moderate angular blocks; very hard, firm, very sticky and very plastic; strongly calcareous with few fine lime threads and nodules of 2.5Y 8/2; gradual smooth boundary.
C12 8544	40 to 52 inches. Pale yellow (5Y 8/3 dry) to pale olive (5Y 6/3 moist) clay; medium moderate angular blocks; hard, firm, very sticky and very plastic; strongly calcareous with few fine and faint lime threads.
C2 8545	52 to 60 inches. Same description as C12 horizon.

SOIL SURVEY LABORATORY Lincoln, N br. July 1961

SOIL TYPE Renshaw loam, sandy substratum phase with lighter-textured B horizon than typical **LOCATION** LaMoure County, North Dakota

SOIL NOS. S59NDak-23-1-(1-9) **LAB. NOS.** 11733-11741

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	5.0	26.0	16.1	12.8	5.3	23.8	11.0	20.6	13.5	Tr.	cosl
6-12	B2	7.7	32.8	16.4	10.8	3.8	17.1	11.4	16.0	8.3	Tr.	c sl
12-16	A1b	6.8	28.8	17.8	12.6	3.5	17.9	12.6	15.2	9.6	Tr.	cosl
16-20	B2b	13.5	27.5	17.8	15.9	3.2	13.3	8.8	13.7	6.4	4	cosl
20-23	B3b	10.2	30.6	26.5	21.6	2.5	3.7	4.9	8.1	2.2	6	cos
23-32	D1	6.8	45.3	27.3	14.9	1.5	1.6	2.6	6.6	0.7	4	cos
32-41	D2	8.0a	43.4a	30.8a	11.0a	1.0a	3.1	2.7	5.3	1.4	5	cos
41-49	D3	1.9a	25.7a	38.1a	25.6a	3.0a	3.7	2.0	10.6	1.6	4	cos
49-65	D4	34.5a	35.2a	15.6a	8.8a	1.3a	2.8	1.8	5.4	1.1	28	cos

pH 1:1	pH 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.2	6.5	6.7	1.97	0.221	9	0.7	0.5					8
6.6	6.9	7.0	1.00	0.088	11	0.9	0.5	< 1				6
7.0	7.1	7.2	0.65	0.073	9	1.0	0.5	< 1				5
7.1	7.3	7.3	0.43	0.050	9	0.9	0.6	< 1				4
7.3	7.4	7.4	0.20	0.021		1.0	0.6	< 1				2
7.2	7.3	7.2	0.08	0.012		1.0	0.5	< 1				2
8.3	8.9	9.0	0.04			0.6	0.7	6				2
8.4	9.0	9.1	0.03			0.9	0.6	7				1
8.5	9.0	9.0	<0.01			0.7	0.7	12				<1

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 5B1a 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5SA3 Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→							
16.5	11.4	2.4	5.0	< 0.1	0.4	86	74	14.2	19.2	4.8	1.46	
12.6	9.3	2.4	2.4	< 0.1	0.3	95	83	12.0	14.4	3.9	1.65	
12.7	9.3	2.9	2.4	< 0.1	0.2	98	84	12.4	14.8	3.2	1.62	
9.5	6.5	1.9	1.6	0.2	0.2	93	85	8.8	10.4	3.4	1.52	
6.0	4.5	1.4	0.9	0.1	0.1	102	87	6.1	7.0	3.2		
3.7	2.0	1.0	1.2	0.1	0.1	86	73	3.2	4.4	2.0		
2.8				0.1	0.1							
1.8				0.1	0.1							
2.4				0.1	0.1							

a. Trace carbonate concr. $CaCO_3$?

Soil type: Renshaw loam, sandy substratum phase with lighter-textured B horizon than typical
Soil No.: S59NDak-23-1-(1-9)
Location: 280 feet west and 75 feet south of east quarter corner of Sec. 5, T134N, R61W, LaMoure County, North Dakota.
Vegetation: Blue grama, crested wheatgrass, curlycup gumweed.
Climate: Mean annual temperature 41 degrees F.; mean annual precipitation 19 inches.
Parent material: Alluvium.
Physiography: Nearly level terrace of James River.
Relief: Area 4 feet, site 2 feet.
Slope: 1 percent.
Aspect: South.
Drainage: Well to somewhat excessive.
Moisture: Dry to 40 inches.
Erosion: Slight.
Root distribution: Numerous to 6 inches, common to 20 inches, and few to 30 inches.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 21, 1959.

Horizon and Lincoln Lab. Number	
Ap 11733	0 to 6 inches. Black (10YR 2/1 moist) loam, dark gray (10YR 4/1 dry); moderate medium subangular blocky structure breaking to moderate fine granules; hard, very friable, slightly sticky and slightly plastic; few clear quartz grains; noncalcareous; abrupt smooth boundary.
B2 11734	6 to 12 inches. Very dark grayish brown (10YR 3/2 moist) loam, dark grayish brown (10YR 4/2 dry); peds coated with very dark brown (10YR 2/2 moist), very dark grayish brown (10YR 3/2 dry); strong medium prismatic structure breaking to strong medium blocks; hard, very friable, slightly sticky and slightly plastic; few bleached quartz grains; faint patches of clay films; noncalcareous; clear wavy boundary.
A1b 11735	12 to 16 inches. Black to very dark brown (10YR 2/1.5 moist) loam, dark gray (10YR 4/1 dry); strong medium prisms breaking to moderate medium blocks; hard, very friable, slightly sticky and slightly plastic; few bleached quartz grains; faint continuous clay films with patches of distinct clay films; sand grains bridged and coated; noncalcareous; abrupt smooth boundary. (The use of buried horizon nomenclature may be questionable because of the wavy upper boundary of this horizon.)
B2b 11736	16 to 20 inches. Very dark grayish brown (10YR 3/2 moist) sandy loam, dark grayish brown (10YR 4/2 dry); weak fine and medium subangular blocky structure; slightly hard, very friable, and slightly sticky; abrupt smooth boundary.
B3b 11737	20 to 23 inches. Very dark grayish brown (10YR 3/2 moist) loamy coarse sand, dark grayish brown (10YR 4/2 dry); very weak fine subangular blocky structure; soft, very friable, and nonsticky; few bleached quartz grains; noncalcareous; clear smooth boundary.
D1 11738	23 to 32 inches. Very dark grayish brown (10YR 3/2 moist) coarse sand, dark grayish brown (10YR 4/2 dry); single grain; loose; noncalcareous; clear wavy boundary. (A pocket of very dark grayish brown (2.5Y 3/2 moist) shale gravel occurs at 23-26 inches on one side of the pit. There are also thin discontinuous bands that appear to be of organic origin.)
D2 11739	32 to 41 inches. Dark grayish brown (10YR 4/2 moist) coarse sand, grayish brown (10YR 5/2 dry); single-grain structure; loose; slightly calcareous; few lime-coated pebbles; clear wavy boundary.
D3 11740	41 to 49 inches. Dark grayish brown (10YR 4/2 moist) coarse sand, light brownish gray (10YR 6/2 dry); thin bands of dark reddish brown (5YR 3/3 moist) iron-stained sand; single grain; loose; slightly calcareous; few pebbles lime-coated on bottom; clear wavy boundary.
D4 11741	49 to 65 inches. Multicolored coarse sand and gravel with common distinct dark yellowish brown (10YR 4/4 moist) and reddish brown (5YR 4/4 moist) iron stains; single grain structure; loose; slightly calcareous with pebbles lime-coated on bottom.

SOIL SURVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE Renshaw silt loam, gravel substratum phase **LOCATION** Ransom County, North Dakota

SOIL NOS. S59NDak-37-1-(1-9) **LAB. NOS.** 11714-11722

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	3.6	12.0	9.6	11.0	5.3	38.1	20.4	24.6	23.4	Tr.	l
6-12	B2	4.4	12.1	9.6	10.2	5.7	36.8	21.2	27.5	19.3	2	l
12-14	A1b	3.0	10.6	10.4	11.5	7.2	35.7	21.6	29.1	19.0	Tr.	l
14-18	B2b	4.8	9.0	7.8	12.2	13.7	34.8	17.7	39.8	15.6	3	l
18-21	B3b	15.0a	18.2b	20.3b	14.9b	4.0b	13.3	14.3	14.6	6.9	57	cosl
21-24	D1	6.4c	14.5c	22.0b	27.0b	3.8b	12.3	14.0	14.9	8.4	35	sl
24-38	D2ca	26.0c	36.0b	17.5b	6.8b	1.7b	7.4	4.6	5.7	5.4	53	cos
38-46	D3	12.8c	47.8b	18.4b	4.0b	0.7b	9.3	7.0	4.4	6.4	7	lcos
48-60	D4	31.4c	28.7b	11.7b	10.7b	1.7b	9.7	6.1	7.7	6.7	36	lcos

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.5	6.7	6.9	3.76	0.313	12	0.8	0.4	< 1				13
6.8	7.0	7.3	1.63	0.156	10	0.9	0.5	< 1				11
7.0	7.2	7.4	1.24	0.119	10	0.9	0.5	< 1				10
7.2	7.6	7.6	0.85	0.085	10	1.0	0.4	< 1				8
7.8	8.3	8.6	0.77	0.089	9	1.2	0.7	9				8
7.8	8.2	8.7	0.43	0.061	7	0.8	0.7	5				9
8.2	8.8	9.0	0.12			1.2	0.6	17				4
8.4	9.0	9.0	0.04			0.5	0.6	12				7
8.4	9.0	9.0	0.04			0.8	0.6	18				5

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→							
26.0	19.6	5.1	6.0	0.1	0.5	97	81	25.3	31.3	3.8		
21.5	16.0	4.9	3.4	0.1	0.3	99	86	21.3	24.7	3.3	1.57	
21.6	16.1	5.2	3.1	0.1	0.3	100	88	21.7	24.8	3.1	1.56	
17.9	13.3	4.7	1.9	0.1	0.2	102	90	18.3	20.2	2.8	1.59	
13.3				0.1	0.2							
14.3				0.2	0.3							
5.2				0.1	0.1							
8.2				0.2	0.2							
6.7				0.2	0.2							

a. Few carbonate concr. $CaCO_3$?
b. Trace carbonate concr. $CaCO_3$?
c. Few shale fragments. Trace carbonate concr. $CaCO_3$? (Count of 0.25 to 2 mm. separate yielded 2% shale in B2b; 12% shale in D1 horizon.)

Soil type: Renshaw silt loam, gravel substratum phase
Soil No.: S59NDak-37-1-(1-9)
Location: 540 feet west and 60 feet north of southeast corner of Sec. 12, T134N, R58W, Ransom County, North Dakota.
Vegetation: Oats.
Parent material: Glacial outwash.
Physiography: Gently undulating outwash plain.
Relief: Area 10 feet, site 5 feet.
Moisture: Dry to 40 inches.
Root distribution: Numerous to 14 inches, common to 24 inches, and few to 46 inches.
Slope: 2 percent.
Aspect: Northeast.
Drainage: Well drained.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 20, 1959.

Horizon and Lincoln Lab. Number	
Ap 11714	0 to 6 inches. Black (10YR 2/1 moist) silt loam, dark gray (10YR 4/1 dry); weak fine and medium subangular blocky structure breaking to moderate medium granules; soft, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B2 11715	6 to 12 inches. Very dark grayish brown (10YR 3/2 moist) clay loam, dark gray brown (10YR 4/2 dry); strong coarse and medium prismatic structure breaking to moderate medium blocks; hard, friable, sticky and plastic; distinct clay films with sand grains bridged and coated; noncalcareous; clear smooth boundary.
A1b 11716	12 to 14 inches. Black (10YR 2/1 moist) clay loam, dark gray (10YR 4/1 dry); strong coarse and medium prismatic structure breaking to moderate medium blocks; hard, friable, slightly sticky and plastic; distinct clay films with sand grains bridged and coated; noncalcareous; clear smooth boundary.
B2b 11717	14 to 18 inches. Very dark grayish brown (10YR 3/2 moist) loam, grayish brown (10YR 5/2 dry); moderate medium prismatic structure breaking to moderate medium blocks; faint continuous clay films; noncalcareous; clear smooth boundary. A strongly iron-stained stratum 1/4-to 1/2-inch thick occurs at base of B2b horizon.
B3b 11718	18 to 21 inches. Very dark grayish brown (2.5Y 3/2 moist) gravelly sandy clay loam, grayish brown (2.5Y 5/2 dry); weak fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; slightly calcareous; quartzitic pebbles lime-coated; abrupt smooth boundary.
D1 11719	21 to 24 inches. Dark grayish brown (2.5Y 4/2 moist) loamy coarse sand, grayish brown (2.5Y 5/2 dry); single-grain structure; loose; slightly calcareous; few fine distinct nodules of lime and pebbles lime-coated on bottom; abrupt smooth boundary.
D2ca 11720	24 to 38 inches. Dark brown (7.5YR 4/4 dry) and yellowish red (5YR 4/6 dry) iron-stained gravel and coarse sand; single-grain structure; loose; krotovinas; strongly calcareous with large distinct segregations of lime; abrupt smooth boundary.
D3 11721	38 to 46 inches. Grayish brown (2.5Y 5/2 moist) fine gravel and coarse sand, light brownish gray (2.5Y 6/2 dry); single-grain structure; loose; cross-bedded strata of sand and gravel; krotovinas; slightly calcareous; clear wavy boundary.
D4 11722	46 to 60 inches. Dark grayish brown (2.5Y 4/2 moist) fine gravel and coarse sand, light brownish gray (10YR 6/2 dry); single-grain structure; loose; calcareous with large segregations of lime.

SOIL SURVEY LABORATORY Lincoln, Nebr. July 1961

SOIL TYPE Renshaw loam, gravelly substratum phase **LOCATION** Ransom County, North Dakota

SOIL NOS. S59NDak-37-2-(1-10) **LAB. NOS.** 11723-11732

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-6	Ap	6.6	16.0	8.4	6.2	5.2	38.0	19.6	23.4	22.8	Tr.	l
6-11	B2	4.2	14.7	9.6	7.8	7.2	35.9	20.6	27.5	19.5	Tr.	l
11-13	A1b	5.0	16.6	11.1	8.4	6.2	31.6	21.1	25.0	17.0	Tr.	l
13-15	B2b	9.1	15.9	11.1	10.2	6.4	27.5	19.8	24.6	14.9	23	sl/scl
15-18	B3b	15.8a	29.0a	21.1b	9.0b	3.6b	13.9	7.6	13.6	7.0	58	lcos
18-24	D11ca	19.4a	30.1a	19.0b	11.0b	3.8b	11.4	5.3	12.6	5.9	60	lcos
24-30	D12ca	34.7a	27.0a	7.7b	6.0b	3.1b	13.6	7.9	10.5	8.5	59	lcos
30-31	D2	19.1b	42.5b	15.4b	6.8b	2.4b	9.7	4.1	8.3	5.9	44	lcos
31-42	D3	15.2c	42.9c	16.6b	5.3b	1.0b	11.1	7.9	5.4	7.9	19	lcos
42-60	D4	28.1c	32.8c	10.9b	3.3b	1.0b	13.9	10.0	5.5	10.3	19	cosl

pH 1:1	pH 1:5	pH 1:10 (8C1a)	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	Free Iron Fe_2O_3% 6C1a	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS		4B2 15-Atmos. %
6.3	6.6	6.7	4.39	0.361	12	1.1	0.8					13
7.0	7.2	7.2	1.72	0.178	10	1.2	0.6	< 1				10
7.2	7.4	7.4	1.32	0.137	10	1.4	0.6	< 1				11
7.4	7.7	7.6	1.29	0.130	10	1.8	0.7	< 1				10
8.0	8.4	8.5	0.92	0.089	10	1.9	0.7	12				5
8.2	8.7	8.8	0.51	0.065	8	2.2	0.7	14				5
8.4	8.9	8.9	0.28			1.1	0.7	18				6
8.4	8.9	8.9	0.13			2.0	0.6	16				4
8.4	8.8	9.0	0.07			0.8	0.7	14				7
8.4	8.9	8.9	0.04			0.8	0.6	14				7

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	BASE SAT. % NH_4OAc EXCH. 5C1	5C3 Base Sat. % on Sum Cations	5B1a Sum Ext. Bases	5A3a Sum Ext. Cations	8D3 Ca/Mg	4A1h Bulk Density O.D. g/cc	MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →												
28.1	21.6	5.0	2.6	0.1	0.5	97	91	27.2	29.8	4.3		
20.3	16.2	4.4	3.4	<0.1	0.3	103	86	20.9	24.3	3.7	1.44	
21.0	16.1	5.4	2.9	0.1	0.3	104	88	21.9	24.8	3.0		
20.0	15.8	5.7	2.2	0.1	0.3	110	91	21.9	24.1	2.8		
10.7				<0.1	0.2							
8.2				<0.1	0.2							
7.6				0.1	0.2							
5.3				0.1	0.2							
9.2				0.1	0.4							
10.0				0.2	0.3							

a. Few carbonate concr. $CaCO_3$? (Count of 0.25 to 2 mm. separate yielded 2% shale in B2b 6% shale in D11ca horizon.)

b. Trace carbonate concr. $CaCO_3$?

c. Few shale fragments. Trace carbonate concr. $CaCO_3$?

Soil type: Renshaw loam, gravelly substratum phase
Soil No.: S59NDak-37-2-(1-10)
Location: 800 feet west and 370 feet north of south quarter corner of Sec. 13, T134N, R58W, Ransom County, North Dakota.
Climate: Subhumid; mean annual temperature 41 degrees F.; mean annual precipitation 20 inches.
Vegetation: Fallow.
Parent material: Glacial outwash.
Physiography: Gently undulating glacial outwash plain.
Relief: Area 8 feet, site 4 feet.
Slope: 2 percent.
Aspect: Southwest.
Drainage: Well drained.
Moisture: Moist to 60 inches.
Root distribution: Numerous to 12 inches, common to 30 inches, very few below 30 inches.
Erosion: Slight.
Permeability: Moderate in solum, rapid in substratum.
Described by: Hollis W. Omodt.
Date: August 21, 1959.

Horizon and Lincoln Lab. Number	
Ap 11723	0 to 6 inches. Black (10YR 2/1 moist) loam, very dark gray (10YR 3/1 dry); weak medium subangular blocky and moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; noncalcareous; abrupt smooth boundary.
B2 11724	6 to 11 inches. Very dark grayish brown (10YR 3/2 moist) loam, dark grayish brown (10YR 4/2 dry); peds coated with black (10YR 2/1 moist), very dark gray (10YR 3/1 dry); strong medium prismatic structure breaking to strong medium blocks; hard, friable, slightly sticky and plastic; faint continuous and distinct patches of clay films; noncalcareous; clear wavy boundary.
A1b 11725	11 to 13 inches. Very dark brown (10YR 2/2 moist) loam, dark gray (10YR 4/1 dry); moderate medium prismatic structure; hard, friable, slightly sticky and plastic; distinct clay films; noncalcareous; clear wavy boundary. (Buried horizon nomenclature may be questionable because of wavy upper boundary of horizon.)
B2b 11726	13 to 15 inches. Very dark grayish brown (10YR 3/2 moist) clay loam, dark grayish brown (10YR 4/2 dry) weak medium prismatic structure breaking to strong medium blocks; distinct clay films; noncalcareous; abrupt wavy boundary.
B3b 11727	15 to 18 inches. Very dark grayish brown (10YR 3/2 moist) sandy clay loam, dark grayish brown (10YR 4/2 dry); few fine distinct dark yellowish brown (10YR 4/4 moist) iron stains; moderate fine subangular blocky structure; hard, very friable, sticky and plastic; slightly calcareous with lime-coated pebbles; clear smooth boundary.
D11ca 11728	18 to 24 inches. Mottled very dark grayish brown (10YR 3/2 moist) coarse sand and gravel; common distinct dark yellowish brown (10YR 4/4 moist) and reddish brown (5YR 4/4 moist) iron stains; single-grain structure; loose; moderately calcareous with pebbles lime-coated on lower side; clear wavy boundary.
D12ca 11729	24 to 30 inches. Multicolored very coarse sand and gravel; dark yellowish brown (10YR 4/4 moist) and reddish brown (5YR 4/4 moist) iron stains; single-grain structure; loose; moderately calcareous with gravel lime-coated on lower side; abrupt smooth boundary.
D2 11730	30 to 31 inches. Dark reddish brown (2.5YR 3/4 moist) and dark red (2.5YR 3/6 moist) iron-stained gravel and coarse sand; single-grain structure; pebbles lime-coated on lower side; abrupt smooth boundary.
D3 11731	31 to 42 inches. Multicolored gravel and coarse sand with dark yellowish brown (10YR 4/4 moist), pale brown (10YR 6/3 moist), and dark reddish brown (5YR 3/3 moist) iron stains; loose; slightly calcareous with a few large segregations of lime; abrupt smooth boundary. (Reddish brown (5YR 4/6 moist) iron-stained gravel occurs at 40 to 42 inches with common fine prominent dark red (2.5YR 3/6 moist) nodules of iron. Not sampled by agreement of the sampling party.)
D4 11732	42 to 60 inches. Dark brown (10YR 4/3 moist) coarse sand, pale brown (10YR 6/3 dry); thin strata of yellowish red (5YR 3/6 moist) iron-stained pebbles; loose; finely cross-bedded quartz and shale sand strata that pinch out at opposite sides of pit; slightly calcareous with a few large lime segregations.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Renville loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-3 **LAB. NOS.** 20-25

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	3.1	6.9	7.4	16.1	11.0	35.8	19.7	37.2	19.3	4.0	1
6-11	B2	2.3	5.2	6.5	16.5	13.4	34.3	21.8	40.5	17.8	1.6	1
11-16	B3	1.6	3.4	5.3	16.8	15.3	38.9	18.7	45.5	19.9	1.1	1
16-26	Cca	1.7	4.0	6.1	16.2	12.7	38.8	20.6	39.2	22.3	2.7	1
26-40	C1	2.0	4.8	5.4	13.5	10.8	42.2	21.3	35.7	25.9	4.2	1
40-60	C2	1.8	4.2	5.8	16.7	12.1	39.1	20.4	39.2	22.5	1.7	1

pH 8C1b SATURATED PASTE	8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.6	7.0	8.3	2.23	.201	11.1	-	0.8	-	-			
6.2	6.7	7.1	0.82	.092	8.9	-	0.4	-	-			
7.3	7.9	8.3	0.73	.081	9.0	-	0.6	1	-			
8.1	8.9	9.2	0.36	.044	8.2	-	0.6	15	-			
8.5	9.3	9.6	0.19	.023		-	1.9	14	-			
8.3	8.8	9.3	0.18	.020		0.26	6.2	10	-			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter	→	
19.2	11.1	6.0	0.4	3.5	2	0.9	-	43.2
16.3	8.2	6.5	0.4	0.4	2	0.7	0.7	40.0
14.2		7.6	0.4	0.3	2	1.4	1.1	44.3
10.5		10.0	1.2	0.3	12	4.7	1.9	36.4
12.2		16.6	2.2	0.9	18	19.9	4.9	45.2
12.5		15.7	2.7	1.0	22	41.4	6.4	39.4

Soil type: *Renville loam
Soil No.: S49NDak-38-3
Location: Southwest quarter of southeast quarter Sec. 14, T161N, R87W, Renville County, North Dakota.
Vegetation or crop: Fallow.
Parent material: Firm glacial till.
Physiography: Ground moraine.
Relief: Gently undulating.
Slope: 2 percent.
Drainage: Well drained.
Moisture: Moist throughout.
Described by: B. L. Matzek.
Date: September 20, 1949.

Horizon and Mandan Lab. Number	
Ap 20	0 to 6 inches. Dark grayish brown or very dark brown (10YR 4/2 dry, 2/2 moist) loam.
B2 21	6 to 11 inches. Dark yellowish brown (10YR 4/4 moist) loam with moderately developed medium prismatic structure.
B3 22	11 to 16 inches. Yellowish brown (10YR 5/4 moist) loam with irregular blocky structure.
Ccs 23	16 to 26 inches. Yellowish brown (10YR 5/6 moist) strongly calcareous, friable loam, mottled with light gray and reddish brown and with massive structure.
C1 24	26 to 40 inches. Yellowish brown to pale brown (10YR 5/8 to 6/3 moist) calcareous loam that is slightly plastic and has a massive structure.
C2 25	40 to 60 inches. Light olive brown (2.5Y 5/4 moist) calcareous loam till with concretions of iron, manganese and lime present. Some gypsum and lignite evident.

Note: Area contains numerous small rocks exposed on the surface; very little erosion evident.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Renville loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-4 **LAB. NOS.** 26-31

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 <19mm	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-6	Ap	2.0	5.4	6.7	14.5	11.1	37.1	23.2	39.3	17.6	2.1	l
6-14	B	1.4	4.3	5.1	11.4	12.0	41.0	24.9	41.3	18.6	1.9	l
14-24	Cca1	1.5	2.8	3.2	9.6	12.3	48.1	22.4	42.8	24.3	4.1	l
24-36	Cca2	2.7	5.4	6.0	13.4	9.8	35.1	27.6	33.2	20.0	4.4	cl
36-48	C11	4.3	5.9	5.9	13.2	9.4	36.4	24.8	33.2	20.8	5.5	l
48-60	C12	3.6	6.0	6.6	13.7	9.5	36.3	24.4	34.0	20.2	5.7	l

8C1b pH SATURATED PASTE	8C1a pH 1:2.5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6R1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.6	8.0	8.4	2.84	.257	11.0	-	0.6	-	-			
7.7	8.2	8.5	1.14	.121	9.4	-	0.4	-	-			
7.9	8.4	8.9	0.40	.048	8.3	-	2.7	23	-			
8.1	8.4	9.0	0.19	.024		0.28	6.2	17	-			
8.1	8.5	8.9	0.12	.020		0.33	7.1	14	-			
8.0	8.5	8.9	0.14	.021		0.37	8.0	13	1			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1		8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter →				
24.4	23.5	7.4	0.2	1.3	-	1.0	0.6			49.8
20.7	16.4	9.4	0.2	0.4	1	1.1	-			45.5
9.8		12.6	0.5	0.4	5	7.7	3.7			37.6
13.9		19.9	1.4	0.7	10	27.9	5.6			46.2
13.7		14.9	2.3	0.7	17	48.7	11.3			41.5
13.4		14.6	2.6	2.0	19	30.5	5.9			42.7

Soil type: *Renville loam
Soil No.: S49NDak-38-4
Location: 1/4 mile west of southeast corner and 100 feet north of road, Sec. 17, T161N, R84W, Renville County, North Dakota.
Vegetation or crop: Summer fallow.
Parent material: Till, relatively stone free.
Physiography: Ground moraine deposit.
Relief: Gently undulating.
Slope: Less than 1 percent.
Drainage: Well drained.
Moisture: Moist throughout.
Other features: No erosion evident.
Described by: B. L. Matzek.
Date: September 20, 1949.

Horizon and Mandan Lab. Number	
Ap 26	0 to 6 inches. Very dark gray or black (10YR 3/1.5 dry, 2/1.5 moist) loam.
B 27	6 to 14 inches. Yellowish brown or dark yellowish brown (10YR 5/4 dry, 4/4 moist) moderately friable loam with well-developed medium prismatic structure.
Ccal 28	14 to 24 inches. Very pale brown or pale brown (10YR 7/3 dry, 6/3 moist) loam with weakly developed fine prismatic structure easily crushing to fine crumb.
Cca2 29	24 to 36 inches. Light olive brown (2.5Y 5/4 moist) mottled gray and yellow, strongly calcareous, massive, clay loam till.
C11 30	36 to 48 inches. Olive brown mottled with brownish olive (2.5Y 4/4 moist, 4/6 mottled) calcareous loam till.
C12 31	48 to 60 inches. Similar to layer above.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Renville loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-6 **LAB. NOS.** 472-479

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-5	A1	1.8	4.4	4.8	9.5	10.3	43.9	25.3	35.8	24.0	1	1
5-12	B2	2.7	6.6	7.2	13.7	11.5	32.7	25.6	36.1	16.0	1	1
12-19	C11ca	3.3	5.5	5.9	12.0	9.3	35.1	28.9	32.6	18.8	2	cl
19-32	C12ca	5.2	6.7	6.7	12.6	10.0	32.1	26.7	31.6	18.0	6	1
32-48	C21	3.6	5.9	6.6	13.7	12.1	35.9	22.2	36.7	19.8	7	1
48-56	C22											
56-72	C31cs	4.0	6.4	7.3	14.6	12.1	34.3	21.3	36.8	18.2	8	1
72-90	C32cs											

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.1	7.4	7.6	6.18	.517	12.0	-	0.6	-	-			18.4
7.2	8.0	8.1	1.29	.135	9.6	-	0.6	-	-			10.8
7.8	8.5	8.8	0.74	.077	9.6	-	4.5	20	-			9.4
8.5	8.9	9.1	0.34	.037	9.2	0.41	12.0	19	3			9.2
8.4	8.8	9.0	0.18	.026		0.56	15.0	13	-			8.8
8.2	8.8	9.0	0.14	.019		0.51	13.5	13	-			8.9
8.1	8.5	8.8	0.15	.018		0.51	13.0	12	23			8.7
8.0	8.4	8.7	0.18	.019		0.49	12.5	13	20			9.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
33.9	27.4	6.6		-	1.8	-	0.2	0.9				77.2
20.7	17.3	6.6		-	0.8	-	0.2	0.4				45.8
12.9				0.8	0.3	6	18.9	0.7				42.9
11.4				4.0	0.3	35	82.6	0.5	1.7	3.3	33.2	40.3
12.7				3.9	0.4	31	130.1	0.7				40.9
13.1				3.6	0.4	27	108.6	0.5	2.5	4.6	43.0	42.9
12.7				2.7	0.4	21	102.7	0.5				40.8
12.2				2.9	0.5	24	98.0	0.5	2.7	3.7	38.5	39.6

Soil type: *Renville loam
Soil No.: S50NDak-38-6
Location: 150 feet east of north quarter corner northwest quarter of northeast quarter, Sec. 31, T162N, R85W, Renville County, North Dakota.
Vegetation: Native grasses; western wheat, blue grama, feathered bunchgrass.
Parent material: Calcareous glacial till.
Physiographic position: Upland till plain.
Topography: Very gently undulating.
Drainage: Well drained.
Slope: 1 percent.
Moisture: Moist.
Stoniness: Slight.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 19, 1950.

Horizon and Mandan Lab. Number	
A1 472	0 to 5 inches. Dark gray, dry, and black, moist (10YR 4/1, 2/1), noncalcareous loam having a soft moderately developed fine crumb structure; very friable when moist. This changes in a clear irregular pattern to
B2 473	5 to 12 inches. Brown coated with gray when dry, dark grayish brown coated with very dark gray when moist (10YR between 5/2 and 5/3 with 5/1 dry, 10YR 4/2 and 3/1 moist), noncalcareous loam having a well-defined fine prismatic structure; prisms tend to separate into moderately developed medium-sized granules; hard when dry; friable when moist. This grades clearly in an irregular boundary to
C11ca 474	12 to 19 inches. Distinctly mottled light brownish gray and white in a fine- and medium-sized pattern, dry, and mottled olive brown and light gray when moist (2.5Y 6/2 and 8/2 dry, 2.5Y 4/3 and 7/2 moist), strongly calcareous clay loam with a moderate amount of segregated lime. This has a weak medium-sized prismatic structure; prisms separate into moderately developed, medium-sized granules; hard when dry; friable when moist. This grades into
C12ca 475	19 to 32 inches. Light brownish gray distinctly mottled with some spots of white and with a very few fine spots of yellowish red, dry, and light olive brown mottled with light gray and with spots of yellowish red, moist (2.5Y 6/2 and 8/2, 5YR 5/8 dry, 2.5Y 5/3 and 7/2, 5YR 4/8 moist), moderately calcareous loam; slight amount of segregated lime; weak medium-sized granular structure; hard when dry; friable when moist. This grades into
C21 476	32 to 48 inches. Faintly mottled grayish brown, light yellowish brown and gray with very few spots of white and reddish yellow, dry, faintly mottled olive brown, light olive brown and light gray with spots of strong brown, moist (2.5Y 5/2, 6/3, 6/0 and 9/2 with 7.5YR 6/8 dry, 2.5Y 4/3, 5/4, and 7/1 with 7.5YR 5/8 moist), moderately calcareous loam; moderate very thick platy; hard when dry; friable to firm when moist.
C22 477	48 to 56 inches. Pale yellow faintly mottled with a few fine spots of light gray and with reddish yellow, dry, and light olive brown mottled with grayish brown and with spots of yellowish red, moist (2.5Y 7/3 and 6/1, 5YR 6/8 dry, 2.5Y 5/3 and 5/2, 5YR 5/8 moist), mildly calcareous loam; moderate very thick platy.
C31cs 478	56 to 72 inches. Light yellowish brown faintly mottled with some fine spots of light gray and with a very few fine spots of brownish yellow, dry, and olive brown mottled with gray and with yellowish brown, moist (2.5Y 6/3 and 6/0, 10YR 6/8 dry, 2.5Y 4/3 and 5/0, 10YR 5/8 moist), mildly calcareous loam having a moderate amount of crystalline gypsum; moderate very thick platy; very hard when dry; firm when moist.
C32cs 479	72 to 90 inches. Light yellowish brown faintly mottled with some fine spots of light gray and with a very few fine spots of brownish yellow, dry, and olive brown mottled with gray and yellowish brown, moist (2.5Y 6/3, 10YR 7/1 and 6/8 dry, 2.5Y 4/3 and 10YR 5/1 and 5/8 moist), mildly calcareous loam; moderate very thick platy, and quantity of gypsum as in the horizon above.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE *Sen loam **LOCATION** Golden Valley Co., North Dakota

SOIL NOS. S58ND-17-1-(1-8) **LAB. NOS.** 8617-8624

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	0.1a	0.2a	0.2a	12.0a	22.7a	44.3	20.5	58.9	18.5	-	l
5-14	B2	0.1b	0.1b	0.2a	11.8a	24.9a	42.9	20.0	61.5	16.5	Tr.	l
14-17	B3ca	0.1c	0.2c	0.2d	8.6a	23.7d	44.6	22.6	56.0	19.8	Tr.	l
17-22	Cca	<0.1	0.4c	0.3d	7.1d	18.0d	45.3	28.9	44.6	24.9	-	cl
22-28	C1	0.1e	0.2e	0.3e	8.9e	23.4e	48.4	18.7	55.9	24.1	-	l
28-37	C2	0.1e	0.1e	0.1e	8.0e	46.7e	35.5	9.5	77.6	12.3	Tr.	vfsl
37-50	C3	<0.1	0.1e	0.1e	5.3e	47.8e	38.6	8.1	79.5	12.0	-	vfsl
50-61	D	<0.1	<0.1	<0.1	0.2f	1.1f	69.5	29.2	14.7	56.1	-	sicl

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6K1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.5	7.8	7.8	1.73	0.157	11.0	<0.20	0.6	<1				8.0
7.3	7.6	7.7	0.99	0.097	10	<0.20	0.5	<1				7.4
8.1	8.4	8.7	1.28	0.130	9.8	<0.20	0.7	16				9.0
8.3	8.7	9.0	1.16	0.115	10.1	<0.20	0.8	38				8.6
8.5	9.0	9.2	0.42	0.041	10	<0.20	1.4	31				6.5
8.6	9.1	9.3	0.16			<0.20	3.2	24	<1			3.8
8.7	9.1	9.4	0.07			<0.20	5.2	20	<1			3.5
8.3	8.7	8.8	0.10			0.45	10.0	32	1			12.4

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	8A1 6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
16.5	13.2	3.2	1.4	<0.1	0.8	<1	0.6	0.4				44.7
14.5	11.2	3.2	1.4	<0.1	0.2	<1	0.5	0.1				47.4
10.6				<0.1	0.2	<1	0.6	0.1				54.7
6.8				0.1	0.1	<1	1.4	0.1				54.1
4.3				0.3	0.1	2	4.6	0.1				45.4
3.0				0.9	<0.1	10	14.3	0.2				41.9
3.4				2.0	0.1	20	30.2	0.2	1.9	4.9	54.7	43.1
9.8				6.3	0.1	18	60.0	0.1	2.1	7.8	124.4	74.9

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Many smooth light brown and few, black concr. (Fe-Mn?)
c. Many smooth light brown and few, black concr. (Fe-Mn?);also few $CaCO_3$ concr.
d. Few smooth light brown to black concr. (Fe-Mn?);also few $CaCO_3$ concr.
e. Few smooth light brown to black concr. (Fe-Mn?); also common $CaCO_3$ concr.
f. Many smooth black concr. (Mn?);also few $CaCO_3$ concr.

Soil type: *Sen loam
Soil No.. S58NDak-17-1-(1-8)
Location: 930 feet south and 930 feet east of north quarter corner of Sec. 29, T140N, R105W, Golden Valley County, North Dakota.
Vegetation: Cropland (summer fallow, 1958).
Parent material: Ft. Union silts and fine sands.
Physiography: Upland, gently undulating relief.
Slope: 3 percent northeast facing.
Drainage: Well.
Ground water: None.
Moisture: Moist.
Erosion: Slight.
Permeability: Moderate.
Root distribution: Few to 50 inches.
Date: July 28, 1958. Described by: Lloyd Shoesmith and Francis Bahr.

Horizon and Lincoln Lab. Number	
Ap 8617	0 to 5 inches. Grayish brown or very dark brown (10YR 5/2 dry, 2/2 moist) loam with fine crumb structure; soft when dry; friable when moist; slightly sticky and slightly plastic when wet; noncalcareous; abrupt boundary.
B2 8616	5 to 14 inches. Pale brown or dark brown (10YR 6/3 dry, 3/3 moist) loam with coarse weak prismatic to coarse weak angular blocky structure; soft when dry; friable when moist; slightly sticky and slightly plastic when wet; noncalcareous; abrupt boundary; patches of very dark grayish brown (10YR 3/2 moist) clay on vertical faces.
B3ca 8619	14 to 17 inches. Pale yellow or olive brown (2.5Y 7/3 dry, 4/3 moist) loam with coarse weak prismatic to coarse weak angular blocky structure; slightly hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strongly calcareous; clear boundary.
Cca 8620	17 to 22 inches. White or light olive brown (2.5Y 8/2 dry, 5/3 moist) silt loam with medium weak platy to fine weak angular blocky structure; slightly hard when dry; friable when moist; slightly sticky and slightly plastic when wet; strongly calcareous; clear boundary; root and organic staining on plate surfaces.
C1 8621	22 to 28 inches. Pale yellow or light yellowish brown (2.5Y 8/4 dry, 6/4 moist) silt loam with massive and medium weak platy structure; loose when dry; friable when moist; sticky and plastic when wet; strongly calcareous; abrupt boundary.
C2 8622	28 to 37 inches. Pale yellow or olive (5Y 8/3 dry, 5/3 moist) very fine sandy loam with massive structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strongly calcareous; abrupt boundary.
C3 8623	37 to 50 inches. White or light olive gray (5Y 8/2 dry, 6/2 moist) very fine sand with massive structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; strongly calcareous; abrupt boundary.
D 8624	50 to 61 inches. Pale yellow and yellow or light olive brown and yellowish brown (2.5Y 8/4 and 10YR 7/8 dry, 2.5Y 5/4 and 10YR 5/6 moist) silty clay loam with coarse and medium moderate platy structure; sticky and plastic when wet; strongly calcareous; stratified.

Note: For soil characterization sampling. Few vertical cleavage lines in Cca and C extending from B horizon.

SOIL SURVEY LABORATORY Lincoln, N br. August 1960

SOIL TYPE *Sen loam **LOCATION** Golden Valley County, North Dakota

SOIL NOS. S59ND-17-1-(1-9) **LAB. NOS.** 11652-11660

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-6	Ap	0.1a	0.3c	0.5b	19.8	21.0	35.3	23.0	54.2	17.3	Tr.	l
6-11	B2	<0.1	0.1c	0.2b	14.5	22.5	38.8	23.9	52.9	19.7	Tr.	l
11-16	B3ca	0.1d	0.2d	0.3d	6.2g	16.3g	48.7	28.2	38.1	31.7	Tr.	cl
16-24	Cca1	<0.1	0.2d	0.3d	5.7g	22.7g	43.0	28.1	43.3	26.8	Tr.	cl
24-28	Cca2	0.1f	0.3f	0.3f	3.1g	42.9g	36.1	17.2	63.7	17.7	Tr.	l
28-34	C1	0.1f	0.1f	0.2f	1.6f	57.1g	31.6	9.3	78.4	11.5	Tr.	vfsl
34-46	C2	<0.1	<0.1	<0.1	0.2g	1.1g	73.6	25.1	18.3	56.5	Tr.	sil
46-56	C3	<0.1	<0.1	<0.1	<0.1	1.4g	68.6	30.0	10.8	59.2	Tr.	sicl
56-64	C4	<0.1	<0.1	0.1g	0.9g	54.2g	38.5	6.3	83.9	9.5	Tr.	vfsl

pH 1:1	pH 1:5	pH 1:10 (8C1a)	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	6C1a Free Iron Fe_2O_3 %	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM	6K1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.9	8.2	8.4	1.86	0.160	11.6	1.1	0.8	1				7.9
7.8	8.1	8.2	0.98	0.100	10	1.1	0.6	<1				7.0
8.0	8.5	8.7	1.16	0.119	9.7	0.8	0.6	21				9.0
8.2	8.8	9.0	0.58	0.067	9	0.7	0.6	27				7.3
8.5	9.0	9.1	0.27			0.4	0.6	24				4.8
8.6	9.2	9.4	0.15			0.2	0.6	20				3.1
8.5	9.0	9.3	0.15			1.1	1.2	31				6.9
8.2	8.8	9.0	0.12			1.4	3.2	28	<1			9.8
8.3	8.9	9.1	0.08			0.4	3.4	18	<1			2.3

5A1a CATION EXCHANGE CAPACITY NH_4OAc	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	5B1a 5I2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6F1a Na	6Q1a K			4A1h Bulk Density O.D. g/cc	8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil →						← milliequivalents per liter →					
16.3	22.7	2.8	0.5	<0.1	0.7	<1	0.3	0.4			1.50	44.8
14.7	13.5	2.8	1.0	<0.1	0.3	<1	0.3	0.1			1.46	44.6
11.4				<0.1	0.2	<1	0.4	0.1				52.3
7.9				<0.1	0.2	<1	0.5	0.2				45.8
5.2				<0.1	0.1	<1	0.6	0.2				40.3
4.4				0.1	0.1	2	1.0	0.2				44.4
9.1				0.6	0.2	3	4.8	0.2			1.46	55.9
10.9				1.7	0.2	7	15.4	0.2				59.8
4.0				0.7	0.1	8	10.6	0.3				43.3

a. Many Fe-Mn? concr.
b. Few Fe-Mn? concr.
c. Common Fe-Mn? concr.
d. Few Fe-Mn? concr. Few carbonate concr. $CaCO_3$?
f. Common carbonate concr. $CaCO_3$?
g. Few carbonate concr. $CaCO_3$?

Soil type: *Sen loam
Soil No.: S59NDak-17-1-(1-9)
Location: 1320 feet north and 1275 feet east of southeast corner of Sec. 36, T140N, R106W, Golden Valley County, North Dakota. (Approximately 166 feet north of east-west running swale; on knoll and approximately 100 feet south of base of slope.)
Vegetation: Cropland.
Parent material: Ft. Union silts and fine sands.
Physiography: Upland.
Slope: 5 percent.
Relief: Gently undulating.
Permeability: Moderate.
Aspect: North-northwest facing.
Drainage: Well.
Erosion: Slight.
Date: August 17, 1959. Described by: Lloyd Shoesmith.

Horizon and Lincoln Lab. Number	
Ap 11652	0 to 6 inches. Grayish brown (10YR 5/2 dry) to very dark grayish brown (10YR 3/2 moist) loam with fine crumb and weak medium subangular blocky structure; soft when dry; friable when moist; slightly sticky and slightly plastic when wet; strongly calcareous; roots numerous; boundary clear and wavy. (See notes at end.)
B2 11653	6 to 11 inches. Pale brown and brown (coated) (10YR 6/3 and 5/3 dry) to brown and dark brown (10YR 4/3 and 3/3 moist) silt loam; weak coarse prismatic to weak coarse and medium subangular blocky structure; slightly hard when dry; friable when moist; slightly sticky and slightly plastic when wet; roots numerous; patches of clay on vertical faces; noncalcareous; boundary gradual and wavy.
B3ca 11654	11 to 16 inches. Very pale brown and pale brown (10YR 7/3 and 6/3 dry) to brown (10YR 4/3 moist) silt loam; weak coarse prismatic to medium and fine angular blocky structure; slightly hard when dry; friable when moist; slightly sticky and slightly plastic when wet; violent effervescence; roots common; patches of clay on vertical faces; diffuse boundary.
Cca1 11655	16 to 24 inches. White and light gray (2.5Y 8/2 and 7/2 dry) to grayish brown and light brownish gray (2.5Y 5/2 and 6/2 moist) silt loam; weak medium platy and weak fine angular blocky structure; hard when dry; friable when moist; slightly sticky and slightly plastic when wet; violent effervescence; roots common; patches of clay on vertical faces; common medium prominent nodules of lime; clear boundary.
Cca2 11656	24 to 28 inches. White and light gray (2.5Y 8/2 and 7/2 dry) to grayish brown and light brownish gray (2.5Y 5/2 and 6/2 moist) silt loam; coarse and medium angular blocky structure; hard when dry; very friable when moist; slightly sticky and slightly plastic when wet; some roots; patches of clay on vertical faces; violent effervescence; clear boundary.
C1 11657	28 to 34 inches. Light gray (5Y 7/2 dry), light olive gray (5Y 6/2 moist) loam; weak coarse and medium angular blocky structure; soft when dry; very friable when moist; slightly sticky and slightly plastic when wet; very few fine roots; violent effervescence; abrupt boundary.
C2 11658	34 to 46 inches. Yellow, pale yellow and white (2.5Y 8/6, 8/4 and 5Y 8/1 dry) to olive yellow, yellow and light gray (2.5Y 6/6, 7/6 and 5Y 7/2 moist) silt loam; weak fine platy structure; soft when dry; friable when moist; slightly sticky and slightly plastic when wet; few medium prominent iron concretions; violent effervescence; clear boundary.
C3 11659	46 to 56 inches. Pale yellow (2.5Y 8/4 and 5Y 8/3 dry) to yellow and pale yellow (2.5Y 7/6 and 5Y 7/3 moist) silt loam; weak fine platy and weak fine angular blocky structure; hard when dry; firm when moist; sticky and plastic when wet; violent effervescence; clear boundary.
C4 11660	56 to 64 inches. Light gray and pale yellow (5Y 7/2, 7/3 and 8/4 dry) to light olive gray, pale olive and pale yellow (5Y 6/2, 6/3 and 7/4 moist) fine sandy loam; massive structure; soft when dry; very friable when moist; nonsticky and nonplastic when wet; few medium prominent iron concretions; violent effervescence.

Note: The bottom two inches of the Ap horizon show a definite traffic pan; density is higher than upper part of the horizon. The C2 and C3 consist of a number of strata approximately one to two inches in thickness, showing some color variations.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Sherwood loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-2 **LAB. NOS.** 8-12

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	Ap	3.4	5.9	6.3	14.1	11.0	40.0	19.4	41.2	18.0	3.1	l
6-13	B	1.0	3.3	4.1	9.6	11.1	49.2	21.6	47.6	18.6	0.6	l
13-19	Bca	2.9	5.2	4.9	10.2	13.5	51.0	12.2	54.6	16.1	1.9	sil
19-25	Cca	3.7	3.5	5.7	17.0	13.6	43.8	12.7	49.5	18.8	5.0	l
25-40	C	2.2	3.8	5.4	17.2	13.3	40.8	17.2	45.6	19.9	4.3	l
40-61	D	3.8	6.4	6.4	13.8	9.9	34.4	25.2	33.7	19.1	5.9	l

pH 8C1b SATURATED PASTE	8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.8	7.7	8.3	2.20	.197	11.2	-	0.6	-	-			
7.4	7.5	8.0	0.93	.107	8.7	-	2.4	-	-			
7.8	8.1	8.7	0.42	.046	9.1	-	4.5	22	-			
8.0	8.5	8.9	0.24	.028		0.20	5.5	23	-			
8.2	8.7	9.1	0.20	.019		0.26	6.5	19	-			
8.0	8.7	9.1	0.20	.021		0.28	6.0	15	-			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS 5B1a EXTRACTABLE 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
21.1	18.5	5.3		0.1	1.1	-	1.2	0.6				49.2
19.6	13.6	8.2		-	0.9	-	4.1	0.6				48.6
6.9		6.9		1.2	1.6	18	13.8	3.2				34.8
6.2		9.5		1.6	1.6	26	28.0	4.0				35.4
9.5		13.7		3.0	1.6	31	39.0	10.2				34.1
13.6		14.3		1.1	1.6	8	90.3	5.5				43.5

Soil type: *Sherwood loam
Soil No.: S49NDak-38-2
Location: 150 feet northeast of south quarter corner Sec. 14, T161N, R84W, Renville County, North Dakota; one-half mile west of Mohall, North Dakota.
Vegetation or crop: Rye stubble.
Parent material: Water-worked till over firm till.
Physiography: Water-reworked till plain.
Relief: Level to very gently undulating.
Slope: Less than 1 percent.
Drainage: Well drained.
Moisture: Dry to 25 inches; moist below.
Described by: B. L. Matzek.
Date: September 9, 1949.

Horizon and Mandan Lab. Number	
Ap 8	0 to 6 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) loam with moderately developed fine granular structure and friable consistence.
B 9	6 to 13 inches. Very dark grayish brown (10YR 3/2 dry) loam with moderately developed medium prismatic structure.
Bca 10a	13 to 19 inches. Strongly calcareous silt loam with weakly developed irregular blocky structure.
Cca 10b	19 to 25 inches. Light olive brown (2.5Y 5/4 dry) strongly calcareous loam.
C 11	25 to 40 inches. Light olive brown (2.5Y 5/4 moist) mottled with orange and light gray, strongly calcareous, soft irregular blocky loam.
D 12	40 to 61 inches. Olive brown (2.5Y 4/4 moist) moderately calcareous, irregularly massive, firm loam till.

Note: Some rocks were present in the profile and horizontal striation above the till was evident. Color of Bca not noted; however, in similar profiles the B is usually light-colored and Bca light brown gray to light gray. Cca color appears to be too dark.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Sherwood fine sandy loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-8 **LAB. NOS.** 487-493

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	4.2	8.1	9.5	18.4	14.7	28.4	16.6	22.0	31.7	3	fsl
7-16	B2	2.9	8.7	12.2	21.6	14.3	22.5	17.7	39.8	8.8	2	fsl
16-38	C1ca	0.4	1.7	3.0	9.8	18.9	40.4	25.8	45.7	19.9	-	1
38-48	D1	4.1	6.1	6.4	12.3	10.8	38.2	22.0	34.0	22.2	6	1
48-60	D21											
60-70	D22	3.4	5.8	6.2	11.9	10.5	39.6	22.6	33.5	23.6	6	1
70-80	D3cs											

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.7	8.0	8.1	2.71	.253	10.7	-	0.6	-	-			9.6
7.9	8.4	8.6	1.20	.123	9.8	-	0.4	1	-			9.5
8.0	8.8	9.1	0.49	.051	9.6	-	2.2	29	-			7.4
8.0	8.7	9.0	0.17	.021		0.28	7.0	19	-			8.8
8.0	8.6	8.8	0.14	.019		0.36	8.0	16	-			9.5
8.0	8.6	8.9	0.14	.019		0.36	8.0	16	-			9.9
7.9	8.1	8.5	0.15	.01		0.42	9.0	16	26			9.6

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				← milliequivalents per liter	→				
21.3	19.4	3.6	-	1.0	-	0.2	0.4				44.5
15.6			-	0.5	-	-	-				38.8
10.2			0.2	0.3	2	6.5	0.2				39.7
11.8			1.7	0.5	14	39.3	-				42.2
12.3			1.8	0.4	15	43.5	0.7	2.8	3.6	24.5	43.0
12.4			1.6	0.5	13	42.0	0.7				44.7
12.0			1.8	0.5	15	43.0	0.9	2.6	2.2	31.1	44.2

Soil type: *Sherwood fine sandy loam
Soil No.: S50NDak-38-8
Location: Northeast quarter of southwest quarter, Sec. 34, T163N, R84W, Renville County, North Dakota.
Vegetation: Quack grass.
Parent material: Glaciofluvial over till.
Physiographic position: Upland. Crest of low rise among numerous wet depressions.
Topography: Gently undulating.
Slope: 1 percent.
Drainage: Well drained.
Ground water: Very deep.
Moisture: Moist.
Stoniness: Free.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 20, 1950.

Horizon and Mandan Lab. Number	
Ap 487	0 to 7 inches. Dark gray, dry, and black, moist (10YR 4/1, 2/1), noncalcareous fine sandy loam having a soft moderately developed fine crumb structure; very friable when moist. This changes clearly into
B2 488	7 to 16 inches. Grayish brown, dry, and very dark grayish brown, moist (10YR 5/2, 3/2), noncalcareous fine sandy loam; weak medium-sized prisms separating into moderately developed fine- and medium-sized granules; slightly hard when dry; very friable when moist. This changes clearly into
C1ca 489	16 to 38 inches. Mottled white and pale yellow, dry, and mottled light yellowish brown and light gray, moist (mottlings are faint and small in size), (2.5Y 8/2 and 7/3 dry, 6/3 and 7/2 moist), strongly calcareous loam with a moderate amount of segregated lime; weak fine granular structure; slightly hard when dry; very friable when moist; in the lower 2 inches of this horizon there is a loose single-grain gravelly sandy loam overlying
D1 490	38 to 48 inches. Light brownish gray with some fine faint mottlings of pale yellow, dry, and grayish brown mottled with light olive brown, moist (2.5Y 6/2 and 7/4 dry, 5/2 and 5/4 moist), moderately calcareous loam; moderate very thick platy; hard when dry; firm when moist; slight amount of segregated lime. This grades into
D21 491	48 to 60 inches. Mottled light gray, light yellowish brown and yellow, dry, and mottled grayish brown, light olive brown and yellowish brown, moist (mottlings are faint and small in size), (2.5Y 7/1 and 6/3, 10YR 7/6 dry, 2.5Y 5/2 and 5/3, 10YR 5/6 moist), mildly calcareous loam; moderate very thick platy; very hard when dry; firm when moist.
D22 492	60 to 70 inches. Mildly calcareous loam; moderate very thick platy as in the horizon above. (Not sampled for vials.)
D3cs 493	70 to 80 inches. Mildly calcareous loam; moderate very thick platy as in the horizon above but with a moderate amount of crystalline gypsum.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Sherwood loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-11 **LAB. NOS.** 558-562

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
0-7	Ap	6.1	7.0	7.1	13.4	10.5	35.6	20.4	39.2	14.8	2	l
7-16	B2	1.9	5.0	6.6	14.3	16.4	35.0	20.8	47.4	11.9	-	l
16-30	B3ca	1.7	4.6	6.4	18.6	15.1	33.5	20.0	44.9	13.6	-	l
30-45	C	2.0	4.4	7.1	23.5	19.4	28.8	14.7	50.7	12.0	1	vfsl
45-60	D	3.9	9.6	9.4	15.1	11.6	32.0	18.4	34.5	17.7	6	l

8C1b SATURATED PASTE	pH 8C1a 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6E1a NITROGEN %	ORGANIC MATTER C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	MOISTURE TENSIONS 1/3 ATMOS. %	MOISTURE TENSIONS 4B2 15 ATMOS. %
7.0	7.3	7.5	2.77	.248	11.2	-	0.5	-	-			11.0
7.4	8.1	8.2	1.06	.111	9.6	-	0.5	1	-			9.1
8.1	8.8	8.9	0.42	.052	8.1	-	0.5	22	-			5.6
8.4	9.2	9.2	0.19	.024		-	1.5	14	-			5.1
8.2	9.3	9.4	0.14	.015		-	3.3	18	-			7.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS 5B1a EXTRACTABLE 6N2b Ca	602b Mg		5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		←	milliequivalents per liter			→	
21.9	15.2	5.0		-	1.1	-	-	0.6				47.5
17.5				-	0.5	-	0.2	-				42.4
8.5				0.1	0.2	1	0.3	-				32.4
8.2				0.7	0.3	8	8.4	0.3				29.8
10.3				1.6	0.5	16	24.0	0.3				36.2

Soil type: *Sherwood loam
Soil No.: 850NDak-38-11
Location: 1320 feet north and 990 feet west of the south 1/4 corner of southeast quarter of southeast quarter, Sec. 2, T161N, R85W, Renville County, North Dakota.
Vegetation: Good small grain stubble.
Parent material: Glaciofluvial material from Mankato drift.
Physiographic position: Upland terrace.
Topography: Nearly level.
Slope: 1 percent.
Moisture: Moist.
Stoniness: Slight.
Root distribution: Many.
Described by: C. A. Mogen.
Date: November 1, 1950.

Horizon and Mandan Lab. Number	
Ap 558	0 to 7 inches. Very dark gray (10YR 3/1 dry), and black (10YR 2/1 moist) loam having a soft fine crumb structure; friable when moist.
B2 559	7 to 16 inches. Brown coated with dark grayish brown (10YR 5/3 and 4/2 dry), and dark brown covered with very dark grayish brown (10YR 4/3 and 3/2 moist) loam, having a weakly developed, medium prismatic structure which breaks readily when moist to medium subangular blocky; slightly hard when dry; friable when moist.
B3ca 560	16 to 30 inches. Mottled light gray and white (2.5Y 7/2 and 8/2 dry), and light brownish gray and light gray (2.5Y 6/3 and 7/2 moist), moderately calcareous loam having a weakly developed, medium prismatic structure; slightly hard when dry; friable when moist; a slight amount of segregated lime.
C 561	30 to 45 inches. Light yellowish brown splotched with white (2.5Y 6/3 and 8/2 dry), and light olive brown splotched with light gray (2.5Y 5/4 and 7/2 moist), weakly calcareous very fine sandy loam having a weakly developed irregular-blocky structure; slightly hard when dry; very friable when moist.
D 562	45 to 60 inches. Mottled light yellowish brown and white (2.5Y 5/4 and 8/2 dry), and mottled light olive brown and light gray (2.5Y 5/4 and 7/2 moist), moderately calcareous plastic loam containing small distinct spots of red (2.5YR 4/8); weak medium irregular-blocky structure; firm when moist; hard when dry. This is glacial till of Mankato age.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Stirum loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-11-(1-8) **LAB. NOS.** 4517-4524

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	A11	0.3	0.5	1.0	21.3	26.6	28.3	22.0	57.1	14.7	-	1 a/
5-10	A12	0.5	11.9	4.2	39.2	7.5	18.0	18.7	26.8	9.5	-	fsl a/
10-21	B2	0.2	2.4	1.9	48.8	10.7	13.7	22.3	30.4	6.8	-	scl a/
21-26	Cgca	-	0.2	1.2	27.4	30.4	14.1	26.7	60.0	7.0	-	scl a/
26-34	Dg1	-	0.1	1.0	40.4	34.7	11.9	11.9	76.6	4.7	-	fsl
34-48	Dg2	-	-	1.0	46.9	35.4	7.5	9.2	80.6	4.0	-	lfs
48-64	Dg3	0.2	0.3	3.0	38.0	39.8	11.9	6.8	76.4	5.8	-	lvfs b/
64-65		15.0	5.9	5.0	23.8	30.9	15.8	3.6	56.9	6.8	-	ls c/

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.3	8.4	6.23	.606	10.3	<0.20	1.1	7				19.4
8.4	9.3	9.5	2.23	.213	10.5	<0.20	1.3	12				10.7
8.8	9.8	9.9	0.93	.093	10.0	<0.20	1.4	16				10.2
8.7	9.6	9.8	0.49	.048	10.2	<0.20	3.2	17				9.9
8.4	9.3	9.5	0.14			0.27	6.2	13				5.8
8.2	9.1	9.3	0.09			0.22	6.0	5				5.0
8.1	8.8	9.0	0.08			<0.20	6.0	10				4.2
8.2	8.8	9.1	0.08			<0.20	5.5	29				2.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a Ca	602b Mg	H	6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	4A3a Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
27.9		14.6		0.7	2.1	2	2.6	1.7	3.7	4.4		87.4
13.4		10.5		3.3	1.6	20	11.5	1.0	1.6	1.2		50.5
8.4		6.6		3.5	1.4	34	14.0	0.6	1.5	1.8	1.44	46.0
8.4				4.2	1.1	31	27.0	0.8	1.6	2.2		59.0
7.5				3.9	0.8	23	51.6	1.2	6.1	20.4		42.2
7.2				3.0	0.6	21	41.0	1.1	10.4	33.3		36.7
6.2				2.4	0.5	19	35.0	0.9	16.1	25.5	1.58	32.9
4.4				2.5	0.4	39	23.7	0.8	18.1	21.1		34.2

a/ Snail shells in sand fraction.
b/ Some $CaCO_3$ in sand fraction.
c/ Very coarse, coarse and medium sand percentages are mostly $CaCO_3$.

Soil type: Stirum loam
Soil No.: S56NDak-41-11-(1-8)
Location: 970 feet west and 123 feet south of east quarter corner of Sec. 4, T130N, R57W, Sargent County, North Dakota.
Vegetation: Coarse grasses.
Topography: Level.
Parent material: Glacial melt water deposits.
Physiographic position: Depressed basin in glacial Lake Dakota.
Drainage: Poorly drained; artificial surface drainage.
Moisture: Moist.
Ground water: Deeper than 60 inches.
Described by: Wesley M. Larsen.
Date: July 10, 1956.

Horizon and Lincoln Lab. Number	
A11 4517	0 to 5 inches. Very dark gray (5Y 3/1 moist) loam; fine crumb structure; very friable, slightly sticky and plastic; moderately calcareous; smooth boundary.
A12 4518	5 to 10 inches. Dark olive gray (5Y 3/2 moist) loam; weak medium prismatic structure breaking easily to moderate very fine angular blocks; friable, slightly sticky and plastic; strongly calcareous; smooth boundary.
B2 4519	10 to 21 inches. Olive gray (5Y 5/2 moist) loam; strong coarse prisms; the faces of these prisms are coated with dark olive gray (5Y 3/2 moist); continuous distinct clay skins on vertical faces and a few patches on horizontal faces; very strongly calcareous; smooth boundary.
Cgca 4520	21 to 26 inches. Dark gray (5Y 4/1 moist) loam with many large lime concretions of light gray (5Y 7/2 moist); medium angular blocks; friable; very strongly calcareous; abrupt smooth boundary.
Dg1 4521	26 to 34 inches. Olive gray (5Y 5/2 moist) fine sandy loam; few faint mottles of light olive gray (5Y 6/2 moist) and prominent mottles of black (N 2/0 moist); strongly calcareous; smooth boundary.
Dg2 4522	34 to 48 inches. Light yellowish brown (2.5Y 6/4 moist) highly mottled with strong brown (7.5YR 5/8 moist), pale olive (5Y 6/3 moist) and black (N 2/0 moist) loamy fine sand; slightly sticky; strongly calcareous; smooth boundary.
Dg3 4523	48 to 64 inches. Olive (5Y 5/3 moist) fine sand with wide horizontal stains of dark reddish brown (2.5YR 3/4 moist); moderately calcareous; smooth boundary.
4524	64 to 65 inches. Cemented layer.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Stirum loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-14-(1-7) **LAB. NOS.** 4537-4543

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-3	A11	0.3	3.0	5.6	28.6	29.7	18.9	13.9	62.9	9.1	-	vfsl a/
3-8	A12	0.3	3.2	6.5	31.6	31.3	12.5	14.6	64.2	6.6	-	vfsl a/
8-12	B2	0.1	4.8	8.4	34.7	28.3	9.2	14.5	62.0	4.9	-	fsl a/
12-24	Cg1	0.1	4.1	9.0	38.4	31.1	6.1	11.2	66.6	2.8	-	lfs
24-36	Cg2	0.1	5.7	6.1	34.0	35.0	9.2	9.9	71.1	4.3	-	lfs
36-48	Cgca	0.5	29.1	32.4	12.3	9.8	7.8	8.1	21.9	5.2	-	ls
48-56	Cg3	1.4	30.6	29.3	12.5	8.8	9.4	8.0	21.1	6.5	-	ls

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.8	8.4	8.7	4.15	.346	12.0	<0.20	1.1	4				13.8
8.5	9.7	9.9	2.44	.228	10.7	<0.20	2.2	6				13.1
9.0	10.0	10.2	0.87	.070	12.4	<0.20	3.7	7				9.0
8.8	9.9	10.0	0.13	.018		<0.20	2.6	5				5.5
8.3	9.4	9.6	0.07			<0.20	1.4	4				5.1
8.1	9.2	9.4	0.02			<0.20	1.2	3				5.9
7.9	9.2	9.4	0.02			<0.20	1.2	4				7.5

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 5B1a Ca	6G2b Mg	H	6F2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →				
16.7		10.5		0.4	1.8	1	3.0	2.2	2.6	4.7	62.7
14.2		11.5		4.7	1.8	27	15.5	1.4	3.7		49.5
8.9		7.8		6.3	1.2	56	30.4	1.0	2.4	3.0	44.0
5.9		5.6		3.0	0.6	36	21.3	0.6	0.7	3.0	42.8
6.8		5.3		0.9	0.7	9	8.7	0.7	1.6	5.2	34.3
7.5				0.6	0.6	5	5.4	0.7	1.8	5.1	27.9
9.3				0.7	0.8	6	4.7	0.6	2.0	4.6	29.9

a/ Snail shells in sand fraction.

Soil type: Stirum loam
Soil No.: S56NDak-41-14-(1-7)
Location: 100 feet east and 215 feet south of northwest corner of Sec. 9, T131N, R57W, Sargent County, North Dakota.
Vegetation: Native, mainly coarse, grasses.
Parent material: Glacial melt water deposited sands.
Physiographic position: Sandy portion of a glacial lake basin.
Topography: Level.
Drainage: Poorly drained; artificial surface drainage.
Moisture: Free water at 54 inches at time of sampling.
Described by: Wesley M. Larsen.
Date: July 10, 1956.

Horizon and Lincoln Lab. Number	
A11 4537	0 to 3 inches. Black (10YR 2/1 moist) loam with a fine crumb structure; strongly calcareous; abrupt smooth boundary; roots are matted in this horizon.
A12 4538	3 to 8 inches. Black (10YR 2/1 moist) loam with a fine crumb structure; friable; very strongly calcareous; smooth boundary.
B2 4539	8 to 12 inches. Very dark grayish brown (2.5Y 3/1 moist) loam; coarse moderate prisms; firm, slightly sticky and plastic; very strongly calcareous; clear smooth boundary.
Cg1 4540	12 to 14 inches. Grayish brown (10YR 5/2 moist) fine sandy loam; common medium mottles of olive gray (5Y 4/2 moist), brown (7.5YR 4/4 moist), and very dark gray (N 3/0 moist); very friable; nonsticky; very strongly calcareous; gradual boundary.
Cg2 4541	24 to 36 inches. Same as above.
Cgca 4542	36 to 48 inches. Olive (5Y 5/3 moist) prominently mottled dark reddish brown (5YR 3/3), strong brown (7.5YR 5/6 moist), very dark gray (N 3/0 moist) and white (2.5Y 8/2 moist) loamy sand; strongly calcareous; smooth boundary.
Cg3 4543	48 to 56 inches. Grayish brown (10YR 5/2 moist) loamy sand; moderately calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Straw loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-2-(1-11) **LAB. NOS.** 8477-8486

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-3	A1	0.9	1.4	4.2a	18.6a	18.1a	38.1	18.7	47.4	19.2	-	l
3-8	B2	0.3	0.4	2.0a	14.8a	17.5a	41.5	23.5	45.2	23.2	-	l
8-12	A1b	0.2	0.6	3.5a	21.2a	21.1a	33.4	20.0	51.3	15.8	Tr.	l
12-19	B2b	0.3b	0.9b	4.6b	26.9b	21.1b	29.4	16.8	51.5	14.3	Tr.	fsl
19-21	B31	0.3b	2.4b	18.1b	32.8b	13.1b	21.2	12.1	35.2	10.3	-	fsl
21-31	B32	0.2c	1.8c	5.8c	18.4c	15.6c	38.7	19.5	43.4	20.7	Tr.	l
31-42	Cca	0.5c	2.2c	8.7c	20.4c	16.6c	33.8	17.8	43.8	16.4	-	l
42-50	C1	1.2c	5.7c	22.9c	29.3c	9.7c	19.2	12.0	29.3	9.3	Tr.	fsl
50-54	C2	<0.1	0.6c	5.8c	40.6c	19.1c	21.4	12.5	54.7	7.7	Tr.	fsl
54-58	C3	<0.1	0.7c	8.7c	46.7c	15.6c	15.9	12.4	45.6	7.7	Tr.	fsl

pH 1:1	pH 1:5	8C1a ORGANIC MATTER 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.5	6.8	7.0	3.54	0.316	11.2	<0.20	0.5	<1				10.8
6.5	7.1	7.1	1.58	0.148	10.7	<0.20	0.4	<1				10.1
6.8	7.3	7.2	1.53	0.131	11.7	<0.20	0.4	<1				8.9
7.2	7.5	7.4	1.34	0.100	13.4	<0.20	0.5	<1				7.8
7.6	8.1	8.2	0.79	0.061	13	<0.20	0.5	<1				5.8
8.3	8.7	9.1	1.03	0.072	14.3	<0.20	0.6	3				8.2
8.3	8.8	9.0	1.08			<0.20	0.6	3				7.9
8.4	8.9	9.1	1.16			<0.20	0.7	2				6.2
8.4	9.0	9.1	0.86			<0.20	1.0	2				6.6
8.4	9.0	9.1	2.60			<0.20	1.2	2				7.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	6N2b Ca	6O2b Mg	6H1a H	6P2a Na	6Q2a K	BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
21.1	14.6	4.0	5.7	<0.1	1.2	94	0.3	0.9				65.6
19.7	13.8	4.8	3.8	<0.1	0.9	99	0.3	0.6				49.0
18.2	13.7	4.7	2.8	<0.1	0.5	104	0.3	0.3				47.6
16.8	12.9	4.8	1.9	<0.1	0.3	107	0.4	0.2				45.8
12.0	9.7	3.4	1.4	<0.1	0.2	111	0.5	0.2				38.3
14.7				0.1	0.2		0.5	0.1				46.1
14.9				0.1	0.2		0.7	0.1				45.2
12.4				0.2	0.1		1.5	0.1				40.4
11.9				0.4	0.1		3.4	0.2				40.5
17.4				0.7	0.1		5.0	0.1				44.8

a. Common smooth black concr. (Mn-Fe?)
b. Common smooth light brown to black concr. (Fe-Mn?)
c. Common smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.

Soil type: Straw loam
Soil No.: S58NDak-45-2-(1-11)
Location: 950 feet east and 400 feet north of southwest corner, Sec. 36, T140N, R95W, Stark County, North Dakota.
Vegetation: Green needlegrass and western wheatgrass.
Parent material: Alluvium.
Physiography: First bench of Green River (flat).
Slope: 1 percent.
Drainage: Moderately well.
Erosion: Slight.
Permeability: Moderate.
Moisture: Moist to 39 inches.
Root distribution: Numerous to 40 inches, few to 60 inches.
Described by: K. E. Larson.
Date: July 15, 1958.

Horizon and Lincoln Lab. Number	
A1 8477	0 to 3 inches. Very dark gray (10YR 3/1 dry) to very dark brown (10YR 2/2 moist) loam; fine and medium moderate crumb structure; slightly hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
B2 8478	3 to 8 inches. Dark gray (10YR 4/1 dry) to very dark grayish brown (10YR 3/2 moist) loam; fine and medium moderate prisms that break to medium moderate angular blocks; peds have clay skins on top and vertical faces of 10YR 2/2; hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
A1b 8479	8 to 12 inches. Olive brown (2.5Y 4/3 dry) to very dark gray brown (2.5Y 3/2 moist) loam; fine and medium moderate prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and and slightly plastic consistence; noncalcareous; patches of clay skins on top and vertical faces of peds; abrupt and smooth boundary.
B2b 8480	12 to 19 inches. Gray brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) loam; medium and coarse moderate prisms that break to medium and coarse moderate angular blocks; peds have patches of clay skins on top and vertical faces; slightly hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
B31 8481	19 to 21 inches. Gray brown (2.5Y 5/2 dry) to olive brown (2.5Y 4/3 moist) sandy loam; medium weak prisms that break to medium weak subangular blocks; hard, friable, slightly sticky and nonplastic consistence; noncalcareous; abrupt and smooth boundary.
B32 8482	21 to 31 inches. Olive gray (5Y 5/2 dry) to olive gray (5Y 4/2 moist) loam; coarse weak prisms that break into medium weak angular blocks; hard, friable, slightly sticky and slightly plastic consistence; calcareous; gradual smooth boundary.
Cca 8483	31 to 42 inches. Olive (5Y 5/3 dry) to olive gray (5Y 4/2 moist) loam; weak blocky structure in this horizon and below; hard, friable, slightly sticky and slightly plastic; strongly calcareous with many prominent lime threads; abrupt and smooth boundary.
C1 8484	42 to 50 inches. Olive (5Y 5/3 dry) to dark grayish brown (2.5Y 4/2 moist) sandy loam; hard, friable, slightly sticky and nonplastic consistence; calcareous with a few fine lime threads visible; abrupt and smooth boundary.
C2 8485	50 to 54 inches. Olive (5Y 5/3 dry) to olive brown (2.5Y 4/3 moist) sandy loam; slightly hard, friable, slightly sticky and nonplastic; calcareous; abrupt and smooth boundary.
C3 8486	54 to 58 inches. Pale olive (5Y 6/3 dry) to dark grayish brown (2.5Y 4/2 moist) loam; slightly hard, friable, slightly sticky and slightly plastic; calcareous.
C4	58 to 63 inches. Pale yellow (5Y 7/3 dry) to dark grayish brown (2.5Y 4/2 moist) silt loam; hard, friable, slightly sticky and plastic consistence; calcareous.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE Straw loam **LOCATION** Stark County, North Dakota

SOIL NOS. S58ND-45-3-(1-8) **LAB. NOS.** 8488-8495

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-3	A1	0.9a	1.3a	4.5a	16.7a	17.1a	38.7	20.8	45.8	19.5	Tr.	l
3-12	B1	0.2a	1.7a	5.5a	19.2a	16.0a	36.3	21.1	44.2	18.5	Tr.	l
12-24	B2	0.1a	2.1a	9.1a	26.5a	16.8a	29.7	15.7	46.2	13.5	-	fsl
24-27	B3	0.2a	8.1a	13.3a	38.2a	12.2a	17.4	10.6	39.7	7.7	-	fsl
27-37	Cca1	0.1a	1.1a	8.3a	26.9a	16.5a	29.8	17.3	45.7	14.1	-	fsl
37-49	Cca2	0.2	0.7b	3.6b	21.1b	20.6b	35.7	18.1	53.2	15.7	-	l
49-51	C2	3.7	5.1b	11.4b	35.3b	17.2b	16.6	10.7	45.3	6.4	4.2	fsl
51-60	C3	0.4	0.7b	1.6b	15.0b	32.7b	32.0	17.6	61.5	13.8	Tr.	l

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.3	6.6	6.7	3.14	0.272	11.5	<0.20	0.7					10.1
7.0	7.3	7.4	1.81	0.157	11.5	<0.20	0.5	<1				8.8
7.7	8.0	8.1	0.98	0.089	11	<0.20	0.6	<1				6.9
8.1	8.8	8.9	0.55			<0.20	0.6	2				5.0
8.2	8.8	9.0	0.81			<0.20	0.8	2				7.1
8.4	8.9	9.1	0.84			<0.20	0.8	4				7.5
8.5	8.9	9.2	0.87			<0.20	0.9	2				5.5
8.4	8.9	9.1	0.69			<0.20	1.2	4				7.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	602b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	BASE SAT. % NH_4Ac EXCH. 5C1	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
22.2	14.6	4.4	3.9	<0.1	1.7	93	0.4	1.4				55.9
19.1	14.2	4.5	2.9	0.1	0.8	103	0.6	0.6				46.7
14.4	11.4	4.2	0.5	<0.1	0.3	110	0.5	0.2				40.6
9.6	15.4	3.3	<0.1	<0.1	0.2	197	0.6	0.2				36.0
13.2				0.1	0.3		1.0	0.3				43.7
13.2				0.3	0.3		2.3	0.2				44.8
10.2				0.3	0.2		3.1	0.2				35.7
12.4				0.5	0.2		4.0	0.2				45.2

a. Common smooth light brown to black concr. (Fe+Mn?)
b. Common smooth light brown to black concr. (Fe+Mn?); also few $CaCO_3$ concr.

Soil type: Straw loam
Soil No.: S58NDak-45-3-(1-8)
Location: 50 feet north of river bank; 30 rods east and 30 rods south of center of Sec. 22, T140N, R95W, Stark County, North Dakota.
Vegetation: Native grasses.
Parent material: Alluvium.
Physiography: Low flat terrace long Green River.
Slope: 1 percent, nearly flat.
Drainage: Well.
Erosion: Slight.
Permeability: Moderate.
Stoniness: Free.
Root distribution: Numerous to 37 inches, few to 60 inches.
Described by: K. E. Larson.
Date: July 16, 1958.

Horizon and Lincoln Lab. Number	
A1 8488	0 to 3 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) loam; medium moderate crumb structure and fine moderate angular blocks; slightly hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
B1 8489	3 to 12 inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) loam; fine and medium moderate prisms that break to medium moderate angular blocks; clay skins of 10YR 2/2 are visible on top and vertical faces of peds; very hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; clear and smooth boundary.
B2 8490	12 to 24 inches. Olive (5Y 5/3 dry) to dark grayish brown (10YR 4/2 moist) loam; medium moderate prisms that break to medium moderate subangular blocks; patches of clay skins of 10YR 3/2 cover top and vertical faces of peds; slightly hard, friable, slightly sticky and slightly plastic consistence; noncalcareous; abrupt and smooth boundary.
B3 8491	24 to 27 inches. Pale olive (5Y 6/3 dry) to olive brown (2.5Y 4/4 moist) sandy loam; medium weak angular blocks; hard, friable, slightly sticky and nonplastic consistence; noncalcareous; abrupt and smooth boundary.
Cca1 8492	27 to 37 inches. Light brownish gray (2.5Y 6/2 dry) to dark grayish brown (2.5Y 4/2 moist) loam; coarse weak prisms that break to medium moderate angular blocks; very hard, friable, slightly sticky and slightly plastic; calcareous with few fine and distinct lime threads; abrupt and smooth boundary.
Cca2 8493	37 to 49 inches. Light brownish gray (2.5Y 6/2 dry) to dark grayish brown (2.5Y 4/2 moist) loam; coarse weak prisms that break to medium moderate angular blocks; hard, friable, slightly sticky and slightly plastic consistence; strongly calcareous with many fine and distinct lime threads visible; abrupt and smooth boundary.
C2 8494	49 to 51 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2moist) sandy loam; coarse weak prisms that break to medium moderate angular blocks; slightly hard, friable, slightly sticky and nonplastic consistence; calcareous with few faint lime threads visible; abrupt and smooth boundary.
C3 8495	51 to 60 inches. Pale olive (5Y 6/3 dry) to dark grayish brown (2.5Y 4/2 moist) loam; coarse moderate subangular blocks; hard, friable, slightly sticky and slightly plastic consistence; calcareous.

SOIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE Svea loam **LOCATION** Barnes County, North Dakota

SOIL NOS. S53NDak-2-2 **LAB. NOS.** 1648-1655

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	A1p	2.3	4.4	5.1	11.1	8.0	43.0	26.1	33.4	24.1	1.0	1
7-13	A12	1.7	4.6	4.8	9.7	7.8	44.1	27.3	33.3	24.3	1.0	cl
13-18	A31	2.4	5.5	5.0	9.4	7.4	42.4	27.9	35.0	20.3	0.9	cl
18-21	A32(?)	2.5	5.1	4.8	9.3	7.2	40.6	30.5	33.3	19.9	1.4	cl
21-28	B2	3.4	5.9	6.6	13.3	8.7	33.5	28.6	32.0	18.1	2.9	cl
28-35	Cca1	4.6	5.4	5.6	12.3	8.5	36.0	27.6	29.1	22.5	3.0	cl
35-43	Cca2	3.2	4.5	4.9	10.3	7.4	38.9	30.8	27.6	24.8	2.6	cl
43-60	C1	2.1	3.2	3.2	6.9	6.0	42.8	35.8	23.5	29.4	1.6	cl

pH 8C1b SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.8			4.6	0.359	12.8	<0.20	0.6	-				16.6
6.6			2.67	0.209	12.8	<0.20	0.6	-				14.9
6.6			1.20	0.114	10.5	<0.20	0.6	-				12.2
6.6			1.03	0.102	10.1	<0.20	0.6	-				11.6
7.0			0.56	0.068	8.2	<0.20	0.7	-				10.7
8.0			0.43	0.048	9.0	<0.20	0.7	17				9.4
8.3			0.30	0.034	8.8	<0.20	0.8	20				10.5
8.3			0.21	0.030		<0.20	0.8	19				13.9

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	5B1a 6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K			8A1	8A MOISTURE AT SATURATION
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					%
35.9	22.6	8.5		0.1	0.4	4.3	-	0.1				60.8
27.8	15.8	7.6		0.1	0.2	4.1	0.2	-				53.9
22.5	11.8	7.8		-	0.2	2.7	0.2	-				43.8
22.8	11.5	8.4		-	0.4	2.5	0.2	-				44.5
20.5	9.8	9.1		-	0.1	1.5	0.2	-				45.4
		9.2		0.1	0.1	-	0.2	-				43.8
		12.9		0.2	0.1	-	0.6	-				50.2
		9.2		0.3	0.2	-	1.5	-				57.6

Soil type: Svea loam
Soil No.: S53NDak-2-2
Location: 0.45 mile east and 65 feet south of the northwest corner Sec. 4, T143N, R56W, Barnes County, North Dakota.
Crop: Cultivated, fallow after wheat.
Climate: Average annual precipitation 19 inches; mean annual temperature 39° F.
Parent material: Calcareous, friable clay loam glacial till of late Wisconsin age, and local alluvium derived from soils formed on the same till.
Drainage: Moderately well drained.
Physiography: Very gentle concave upland slope near the head of a very shallow intermittent drainageway.
Slope: About 1 percent, facing toward the north - gently concave, nearly plane.
Described by: W. M. Johnson, 1953.

Mandan Lab. No.	Horizon	
1648	A1p	0 to 7 inches. Very dark gray to black (10YR 3/1 dry; 2/0.5 moist) soft, friable, moderate very fine granular loam. In the cultivated condition includes many soft round clods 3/8 to 1 inch in diameter. Abrupt, smooth lower boundary.
1649	A12	7 to 13 inches. Very dark gray to black (10YR 3/1 dry; 2/0.5 moist) soft friable clay loam. Moderate medium and coarse prisms break down to fine granule-like aggregates. The upper 2 inches of this horizon has a weak coarse platy structure due to effects of tillage implements. Lower boundary is clear and smooth.
1650	A31	13 to 18 inches. Dark gray to very dark brown (10YR 3.5/1.5 dry; 2/1.5 moist) slightly hard, friable clay loam. Crushed material is only slightly browner in color than the faces of aggregates. Moderate medium and coarse prisms break to weak irregular medium blocks that may be crushed easily to fine granule-like fragments. Clear, smooth lower boundary.
1651	A32(?)	18 to 21 inches. Dark gray to very dark brown (10YR 3.5/1.5 dry; 2/1.5 moist) clay loam with a very few faint fine brown mottles. Slightly hard, friable, moderate medium prisms break to weak medium blocks. Porous. These peds do not seem to have colloidal films on their surfaces. Clear, smooth lower boundary.
1652	B2	21 to 28 inches. Light olive brown to olive brown (2.5Y 5/3 dry; 4/3 moist) slightly hard, friable clay loam, with a very few conspicuous fine strong brown specks. Moderate medium prisms break to moderate medium blocks. Peds have thin, inconspicuous, colloidal films; some peds have black coatings. Porous, clear, slightly wavy lower boundary.
1653	Cca1	28 to 35 inches. Light olive brown to olive brown (2.5Y 5/3 dry; 4/3 moist) soft, friable clay loam, with a few strong brown specks and many fine and medium white spots. Weak coarse prismatic structure. Strongly calcareous. Very porous. Lower boundary is gradual and smooth.
1654	Cca2	35 to 43 inches. Light brownish gray to light olive brown (2.5Y 6/2 dry; 5/3 moist) soft, friable clay loam till with abundant fine and medium white soft, friable clay loam till with abundant fine and medium white mottles in the form of threads and spots. Weak coarse blocks can be broken in the hand into coarse plates. Strongly calcareous. Very porous. Gradual, smooth lower boundary.
1655	C1	43 to 60 inches. Finely and inconspicuously mottled light brownish gray, gray, white and strong brown, giving a mass effect of light brownish gray (2.5Y 6/2 dry; 4/3 moist) soft, friable clay loam till. Moderate very coarse platy structure that can be broken out in weak coarse blocks. Material appears to be laminated in some places. It is compact in place. Moderately calcareous.

Note: Krotovinas common in A3 and B2 horizons. There is an occasional sand pocket in the Cca2 and C1 horizons.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE Svea loam **LOCATION** Barnes County, North Dakota

SOIL NOS. S53NDak-2-3 **LAB. NOS.** 1765-1771

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1 VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	5.5	8.1	7.8	13.3	8.1	36.9	20.3	32.0	20.1	0.8	l
6-10	A11	2.6	6.6	7.0	13.4	9.3	39.0	22.1	35.1	20.9	0.7	l
10-17	AB	2.9	6.4	7.0	12.4	8.9	39.2	23.2	37.2	17.8	0.6	l
17-23	B2	2.5	6.1	6.9	14.6	10.3	32.2	27.4	34.2	16.7	2.5	cl
23-30	B3ca	4.6	5.8	5.5	11.0	8.0	36.6	28.5	28.1	23.1	4.5	cl
30-46	Cca	2.2	3.8	3.8	8.2	6.9	40.9	34.2	23.8	28.8	2.7	cl
46-60	C	4.5	6.5	6.2	12.8	10.2	41.6	18.2	34.3	25.2	5.2	l

8C1b pH SATURATED PASTE	pH 1:5	pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST. % SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x 10³ MILLIMHOS PER CM 6A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.4			3.46	0.259	13.4	<0.20	0.4	-				13.5
6.5			2.65	0.206	12.9	<0.20	0.4	-				12.4
6.6			0.81	0.087	9.3	<0.20	0.4	-				10.2
7.0			0.49	0.056	8.8	<0.20	0.5	-				11.4
7.6			0.38	0.050	7.6	<0.20	0.6	12				13.1
8.0			0.29	0.036	8.0	<0.20	1.1	24				12.9
7.8			0.12	0.017		<0.20	3.0	16				9.9

5A3a SUM OF CATIONS	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg		6P2a Na	5B1a 6Q2a K	6H1a EXTRACTABLE ACIDITY	SATURATION EXTRACT SOLUBLE 6F1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
30.8	18.4	5.7		0.1	0.9	5.7	-	0.1				55.0
27.2	16.6	5.7		0.2	0.4	4.3	0.2	-				51.6
20.5	11.1	7.0		0.2	0.4	1.8	1.1	-				40.9
22.0	11.3	9.0		0.2	0.5	1.0	1.1	-				44.9
							1.1	-				48.5
							2.4	-				49.2
							6.1	0.1				38.7

Soil type: Svea loam
Soil No.: S53NDak-2-3
Area: Barnes County, North Dakota
Location: 1/4 mile north and 180 feet west of SE corner Sec. 4, T143N, R56W.
Vegetation: Good crop of oats - harvested.
Parent material: Calcareous loam glacial till - Mankato.
Physiographic position: Head of small drain in till plain upland.
Topography: Undulating (local relief five to twenty feet).
Slope: 2 percent plane to southwest.
Drainage: Well drained.
Permeability: Moderately slow.
Moisture: Dry.
Stoniness: Some glacial stones and boulders.
Described by: C. A. Mogen.
Date: August 13, 1953.
Mandan

Lab.No.	Horizon	
1765	A1p	0 to 6 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; moderate to strong very fine granules; slightly hard, very friable. Clear boundary.
1766	A11	6 to 10 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) loam; compound structure of moderate coarse prisms and medium subangular blocks; slightly hard, very friable. Gradual boundary.
1767	AB	10 to 17 inches. Grayish brown (10YR 5/2 dry) to very dark brown (10YR 2/2 moist) crushing to very dark grayish brown (10YR 3/2 moist) loam; compound structure of moderate medium and coarse prisms separating to moderate fine blocks; slightly hard, friable. Gradual boundary.
1768	B2	17 to 23 inches. Brown (10YR 5.5/3 dry, 4/3 moist) clay loam; compound structure of strong fine and medium prisms separating to moderate fine blocks; faces of prisms are coated grayish brown (10YR 5/2 dry) and very dark grayish brown (2.5Y 3/2 moist); hard friable. Clear boundary.
1769	B3ca	23 to 30 inches. Light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/3 moist) clay loam; compound structure of moderate to strong fine and medium prisms separating to moderate fine blocks; hard, friable; moderately calcareous with a slight amount of segregated lime. Faces of prisms are coated grayish brown (2.5Y 5/2 dry) and very dark grayish brown (2.5Y 3/2 moist). Clear wavy boundary.
1770	Cca	30 to 46 inches. Light gray and pale yellow (2.5Y 7/2 and 7/4 dry) to light yellowish brown (2.5Y 6/4 moist) clay loam; strongly calcareous with a large amount of segregated lime in white seams, films and small soft round concretions; moderate fine blocky structure; hard, friable. Gradual boundary.
1771	C	46 to 60 inches. Pale yellow (2.5Y 7/4 dry) with common fine distinct mottlings of white (N 8/0) and strong brown (7.5YR 5/8 dry) to light yellowish brown (2.5Y 6/4 moist) mottled with light gray (2.5Y 7/2 moist) loam; strongly calcareous with a slight amount of segregated lime; moderate fine blocky structure; hard, friable.

Note: This profile is representative of the soil occurring in small area on short concave slopes or on flats in association with Barnes loam. Many larger soil areas considered for sampling had a marl-like lime layer at shallow depths.

SOIL SURVEY LABORATORY Mandan, N. Dak.

OIL TYPE Svea loam **LOCATION** Renville County, North Dakota

SOIL NOS. S49NDak-38-6 **LAB. NOS.** 38-44

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-5	Ap	1.4	4.3	5.1	10.7	9.2	44.8	24.6	36.8	23.8	0.6	1
5-15	AB	2.1	4.7	5.6	11.9	10.2	42.1	23.4	40.2	19.1	1.3	1
15-19	B2	3.1	6.9	8.4	17.4	11.7	31.4	21.1	39.2	14.4	4.4	1
19-29	Cca1	4.1	7.2	7.6	14.2	8.7	32.5	25.6	31.1	18.5	6.5	1
29-39	Cca2	3.4	5.5	5.8	13.1	9.1	34.9	28.1	31.3	20.8	3.0	c1
39-50	C1	3.8	6.4	5.2	13.4	9.8	37.5	24.1	33.1	22.5	3.6	1
50-60	C2	4.5	6.0	5.9	13.6	9.4	35.5	25.0	32.6	20.8	4.5	1

8C1b SATURATED PASTE	pH 8C1a 1:2.5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.4	7.6	7.8	3.72	.333	11.2	-	1.5	-	-			
7.3	7.7	7.8	1.02	.105	9.7	-	0.5	-	-			
7.6	8.0	8.2	0.65	.070	9.3	-	0.9	-	-			
8.1	8.3	8.8	0.45	.048	9.4	0.26	7.1	21	-			
8.3	8.6	8.9	0.28	.032	8.8	0.52	10.0	19	1			
8.2	8.7	8.9	0.26	.025	10.4	0.47	9.8	18	-			
8.2	8.6	8.9	0.24	.023		0.39	9.0	15	-			

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE 6N2b Ca	602b Mg	CATIONS	5B1b EXCHANGEABLE 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
29.2	24.8	7.9		-	1.1	-	1.3	1.8				55.4
19.2				0.2	0.8	-	1.1	1.4				44.0
14.9				0.2	0.5	1	2.4	1.3				37.6
11.6				1.9	0.6	16	32.6	5.2				38.7
12.8				2.9	0.1	23	37.3	8.2				41.6
13.5				2.6	0.9	19	36.0	8.3				38.6
13.5				2.4	1.1	17	29.8	7.7				39.2

Soil type: Svea loam
Soil No.: S49NDak-38-6
Location: 100 feet south of road and 1/8 mile west of northeast corner Sec. 20, T161N, R84W, Renville County, North Dakota.
Vegetation or crop: Fallow.
Parent material: Glacial till, possibly slightly water reworked.
Physiography: Ground moraine deposit.
Relief: Gently undulating.
Slope: 1 percent.
Drainage: Moderately well.
Moisture: Moist throughout.
Other features: Sampled not far from small pothole.
Described by: B. L. Matzek.
Date: September 21, 1949.

Horizon and Mandan Lab. Number	
Ap 38	0 to 5 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) loam.
AB 39	5 to 15 inches. Dark grayish brown or very dark brown (2.5Y 4/2 dry, 2/2 moist) loam with weakly developed medium prismatic structure; aggregates have colloidal coatings.
B2 40	15 to 19 inches. Grayish brown or very dark grayish brown faintly mottled with yellowish brown (2.5Y 5/2 dry, 3/2 moist, 10YR 5/8 mottled) loam with moderate medium prismatic structure breaking readily to coarse crumbs.
Cca1 41	19 to 29 inches. Light olive brown or olive brown (2.5Y 5/3 to 5/4 dry or 4/4 moist) strongly calcareous massive loam till with light gray streaks of lime.
Cca2 42	29 to 39 inches. Same as Cca1.
C1 43	39 to 50 inches. Light olive brown mottled with grayish brown to dark grayish brown and brown (2.5Y 5/4 with 5/2 and 4/2 dry, 7.5YR 4/4 moist) calcareous, massive, loam till.
C2 44	50 to 60 inches. Similar to C1 but with less lime.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE *Tagus silty clay loam **LOCATION** Burke County, North Dakota

SOIL NOS. S58ND-7-1-(1-8) **LAB. NOS.** 8634-8641

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	0.3a	0.7a	0.9a	2.9a	2.7a	41.8	50.7	15.0	31.2	Tr.	sic
2-5	A12	0.2a	0.6a	1.0a	2.9a	2.3a	32.9	60.1	11.1	25.7	-	c
5-9	B21	0.2b	0.9b	1.1b	2.5b	2.1b	35.0	58.2	9.9	28.6	-	c
9-19	B22	0.4b	0.8b	0.8b	2.3b	1.7b	36.4	57.6	9.0	30.4	-	c
19-26	B3ca	0.4b	1.2b	1.4b	3.4c	2.9c	37.9	52.8	12.1	30.6	Tr.	c
26-38	Cca	0.8b	2.4b	2.6b	6.1c	5.2c	40.0	42.9	18.6	30.0	Tr.	sic/c
38-51	C1	1.1b	2.8b	3.4b	9.0c	7.3c	40.6	35.8	24.4	28.4	Tr.	cl
51-61	C	1.6b	3.3b	3.3b	7.9b	6.3b	40.9	36.7	22.0	29.6	Tr.	cl

pH 1:1	1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me. 100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.8	7.0	7.66	0.549	14.0	<0.20	0.7	<1				26.6
6.9	7.1	7.3	3.15	0.268	11.8	<0.20	0.9	1				24.8
7.7	8.3	8.5	2.18	0.185	11.8	<0.20	0.7	7				22.1
8.0	8.4	8.7	1.46	0.126	11.6	<0.20	0.6	9				20.7
8.1	8.5	8.9	1.16	0.100	11.6	<0.20	0.6	10				19.2
8.4	8.9	9.2	0.56			<0.20	0.7	13				16.1
8.4	9.0	9.2	0.38			<0.20	1.1	13				15.7
7.8	8.1	8.3	0.44			0.32	5.5	10	44			16.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3^-	6K1a Cl^-	6L1a $SO_4^=$	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
41.0	22.2	8.7	7.2	<0.1	3.0	<1	0.3	1.1				120.8
40.0	33.2	10.3	4.8	<0.1	2.3	<1	0.2	0.7				87.0
35.8				<0.1	1.6	<1	0.2	0.4				77.8
34.0				0.2	1.1	<1	0.5	0.2				79.2
31.5				0.6	0.6	2	1.5	0.1				74.6
24.7				1.5	0.4	5	3.9	0.1				69.1
20.8				2.2	0.4	9	6.3	0.2				64.2
20.5				2.7	0.5	8	16.8	0.7	3.0	2.2	75.7	67.1

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?); also few $CaCO_3$ concr.
c. Few smooth light brown to black concr. (Fe-Mn?); also common $CaCO_3$ concr.

Soil type: *Tagus silty clay loam
Soil No.: S58NDak-7-1-(1-8)
Location: 660 feet north and 250 feet west of southeast corner of Sec. 36, T159N, R90W, Burke County, North Dakota.
Vegetation: Native grassland pasture with western wheatgrass and green needlegrass predominant.
Parent material: Fine-textured shaly glacial till.
Physiography: Upland till plain.
Topography: Broad, slightly convex, slope with less than 5 feet of local relief. Gilgai microrelief of 3 to 5 inches occurs in hexagonal patterns 3 to 6 feet across.
Slope: Less than 1 percent facing north.
Drainage: Moderately well; medium surface runoff.
Permeability: Moderate in A and B; slow in substrata.
Moisture: Dry with surface cracks beginning to develop along the hexagonal pattern of microrelief.
Root distribution: Matted in surface 2 inches, numerous through the B horizon and some to 61 inches.
Salt or alkali: None observed in the solum.
Stoniness: None.
Described by: Robert L. Howey
Date: July 30, 1958.

Horizon and Lincoln Lab. Number	
A11 8634	0 to 2 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) noncalcareous silty clay loam; slightly hard, friable, sticky and plastic; weak fine subangular blocks granulating readily to strong fine and very fine granules.
A12 8635	2 to 5 inches. Very dark gray (10YR 3/1 dry) to black (10YR 2/1 moist) noncalcareous silty clay; hard, friable, sticky and plastic; weak medium prisms breaking to weak subangular blocks which granulate readily to strong fine and very fine granules. This horizon tongues clearly but irregularily into next horizon.
B21 8636	5 to 9 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) slightly calcareous silty clay; hard, friable, sticky and plastic; weak medium prisms breaking to weak blocks which granulate readily to strong fine and very fine granules.
B22 8637	9 to 19 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) slightly calcareous clay; hard, friable, sticky and very plastic; weak coarse prisms breaking to weak blocks which granulate readily.
B3ca 8638	19 to 26 inches. Grayish brown (2.5Y 5/2 dry) to very dark grayish brown (2.5Y 3/2 moist) moderately calcareous clay without segregated lime; hard, friable, sticky and very plastic; weak coarse prisms and blocks which granulate readily. Gradual, irregular boundary.
Cca 8639	26 to 38 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) strongly calcareous clay with only a slight segregation of lime in nodules; hard, friable, sticky and very plastic; moderate fine to very fine granular. Gradual boundary.
C1 8640	38 to 51 inches. Light gray and light olive gray (5Y 6/1 and 6/2 dry) to olive gray and olive (5Y 4/2 and 4/3 moist) moderately calcareous clay with a few fine black lignite fragments; very hard, firm, sticky and very plastic; natural moderate blocks; gradual boundary.
C 8641	51 to 61 inches. Light gray (5Y 6/1 dry) to olive gray (5Y 4/2 moist) moderately calcareous clay with a few large prominent dark yellowish brown (10YR 4/4 moist) mottles; very hard, firm, sticky and very plastic; natural moderate angular blocks or fragments.

Note: Tongues of A horizon extend to a depth of 20 inches. Coatings of peds in B horizon were not as calcareous as the interiors; prominent vertical faces extend down through the C1 horizon.

SOIL SURVEY LABORATORY Lincoln, Nebr. March 1959

SOIL TYPE *Tagus silty clay loam **LOCATION** Mountrail County, North Dakota

SOIL NOS. S58ND-31-1-(1-7) **LAB. NOS.** 8642-8648

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-2	A11	0.1a	0.3a	0.3a	0.9a	1.2a	44.0	53.2	12.4	33.3	-	sic
2-6	A12	0.2a	0.3a	0.3a	0.7a	0.7a	37.6	60.2	8.8	29.9	-	c
6-10	B2	0.1a	0.2a	0.3a	0.7a	0.6a	40.1	58.0	9.1	32.0	-	sic/c
10-21	B3ca	<0.1	0.1b	0.1c	0.4c	0.6c	41.3	57.5	7.6	34.5	Tr.	sic
21-33	Cca	<0.1	0.1b	0.1d	0.3d	0.6d	46.9	52.0	10.4	37.3	-	sic
33-43	C1	<0.1	0.1b	0.1d	0.3d	0.7d	48.6	50.2	9.2	40.3	-	sic
43-60	C	<0.1	0.1b	0.1d	0.3d	0.7d	53.9	44.9	12.6	42.2	-	sic

pH 1:1	pH 1:5	8C1a pH 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.1	7.1	7.75	0.554	14.0	<0.20	1.0	<1				29.4
7.4	7.8	8.2	3.05	0.294	10.4	<0.20	0.8	3				25.6
7.8	8.2	8.5	2.07	0.213	9.7	<0.20	0.7	8				23.0
8.0	8.5	8.7	1.22	0.119	10.2	<0.20	0.6	16				21.0
8.2	8.6	9.0	0.81	0.076	11	<0.20	0.5	18				19.6
8.3	8.7	9.0	0.57			<0.20	0.6	18				19.3
8.4	8.9	9.2	0.47			<0.20	0.7	18				18.7

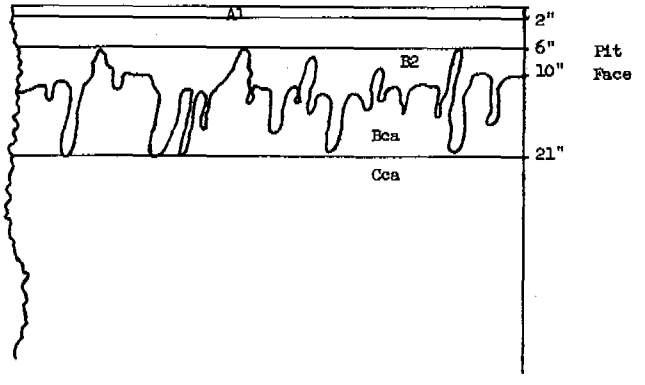
5A1a CATION EXCHANGE CAPACITY NH_4Ac	6N2b Ca	EXTRACTABLE CATIONS 6O2b Mg	6H1a H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
42.9	34.7	9.2	4.8	<0.1	3.1	<1	0.3	1.3				112.9
40.1		9.4	5.3	<0.1	2.4	<1	0.2	0.7				85.9
36.0				0.1	1.6	<1	0.3	0.3				78.4
31.6				0.2	0.8	1	0.4	0.1				78.4
28.4				0.4	0.5	1	0.8	0.1				81.5
26.0				0.8	0.4	3	1.5	0.1				83.6
23.8				1.5	0.4	5	3.3	0.1				83.9

a. Few smooth light brown to black concr. (Fe-Mn?)
b. Few smooth light brown to black concr. (Fe-Mn?);also few $CaCO_3$ concr.
c. Common irregular black and few light brown concr. (Mn-Fe?);also few $CaCO_3$ concr.
d. Many irregular black and few light brown concr. (Mn-Fe?);also few $CaCO_3$ concr.

Soil type: *Tagus silty clay loam
Soil No.: S58NDak-31-1-(1-7)
Location: 0.3 mile south and 360 feet east of north quarter corner of Sec. 16, T157N, R88W, Mountrail County, North Dakota.
Vegetation: Native grassland pasture with western wheatgrass, green needlegrass and blue grama predominant.
Parent material: Fine-textured shaly glacial till.
Physiography: Upland till plain in the Altamont moraine.
Topography: Broad, slightly convex, slope with up to 20 feet of local relief. Gilgai microrelief of 3 to 5 inches occurs in hexagonal patterns three to six feet across.
Elevation: About 2300 feet above sea level.
Climate: About 15 inches annual precipitation; 38 degrees F. mean annual temperature.
Slope: 1 percent facing north.
Drainage: Moderately well with medium surface runoff.
Permeability: Moderate in A and B; slow in substrata.
Moisture: Dry with surface cracks beginning to develop.
Root distribution: Matted in surface 2 inches, numerous through the B horizon and some to 60 inches.
Salt or alkali: None observed in the solum.
Stoniness: None.
Described by: Robert L. Howey.
Date: July 30, 1958.

Horizon and Lincoln Lab. Number	
A11 8642	0 to 2 inches. Dark gray (10YR 4/1 dry) to black (10YR 2/1 moist) noncalcareous silty clay loam; slightly hard, friable, sticky and plastic; compound structure of weak fine subangular blocks to strong fine and very fine granules.
A12 8643	2 to 6 inches. Dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist) weakly calcareous (within peds) silty clay; hard, friable, sticky and plastic; compound structure of weak prisms and subangular blocks to strong fine and very fine granules. Clear but irregular boundary.
B2 8644	6 to 10 inches. Dark gray and grayish brown (2.5Y 4/1 and 5/2 dry) to very dark gray and very dark grayish brown (2.5Y 3/1 and 3/2 moist) moderately calcareous silty clay; hard, friable, sticky and plastic; weak coarse prisms breaking to weak blocks which granulate readily. (Sampled with this horizon were its thick tongues and pendants extending to depths as great as 21 inches; excluded from this sample were the pinnacles of the B3ca horizon protruding into and through this horizon.) Irregular boundary.
B3ca 8645	10 to 21 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) strongly calcareous silty clay without segregated lime; hard, friable, sticky and plastic; weak coarse prisms and blocks which granulate readily. (Sampled with this horizon were its pyramid and pinnacle-like protrusions into and through the above horizon to depths as shallow as 6 inches below the surface; excluded from this sample were the tongues and pendants of the B2 horizon that extend into and to the base of this horizon.) Gradual boundary.
Cca 8646	21 to 33 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) strongly calcareous silty clay with only a slight amount of segregated lime in nodules; hard, friable, sticky and plastic; moderate fine and very fine granular structure. Gradual boundary.
C1 8647	33 to 43 inches. Light olive gray (5Y 6/2 dry) to olive gray (5Y 4/2 moist) moderately calcareous clay without segregated lime; hard, firm, sticky and plastic; contains some strong fine shaly angular blocks.
C 8648	43 to 60 inches. Gray (5Y 6/1 dry) to dark gray (5Y 4/1 moist) moderately calcareous silty clay with thin lamina of dark grayish brown (2.5Y 4/2 moist) silty clay loam between strong plates and angular blocks of only slightly modified shaly till.

Note: This profile is even more disrupted by tonguing of the A and B and apparent bulging or pyramiding of the calcareous substrata than S58NDak-7-1. Illustration is shown below.



SOIL SURVEY LABORATORY Mandan, North Dakota[1/] 9-8-55

SOIL TYPE *Temvik silt loam **LOCATION** Emmons County, North Dakota

SOIL NOS. S54NDak-15-1-(1-7) **LAB. NOS.** 2100-2106

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	A1p	0.2	0.7	1.6	7.4	13.1	54.2	22.8	51.1	20.8	-	sil
7-11½	B21	0.3	0.6	1.3	6.3	12.9	54.9	23.7	53.5	18.2	-	sil
11½-20	B22	0.2	0.5	0.9	3.8	13.2	57.6	23.8	53.1	20.0	-	sil
20-24	B3	0.3	0.6	0.9	3.7	16.3	56.5	21.7	56.5	18.6	-	sil
24-36	Dca	1.6	2.2	4.0	16.1	11.0	29.5	35.6	31.2	19.3	1.9	cl
36-44	Dca2	1.4	2.4	5.0	18.9	11.5	28.0	32.8	32.9	17.9	2.3	cl
44-60	D	2.1	2.5	4.0	16.0	11.8	31.5	32.1	33.5	19.9	3.6	cl

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.1	6.6	6.9	2.73	.234	11.7	-	0.6	-				10.9
6.1	7.0	7.1	1.73	.163	10.6	-	0.6	-				10.0
6.6	7.2	7.2	1.10	.104	10.6	-	0.6	-				9.8
6.9	7.5	7.6	0.84	.086	9.8	-	0.7	-				9.4
7.7	8.8	9.1	0.35			-	1.3	14				14.0
7.8	8.9	9.1	0.27			-	1.3	8				13.8
7.8	9.0	9.3	0.21			-	1.2	5				15.0

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
24.4	15.3	5.2		0.1	1.5	-	0.4	0.8				52.5
19.6	13.7	5.1		0.1	1.0	-	0.4	0.4				50.6
20.1	12.6	6.9		0.1	0.3	-	0.6	0.1				49.7
19.1	11.3	7.5		0.1	0.2	-	0.6	0.1				49.7
22.0				0.4	0.2	1	1.8	0.2				57.7
21.5				0.9	0.2	3	3.5	0.2				55.3
23.6				1.4	0.4	5	4.5	0.2				58.4

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: *Temvik silt loam
Soil No.: S54NDak-15-1
Area: Emmons County, North Dakota.
Location: 280 feet east, 35 feet south of W1/4 corner Sec. 20, T135N, R76W.
Vegetation or crop: Grain stubble.
Parent material: Bignell (?) loess over Iowan (?) loam till.
Physiographic position: Crest of hill above 1/4 mile-long slope.
Topography: Undulating with nearly level 1 percent broad tops and long 4 to 7 percent plane sloping sides.
Slope: 1 percent north.
Drainage: Well drained.
Moisture: Moist to 24 inches.
Stoniness: Free.
Described by: C. A. Mogen.
Date: June 1, 1954.

Mandan Lab.No.	Horizon	
2100	A1p	0 to 7 inches. Dark gray (10YR 4/1.5 dry) to very dark brown (10YR 2/2 moist) silt loam; soft, very friable; moderate fine granules. Clear boundary.
2101	B21	7 to 11½ inches. Brown (10YR 4/3 dry) to dark brown (10YR 3/3 moist) silt loam; hard, very friable; weak medium prisms. Gradual boundary.
2102	B22	11½ to 20 inches. Brown (10YR 5/3 dry) to dark brown (10YR 3/3 moist) crushing to dark yellowish brown (10YR 3.5/4 moist) silt loam; hard, very friable; moderate medium prisms; noticeable clay skins on prisms--continuous and thin. Clear boundary.
2103	B3	20 to 24 inches. Brown (10YR 5.5/3 dry) to brown (10YR 4/3 moist) with coating of a darker brown (10YR 3.5/3 moist) silt loam; slightly hard, very friable; weak medium prisms; common small thin clay skins on faces of prisms. Clear boundary.
2104	Dca	24 to 36 inches. Light gray (5Y 6/1 dry) moderately calcareous clay loam; a large amount of segregated lime in soft, small concretions; very hard, friable; weak coarse prisms and moderate medium blocks; the dry soil has many large and fine prominent mottlings of white (5Y 9/1 dry) and a few fine prominent mottlings of yellowish brown (10YR 5/8 dry); the moist soil is olive (5Y 4/3 moist) mottled with white (5Y 9/1 moist). Clear boundary.
2105	Dca2	36 to 44 inches. Light olive gray (5Y 6/2 dry) to olive (5Y 4/3 moist) moderately calcareous clay loam with a moderate amount of segregated lime; very hard, friable; weak, medium blocks. Gradual boundary.
2106	D	44 to 60 inches. Light brownish gray (2.5Y 6/2 dry) to olive brown (2.5Y 4/3 moist) moderately calcareous clay loam with a slight amount of segregated lime; very hard, friable to firm; weak medium blocks; a few fine prominent red, yellow and white mottlings.

SOIL SURVEY LABORATORY Mandan, North Dakota 1/ 9-8-55

SOIL TYPE *Temvik silt loam **LOCATION** Emmons County, North Dakota

SOIL NOS. S54NDak-15-2-(1-6) **LAB. NOS.** 2107-2112

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	A1p	0.3	0.8	1.7	7.3	10.4	57.5	22.0	51.2	21.1	-	sil
7-17	B21	0.2	0.5	1.0	5.4	12.5	56.5	23.9	51.0	21.3	-	sil
17-23	B22	0.1	0.2	0.7	3.7	14.6	58.3	22.4	55.8	19.6	-	sil
23-35	Dca1	0.6	1.8	5.5	29.7	18.6	21.7	22.1	48.3	10.9	0.8	scl
35-50	Dca2	1.2	2.2	4.8	18.7	13.2	30.3	29.6	36.1	18.9	1.7	cl
50-60	D	1.0	2.3	4.9	18.6	13.1	31.2	28.9	36.7	19.3	3.0	cl

8C1b SATURATED PASTE	pH 8C1a 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	ORGANIC MATTER C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	MOISTURE TENSIONS 1/3 ATMOS. %	4B2 15 ATMOS. %
7.0	7.6	7.7	2.61	.214	12.2	-	0.7	-				11.0
6.6	7.4	7.4	1.11	.109	10.2	-	0.6	-				10.2
6.6	7.6	7.6	0.75	.078	9.6	-	0.5	-				9.6
7.7	8.8	9.0	0.39			-	0.7	2				9.0
7.9	9.2	9.3	0.25			-	0.8	4				13.4
7.8	9.2	9.3	0.21			-	0.8	3				13.9

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
24.0	17.5	5.6		0.1	1.4	-	0.4	0.7				53.7
20.8	13.1	6.7		0.1	0.4	-	0.4	0.1				48.6
19.3	10.8	7.8		0.1	0.2	-	0.6	0.1				51.0
17.7				0.2	0.2	1	0.9	0.1				47.4
22.0				1.0	0.3	4	3.2	0.1				54.1
22.5				1.5	0.6	6	4.3	0.2				54.4

1/ Mechanical analyses by Beltsville Laboratory.

Soil type: *Temvik silt loam
Soil No.: S54NDak-15-2
Area: Emmons County, North Dakota.
Location: 445 feet west, 140 feet south of N1/4 corner Sec. 28, T135N, R76W.
Vegetation or crop: Spring wheat.
Parent material: Loess over till.
Physiographic position: Upland plain on Missouri Plateau.
Topography: Gently undulating and nearly level.
Slope: 1 percent north.
Erosion: Slight. Stoniness: Free.
Drainage: Well drained.
Moisture: Moist to 26 inches.
Described by: C. A. Mogen.
Date: June 1, 1954.

Mandan Lab.No.	Horizon	
2107	A1p	0 to 7 inches. Dark grayish brown (10YR 3.5/2 dry) to very dark brown (10YR 2/2 moist) heavy silt loam; soft, very friable; moderate fine granules. Clear boundary.
2108	B21	7 to 17 inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 3/2 moist) crushing to dark brown (10YR 3/3 moist) silt loam; hard, very friable; very weak medium prisms on which there is very weak clay skins. Clear boundary.
2109	B22	17 to 23 inches. Brown (10YR 5.5/3 dry) to brown (10YR 4/3 moist) with coatings of very dark grayish brown (10YR 3/2 moist) silt loam; slightly hard, very friable; weak medium prisms and blocks with very weak clay skins on faces of peds. Clear boundary.
2110	Dca1	23 to 35 inches. Light olive brown (2.5Y 5/3 dry) to olive brown (2.5Y 4/3 moist) moderately calcareous sandy clay loam with a slight amount of segregated lime; slightly hard, friable; weak medium prisms on which there are coatings of dark brown (10YR 3/3 moist). Clear boundary.
2111	Dca2	35 to 50 inches. Light olive gray (5Y 6/2 dry) mottled with white (5Y 9/1 dry) to olive gray (5Y 4/2 moist) moderately calcareous light-textured clay loam with a moderate amount of segregated lime in soft, rounded concretions; very hard, firm; moderately developed coarse prisms and weak medium blocks; peds have a coating of dark brown (10YR 3/3 moist) on very coarse prisms. Gradual boundary.
2112	D	50 to 60 inches. Light yellowish brown (3.5Y 6/3 dry) to olive brown (3.5Y 4/3 moist) moderately calcareous light-textured clay loam with a slight amount of segregated lime; very hard, friable; weak medium blocks.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Tetonka silt loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-3-(1-9) **LAB. NOS.** 4456-4464

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-3	A11	-	0.7	1.6	8.3	9.2	46.4	33.8	31.5	29.2	-	sicl
3-10	A12	0.3	1.0	1.4	4.0	5.5	55.6	32.2	25.7	38.0	-	sicl
10-13	A2	3.8	4.3	4.3	9.0	8.6	45.4	24.6	33.2	26.2	2.9	l
13-16	B1	2.5	3.5	3.7	7.9	7.8	39.6	35.0	29.7	22.6	1.8	cl
16-25	B2	2.8	4.5	5.0	9.6	7.9	29.2	41.0	26.2	16.6	2.9	c
25-31	Bg	8.5	10.7	8.8	13.5	8.3	20.4	29.8	24.3	11.8	6.0	scl
31-36	Bgca	5.9	8.4	7.7	14.3	9.8	29.0	24.9	30.0	17.1	10.5	l
36-48	Cgca	10.8	10.3	7.2	11.5	8.5	31.0	20.7	26.8	19.6	15.2	l
48-60	Cg	8.4	9.5	7.5	13.1	9.6	31.5	20.4	29.6	19.0	11.0	l

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.4	6.7	6.9	6.87	.565	12.2	<0.20	1.2	-				21.9
5.7	6.1	6.3	6.29	.501	10.8	<0.20	0.6	-				20.8
5.6	6.2	6.3	1.26	.141	8.9	<0.20	0.5	-				9.8
5.4	6.0	6.3	0.87	.104	8.4	<0.20	0.5	-				13.0
5.5	6.9	6.8	0.53	.064	8.3	<0.20	0.4	4				14.8
6.2	6.9	6.9	0.41			<0.20	0.5	2				11.0
7.6	8.4	8.7	0.33			<0.20	0.7	16				8.8
7.6	8.6	8.9	0.24			<0.20	0.7	26				6.5
7.7	8.6	8.9	0.18			<0.20	0.7	23				6.6

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6F2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6O1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
← milliequivalents per 100g. soil →							← milliequivalents per liter →					
37.3	25.6	7.9		-	3.1	-	0.5	2.3	7.1	4.1		88.8
35.0	19.6	6.3		-	2.1	-	0.3	1.0	3.3	2.1		87.2
15.9	8.2	3.7		-	1.1	-	0.3	0.6	1.8	1.5		43.6
22.2	12.1	5.9		-	1.2	-	0.3	0.5	2.2	1.3		47.5
25.9		7.9		-	1.1	-	0.3	0.4	1.9	1.2		59.8
18.8		5.7		-	0.6	-	0.4	0.3	2.2	1.7		47.2
13.2				-	0.4	-	0.6	0.4	4.4	2.1		41.7
9.3				-	0.3	-	0.5	0.4	4.1	2.2		36.1
9.3				-	0.3	-	0.4	0.4	4.2	2.0		30.6

Soil type: Tetonka silt loam
Soil No.: 856NDak-41-3-(1-9)
Location: 1465 feet east and 125 feet south of northwest corner of Sec. 18, T130N, R55W, Sargent County, North Dakota.
Vegetation: Coarse grasses.
Parent material: Local alluvium and glacial lacustrine over glacial till.
Physiographic position: Small closed depression in upland.
Topography: Slightly concave slope.
Drainage: Imperfect.
Root distribution: Abundant to 10 inches, plentiful to 30 inches, and few through 60 inches.
Described by: Wesley M. Larsen
Date: July 11, 1956.

Horizon and Lincoln Lab. Number	
A11 4456	0 to 3 inches. Very dark gray to black (10YR 3/1 dry to 2/1 moist) silt loam containing a very large amount of freshly decomposed organic matter and matted live roots; weak fine crumb structure; slightly hard, friable, slightly sticky and slightly plastic; many clear quartz fine sand grains throughout; noncalcareous.
A12 4457	3 to 10 inches. Dark gray to black (10YR 4/0.5 dry to 2/1 moist) silt loam; strong fine to medium plates having distinct gray upper side when dry from coating of bleached clear quartz silt and very fine sand; slightly hard, very friable, slightly sticky and slightly plastic; noncalcareous; clear wavy boundary.
A2 4458	10 to 13 inches. Gray with many fine distinct light gray and brownish yellow mottlings (10YR 5/0.5, 6/0.5 and 6/8 dry) to very dark gray mottled with very dark grayish brown (10YR 3/0.5 and 3/2 moist) silty clay loam; moderate medium plates coated with clear very fine quartz; very hard, friable, sticky and plastic; noncalcareous; clear wavy boundary.
B1 4459	13 to 16 inches. Very dark gray with common mottles of dark brown and coats of gray (10YR 3.5/1 dry to 3/1, 4/3 and 5/1 moist) clay; moderate very fine blocky structure when moist; weak when dry; very hard, firm, very sticky and very plastic; noncalcareous; clear wavy boundary.
B2 4460	16 to 25 inches. Very dark gray to black (10YR 3/1 dry to 2/1 moist) clay; weak coarse prisms breaking to strong medium blocks when moist; extremely hard, very firm, very sticky and very plastic; noncalcareous; clear smooth boundary.
Bg 4461	25 to 31 inches. Dark gray to dark olive gray with common mottles of olive (5Y 4/1 dry to 3/2 and 5/3 moist) clay; weak coarse prisms to moderate fine angular blocks; extremely hard, very firm, very sticky and very plastic; noncalcareous; clear wavy boundary.
Bgca 4462	31 to 36 inches. Gray with common fine distinct light olive brown mottles (5Y 6/1 and 5/1 and 2.5Y 5/4 dry) to olive gray and dark yellowish brown (5Y 4/2 and 10YR 4/4 moist); strongly calcareous clay having little or no segregated lime; weak coarse prisms breaking to moderate fine angular blocks; extremely hard, very firm, very sticky and very plastic; common fine and medium-sized gravel not present in above horizons occur throughout this and lower horizons; clear smooth boundary.
Cgca 4463	36 to 48 inches. Light gray to dark gray with many fine distinct white and medium to large prominent brown mottles (5Y 6/1 dry to 4/1 moist with 8/1 and 7.5YR 4/4 mottles) clay loam; weak medium angular blocks; very hard, firm, sticky and plastic; very strongly calcareous with many small soft segregations of lime and soft thin crusts on gravel; clear smooth boundary.
Cg 4464	48 to 60 inches. Light gray and light olive brown to gray and olive brown with common fine white and many coarse mottles of dark yellowish brown (5Y 6/1 and 2.5Y 5/4 dry to 5Y 5/1 and 2.5Y 4/4 moist mottled with 10YR 8/1 and 4/4 dry or moist) loam; hard, firm, slightly sticky and slightly plastic; strongly calcareous with a slight amount of softly segregated lime.

SOIL SURVEY LABORATORY Lincoln, Nebr. 12/17/57

SOIL TYPE Tetonka silt loam **LOCATION** Sargent County, North Dakota

SOIL NOS. S56ND-41-10-(1-8) **LAB. NOS.** 4509-4516

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-6	A1p	0.7	2.3	2.9	7.0	7.1	50.2	29.8	30.0	31.7	-	cl a/
6-11	A2	1.4	2.5	2.8	6.2	7.3	56.2	23.6	33.1	34.2	-	sil a/
11-19	B21	3.5	3.4	4.7	11.4	6.8	29.6	40.6	26.2	16.8	3.3	c a/
19-27	B22	3.2	5.1	5.4	9.7	5.9	33.5	37.2	23.5	21.2	4.3	cl a/
27-34	B3ca	5.5	3.2	3.2	9.7	13.5	34.6	30.3	35.2	19.4	7.1	cl
34-45	Cca1	5.2	6.3	5.4	9.8	8.7	36.8	27.8	27.7	23.4	9.7	cl
45-53	Cca2	6.3	6.2	5.4	9.7	8.4	35.6	28.4	26.4	23.2	12.1	cl
53-60	Cg	6.7	6.3	5.7	10.4	8.8	35.9	26.2	27.2	23.3	8.0	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.8	7.0	3.25	.281	11.6	<0.20	0.6	-				14.0
6.0	6.4	6.5	0.95	.108	8.8	<0.20	0.4	-				9.8
5.7	6.2	6.4	0.76	.076	10.0	<0.20	0.4	-				15.1
6.2	6.5	6.9	0.74	.072	10.3	<0.20	0.6	-				14.8
7.7	8.3	8.6	0.33			<0.20	0.7	6				10.9
7.8	8.6	8.6	0.25			<0.20	0.7	11				9.4
8.0	8.6	8.8	0.20			<0.20	0.6	25				9.3
8.1	8.6	8.7	0.18			<0.20	0.7	26				8.8

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6Q2b Mg	H	5B1a 6P2a Na	6Q2a K	5D2 EXCH. Na %	8A1 SATURATION EXTRACT SOL. 6P1a Na	6Q1a K	6N1a Ca	6Q1a Mg	Vol. Wt. g/cc	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
28.7	20.8	7.4		0.1	0.7	-	0.4	0.2	3.4	2.2		54.0
18.0	10.7	5.1		0.1	0.4	1	0.5	0.1	2.1	1.6		40.7
29.1	15.8	11.0		0.1	0.5	-	0.6	0.1	1.8	1.5		51.7
28.2	16.8	10.9		0.2	0.5	1	0.8	0.1	2.4	2.5		49.4
19.0				0.1	0.3	1	0.8	0.1	3.3	2.8		49.4
15.2				0.1	0.2	1	0.9	0.1	3.0	2.8		45.6
14.5				0.1	0.3	1	0.8	0.1	2.5	2.7		45.0
13.3				0.1	0.2	1	1.0	0.1	2.5	3.3		42.0

a/ Shot-like conc. in sand fraction (Mn?)

Soil type: Tetonka silt loam
Soil No.: S56NDak-41-10-(1-8)
Location: 900 feet north and 100 feet west of southeast corner of Sec. 15, T131N, R56W, Sargent County, North Dakota.
Vegetation: Corn.
Parent material: Glacial till.
Physiographic position: Large flat depression in upland.
Slope: Nearly level.
Drainage: Imperfect.
Moisture: Moist to 60 inches.
Described by: Wesley M. Larsen.
Date: August 7, 1956.

Horizon and Lincoln Lab. Number	
Alp 4509	0 to 6 inches. Black (10YR 2/1 moist) silt loam; fine crumb structure; friable, slightly sticky and slightly plastic; wavy boundary.
A2 4510	6 to 11 inches. Very dark gray (10YR 3/1 moist) silt loam; moderate medium platy structure; very friable; slightly sticky and slightly plastic; wavy boundary.
B21 4511	11 to 19 inches. Very dark gray (10YR 3/1 moist) clay; moderate medium prisms breaking to moderate medium angular blocks; very firm, very sticky and very plastic; noncalcareous; wavy boundary.
B22 4512	19 to 27 inches. Same as horizon above.
B3ca 4513	27 to 34 inches. Very dark gray (10YR 3/1 moist) clay loam; continuous distinct clay on all vertical faces and patches on horizontal faces; in all other respects this horizon is the same as the one above it.
Cca1 4514	34 to 45 inches. Light olive brown and olive brown (2.5Y 5/4 and 4/4 moist) with many light gray lime concretions, 2.5Y 7/2 moist, clay loam; moderate medium angular blocky structure; friable, sticky and plastic; smooth boundary.
Cca2 4515	45 to 53 inches. Same as horizon above.
Cg 4516	53 to 60 inches. Olive gray (5Y 5/2 moist) highly mottled with light gray lime spots (5Y 7/2 moist), dark red (2.5YR 3/6 moist), and reddish brown (5YR 4/4 moist) clay loam; weak angular blocky structure; friable; sticky and plastic.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Towner loamy sand **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-3 **LAB. NOS.** 864-869

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-7	Ap	2.0	8.6	16.0	44.7	11.2	9.8	7.7	41.4	4.8	2	ls
7-15	A1	1.3	7.7	14.6	43.6	12.5	9.6	10.8	42.2	4.6	1	fsl
15-28	Cca1,2	1.0	4.5	10.5	45.1	15.4	9.7	13.8	48.2	4.8	3	fsl
28-48	Dca	7.1	7.0	6.7	14.4	9.0	30.4	25.4	29.5	18.2	8	l
48-60	D	6.3	6.9	6.3	11.3	9.2	35.0	25.0	30.3	20.4	7	l

8C1b pH SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC MATTER ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC x10³ MILLIMHOS PER CM 8A1a	6E1a CaCO₃ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
7.3	8.1	8.3	1.32	0.111	11.9	-	0.6	-	-			5.8
7.9	8.6	8.9	0.62	0.065	9.5	-	0.5	5	-			6.3
8.0	8.8	9.0	0.33	0.042	7.8	-	0.6	14	-			5.4
8.3	9.0	9.2	0.23	0.028		-	0.8	24	-			8.9
8.1	9.1	9.3	0.13	0.022		-	0.6	18	-			10.8

5A1a CATION EXCHANGE CAPACITY NH₄Ac	5B1a CATIONS EXTRACTABLE 6N2b Ca	602b Mg	EXCHANGEABLE 6P2a Na	5B1b 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil			→		← milliequivalents per liter →					
10.7	9.6	1.5	-	0.5	-	1.5	0.6				32.3
6.9			-	0.3	-	0.9	0.2				29.5
4.8			0.1	0.2	2	1.3	0.2				28.2
9.6			0.3	0.5	3	3.3	0.2				41.2
12.8			0.4	0.5	3	3.5	0.2				46.2

Note: Laboratory No. 866 was skipped. Horizons Cca1 and Cca2 were combined for laboratory analysis.

Soil type: *Towner loamy sand
Soil No.: S51NDak-5-3
Location: 100 feet north of North Dakota Highway 5, southwest quarter of southeast quarter of Sec. 25, T162N, R81W, Bottineau County, North Dakota.
Vegetation: Quackgrass.
Parent material: Coarse-textured glacial lacustrine materials, probably reworked by wind.
Physiographic position: Upland delta.
Topography: Nearly level; simple slope.
Slope: 1 percent or less.
Drainage: Moderate.
Moisture: Moist.
Stoniness: None.
Root distribution: Numerous roots to 12 inches.
Described by: C. A. Mogen.
Date: September 9, 1951.

Horizon and Mandan Lab. Number	
Ap 864	0 to 7 inches. Very dark gray or black (10YR 3/1 dry, 2/1 moist) loose noncalcareous loamy sand having a single-grain structure. This changes abruptly but irregularly to
A1 865	7 to 15 inches. Dark grayish brown or very dark grayish brown (10YR 4/2 dry, 3/2 moist) soft, noncalcareous sandy loam having a crumb to single-grain structure; underlain distinctly by
Cca1 (see 867 note)	15 to 21 inches. Light brownish gray or dark grayish brown (2.5Y 6/2 dry, 4/2 moist) friable, moderately calcareous sandy loam having a crumb to single-grain structure; moderate faint mottlings of olive brown or light olive brown (2.5Y 5/4 dry, 4/4 moist). This changes gradually to
Cca2 (see 867 note)	21 to 28 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) friable, very slightly plastic, gravelly loam to gravelly sandy loam; moderately calcareous. This changes rather abruptly to
Dca 868	28 to 48 inches. Light yellowish brown or light olive brown (2.5Y 6/4 dry, 5/4 moist) firm, plastic, moderately calcareous clay loam; mottled with white or light gray to light brownish gray (2.5Y 8/2 dry, 7/2 to 6/2 moist) and small distinct specks of strong brown (7.5YR 5/6). This grades to
D 869	48 to 60 inches. Firm, plastic, calcareous clay loam similar in color to the layer directly above.

Note: Laboratory number 866 was skipped. Horizons Cca1 and Cca2 were combined for analysis. The B horizon is absent in this profile but is generally present, although rather thin.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE* Towner fine sandy loam **LOCATION** Bottineau County, North Dakota

SOIL NOS. S51NDak-5-10 **LAB. NOS.** 905-910

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-9	A1	0.4	4.8	11.4	42.6	16.9	14.2	9.7	49.5	8.4	-	fsl
9-13	A3	0.2	3.7	10.0	44.2	18.8	13.4	9.7	52.8	7.8	-	fsl
13-23	B	0.5	4.2	11.9	46.6	18.0	10.4	8.4	51.5	6.1	-	lfs
23-31	Ca,g1	0.4	2.7	7.6	46.9	25.2	8.8	8.4	60.6	5.6	-	lfs
31-36	Ca,g2	0.6	1.3	2.8	14.3	7.7	40.6	32.7	22.4	35.4	-	cl
36-60	Dca,D	4.7	6.4	5.9	10.7	8.3	37.8	26.2	29.2	23.1	5	l

8C1b SATURATED PASTE	pH 8C1a 1:5	pH 8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	ORGANIC MATTER 6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 4B1a 1/10 ATMOS. %	4B1a 1/3 ATMOS. %	4B2 15 ATMOS. %
7.3	7.7	7.8	2.14	0.174	12.3	-	0.4	-	-	26.2	14.8	7.4
7.5	8.3	8.4	0.94	0.083	11.3	-	0.4	1	-	20.3	11.9	5.3
7.8	8.6	8.8	0.52	0.052	10.0	-	0.4	-	-	17.8	10.8	4.2
8.2	9.0	9.2	0.28	0.030	9.3	-	0.4	10	-	15.9	9.3	3.2
8.4	9.2	9.3	0.40	0.043	9.3	-	0.6	38	-	33.0	26.3	6.4
8.5	9.4	9.5	0.15	0.022		-	1.0	23	-	30.9	24.2	7.1

5A1a CATION EXCHANGE CAPACITY NH_4Ac	CATIONS EXTRACTABLE 5B1a 6N2b Ca	602b Mg	EXCHANGEABLE 5B1b 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil					milliequivalents per liter					
14.4	11.1	2.8	0.1	0.6	1	1.3	0.6				41.6
9.9		2.3	0.1	0.3	1	1.3	0.2				38.0
8.6		2.0	0.1	0.2	1	0.6	-				31.1
5.0			0.1	0.2	2	0.9	-				25.7
9.6			0.3	0.2	3	3.3	-				46.0
12.6			1.5	0.2	12	8.0	-				51.9

Soil type: *Towner fine sandy loam
Soil No.: S51NDak-5-10
Location: 500 feet southwest of corner, northeast quarter of northeast quarter Sec. 36, T162N, R81W, Bottineau County, North Dakota.
Vegetation: Quackgrass in poor flax crop.
Parent material: Coarse-textured glacial lacustrine material which has been reworked by the wind.
Physiographic position: Upland delta.
Topography: Nearly level.
Slope: 1 to 2 percent.
Drainage: Moderate.
Moisture: Moist throughout.
Stoniness: None.
Root distribution: Many quackgrass rhizomes in the upper 2½ feet.
Described by: C. A. Mogen.
Date: September 12, 1951.

Horizon and Mandan Lab. Number	
A1 905	0 to 9 inches. Dark gray or black (10YR 4/1 dry, 2/1 moist) loose, soft, noncalcareous fine sandy loam. This grades to
A3 906	9 to 13 inches. Dark gray to dark grayish brown or black to very dark brown (10YR 4/1 to 4/2 dry, 2/1 to 2/2 moist) soft, very friable, noncalcareous fine sandy loam having a medium blocky structure which breaks easily to weak fine crumb. This is underlain distinctly by
B 907	13 to 23 inches. Grayish brown to brown or dark grayish brown (10YR 5/2 to 5/3 dry, 4/2 to 4/3 moist) soft, very friable, noncalcareous loamy fine sand having a weak medium prismatic structure breaking to a weak fine crumb. This is underlain distinctly by
Ccag1 908	23 to 31 inches. Light gray to pale yellow or grayish brown to light olive brown (2.5Y 7/2 to 7/4 dry, 5/4 to 5/2 moist) soft, loose, weakly calcareous loamy fine sand having a weak blocky to single grain structure. This is underlain distinctly by
Ccag2 909	31 to 36 inches. Light gray to white or light brownish gray to light yellowish brown (2.5Y 7/2 to 8/2 dry, 6/2 to 6/4 moist) firm, slightly plastic, slightly hard, moderately calcareous clay loam; weakly laminated breaking to weak medium subangular structure; faint mottlings of light gray when moist, 2.5Y 7/2. This is underlain distinctly and sharply by
Dca 910	36 to 39 inches. Light gray or pale yellow when dry and light olive brown mottled with light brownish gray when moist (2.5Y 7/2 to 7/4 dry, 5/4 to 6/2 moist) friable, slightly plastic, slightly hard, moderately calcareous gravelly clay loam changing to
D 910	39 to 60 inches. Pale yellow or light olive brown (2.5Y 7/4 dry, 5/4 moist) firm, moderately plastic, moderately hard, weakly calcareous loam having a subangular blocky structure; faintly mottled with white when dry or light brownish gray when moist (2.5Y 8/2 dry, 6/2 moist) and distinctly mottled with small mottlings of strong brown (7.5YR 5.6).

SOIL SURVEY LABORATORY Mandan, N. Dak. 9-5-55

SOIL TYPE Vebar fine sandy loam **LOCATION** Stark County, North Dakota

SOIL NOS. S54NDak-45-1-(1-8) **LAB. NOS.** 2269-2276

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-1½	A11	0.6	1.6	8.6	39.6	11.2	25.2	13.2	45.2	12.9	-	fsl
1½-5½	A12	0.3	1.9	12.1	49.7	10.7	14.1	11.2	43.4	7.7	-	fsl
5½-8	AB	0.1	1.3	10.2	50.2	12.6	13.4	12.2	46.7	7.0	-	fsl
8-15	B21	0.1	1.1	10.1	48.9	13.4	14.0	12.3	47.0	7.1	-	fsl
15-22	B22	0.1	1.2	11.0	47.2	12.4	15.6	12.5	44.3	7.9	-	fsl
22-31	B23	0.1	1.0	9.4	39.2	13.8	21.5	15.0	45.5	10.8	-	fsl
31-46	C1	-	0.4	3.4	56.7	17.4	11.0	11.1	60.1	6.6	-	fsl
46-60	C2	-	0.4	7.8	61.2	12.0	9.0	9.6	49.4	5.5	-	lfs

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.2	6.5	6.7	3.15	.259	12.2	-	0.6	-				8.2
5.9	6.4	6.6	1.30	.116	11.2	-	0.5	-				5.7
6.1	6.6	6.8	0.82	.075	10.9	-	0.4	-				5.5
6.2	6.8	6.8	0.53	.047	11.3	-	0.4	-				5.6
6.4	7.0	7.1	0.44	.041	10.7	-	0.4	-				5.6
6.6	7.2	7.3	0.42	.045	9.3	-	0.4	-				6.7
6.8	7.3	7.4	0.26			-	0.4	-				7.2
6.9	7.7	7.8	0.14			-	0.4	-				6.3

5A1a CATION EXCHANGE CAPACITY NH_4Ac	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil				→		← milliequivalents per liter →					
16.2	10.4	2.6		-	1.0	-	0.6	1.0				54.6
11.2	7.1	1.6		0.1	0.5	1	0.6	0.4				38.2
10.8	6.9	2.4		0.1	0.3	1	0.4	0.2				33.2
10.7	7.2	2.4		0.1	0.1	1	0.6	0.1				33.7
11.3	7.7	2.6		0.1	0.1	1	0.6	-				35.4
13.3	9.4	3.3		0.1	0.1	1	0.6	-				39.4
14.8	10.3	4.2		0.1	0.1	1	0.6	-				41.6
13.2	9.3	3.7		0.1	0.1	1	1.1	-				41.8

Soil type: Vebar fine sandy loam
Soil No.: S54NDak-45-1
Area: Stark County, North Dakota
Location: 300 feet north and 600 feet east of center Sec. 5, T139N, R96W.
Vegetation or crop: Native grasses; blue grama, sandreed grass, needle-and-thread grass, needleleaf sedge, silverleaf scurfpea, fringed sagewort, silver sage, common weeds, and some bluegrass.
Parent material: Fort Union sands.
Physiographic position: 100 feet below crest of 500-foot long slope; slope becomes 4 percent near crest; 100 feet below the sample site the slope changes to concave in the head of a draw and the soil changes to Timmer fine sandy loam.
Topography: Undulating and gently rolling.
Slope: 2½ percent southeast.
Drainage: Well.
Permeability: Moderately rapid.
Moisture: Dry to 60 inches; moist 60 inches plus.
Salt or alkali: Free.
Stoniness: Free.
Root distribution: Abundant and extends to 60 inches; roots massed between prisms but also distributed through prisms.
Described by: C. A. Mogen.
Date: July 19, 1954.

Mandan Lab.No.	Horizon	
2269	A11	0 to 1½ inches. Dark grayish brown (10YR 4/2 dry) to very dark grayish brown (10YR 2.5/2 moist) fine sandy loam; soft, very friable, non-sticky and non-plastic; weak fine platy structure. Clear boundary.
2270	A12	1½ to 5½ inches. Dark grayish brown (9YR 4/2 dry) to very dark grayish brown (10YR 3/2.7 moist) fine sandy loam; slightly hard, very friable, non-sticky and non-plastic; moderately developed coarse prisms. Gradual boundary.
2271	AB	5½ to 8 inches. Brown (8.5YR 4.5/3 dry) to dark brown (8.5YR 3/3 moist) fine sandy loam; slightly hard, very friable; moderate coarse prisms. Gradual boundary.
2272	B21	8 to 15 inches. Brown (9YR 5/3 dry) to dark grayish brown (9YR 4/2 moist) fine sandy loam; slightly hard, very friable; compound structure of moderate coarse prisms breaking to weak coarse and medium blocks. Gradual boundary.
2273	B22	15 to 22 inches. Brown (9YR 5/3 dry) to dark brown (9YR 4/3 moist) fine sandy loam; slightly hard, very friable; structure as in the horizon above. Gradual boundary.
2274	B23	22 to 31 inches. Yellowish brown (9YR 5/4 dry) to dark brown (9YR 4/3 moist) fine sandy loam; slightly hard, very friable; compound structure of moderate coarse prisms breaking to weak coarse and medium-sized blocks. There is a band containing a few pebbles at the base of this horizon and a few pebbles in two bands above. Clear boundary.
2275	C1	31 to 46 inches. Light yellowish brown (2.5Y 6/4 dry) to light olive brown (2.5Y 5/4 moist) fine sandy loam; soft, very friable; massive. Gradual boundary.
2276	C2	46 to 60 inches. Light yellowish brown (2.5Y 6/4 dry) with a few fine faint mottlings of olive yellow (2.5Y 6/8 dry) and grayish brown (2.5Y 5/2 dry) to light olive brown (2.5Y 5/4 moist) loamy fine sand; loose when moist; single grain structure.

Remarks: Profile is noncalcareous through 60 inches.

SOIL SURVEY LABORATORY Mandan, North Dakota 9-9-55

SOIL TYPE Vebar fine sandy loam **LOCATION** Stark County, North Dakota

SOIL NOS S54NDak-45-2-(1-8) **LAB. NOS.** 2277-2284

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-2	A11	0.5	2.4	12.3	37.9	9.3	22.6	15.0	36.9	12.6	-	fsl
2-5	A12	1.3	2.1	13.0	40.7	9.3	19.2	14.4	36.8	10.7	1.1	fsl
5-14	B21	1.4	2.5	14.4	42.1	8.5	18.4	12.7	34.8	11.4	0.8	fsl
14-19	B22	1.3	3.1	14.3	42.0	8.1	15.8	15.4	33.8	9.6	1.1	fsl
19-26	B3	0.2	1.3	9.2	51.2	10.4	13.7	14.0	42.1	8.6	-	fsl
26-32	C1	0.1	0.9	9.6	54.6	11.3	12.5	11.0	43.7	7.8	-	fsl
32-43	Cca	0.1	1.0	11.1	51.3	8.8	14.4	13.3	39.3	9.4	-	fsl
43-60	C2	-	0.9	13.1	60.8	7.2	9.7	8.3	39.7	5.8	-	lfs

8C1b SATURATED PASTE	pH 8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.1	6.5	6.7	3.16	.278	11.4	-	0.6	-				8.9
6.0	6.6	6.7	1.51	.123	12.3	-	0.5	-				6.9
6.2	6.5	6.9	0.97	.081	12.0	-	0.4	-				7.2
6.5	6.9	7.0	0.70	.064	10.9	-	0.4	-				7.8
6.7	7.3	7.5	0.60	.052	11.5	-	0.4	-				7.9
7.6	8.7	8.8	0.44			-	0.6	2				7.1
7.8	8.8	9.0	0.42			-	0.6	6				7.4
7.9	8.8	9.0	0.13			-	0.6	1				5.8

5A1a CATION EXCHANGE CAPACITY (NH4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLES 6P1a Na	6Q1a K			8A1	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
18.8	12.4	2.8		-	1.0	-	0.4	0.9				55.1
13.8	9.1	2.0		-	0.6	-	0.3	0.4				40.2
14.1	10.4	2.5		0.1	0.3	1	0.3	0.1				37.5
15.7	11.9	2.2		0.1	0.1	1	0.3	-				37.2
16.2	13.4	2.5		0.1	0.1	1	0.4	-				39.6
13.4				0.1	0.1	1	0.4	-				37.6
12.8				0.1	0.1	1	0.6	-				39.1
10.6				0.1	0.1	1	0.7	-				40.2

Soil type: Vebar fine sandy loam
Soil No.: S54NDak-45-2
Area: Stark County, North Dakota.
Location: 360 feet south and 72 feet east of N1/4 corner Sec. 16, T138N, R95W.
Parent material: Sandy Fort Union.
Vegetation or crop: Native grasses; blue grama, needle-and-thread, buffalograss, with many silverleaf scurfpea, few needleleaf sedge.
Physiographic position: 100 feet below crest of 300-foot long slope on upland.
Topography: Strongly undulating.
Slope: 4½ percent to southwest.
Drainage: Well.
Permeability: Moderately rapid.
Moisture: Dry to 42 inches; moist to 9 feet.
Salt or alkali: Free.
Stoniness: Free.
Root distribution: Very deep.

Described by: C. A. Mogen.
Date: July 19, 1954.

Mandan Lab.No.	Horizon	
2277	A11	0 to 2 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) fine sandy loam; soft, very friable; compound structure of weak fine plates separating to fine granules. Clear boundary.
2278	A12	2 to 5 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2.5/2 moist) fine sandy loam; slightly hard, very friable; compound structure of moderate coarse prisms separating to weak medium prisms and subangular blocks. Gradual boundary.
2279	B21	5 to 14 inches. Dark grayish brown (9YR 4/2 dry) to dark brown (9YR 3/3 moist) fine sandy loam; slightly hard, very friable; structure as in the horizon above. Gradual boundary.
2280	B22	14 to 19 inches. Brown (9YR 4/3 dry) to dark brown (9YR 3/3 moist) fine sandy loam; slightly hard, very friable; structure as in the two horizons above. Gradual boundary.
2281	B3	19 to 26 inches. Pale brown (1Y 6/3 dry) to brown (1Y 4/3 moist) fine sandy loam; slightly hard, very friable; weak coarse prisms. Clear boundary.
2282	C1	26 to 32 inches. Light yellowish brown (2.5Y 6/4 dry) to dark brown (1Y 4/3 moist) light fine sandy loam; slightly hard, very friable; massive structure. Moderately calcareous with a slight amount of segregated lime. Clear boundary.
2283	Cca	32 to 43 inches. Light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous fine sandy loam with a moderate amount of segregated lime in threads and films; slightly hard, very friable; massive. Clear boundary.
2284	C2	43 to 60 inches. Olive yellow (2.5Y 6/6 dry) to light olive brown (2.5Y 5/6 moist) with sandstone fragments of yellowish brown (10YR 5/8 moist) loamy fine sand; moderately calcareous; loose, single grain.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Westhope loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-9 **LAB. NOS.** 494-500

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	3A1 0.2-0.02	0.02-0.002	2A2 > 2 (<19mm)	TEXTURAL CLASS
0-7	Ap	1.4	5.1	5.6	20.3	12.7	35.9	19.1	43.2	19.8	1	1
7-13	B21	2.2	4.1	4.6	24.7	14.4	32.0	17.9	51.0	14.1	1	1
13-20	B22	2.3	3.3	3.7	25.0	14.6	34.7	16.5	52.8	14.9	1	1
20-28	C1ca	4.6	4.6	4.3	10.7	10.0	42.3	23.7	33.4	25.8	4	1
28-54	C2	4.6	6.4	6.6	12.8	10.3	34.4	24.8	32.3	19.9	5	1
54-62	C31cs											
62-72	C32cs	4.8	6.1	7.7	12.3	10.4	35.3	23.4	32.8	20.6	7	1

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST'D SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 6A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.2	7.4	2.99	.269	11.1	-	0.6	1	-			10.3
6.7	7.1	7.3	0.90	.091	9.9	-	0.4	-	-			7.9
7.2	7.5	7.7	0.71	.084	8.4	-	0.4	-	-			6.8
8.0	8.7	9.1	0.59	.068	8.7	-	0.6	27	-			7.3
8.1	9.0	9.1	0.18	.024		-	2.1	19	-			9.9
7.8	8.2	8.7	0.14	.020		0.30	6.5	16	3			10.4
7.8	8.1	8.4	0.11	.019		0.35	6.0	17	25			10.0

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg	5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	6L1a SO_4	8A1 8A MOISTURE AT SATURATION %
←	milliequivalents per 100g. soil	→				←	milliequivalents per liter	→			
23.3		4.8	0.1	1.3	-	-	0.4				49.4
16.0	10.4	4.4	0.1	0.3	1	-	-				39.0
14.8	10.4	4.6	0.1	0.2	1	0.3	-				37.6
10.1			-	0.1	-	1.3	-				37.8
12.4			1.1	0.2	9	12.9	0.2				46.4
12.7			1.5	0.3	12	31.5	0.9				44.8
12.4			1.5	0.3	12	38.4	0.9	3.4	3.6	4.7	45.8

Soil type: *Westhope loam
Soil No.: S50NDak-38-9
Location: Northeast quarter of southeast quarter, Sec. 17, T163N, R84W, Renville County, North Dakota.
Vegetation: Grain stubble.
Parent material: Glaciofluvial, moderately deep over till.
Physiographic position: Upland glacial plain.
Topography: Very gently undulating.
Slope: 1 percent.
Erosion: None.
Drainage: Moderately well.
Moisture: Moist to 18 inches.
Stoniness: Slight.
Root distribution: Many.
Described by: C. A. Mogen.
Date: September 20, 1950.

Horizon and Mandan Lab. Number	
Ap 494	0 to 7 inches. Dark gray, dry, and black, moist(10YR 4/1, 2/1), noncalcareous loam having a soft moderately developed fine crumb structure; very friable when moist.
B21 495	7 to 13 inches. Dark grayish brown, dry, and between very dark brown and very dark grayish brown, moist (between 10YR and 2.5Y 4/2 dry, between 2/2 and 3/2 moist), noncalcareous loam having a weakly developed medium-sized prismatic structure; prisms separate into moderately developed fine- and medium-sized granules; slightly hard when dry; very friable when moist. This grades into
B22 496	13 to 20 inches. Grayish brown, dry, and very dark grayish brown, moist (2.5Y 5/2, 3/2), noncalcareous loam; structure and consistence as in the horizon above. This changes clearly in an irregular boundary into
C1ca 497	20 to 28 inches. Mottled light gray and white, dry, and mottled light yellowish brown and light gray, moist (mottlings are distinct and of medium size), (2.5Y 7/2 and 8/2 dry, 6/3 and 7/2 moist), strongly calcareous loam with a moderate amount of segregated lime; weak fine granular structure; slightly hard when dry; very friable when moist. This grades into
C2 498	28 to 54 inches. Mottled light yellowish brown, light gray, and white with a very few fine spots of strong brown, dry, and mottled light olive brown, grayish brown and white with spots of strong brown, moist (mottlings are distinct and small in size), (2.5Y 6/4, 10YR 7/1 and 9/1, 7.5YR 5/8 dry, 2.5Y 5/4, 5/2 and 8/2, 7.5YR 5/8 moist), moderately calcareous loam; moderate very thick platy; hard when dry; firm when moist.
C31cs 499	54 to 62 inches. Mottled pale yellow and light gray with very few very fine spots of reddish yellow, dry, and mottled olive brown, gray with spots of strong brown, moist, (mottlings are small in size and faint), (2.5Y 7/3 and 7/0, 7.5YR 6/8 dry, 2.5Y 4/4 and 5/1, 7.5YR 5/8 moist), mildly calcareous loam; moderate very thick platy; very hard when dry, firm when moist. There is a slight amount of crystalline gypsum.
C32cs 500	62 to 72 inches. Mottled light yellowish brown and light gray with a very few small spots of brownish yellow, dry, and mottled light olive brown and grayish brown with small spots of yellowish brown, moist, (mottlings are distinct and small in size), (2.5Y 6/4 and 7/1, 10YR 6/6 dry, 2.5Y 5/4, and 5/2, 10YR 5/6 moist), mildly calcareous loam; moderate very thick platy; moderate amount of crystalline gypsum.

SOIL SURVEY LABORATORY Mandan, N. Dak.

SOIL TYPE *Westhope loam **LOCATION** Renville County, North Dakota

SOIL NOS. S50NDak-38-10 **LAB. NOS.** 501-507

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	2A2 > 2 (19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) 3A1										
0-6	Ap	1.1	4.6	5.5	10.0	12.0	44.7	22.0	39.7	22.9	-	1
6-18	B2	1.0	3.2	4.3	8.7	15.8	45.3	21.9	47.8	18.4	-	1
18-23	B31	1.0	2.9	4.7	8.3	23.3	42.6	17.2	58.3	12.9	-	1
23-28	B32ca	0.6	1.8	2.8	8.4	29.4	41.5	15.4	63.2	13.8	-	1
28-48	C1ca	3.1	5.4	6.0	11.8	10.5	37.1	26.1	32.2	22.2	-	1
48-60	D1											
60-72	D2	2.8	5.9	6.8	15.1	12.4	34.7	22.3	34.6	20.7	6	1

8C1b SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
			ORGANIC MATTER									
6.7	6.8	7.2	3.67	.320	11.5	-	0.4	-	-			12.2
6.7	7.2	7.4	1.05	.104	10.1	-	0.4	-	-			9.1
7.1	7.5	7.7	0.67	.076	8.8	-	0.3	-	-			6.9
7.9	8.5	8.8	0.58	.067	8.7	-	0.4	11	-			6.1
8.2	9.0	9.1	0.27	.032	8.4	-	0.6	22	-			8.5
8.4	9.3	9.5	0.16	.020		-	1.1	17	-			9.5
8.4	9.2	9.3	0.17	.021		-	1.5	17	-			9.7

5A1a CATION EXCHANGE CAPACITY NH_4Ac	5B1a EXTRACTABLE CATIONS 6N2b Ca	602b Mg		5B1b EXCHANGEABLE CATIONS 6P2a Na	6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 8A1 6P1a Na	6Q1a K				8A MOISTURE AT SATURATION %
	← milliequivalents per 100g. soil →						← milliequivalents per liter →					
25.8	17.7	5.4		0.1	1.3	-	-	0.6				53.2
18.8	11.7	5.6		-	0.5	-	-	-				41.0
15.0	9.2	5.3		-	0.3	-	-	-				40.6
12.4				-	0.3	-	-	-				38.8
12.8				0.4	0.3	3	3.6	-				39.1
12.8				1.3	0.4	10	8.8	0.2				44.4
12.6				1.3	0.4	10	11.9	-				45.3

Soil type: *Westhope loam
Soil No.: S50NDak-38-10
Location: Northwest corner of northwest quarter of the southwest quarter, Sec. 29, T163N, R84W, Renville County, North Dakota.
Vegetation: Stubble field.
Parent material: Glaciofluvial deep over till.
Physiographic position: Upland plain.
Topography: Nearly level.
Slope: 1 percent.
Drainage: Moderately well.
Moisture: Moist.
Root distribution: Many.
Stoniness: Free.
Described by: C. A. Mogen.
Date: September 20, 1950.

Horizon and Mandan Lab. Number	
Ap 501	0 to 6 inches. Dark gray, dry, and black, moist (10YR 4/1, 2/1), noncalcareous loam; soft moderately developed fine crumb structure; very friable when moist.
B2 502	6 to 18 inches. Grayish brown, dry, and dark grayish brown, moist (10YR 5/2, 4/2), noncalcareous loam having a moderately well developed medium-sized prismatic structure; slightly hard when dry; very friable when moist. This changes clearly but in an irregular boundary into
B31 503	18 to 23 inches. Light yellowish brown with streaks of grayish brown, dry, and light olive brown streaked with very dark grayish brown, moist (2.5Y 6/3, 5/2 dry, 2.5Y 5/4, 3/2 moist), noncalcareous loam with moderately developed coarse prismatic structure; slightly hard when dry; very friable when moist. This grades in an irregular boundary into
B32ca 504	23 to 28 inches. Light yellowish brown, dry, and light olive brown, moist; faintly mottled with small spots of varied shades of light yellowish brown and light olive brown (2.5Y 6/4, 4/3), mildly calcareous loam with a very slight amount of segregated lime in threads and thin films; moderately developed coarse prismatic structure; slightly hard when dry; very friable when moist. This changes clearly but in a wavy boundary to
C1ca 505	28 to 48 inches. Light brownish gray with numerous medium-sized distinct mottlings of white and with a very few very fine spots of red, dry, and light olive brown mottled with light gray and with spots of red, moist (2.5Y 6/2 and 8/2, 2.5YR 5/8 dry, 2.5Y 5/3 and 7/2, 2.5YR 5/8 moist), strongly calcareous loam; moderate very thick platy; hard when dry; friable when moist; has a moderate amount of segregated lime. This changes clearly and in wavy boundary to
D1 506	48 to 60 inches. Mottled pale yellow and light gray with a very few very fine spots of red, dry, and mottled light olive brown and light gray with spots of dark red, moist; mottlings are faint and small i size (2.5Y 7/3 and 7/1, 2.5YR 4/8 dry, 2.5Y 5/4 and 6/1, 2.5YR 3/6 moist), mildly calcareous loam till; moderate very thick platy; hard when dry; friable to firm when moist.
D2 507	60 to 72 inches. Mottled light gray and light yellowish brown, dry, and gray and olive brown, moist; mottlings are faint and small (2.5Y 7/0 and 6/3 dry, 5/0 and 4/3 moist), mildly calcareous loam till; moderate very thick platy; very hard dry, firm, moist.

SOIL SURVEY LABORATORY Mandan, North Dakota 9/15/55

SOIL TYPE Williams loam **LOCATION** Ward County, North Dakota

SOIL NOS. S54NDak-51-1-(1-6) **LAB. NOS.** 2330-2335

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-5	Ap	2.5	4.7	6.1	13.7	10.6	36.2	26.2	32.0	22.6	1.6	l
5-9	B21	2.0	4.1	5.7	13.9	10.9	33.1	30.3	31.7	20.4	0.7	cl
9-13	B22	1.4	3.8	4.7	12.9	11.8	37.9	27.5	33.7	23.8	1.1	cl
13-25	Cca	1.2	2.6	3.7	10.9	11.4	43.0	27.2	33.5	27.8	1.5	cl
25-40	C1	2.1	3.6	4.2	11.8	11.7	41.9	24.7	33.9	27.2	1.5	l
40-60	C2	1.6	3.4	3.8	11.6	11.7	43.8	24.1	34.1	28.7	1.4	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	6F1a GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.2	6.6	6.8	3.00	.252	11.9	-	0.6	-				11.2
6.0	6.6	6.7	1.21	.125	9.7	-	0.4	-				11.7
6.6	7.0	7.1	1.10	.110	10.0	-	0.5	-				11.1
7.9	8.8	9.0	0.89			-	0.7	16				9.4
8.4	9.4	9.6	0.40			-	2.0	13				9.9
8.2	8.9	9.1	0.38			0.39	6.0	6	-			10.4

5A1a CATION EXCHANGE CAPACITY (NH_4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K	5B1a 5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	6J1a HCO_3	6K1a Cl	8A1 6L1a SO_4	8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil →						← milliequivalents per liter →					
23.6	14.2	4.6		0.1	1.5	1	0.3	0.6				56.3
22.7	13.8	5.8		0.1	0.6	-	0.3	0.1				46.1
21.6	13.9	6.4		0.1	0.5	-	0.3	0.1				51.3
15.9				0.2	0.3	1	0.9	0.1				48.1
15.8				2.8	0.2	13	13.4	-				52.5
15.8				4.3	0.2	15	36.0	-	7.6	4.5	81.8	52.0

Soil type: Williams loam
Soil No.: S54NDak-51-1
Area: Ward County, North Dakota.
Location: 0.1 mile west and 150 feet north of southeast corner Sec. 15, T157N, R87W.
Vegetation or crop: Grasses and sage; once plowed, now in western wheatgrass, sagewort, some needle-and-thread grass, junegrass, and considerable silverleaf scurfpea.
Parent material: Friable calcareous loam glacial till (Mankato Age).
Physiographic position: Approximately 60 feet from shoulder of 150-foot slope into depression.
Topography: Strongly undulating (relief 5 to 15 feet).
Slope: 3 percent west by southwest.
Drainage: Well drained.
Permeability: Moderate.
Moisture: Nearly dry to 40 inches; moist below.
Stoniness: Few.
Described by: C. A. Mogen.
Date: July 22, 1954.

Mandan Lab.No.	Horizon	
2330	Ap	0 to 5 inches. Dark gray (10YR 4/1 dry) to very dark gray (10YR 3/1 moist) loam; slightly hard, very friable; upper 1 inch is weak fine, platy; 1 to 5 inches is weak medium prismatic, separating to strong very fine granules. Clear boundary.
2331	B21	5 to 9 inches. Brown (10YR 5.5/3 dry) to dark brown (10YR 4/3 moist) coated with 10YR 5/3, dry, to dark grayish brown (10YR 4/2 moist) clay loam; very hard, very friable; compound structure of strong medium and fine prisms separating to moderate medium fine blocks; gradual boundary.
2332	B22	9 to 13 inches. Colors as in the horizon above on the 1Y hue in loam; structure as in the horizon above; very hard, very friable. Clear irregular boundary.
2333	Cca	13 to 25 inches. Light yellowish brown (2.5Y 6/3 dry) and white (2.5Y 8/2 dry) to light olive brown (2.5Y 5/4 moist) and light gray (2.5Y 7/2 moist) strongly calcareous clay loam with a moderate amount of segregated lime in threads and films; hard, very friable; weak coarse prisms separating to weak fine blocks. Gradual boundary.
2334	C1	25 to 40 inches. Light brownish gray (2.5Y 6/2 dry) and white (2.5Y 8/2 dry) to light olive brown (2.5Y 5/3 moist) and light gray (2.5Y 7/2 moist) moderately calcareous loam with a moderate to slight amount of segregated lime in threads and films; hard, friable; moderate fine blocks. Gradual boundary.
2335	C2	40 to 60 inches. Light brownish gray (2.5Y 6/2 dry) common fine faint mottling of light gray (N 7/0 dry) and a few fine distinct mottlings of reddish brown in moderately calcareous loam; moderate to strong fine blocky structure; hard, friable.

Remarks: A few glacial pebbles and stones throughout the profile.

SOIL SURVEY LABORATORY Mandan, North Dakota 9/15/55

SOIL TYPE Williams silt loam **LOCATION** Ward County, North Dakota

SOIL NOS. S54NDak-51-2-(1-8) **LAB. NOS.** 2336-2343

DEPTH INCHES	HORIZON	1B1a PARTICLE SIZE DISTRIBUTION (in mm.) (per cent) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
0-2	A11	2.1a	2.6	3.7	11.5	11.3	42.1	26.7	36.1	24.2	1.7	l
2-4	A12	2.7	5.0	6.6	16.7	11.6	30.0	27.4	34.7	16.8	1.5	cl
4-7	B21	1.8	5.3	6.9	17.0	12.1	29.8	27.1	34.6	17.2	1.5	cl
7-10	B22	2.6	4.8	6.0	14.0	11.9	33.6	27.1	34.7	19.6	1.2	cl
10-17	B3ca	2.2	3.5	4.6	12.7	12.0	35.6	29.4	33.5	22.3	1.6	cl
17-27	Cca	2.8	3.8	4.5	12.9	11.3	35.4	29.3	33.1	21.4	1.9	cl
27-42	C11	2.9	3.9	4.5	13.3	12.5	37.7	25.2	36.7	21.6	1.9	l
42-60	C12	2.2	3.6	4.6	13.3	12.7	39.1	24.5	36.6	23.6	1.9	l

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.9	7.0	5.29	.458	11.6	-	0.6	-				16.7
6.2	6.6	6.7	3.08	.243	12.7	-	0.5	-				12.8
6.0	6.5	6.6	1.44	.128	11.2	-	0.4	-				11.2
7.1	7.4	7.8	1.42	.121	11.7	-	0.8	1				11.5
7.7	8.5	8.8	0.97	.091	10.6	-	0.7	29				10.5
7.9	8.8	9.1	0.68			-	0.7	18				10.2
8.4	9.2	9.4	0.39			-	0.7	12				10.1
8.5	9.5	9.6	0.38			-	0.9	9				10.5

5A1a CATION EXCHANGE CAPACITY (NH_4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	6Q2a K 5B1a	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K	8A1			8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
31.3	19.5	6.5		-	2.6	-	0.3	1.4				78.8
24.3	14.7	5.4		0.1	1.7	-	0.3	0.9				56.2
21.9	12.7	5.4		-	1.1	-	0.3	0.4				45.4
21.7				0.1	0.5	-	0.3	0.2				50.0
17.2				0.1	0.2	-	0.3	0.1				53.7
15.6				0.2	0.2	1	0.6	-				52.0
15.5				0.6	0.2	3	2.5	-				52.6
15.7				1.7	0.3	9	5.9	-				57.0

a. Organic matter in sand fraction.

Soil type: Williams silt loam
Soil No.: S54NDak-51-2
Area: Ward County, North Dakota.
Location: 0.3 mile east and 90 feet north of southwest corner Sec. 11, T157N, R87W.
Vegetation or crop: Grasses in an abandoned farmstead, virgin 5-acre tract; western wheatgrass, bluegrass, and needle-and-thread grass; fringed sagewort and annual weeds; patches of bromegrass in swales and on old building sites.
Parent material: Friable, calcareous loam till (Mankato Age).
Physiographic position: 30 feet from crest on 100-foot long slope to intermittent stream channel; stream is long with branched short tributaries.
Topography: Strongly undulating (relief 5 to 15 feet).
Drainage: Well.
Permeability: Moderate.
Moisture: Slightly moist to 52 inches.
Stoniness: Some.
Described by: C. A. Mogen.
Date: July 23, 1954.

Mandan Lab.No.	Horizon	
2336	A11	0 to 2 inches. Very dark grayish brown (10YR 3.5/2 dry) to very dark brown (10YR 2/2 moist) silt loam; soft, very friable; weak fine plates separating to moderate very fine granules. Clear boundary.
2337	A12	2 to 4 inches. Dark grayish brown (10YR 4/2 dry) with some very dark grayish brown (10YR 3.5/2 dry) to very dark brown (10YR 2/2 moist) crushing to dark brown (10YR 3/3 moist) clay loam; slightly hard, very friable; compound structure of moderate medium prisms separating to moderate fine granules. Clear boundary.
2338	B21	4 to 7 inches. Brown (1Y 5/3 dry) to dark brown (1Y 4/3 moist) light-textured clay loam; very hard, friable; compound structure of moderate medium prisms and weak fine prisms separating to moderate medium blocks and weak fine blocks. The prisms have thin, almost continuous, clay skins on their faces and are coated dark grayish brown (10YR 4/2 dry) and very dark grayish brown (10YR 3/2 moist). Gradual boundary.
2339	B22	7 to 10 inches. Colors as in the horizon above in light-textured clay loam with the same structural development but with patchy clay skins on the surfaces of the prisms and with dry coatings of grayish brown (10YR 5/2 dry) and most coatings of dark grayish brown (10YR 4/2 moist); hard, friable. Clear boundary.
2340	B3ca	10 to 17 inches. Light brownish gray (2.5Y 6/2 dry) to grayish brown (2.5Y 5/2 moist) strongly calcareous light-textured clay loam having a large amount of segregated lime in threads and films; hard, friable; compound structure of weak medium prisms separating to moderate medium blocks. Clear, very irregular boundary.
2341	Cca	17 to 27 inches. Light yellowish brown (2.5Y 6/3 dry) to light olive brown (2.5Y 5/4 moist) strongly calcareous heavy-textured clay loam with a large amount of segregated lime in threads and films; hard, friable; moderate fine blocks. Gradual boundary.
2342	C11	27 to 42 inches. Colors as in the horizon above but with many fine faint light gray (2.5Y 6/1 dry) and brown mottlings in moderately calcareous heavy-textured loam with a slight amount of segregated lime in threads and films; very hard, friable; moderate fine blocks. Gradual boundary.
2343	C12	42 to 60 inches. Colors as in the horizon above in moderately calcareous heavy-textured loam; very hard, friable; moderate fine blocks.

Remarks: There are igneous gravel and stones scattered throughout the profile. The segregation of lime is somewhat in seams with streaks of carbonate extending to 42 inches. There are a few orange colored 1-inch diameter stains of rotted sandstone.

SOIL SURVEY LABORATORY Mandan, North Dakota 9/15/55

SOIL TYPE Williams loam **LOCATION** Williams County, North Dakota

SOIL NOS. S54NDak-53-1-(1-7) **LAB. NOS.** 2315-2321

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-1½	A11	3.6a	4.1	4.9	11.6	10.6	43.5	21.7	38.0	22.7	-	1
1½-3	A12	2.2	4.1	5.2	13.1	11.9	39.2	24.3	38.6	20.2	1.6	1
3-8	B21	2.3	4.7	6.0	13.9	11.5	32.3	29.3	35.0	16.8	1.6	cl
8-11	B22	3.7	4.5	5.8	13.8	10.9	33.0	28.3	33.6	18.0	1.3	cl
11-23	Cca1	3.1	4.2	4.7	11.3	10.7	34.5	31.5	30.6	21.2	2.7	cl
23-39	Cca2	3.8	3.8	4.3	11.7	12.0	36.6	27.8	33.7	22.1	2.4	cl
39-60	C	3.3	3.9	4.0	10.5	10.6	37.7	30.0	30.9	23.5	3.0	cl

8C1b SATURATED PASTE	8C1a pH 1:5	8C1a pH 1:10	6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.6	6.9	7.2	4.68	.335	14.0	-	0.8	-				12.8
6.2	6.5	6.7	2.60	.227	11.4	-	0.6	-				11.3
6.3	6.7	7.2	1.26	.116	10.9	-	0.6	-				11.6
7.3	8.1	8.4	1.20	.115	10.4	-	0.7	3				11.5
7.9	8.8	9.0	0.77			-	0.6	19				10.0
8.1	9.1	9.3	0.44			-	0.7	15				9.4
8.5	9.4	9.6	0.35			-	0.7	12				11.0

5A1a CATION EXCHANGE CAPACITY (NH_4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
27.9	18.7	5.4		0.1	1.3	-	0.3	0.8				72.0
20.8	12.0	4.1		0.1	0.9	-	0.3	0.3				59.3
22.6	14.5	5.7		0.1	0.5	-	0.4	0.1				50.2
21.8				0.1	0.3	-	0.3	-				57.0
16.0				0.1	0.2	1	0.4	-				50.1
14.8				0.2	0.2	1	1.2	-				48.0
17.2				1.2	0.3	6	4.2	-				59.0

a. Organic matter in sand fraction.

Soil type: Williams loam
Soil No.: S54NDak-53-1
Area: Williams County, North Dakota.
Location: 260 feet west and 160 feet north of southeast corner Sec. 14, T157N, R102W.
Vegetation or crop: Native grasses; western wheatgrass, needle-and-thread mainly with some green needlegrass, bluegrass and junegrass. Some woody plants (forbs) and a few sweetclover plants.

Parent material: Friable, calcareous loam till (pre-Mankato Age?).
Physiographic position: 40 feet from shoulder and crest of gently rounded knoll on strongly undulating upland till plain. Very few closed depressions.
Topography: Strongly undulating. Relief 10 to 20 feet. Slopes 100 to 300 feet long, locally ridged between fingered drainage pattern.
Slope: 3 percent to west, becoming troughed into head of drain 30 feet below pit.
Drainage: Well.
Moisture: Nearly dry; moist below 48 inches.
Described by: C. A. Mogen.
Date: July 22, 1954.

Mandan Lab.No.	Horizon	
2315	A11	0 to 1½ inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/1.5 moist) loam; soft, very friable; moderate fine crumb. Clear boundary.
2316	A12	1½ to 3 inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2/2 moist) loam; slightly hard, very friable; compound structure of weak medium prisms separating to weak fine granules. Clear boundary.
2317	B21	3 to 8 inches. Dark grayish brown (10YR 4/2 dry) crushing to a slightly browner color (10YR 4.5/2.5 dry) to very dark brown (10YR 2/2 moist) crushing to very dark grayish brown (10YR 3/2.5 moist) clay loam; hard, friable; compound structure of moderate medium prisms separating to moderate or strong fine and medium angular and subangular blocks. Gradual boundary.
2318	B22	8 to 11 inches. Grayish brown (10YR 5/2.5 dry) to dark grayish brown (1Y 4/2 moist) clay loam; hard, friable; compound structure of moderate medium prisms separating to moderate medium angular and subangular blocks. Clear, very irregular boundary.
2319	Cca1	11 to 23 inches. Grayish brown (2.5Y 5/2 dry) mottled with light brownish gray (2.5Y 6/2 dry) and white (2.5Y 8/2 dry) to light olive brown (2.5Y 5/3 moist) mottled with dark grayish brown (2.5Y 4/2 moist) and light brownish gray (2.5Y 6/2 moist) strongly calcareous clay loam with a large amount of segregated lime in threads and films; hard, friable; compound structure of weak coarse prisms separating to weak medium blocks. Clear, very irregular boundary.
2320	Cca2	23 to 39 inches. Light brownish gray (2.5Y 6/2 dry) mottled with white (2.5Y 8/2 dry) to light olive brown (2.5Y 5/3 moist) strongly calcareous clay loam with a slight amount of segregated lime in threads and films; hard, friable; compound structure of weak medium blocks separating to moderately developed very fine blocks. Clear irregular boundary.
2321	C	39 to 60 inches. Light brownish gray (2.5Y 6/2 dry) to light olive brown (2.5Y 5/3 moist) moderately calcareous clay loam; hard, friable; weak medium blocks separating to moderate fine blocks.

Remarks: A few glacial stones and pebbles scattered throughout the profile.

SOIL SURVEY LABORATORY Mandan, North Dakota 9/15/55

SOIL TYPE Williams loam **LOCATION** Williams County, North Dakota

SOIL NOS. S54NDak-53-2-(1-8) **LAB. NOS.** 2322-2329

DEPTH INCHES	HORIZON	1B1a VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY < 0.002	0.2-0.02	0.02-0.002	3A1 2A2 > 2 (<19mm)	TEXTURAL CLASS
		PARTICLE SIZE DISTRIBUTION (in mm.) (per cent)										
0-1½	A11	3.6a	5.6	6.2	13.8	11.0	33.7	26.1	34.1	18.2	3.0	l
1½-3	A12	4.0	5.6	6.6	14.6	10.9	27.9	30.4	32.8	14.1	2.6	cl
3-7	B21	3.2	6.6	7.2	13.8	10.1	26.3	32.8	29.4	14.4	1.3	cl
7-10	B22	2.5	5.2	6.4	13.6	10.6	28.4	33.3	31.0	15.6	1.1	cl
10-13	B3ca	5.3	5.5	4.9	10.9	10.6	32.5	30.3	29.6	19.9	3.0	cl
13-22	Ccal	2.8	4.6	4.4	10.5	10.6	33.9	33.2	29.8	20.8	2.5	cl
22-35	Cca2	4.0	4.9	4.3	10.3	10.6	35.3	30.6	31.0	21.0	2.3	cl
35-60	C1	3.1	5.1	4.9	11.2	10.5	35.8	29.4	31.1	21.8	3.0	cl

pH 8C1b SATURATED PASTE	8C1a 1:5	8C1a 1:10	ORGANIC MATTER 6A1a ORGANIC CARBON %	6B1a NITROGEN %	C/N	8A2 EST% SALT (BUREAU CUP)	ELECTRICAL CONDUCTIVITY EC×10³ MILLIMHOS PER CM 8A1a	6E1a $CaCO_3$ equivalent %	GYPSUM me./100g. SOIL	MOISTURE TENSIONS 1/10 ATMOS. %	1/3 ATMOS. %	4B2 15 ATMOS. %
6.9	7.2	7.5	2.93	.264	11.1	-	0.7	-				12.8
6.7	7.2	7.3	1.96	.187	10.5	-	0.5	-				13.4
6.8	7.3	7.4	1.18	.107	11.0	-	0.5	-				13.1
7.4	8.2	8.4	1.12	.120	9.3	-	0.7	1				13.0
7.9	8.6	8.8	0.98	.101	9.7	-	0.6	10				11.0
8.0	8.9	9.2	0.70			-	0.6	22				10.0
8.3	9.1	9.4	0.31			-	0.6	18				9.6
8.5	9.4	9.6	0.23			-	0.8	16				9.8

5A1a CATION EXCHANGE CAPACITY (NH_4Ac)	EXTRACTABLE CATIONS 6N2b Ca	6O2b Mg	H	6P2a Na	5B1a 6Q2a K	5D2 EXCH. Na %	SATURATION EXTRACT SOLUBLE 6P1a Na	6Q1a K				8A1 8A MOISTURE AT SATURATION %
	milliequivalents per 100g. soil						milliequivalents per liter					
23.7	16.2	6.1		0.1	1.2	-	0.3	0.4				60.2
25.2	16.7	7.0		0.1	0.9	-	0.2	0.1				55.6
25.8	17.0	7.9		0.1	0.5	-	0.3	-				56.2
25.3				0.1	0.3	-	0.3	-				52.9
20.2				0.1	0.2	-	0.3	-				55.4
16.5				0.1	0.3	1	0.4	-				51.0
15.2				0.3	0.3	1	1.4	-				49.4
15.4				1.3	0.4	7	4.7	-				49.2

a. Organic matter in sand fraction.

Soil type: Williams loam
Soil No.: S54NDak-53-2
Area: Williams County, North Dakota.
Location: 540 feet north and 240 feet west of southeast corner Sec. 31, T157N, R102W.
Vegetation or crop: Native grasses; western wheatgrass, needle-and-thread grass, mainly; blue grama, junegrass, and threadleaf sedge, fringed sagewort, some green needle grass and silverleaf scurfpea in a native pasture.
Parent material: Friable, calcareous loam till (pre-Mankato Age?).
Physiographic position: 50 feet from crest of 100 foot slope into intermittent stream. Slopes 7 percent below pit to stream. Slope behind shoulder is gently undulating plain with long 1 to 2 percent slope. Stream pattern dendritic.
Topography: Undulating and gently rolling. Relief 10 to 30 feet. Slopes are long and smooth.
Slope: 3 percent west by southwest.
Drainage: Well.
Moisture: Nearly dry; moist below 48 inches.
Stoniness: Common.
Described by: C. A. Mogen.
Date: July 22, 1954.

Mandan Lab.No.	Horizon	
2322	A11	0 to 1½ inches. Dark grayish brown (10YR 4/2 dry) to very dark brown (10YR 2.5/2 moist) loam; soft, very friable; moderate fine crumb. Clear boundary.
2323	A12	1½ to 3 inches. Very dark grayish brown (10YR 3.5/2 dry) to very dark grayish brown (10YR 3/2 moist) crushing to dark brown (10YR 4/3 moist) and very dark grayish brown (10YR 3/2 moist) clay loam; hard, very friable; compound structure of weak medium blocks separating to moderate fine granules. Clear boundary.
2324	B21	3 to 7 inches. Dark grayish brown (10YR 4/2 dry) to dark brown (10YR 3/3 moist) crushing to dark yellowish brown (1Y 3.5/4 moist) clay loam. Hard, friable; compound structure of moderate medium and strong fine prisms separating to strong medium and fine blocks. Gradual boundary.
2325	B22	7 to 10 inches. Brown (10YR 5/3 dry) to dark grayish brown (10YR 4/2 moist) crushing to dark brown (1Y 4/3 moist) clay loam; hard, friable; structure as in the horizon above. Clear irregular boundary.
2326	B3ca	10 to 13 inches. Grayish brown (2.5Y 5/2 dry) to dark grayish brown (2.5Y 4/2 moist) strongly calcareous clay loam with a large amount of segregated lime in threads and films; hard, friable; compound structure of moderate medium prisms separating to weak fine blocks. Prisms of the dry soil are are light brownish gray (2.5Y 6/2 dry) and white (2.5Y 8/2 dry) on the insides and of the moist soil are grayish brown (2.5Y 5/2 moist) and light gray (2.5Y 7/2 moist) on the insides. Gradual boundary.
2327	Cca1	13 to 22 inches. Light brownish gray (2.5Y 6/2 dry) and white (2.5Y 8/2 dry) to light olive brown (2.5Y 5/3 moist) and light gray (2.5Y 7/2 moist) strongly calcareous clay loam with a large amount of segregated lime in threads and films; slightly hard, friable; weak coarse prisms. Gradual boundary.
2328	Cca2	22 to 35 inches. Dry colors as in the horizon above to dark grayish brown (2.5Y 4.5/2 moist) and light gray (2.5Y 7/2 moist) strongly calcareous clay loam with a moderate amount of segregated lime in threads and films; hard, friable; moderate fine blocky. Gradual boundary.
2329	C1	35 to 60 inches. Light brownish gray (2.5Y 6/2 dry) to dark grayish brown (2.5Y 4/2 moist) moderately calcareous clay loam with a slight amount of segregated lime in the upper part of the horizon; hard, friable; weak fine blocks.

Remarks: There are a few glacial pebbles and stones scattered throughout the profile, and there are pockets of very friable till.

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