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Assessment of the Stratigraphic Controls on Deltaic Subsidence in the Mississippi River Delta

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Assessment of the Stratigraphic Controls on Deltaic Subsidence in the Mississippi River Delta

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By

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Abstract:

Louisiana's coastlines are being lost due to a rise in sea level and land subsidence. This study isolates one aspect of land subsidence, called autocompaction, to access its contributions to overall subsidence. Autocompaction is the process where a growing sequence of sediments collapses due to an increasing overburden load. A total of 36 sediment cores from the Sale-Cypremort deltaic lobe were analyzed. Each core was divided into facies units of natural levee, marsh, poorly drained backswamp, and bay mud. A soil analysis was conducted along with the sediment cores. Each soil was identified as a facies type. By identifying facies, geotechnical parameters based on facies type were applied in an equation that solved for consolidation settlement, also called autocompaction (Sm). Autocompaction measures the decrease in layer thickness by vertical compression. The autocompaction values were compared to depth of facies, thickness of facies layers, as well as depth to Pleistocene. Results show that as thickness of facies layers increases, compaction increased. As depth to Pleistocene increased, compaction had a slight increasing trend. Natural levee facies can be considered firm and nearly incompressible, while marsh, poorly drained backswamp, and bay mud facies are soft and compressible.

Introduction:

The Mississippi Delta is experiencing coastal land loss. There are two main causes of coastal land loss, the first being a rising sea level. It is estimated that the world-wide eustatic sea level rise is about 0.12 cm/yr (Penland and Ramsey, 1990). However, in the delta, the sea level rise is measured to be 1.1 cm/yr (Penland et al., 1987). This accelerated sea level rise is caused by a eustatic sea level rise combined with land subsidence in the delta. Ramsey and Penland state that between 29% and 83% of sea level rise recorded in the delta can be attributed to land subsidence (1989). The causes of subsidence include fluid withdrawal, thermal contraction, delta-front instabilities, halokinetics, faulting, sediment isostatic adjustment (SIA), glacial isostatic adjustment (GIA), and sediment compaction (Kulp 2000) (Yu et al. 2012). Since there are multiple physical processes that can contribute to subsidence, there is difficultly in measuring a subsidence rate that can incorporate all the processes and can apply to the delta in its entirety. This study isolates the process of Holocene sediment compaction to observe its mechanisms and contributions to the whole process of subsidence.

Holocene sediment compaction can be caused by autocompaction. Autocompaction is the process where a growing sequence of sediments collapses due to an increasing overburden load (Allen, 1999). This process is progressive because as new sediments are deposited on top of old ones, the load on the old sediments increases. To measure the degree to which the Holocene sediment has compacted, the amount of autocompaction was measured. These measurements were done by using a geotechnical analysis of consolidation settlement for a set of cores.

Assumptions cannot be made that autocompaction in a sediment core is uniform throughout. Compaction is influenced by the physical properties of the sediment grains, the volume of water within the pores, and the pressure exerted from the sediment deposited above

(Yuill et al., 2009). Thus, autocompaction can vary with location depending on the local sediment and depositional conditions.

Due to the variability of facies types in the cores, it is expected that there are facies that can be considered soft and compressible and facies that can be considered firm and incompressible. There should be a distinction between compaction values that distinguish between soft and firm facies. Second, there should be a greater amount of compaction at greater depths due to the increased overburden load. Third, there should be more compaction in layers of greater thicknesses.

Study Area:

The area of study is the Sale-Cypremort deltaic lobe (figure 1). This area once served as the outlet in Mississippi Delta. The area was abandoned around 4000 years ago when the path of the river diverted and shifted eastward (Coleman and Smith, 1964).   The Holocene sediments are underlain by a Pleistocene basement, with a depth of about 15 meters. Cores located in this area were used for analysis.

Consolidation Theory:

Kuecher (1994) took a geotechnical approach to modeling sediment compaction for the Lafourche Delta. He used a geotechnical equation that would measure consolidation settlement, also known as autocompaction (Sm), by measuring the decrease in soil volume due to the settlement of sediment. This equation is based on Terzaghi's effective stress equation, which states that compression is dependent on the measure of the total stress and the pore pressure (Kooi and de Vries, 1998). Autocompaction is expressed in the following equation:

$$Sm = \frac{Cc * H}{1 + e_0} * log\frac{P_0 + \Delta P}{P_0}$$

In this equation, the first part is a measure of strain in the sediment column, and the second part is a measure of pressure from dewatering. Void ratio (e_0) is the ratio of the volume of voids divided by the volume of solids. Cc is compression index values and is the rate factor in the equation (Kuecher, 1994). Other variables in the model are as follows: thickness (H), overburden pressure (p_0), and change in pressure (Δp).

After studying sediment types in the delta, Kuecher identified five facies that appeared in the Lafourche Delta. These facies are: peat, bay mud/poorly drained backswamp, prodelta, mouth bar sand, natural levee/splay, beach, and point bar sand. For each facies, Kuecher calculated compression index values (Cc), void ratio values (e_0), and bulk densities through his field work (table 1).

Time-Depth Model:

Coleman and Smith (1964) previously studied subsidence in the Sale-Cypremort lobe by looking at land-sea relationships for the post-glacial relative sea level rise. They used a time depth model to find the rate of subsidence and related the model to the overall delta. This method involves radiocarbon dating of marsh peats which allows for interpretations of relationships between former positions of land and sea. Finding a subsidence rate from a peat burial history involves measuring the burial depth of the peat stratum and finding its age (Kulp, 2000). The subsidence rate is computed as follows:

$$\text{Subsidence rate} = \text{present burial depth} / \text{conventional } ^{14}\text{C age of peat}$$

This method is not ideal for the whole delta as the method can only be applied where there are continuous layers of peat, as well as basal peats on the Pleistocene basement. Some areas do not contain ideal peat layers that can be used for the time-depth model. Thus, this time-depth model cannot be uniformly applied to all areas of the delta. This method can be applied to autocompaction by finding the age of the deepest Holocene sediment, and the depth to the Pleistocene basement.

Data and Methodology:

The data consists of a series of cores previously collected in the Mississippi Delta. The information from the cores came from a database from the Tulane Quaternary Research group. The core information from boreholes is viewed through the LLG (Low Land Genesis) program, which will run on Windows. The data that is given from the LLG program divides the cores by 10cm depth increments with corresponding texture and color descriptions. LLG was developed by the Rhine-Meuse Delta Studies group at the Physical Geography Department of Utrecht University.

The cores chosen for this study were from 36 boreholes taken by Scott J. Bick in 2003. The cores I chose needed to be located in the Sale-Cypremort area, extend to the Pleistocene basement, contain multiple facies types, and have facies that could be clearly interpreted. I made facies interpretations for each of the 36 cores by looking at the sediment types in each one. The facies I identified were marsh, natural levee, poorly drained backswamp, and bay mud. Poorly drained backswamp and bay mud share the same densities, void ratios, and compression index values. These cores were used in this study in order to calculate the autocompaction of their vertical profiles.

The autocompaction equation used by Kuecher (1994) in his study was used to calculate the autocompaction of the cores in the Sale-Cypremort area. Kuecher's calculated values of void ratio, compression index, and bulk densities were used in the equation based on the facies identified. Cumulative autocompaction measured in meters was calculated for each facies layer, progressing from top to bottom.

To measure the degree of how much compression there was relative to the thickness, I calculated the extension (e), which is a dimensionless ratio. The extension is the change in vertical length or thickness of a layer. The percent extension is found by multiplying extension by 100%. Extension is calculated by the equation:

$$e = \frac{(change\ in\ thickness)}{(original\ thickness)} = \frac{Sm}{Sm + H}$$

Extension gives the amount compaction that is not dependent on thickness. Thus, cores of varying thickness can be compared with one another.

To find a subsidence rate I used a time-depth model. Each core was assigned an age based on its basal depth by using a published time-depth curve from Coleman and Smith (1964). With the age of each core and the autocompaction, a subsidence rate could be calculated based on autocompaction such as:

$$subsidence\ rate = \frac{cumulative\ autocompaction}{age\ of\ core}$$

This rate represents the amount of time that it took for a core to compact the amount of thickness that it did.

A soil analysis was also done by using soil surveys of the soils in the area to analyze surficial compaction compared to deeper stratigraphy. This analysis only pertained to depths down to 2m. Each soil horizon was identified as either natural levee, poorly drained backswamp, or marsh so that Kuecher's compression index values, and void ratio values could be applied. Any soil containing organic material, such as peat, was placed as a marsh. All fluid clays were a poorly drained backswamp. Silty soils were natural levee. Bulk densities were found by using characterization data from Soil Lab Data (soils.gov). This soil analysis examines the amount of autocompaction within in the shallow surface, and the cores are examples of the effect of autocompaction on deeper stratigraphy.

Results:

Comparisons were made between the soil analysis for 2m depths and the data from the Holocene sediment column. Looking at the soil analysis, there were higher extension values for the shallow soils, then the deeper Holocene column. For soils characterized as natural levees, the minimum percent extension was 1.11%, the mean was 1.35% and the maximum was 1.63% (table 2). For the poorly drained backswamp facies, the minimum percent extension was 1.13%, the mean was 3.56% and the maximum was 11.96%. For marsh soils, the minimum percent extension was 1.26%, the mean was 7.11% and the maximum was 11.13%. For extension values of natural levee facies, the minimum was 2.00%, the maximum was 2.10%, and the mean was 2.04% (table 3). Poorly drained backswamp facies had a minimum extension of 1.50%, a maximum of 6.80% and a mean of 4.03%. Marsh facies had a minimum of 0.20%, a maximum of 3.30% and a mean of 1.30%. The last facies, bay mud had a minimum of 0.30%, a maximum of 3.90% and a mean 2.40%. To show the difference in extension, one example used was the Barbary soil series, a compressible muck. The Barbary soil had a thickness of 1.65m, and compressed about 7.9% from its original thickness, but the thickness of core 600393001 was much greater at 8.10m and only compressed 2.87% of its original thickness (table 4, table 5). Thus, a greater amount of compaction is seen the shallow soils than in the Holocene column.

To further analyze the difference in compaction of the shallow soils versus the deeper stratigraphy, compaction rates based on values of autocompaction were calculated. The time depth model was used to calculate these rates. By dividing the amount of compaction that occurred (Sm) with the age of the deepest sediment, the rate of compaction can be calculated.

While the compaction rates for the Holocene cores ranged from 0.02mm/yr to 0.05mm/yr, the compaction rates for the shallow soils was higher ranging from 0.57mm/yr to 1.08mm/yr (table 6).

A distinction between soft and firm facies can also be identified with the soil data. The range of percent compaction for natural levees has a much smaller range than for the other facies (figure 2). Furthermore, the extension values are the lowest of all the facies. The natural levee facies can be identified as a firm facies, while poorly drained backswamp and marsh are soft facies.

Comparisons between thickness and percent extension were drawn. Four graphs were created to compare thickness and percent extension for each facies of the Holocene columns (figure 3). The natural levee facies had a minimum percent extension of 2.0% and a maximum of 2.1%. Regardless of the thickness, the percent that natural levee facies that will compact remained around 2%. This is caused because natural levee facies for all the cores was at the surface, so the autocompaction equation set the overburden pressure at 0. For the other facies as thickness increased, a facies layer will compress a greater percentage of its original thickness.

A comparison between percent extension and depth yielded a slight trend that as depth increased, the amount of compaction increased. The minimum extension value was 1.37% and the maximum was 6.54% (figure 4). However, there is reasonable scatter, so a linear regression was applied to see if there was a significant relationship between depth and percent extension. The R^2 was 0.0277, which means that the data is too variable to have a linear goodness of fit between depth and compaction.

Discussion:

Higher compaction rates are seen in the shallow sediments when compared to the deeper Holocene stratigraphy. This is a result of the process of sediment compaction. As sediment is compacted, it goes through two stages, called primary consolidation and secondary consolidation (Yuill et al., 2009). During primary consolidation, the compaction rate is rapid as the sediments are losing pore space due to the removal of water (figure 5). During secondary consolidation, the compaction rate is slows down and is much less. In this stage, the grains are reorganizing themselves to be tightly arranged. The fact that extension is high at the surface and decreases with depth suggests that lower layers have been under load for longer than the upper layers. The Holocene cores are in the secondary stage while the sediments in the first two meters are in the first stage of consolidation. When compared to the shorter timescale of primary consolidation with the shallow soils, the deeper sediment undergoing secondary consolidation becomes insignificant at scales of serval years or longer (Kooi and de Vries, 1998). Shallow compressible soils at the sea level can easily sink beneath the water surface as a result of rapid compaction, while subsidence caused by compaction of deeper sediment is gradual.

The shallow soils could be divided into soft and firm facies. Those that were soft had compacted a greater amount, while those considered firm had compacted a smaller amount. This is one cause of differential compaction in the Mississippi Delta. Areas that contain large amounts of firm facies will experience small amounts of compaction, while those areas of the delta deemed to be composed of soft facies will see much more compaction. Furthermore, the order of the facies comes to question. A core that contains a soft facies over a firm facies will experience more compaction than a core with firm over soft. However, in my data, the firm facies, natural levee, was always on the top, so I could not compare different orders of facies in cores. Cores with different vertical profiles would be needed to further that study.

The graph comparing depth and percent extension did not exhibit a strong trend. A possible cause of this could be that the autocompaction equation assumes no horizontal flow, or movement of the sediment. However, as stated by Allen (1999), autocompaction continuously and progressively displaces and distorts buried landscapes. Allen (1999) looked at the impact of autocompaction on coastal wetlands in northern Europe. He found that in a basement valley, autcompaction causes beds to experience a progressive combination of body translation, rotation, and shear stretching. Also, in an irregular basement landscape, there is bed shearing. Thus, there can be distortion and displacement of layers after burial based on the basement landscape that is not accounted for in the autocompaction equation. There is possibility that the scatter seen in the results is caused by buckling of layers, body translation, rotation, and/or shear.

In a study done by Yu et al. (2012), the subsidence rate was found to be 1.5± 0.7 cm/100yr. My average compaction rate was 0.458cm/yr, which is 1/3 of Yu's rate. The reason for this variability is that Yu's rate incorporates the subsidence processes of glacial isostatic adjustment and sediment isostatic adjustment, while my rate is strictly measuring subsidence from autocompaction. This shows that each process contributing towards subsidence is not fully independent from one another. Thus, the contribution of Holocene compaction may only have a partial contribution to the total land subsidence.

The highest rates of sediment compaction are seen across the lower delta plain, where Holocene sediments are the thickest (figure 6.). In the Sale-Cypremort area, the thickness of the Holocene sediments and the depth to the Pleistocene are minimal when compared to other areas of the delta. Therefore, the subsidence in the area will not cause drastic change to the topography. Compaction has been calculated to be much less in the Sale-Cypremort area, than in the Mississippi River depocenter.

Conclusion:

Isolating the process of autocompaction from the other causes of land subsidence in the delta revealed that shallow soft soils are compacting at a greater rate than the whole Holocene sediment column. Both stages of consolidation are represented, as the shallow sediments are in primary consolidation and the deeper stratigraphy exhibits secondary consolidation. Analysis of the percent extension between the facies showed that facies can be split into firm and soft. Natural levee facies is firm, and poorly drained backswamp, bay mud, and marsh are soft. There is a relationship between facies thickness and compaction that as thickness increases, compaction increases. In this study, looking at the relationship between depth and percent extension showed that there may only be a slight trend that as depth to Pleistocene increases, compaction increases.

Tables and Figures:

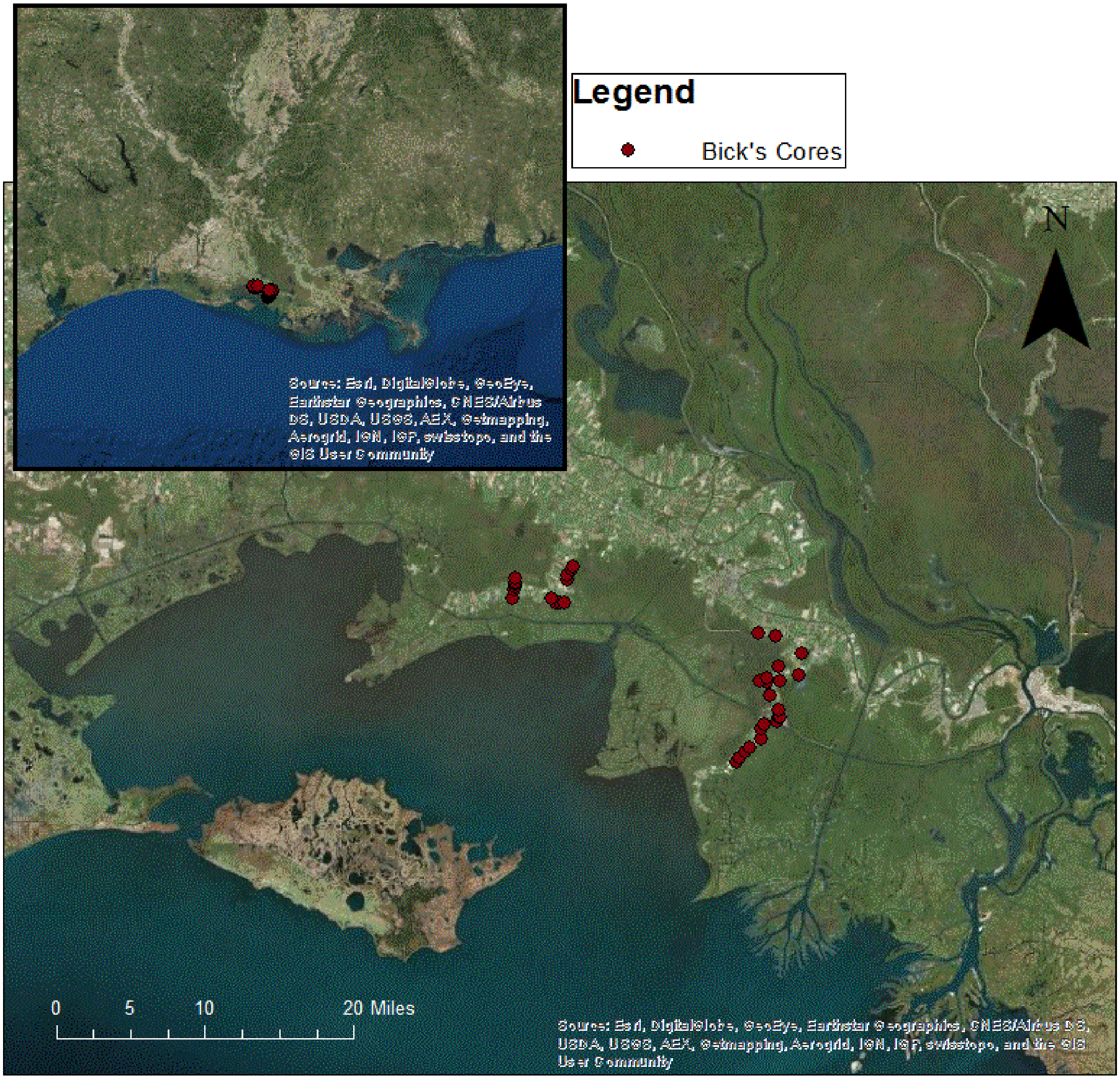

Figure 1. The location of Bick's cores in the Sale-Cypremort deltaic lobe.

Facies unit	Lithology	Cc	e0	Bulk Density (g/cm^3)
Marsh facies	peat	4.72	7.69	0.60-1.60*
Pro delta facies (upper)	mud	2.25	3.10	1.23
Pro delta facies (lower)	mud	1.03	4.67	1.23
Bay mud/poorly drained backswamp facies	mud	0.82	1.58	1.62
Distributary mouth bar	sand	0.12	0.90	1.62
Distributary mouth bar	sand (w/org)	0.23	1.61	1.62
Natural levee facies	silty	0.12	0.73	1.78
Point bar sand facies	sand	0.06	1.30	1.88
Beach sand facies	sand	0.05	0.66	2.01
*depends on depth: <2m 0.60 2-5m 1.45 5-12m 1.45 >12m 1.60				

Table 1. Compression Indices for tested deltaic facies from Kuecher (1994).

	Natural Levee	Poorly Drained Backswamp	Marsh
Min	1.11	1.13	1.26
Mean	1.35	3.56	7.11
Max	1.63	11.96	11.13

Table 2. The minimum, mean and maximum percent extension for the shallow soils.

	Natural Levee	Poorly Drained Backswamp	Marsh	Bay Mud
Min	2.00	1.50	0.20	0.30
Mean	2.04	4.03	1.30	2.40
Max	2.10	6.80	3.30	3.90

Table 3. The minimum, mean, and maximum percent extension for the Holocene core facies.

Barbary				
HORIZON	LITHOLOGY	BASAL DEPTH	Sm	SUM Sm
		(m)	(m)	(m)
Oa	muck	0.10	0.016	0.016
A	mucky clay	0.25	0.010	0.026
Cg	clay	1.65	0.026	0.052

Table 4. The autocompaction results of the Barbary soil series. The percent extension was 7.9% for a total depth thickness of 1.65m

Borehole			
600393001			
FACIES	BASAL DEPTH	Sm	SUM Sm
	(m)	(m)	(m)
NL	2.90	0.058	0.058
PDBS	4.80	0.079	0.137
Marsh	6.20	0.048	0.186
Bay Mud	8.10	0.054	0.239

Table 5. The autocompaction results of Borehole #6000393001. The percent extension was 2.87% for 8.10m.

	Compaction Rate (mm/yr)	
	Soils	Holocene Cores
min	0.57	0.02
mean	0.70	0.04
max	1.08	0.05

Table 6. The minimum, mean, and maximum compaction rates for the soils and Holocene cores.

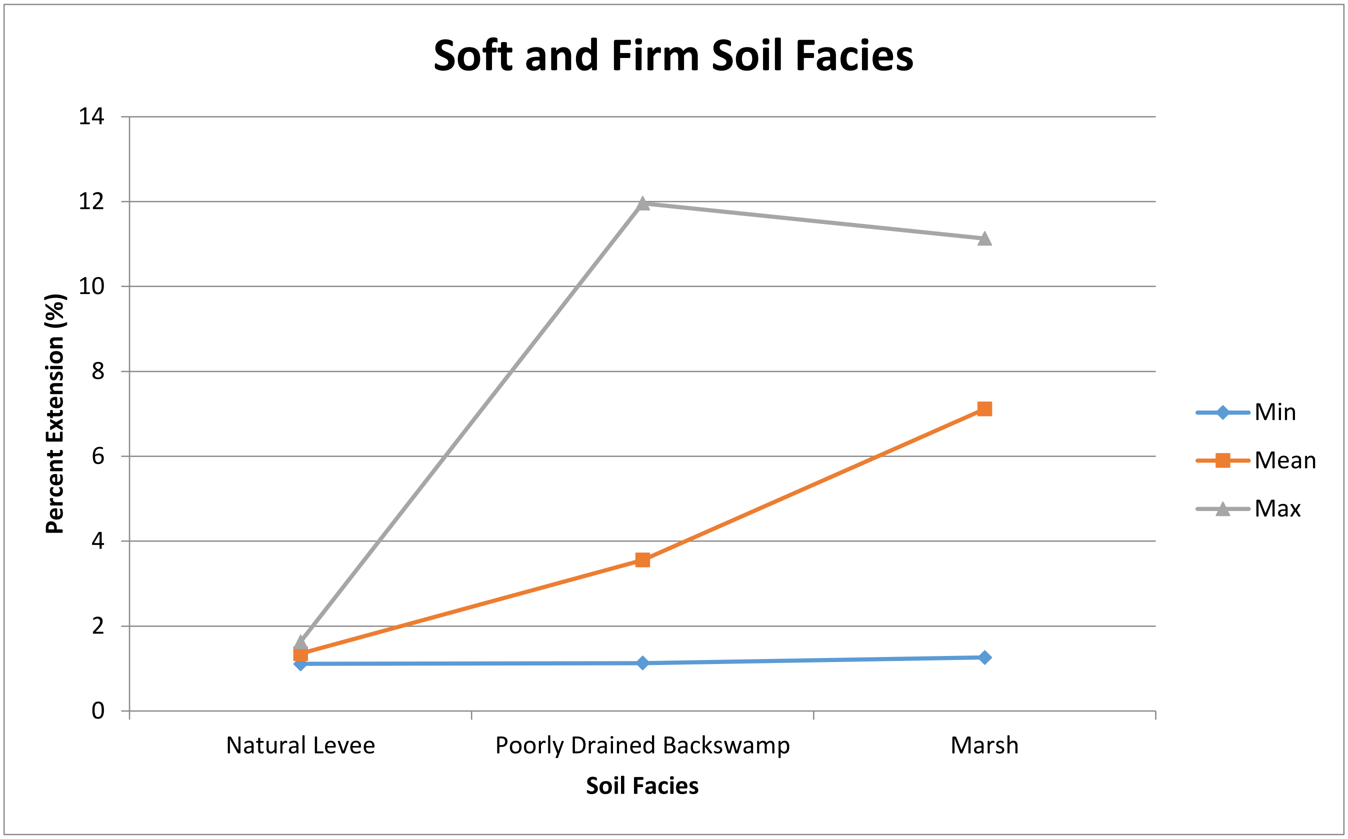

Figure 2. The minimum, maximum and average values of percent extension based on soil facies

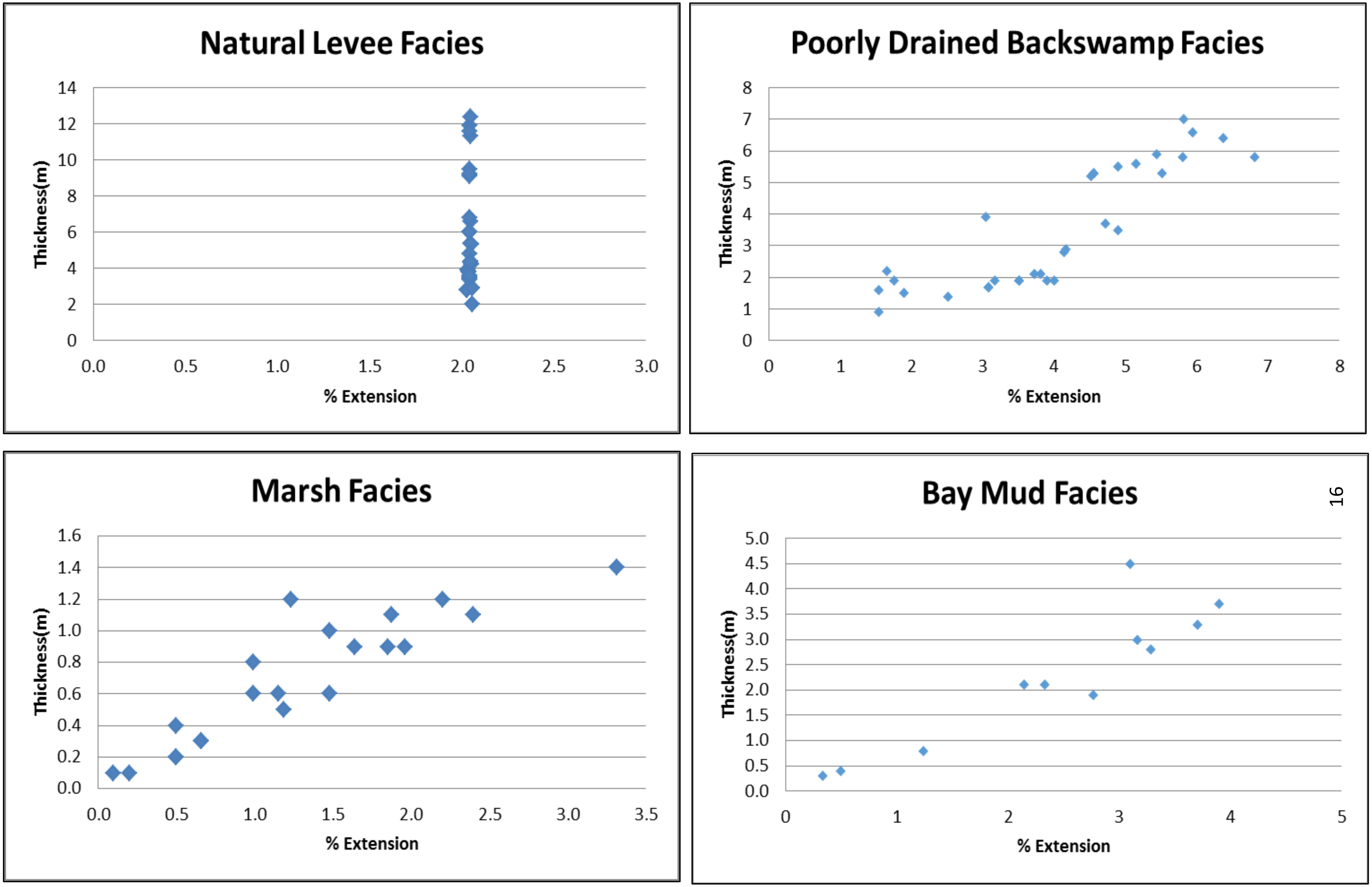

Figure 3: Graphs for each identified facies relating thickness and % extension. There is a positive trend; as thickness increases, the %extension increases.

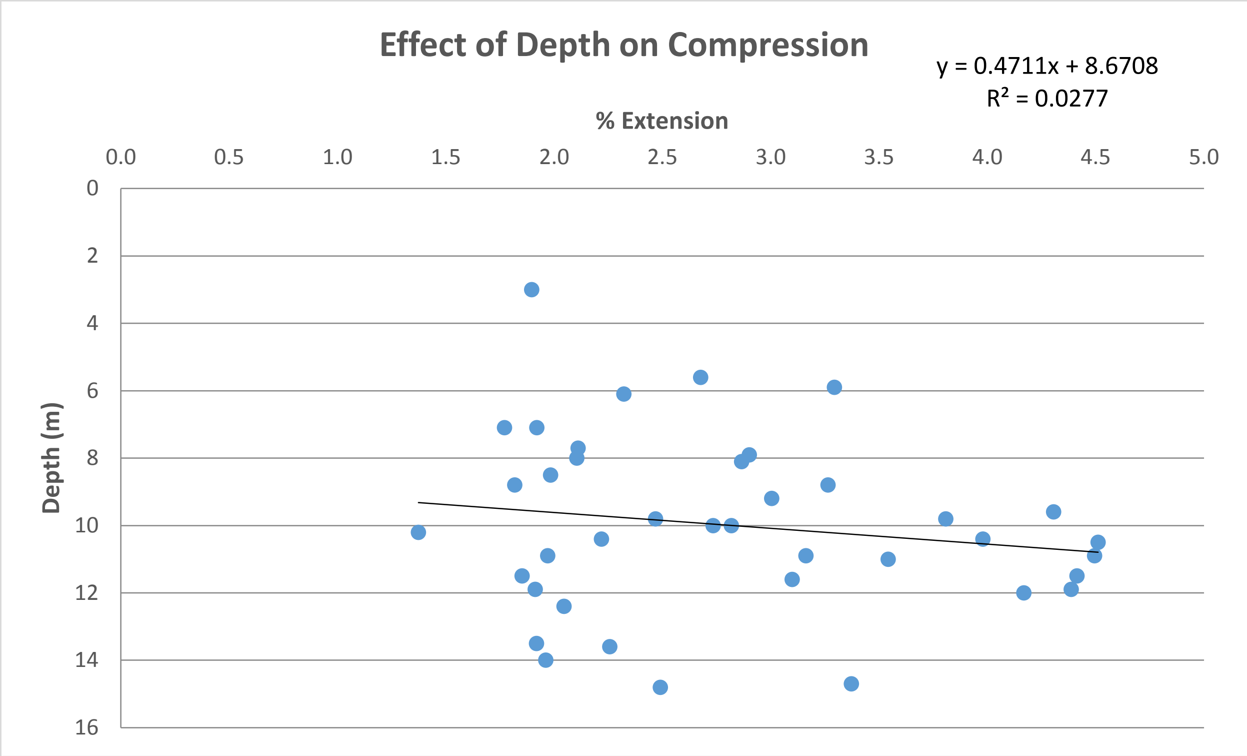

Figure 4. A comparison between depth and compaction. An R^2 value of 0.0277 means there is too much variability to apply a linear goodness of fit.

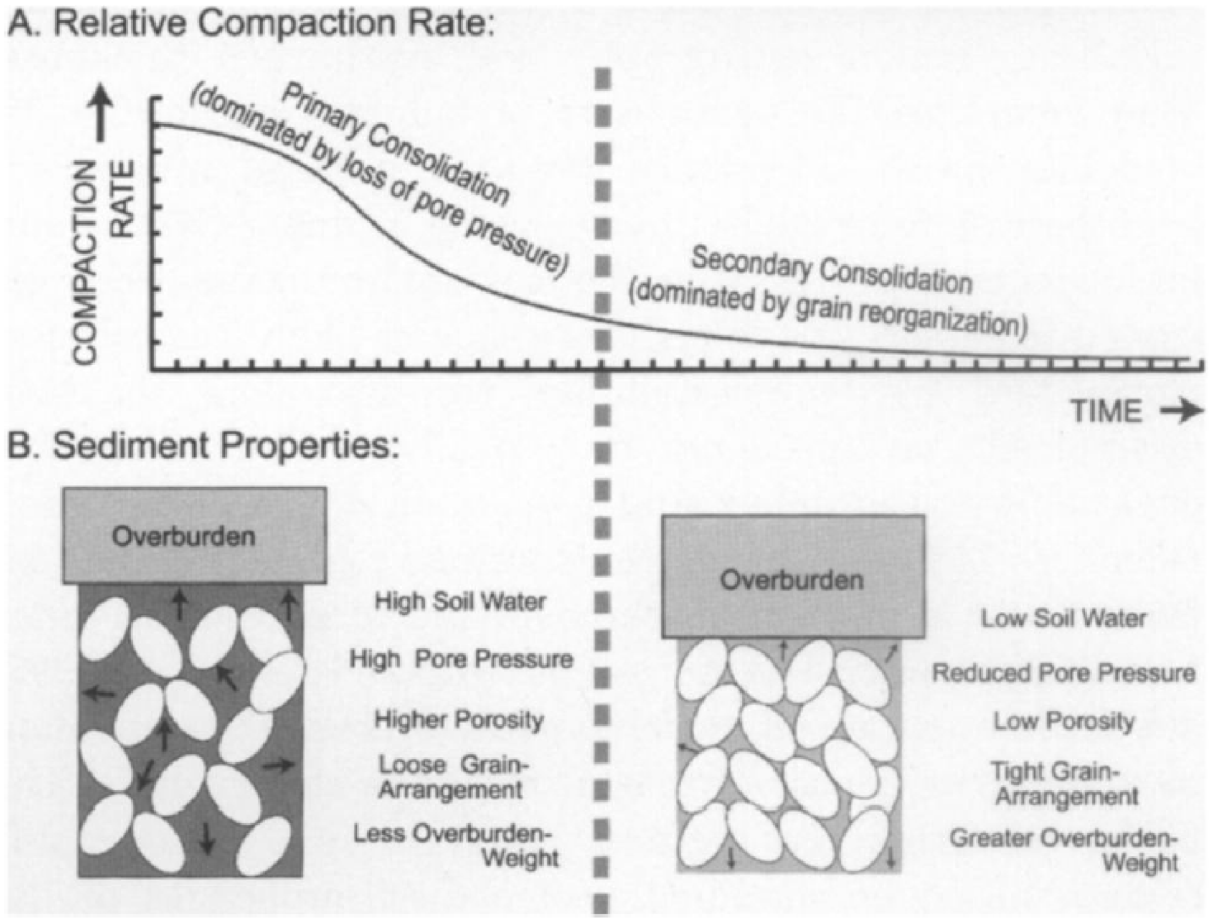

Figure 5. As sediment is compacted, it goes through 2 stages, called primary consolidation and secondary consolidation. During primary consolidation, the compaction rate is rapid. During this stage, the sediment is losing pore space due to the removal of water. During secondary consolidation, the compaction rate is slows down and is much less. During this stage, the grains are reorganizing themselves to be tightly arranged. I believe that the deeper layers have been under load for much longer (Yuill et al., 2009).

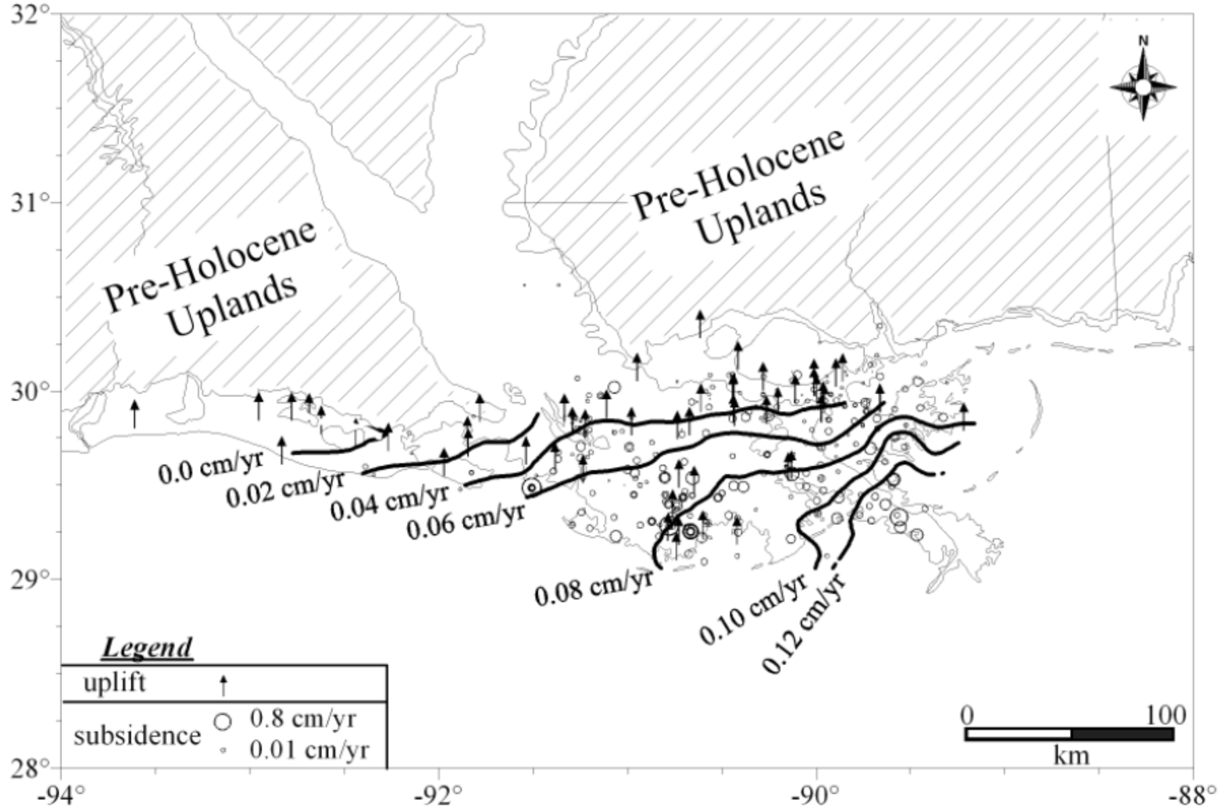

Figure 6. Higher subsidence rates are seen in the lower Mississippi Delta. The Sale-Cypremort area has lower subsidence rates (Kulp, 2000).

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Appendix:

Bick 600393

Borehole 600393001

FACIES	LITHOLOGY	DEPTH (m)	THICKNESS (m)	BASAL DEPTH (m)	BULK DENSITY (g/ cm^3)	UNIT WEIGHT (KN/m^3)	OVERBURDEN (KN/m^2)	SUM PRESSURE (KN/m^2)	Cc	e0	STRAIN	PRESSURE	Sm (m)	SUM Sm (m)
									Sm COMPONENTS					
NL	sand clay silt	0.10-2.90	2.80	2.90	1.78	17.46	21.43	21.43	0.120	0.73	0.19	0.30	0.058	0.058
PDBS	clay	2.90-4.80	1.90	4.80	1.62	15.89	11.56	32.98	0.820	1.58	0.60	0.13	0.079	0.137
Marsh	peat	4.80-6.20	1.40	6.20	1.45	14.22	6.18	39.16	4.720	7.69	0.76	0.06	0.048	0.186
Bay Mud	clay	6.20-8.10	1.90	8.10	1.62	15.89	11.56	50.72	0.820	1.58	0.60	0.09	0.054	0.239
Prairie Loess	silt clay loam	8.10-9.60	1.50	9.60	2.2	21.58	17.66	68.38	0.120	0.73	0.10	0.10	0.010	0.250

Borehole 600393002

FACIES	LITHOLOGY	DEPTH (m)	THICKNESS (m)	BASAL DEPTH (m)	BULK DENSITY (g/ cm^3)	UNIT WEIGHT (KN/m^3)	OVERBURDEN (KN/m^2)	SUM PRESSURE (KN/m^2)	Cc	e0	STRAIN	PRESSURE	Sm (m)	SUM Sm (m)
									Sm COMPONENTS					
NL	sand clay silt	0.40-3.80	3.40	3.80	1.78	17.46	26.02	26.02	0.120	0.73	0.24	0.30	0.071	0.071
PDBS	clay	3.80-7.30	3.50	7.30	1.62	15.89	21.29	47.30	0.820	1.58	1.11	0.16	0.180	0.251
Marsh	peat	7.30-7.90	0.60	7.90	1.45	14.22	2.65	49.95	4.720	7.69	0.33	0.02	0.007	0.258
Bay Mud	clay	7.90-10.90	3.00	10.90	1.62	15.89	18.25	68.20	0.820	1.58	0.95	0.10	0.098	0.356

Borehole 600393003

FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
											Sm COMPONENTS			
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-6.70	6.60	6.70	1.78	17.46	50.50	50.50	0.120	0.73	0.46	0.30	0.138	0.138
PDBS	clay	6.70-8.20	1.50	8.20	1.62	15.89	9.12	59.63	0.820	1.58	0.48	0.06	0.029	0.167
Marsh	peat	8.20-8.80	0.60	8.80	1.45	14.22	2.65	62.27	4.720	7.69	0.33	0.02	0.006	0.173
Bay Mud	clay	8.80-10.90	2.10	10.90	1.62	15.89	12.77	75.05	0.820	1.58	0.67	0.07	0.046	0.219

Borehole 600393004

FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
											Sm COMPONENTS			
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-4.40	3.90	4.40	1.78	17.46	29.84	29.84	0.120	0.73	0.27	0.30	0.081	0.081
PDBS	clay	4.40-8.10	3.70	8.10	1.62	15.89	22.50	52.35	0.820	1.58	1.18	0.16	0.183	0.264
Marsh	peat	8.10-9.20	1.10	9.20	1.45	14.22	4.86	57.20	4.720	7.69	0.60	0.04	0.021	0.285

Borehole 600393005

FACIES	LITHOLOGY	DEPTH (m)	THICKNESS (m)	BASAL DEPTH (m)	BULK DENSITY (g/ cm^3)	UNIT WEIGHT (KN/m^3)	OVERBURDEN (KN/m^2)	SUM PRESSURE (KN/m^2)	Cc	e0	STRAIN	PRESSURE	Sm (m)	SUM Sm (m)
									Sm COMPONENTS					
NL	sand clay silt	0.50-5.90	5.40	5.90	1.78	17.46	41.32	41.32	0.120	0.73	0.37	0.30	0.113	0.113
PDBS	clay	5.90-6.80	0.90	6.80	1.62	15.89	5.47	46.79	0.820	1.58	0.29	0.05	0.014	0.126
Marsh	peat	6.80-7.10	0.30	7.10	1.45	14.22	1.32	48.12	4.720	7.69	0.16	0.01	0.002	0.128

Borehole 600393006

FACIES	LITHOLOGY	DEPTH (m)	THICKNESS (m)	BASAL DEPTH (m)	BULK DENSITY (g/ cm^3)	UNIT WEIGHT (KN/m^3)	OVERBURDEN (KN/m^2)	SUM PRESSURE (KN/m^2)	Cc	e0	STRAIN	PRESSURE	Sm (m)	SUM Sm (m)
									Sm COMPONENTS					
NL	sand clay silt	0.10-3.50	3.40	3.50	1.78	17.46	26.02	26.02	0.120	0.73	0.24	0.30	0.071	0.071
PDBS	clay	3.50-5.60	2.10	5.60	1.62	15.89	12.77	38.79	0.820	1.58	0.67	0.12	0.083	0.154

Borehole 600393007

FACIES	LITHOLOGY	DEPTH (m)	THICKNESS (m)	BASAL DEPTH (m)	BULK DENSITY (g/ cm^3)	UNIT WEIGHT (KN/m^3)	OVERBURDEN (KN/m^2)	SUM PRESSURE (KN/m^2)	Cc	e0	STRAIN	PRESSURE	Sm (m)	SUM Sm (m)
									Sm COMPONENTS					
NL	sand clay silt	0.60-4.40	3.80	4.40	1.78	17.46	29.08	29.08	0.120	0.73	0.26	0.30	0.079	0.079
PDBS	clay	4.40-7.20	2.80	7.20	1.62	15.89	17.03	46.11	0.820	1.58	0.89	0.14	0.121	0.201
Prairie Loess	Silt Loam	7.20-8.10	0.9	8.10	2.2	21.58	10.59	10.59	0.12	0.73	0.06	0.30	0.019	0.220

Borehole														
600393008											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-3.70	3.50	3.70	1.78	17.46	26.78	26.78	0.120	0.73	0.24	0.30	0.073	0.073
PDBS	clay	3.70-5.60	1.90	5.60	1.62	15.89	11.56	38.34	0.820	1.58	0.60	0.11	0.069	0.142
Marsh	peat	5.60-5.90	0.30	5.90	1.45	14.22	1.32	39.66	4.720	7.69	0.16	0.01	0.002	0.145
Prairie Loess	Silt Loam	5.90-8.70	2.80	8.70	2.2	21.58	32.96	72.62	0.12	0.73	0.19	0.16	0.032	0.176

Borehole														
600393009											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-7.30	6.80	7.30	1.78	17.46	52.03	52.03	0.120	0.73	0.47	0.30	0.142	0.142
PDBS	clay	7.30-10.20	2.90	10.20	1.62	15.89	17.64	69.67	0.820	1.58	0.92	0.10	0.090	0.232
Prairie Loess	Silt Loam	10.20-10.70	0.50	10.70	2.2	21.58	5.89	5.89	0.12	0.73	0.03	0.30	0.010	0.243

Borehole														
600393010											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.70-2.70	2.00	2.70	1.78	17.46	15.30	15.30	0.120	0.73	0.14	0.30	0.042	0.042
PDBS	clay	2.70-8.50	5.80	8.50	1.62	15.89	35.28	50.58	0.820	1.58	1.84	0.23	0.424	0.465
Marsh	peat	8.50-9.40	0.90	9.40	1.45	14.22	3.97	54.55	4.700	7.69	0.49	0.03	0.015	0.480
PDBS	clay	9.40-11.50	2.10	11.50	1.62	15.89	12.77	67.33	0.820	1.58	0.67	0.08	0.050	0.531
Prairie Loess	Silt Loam	11.50-12.10	0.60	12.10	2.2	21.58	7.06	74.39	0.12	0.73	0.04	0.04	0.002	0.532

600393011											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.7-4.90	4.20	4.90	1.78	17.46	32.14	32.14	0.120	0.73	0.29	0.30	0.088	0.088
PDBS	clay	4.90-6.80	1.90	6.80	1.62	15.89	11.56	43.69	0.820	1.58	0.60	0.10	0.062	0.149
Marsh	peat	6.80-7.70	0.90	7.70	1.45	14.22	3.97	47.67	4.720	7.69	0.49	0.03	0.017	0.166
Prairie Loess	Silt Loam	7.70-8.70	1.00	8.70	2.2	21.58	11.77	11.77	0.12	0.73	0.07	0.30	0.021	0.187

600393012											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.40-12.30	11.90	12.30	1.78	17.46	91.06	91.06	0.120	0.73	0.83	0.30	0.248	0.248
Marsh	peat	12.30-13.50	1.20	13.50	1.45	14.22	5.30	96.35	4.720	7.69	0.65	0.02	0.015	0.264
Prairie Loess	Silt Loam	13.50-13.70	0.20	13.70	2.2	21.58	2.35	98.71	0.12	0.73	0.01	0.01	0.000	0.264

600393013											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-4.40	3.90	4.40	1.78	17.46	29.84	29.84	0.120	0.73	0.27	0.30	0.081	0.081
PDBS	clay	4.40-6.10	1.70	6.10	1.62	15.89	10.34	40.18	0.820	1.58	0.54	0.10	0.054	0.135
Marsh	peat	6.10-7.00	0.90	7.00	1.45	14.22	3.97	44.15	4.720	7.69	0.49	0.04	0.018	0.153
PDBS	clay	7.00-9.80	2.80	9.80	1.62	15.89	17.03	61.18	0.82	1.58	0.89	0.11	0.095	0.248
Prairie Loess	Silt Loam	9.80-10.20	0.40	10.20	2.2	21.58	4.71	65.89	0.12	0.73	0.03	0.03	0.001	0.249

600393014											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-4.00	3.50	4.00	1.78	17.46	26.78	26.78	0.120	0.73	0.24	0.30	0.073	0.073
PDBS	clay	4.00-6.10	2.10	6.10	1.62	15.89	12.77	39.55	0.820	1.58	0.67	0.12	0.081	0.154
Marsh	peat	6.10-6.70	0.60	6.70	1.45	14.22	2.65	42.20	4.720	7.69	0.33	0.03	0.009	0.163
PDBS	clay	6.7-10.00	3.30	10.00	1.62	15.89	20.07	62.27	0.82	1.58	1.05	0.12	0.127	0.290

600393015												Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.5-10.00	9.50	10.00	1.78	17.46	72.69	72.69	0.120	0.73	0.66	0.30	0.198	0.198
PDBS	clay	10.00-10.80	1.90	11.90	1.62	15.89	11.56	84.25	0.820	1.58	0.60	0.06	0.034	0.232

600393016												Sm COMPONENTS		
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.5-5.8	5.30	5.80	1.78	17.46	40.55	40.55	0.120	0.73	0.37	0.30	0.111	0.111
PDBS	clay	5.80-11.30	5.50	11.30	1.62	15.89	33.45	74.01	0.820	1.58	1.75	0.16	0.283	0.394
Marsh	peat	11.30-12.10	0.80	12.10	1.45	14.22	3.53	77.54	4.720	7.69	0.43	0.02	0.008	0.402
PDBS	clay	12.10-16.60	4.50	16.60	1.62	15.89	27.37	104.91	0.82	1.58	1.43	0.10	0.144	0.546

600393017												Sm COMPONENTS		
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.6-11.9	11.30	11.90	1.78	17.46	86.47	86.47	0.120	0.73	0.78	0.30	0.236	0.236

600393018											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-4.50	4.40	4.50	1.78	17.46	33.67	33.67	0.120	0.73	0.31	0.30	0.092	0.092
PDBS	clay	4.50-10.40	5.90	10.40	1.62	15.89	35.88	69.55	0.820	1.58	1.88	0.18	0.339	0.431
Prairie Loess	silt loam	10.40-11.20	0.80	11.20	1.62	15.89	4.87	4.87	0.12	0.73	0.06	0.30	0.017	0.447

600393019											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.40-12.80	12.40	12.80	1.78	17.46	94.88	94.88	0.120	0.73	0.86	0.30	0.259	0.259

600393020											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.70-4.50	3.80	4.50	1.78	17.46	29.08	29.08	0.120	0.73	0.26	0.30	0.079	0.079
PDBS	clay	4.50-9.80	5.30	9.80	1.62	15.89	32.24	61.31	0.820	1.58	1.68	0.18	0.309	0.388

600393021											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-4.40	3.90	4.40	1.78	17.46	29.84	29.84	0.120	0.73	0.27	0.30	0.081	0.081
PDBS	clay	4.40-6.10	1.70	6.10	1.62	15.89	10.34	40.18	0.820	1.58	0.54	0.10	0.054	0.135
Marsh	peat	6.10-7.20	1.10	7.20	1.45	14.22	4.86	45.04	4.720	7.69	0.60	0.04	0.027	0.162
PDBS	clay	7.20-8.00	0.80	8.00	1.62	15.89	4.87	49.90	0.82	1.58	0.25	0.04	0.010	0.172
Prairie Loess	Silt Loam	8.00-10.80	2.80	10.80	2.2	21.58	32.96	82.87	0.12	0.73	0.19	0.15	0.028	0.200

600393022											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.50-3.50	3.90	3.50	1.78	17.46	29.84	29.84	0.120	0.73	0.27	0.30	0.081	0.081
PDBS	clay	3.50-6.40	2.90	6.40	1.62	15.89	17.64	47.48	0.820	1.58	0.92	0.14	0.126	0.208
Marsh	peat	6.40-7.60	1.20	7.60	1.45	14.22	5.30	52.78	4.720	7.69	0.65	0.04	0.027	0.235
PDBS	clay	7.60-7.90	0.30	7.90	1.62	15.89	1.82	54.60	0.82	1.58	0.10	0.01	0.001	0.236
Prairie Loess	Silt Loam	7.90-8.50	0.60	8.50	2.2	21.58	7.06	61.67	0.12	0.73	0.04	0.05	0.002	0.238

600393023											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-11.80	11.60	11.80	1.78	17.46	88.76	88.76	0.120	0.73	0.80	0.30	0.242	0.242
PDBS	clay	11.80-14.00	2.20	14.00	1.62	15.89	13.38	102.14	0.820	1.58	0.70	0.05	0.037	0.280

600393024									Sm COMPONENTS					
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-9.30	9.10	9.30	1.78	17.46	69.63	69.63	0.120	0.73	0.63	0.30	0.190	0.190
PDBS	clay	9.30-13.20	3.90	13.20	1.62	15.89	23.72	93.35	0.820	1.58	1.24	0.10	0.122	0.312
Marsh	peat	13.20-13.60	0.40	13.60	1.45	14.22	1.77	95.12	4.720	7.69	0.22	0.01	0.002	0.314
Prairie Loess	Silt Loam	13.70-14.40	0.80	14.40	2.2	21.58	9.42	104.54	0.12	0.73	0.06	0.04	0.002	0.316

600393025									Sm COMPONENTS					
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.70-5.00	4.30	5.00	1.78	17.46	32.90	32.90	0.120	0.73	0.30	0.30	0.090	0.090
PDBS	clay	5.00-12.00	7.00	12.00	1.62	15.89	42.58	75.48	0.820	1.58	2.22	0.19	0.432	0.522

600393026									Sm COMPONENTS					
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-3.00	2.80	3.00	1.78	17.46	21.43	21.43	0.120	0.73	0.19	0.30	0.058	0.058

600393027											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.70-9.90	9.20	9.90	1.78	17.46	70.40	70.40	0.120	0.73	0.64	0.30	0.192	0.192
PDBS	clay	9.90-11.50	1.60	11.50	1.62	15.89	9.73	80.13	0.820	1.58	0.51	0.05	0.025	0.217
Prairie Loess	Silt Loam	11.50-12.20	0.70	12.20	2.2	21.58	8.24	88.37	0.12	0.73	0.05	0.04	0.002	0.219

600393028											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-3.90	3.80	3.90	1.78	17.46	29.08	29.08	0.120	0.73	0.26	0.30	0.079	0.079
PDBS	clay	3.90-10.50	6.60	10.50	1.62	15.89	40.14	69.22	0.820	1.58	2.10	0.20	0.417	0.496
Prairie Loess	Silt Loam	10.50-10.70	0.20	10.70	2.2	21.58	2.35	71.57	0.12	0.73	0.01	0.01	0.000	0.496

600393029											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.40-6.40	6.00	6.40	1.78	17.46	45.91	45.91	0.120	0.73	0.42	0.30	0.125	0.125
PDBS	clay	6.40-11.60	5.20	11.60	1.62	15.89	31.63	77.54	0.820	1.58	1.65	0.15	0.246	0.371
Prairie Loess	Silt Loam	11.60-12.10	0.50	12.10	2.2	21.58	5.89	83.42	0.12	0.73	0.03	0.03	0.001	0.372

600393030											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-9.40	6.00	9.40	1.78	17.46	45.91	45.91	0.120	0.73	0.42	0.30	0.125	0.125
PDBS	clay	9.40-14.70	5.30	14.70	1.62	15.89	32.24	78.15	0.820	1.58	1.68	0.15	0.253	0.378
Marsh	peat	14.70-14.80	0.10	14.80	1.45	14.22	0.44	78.59	4.720	7.69	0.05	0.00	0.00013	0.378
Prairie Loess	Silt Loam	14.80-15.40	0.60	15.40	2.2	21.58	7.06	85.21	0.12	0.73	0.04	0.03	0.001	0.380

600393031											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-10.40	6.00	9.40	1.78	17.46	45.91	45.91	0.120	0.73	0.42	0.30	0.125	0.125
PDBS	clay	10.40-15.60	5.30	14.70	1.62	15.89	32.24	78.15	0.820	1.58	1.68	0.15	0.253	0.378
Prairie Loess	Silt Loam	15.60-16.20	0.80	15.50	2.2	21.58	9.42	87.56	0.12	0.73	0.06	0.04	0.002	0.380

600393032											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-3.10	2.90	3.10	1.78	17.46	22.19	22.19	0.120	0.73	0.20	0.30	0.061	0.061
PDBS	clay	3.10-9.50	6.40	9.50	1.62	15.89	38.93	61.12	0.820	1.58	2.03	0.21	0.435	0.496
Marsh	peat	9.50-10.50	1.00	10.50	1.45	14.22	4.41	65.53	4.720	7.69	0.54	0.03	0.015	0.511
PDBS	clay	10.50-10.90	0.40	10.90	1.62	15.89	2.43	67.96	0.820	1.58	0.13	0.02	0.002	0.513
Prairie Loess	Silt Loam	10.90-11.20	0.30	11.20	2.2	21.58	3.53	71.50	0.12	0.73	0.02	0.02	0.000	0.514

600393033											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.20-5.00	2.90	5.00	1.78	17.46	22.19	22.19	0.120	0.73	0.20	0.30	0.061	0.061
PDBS	clay	5.00-6.90	1.90	6.90	1.62	15.89	11.56	33.75	0.820	1.58	0.60	0.13	0.077	0.138
Marsh	peat	6.90-7.10	0.20	7.10	1.45	14.22	0.88	34.63	4.720	7.69	0.11	0.01	0.001	0.139
Prairie Loess	Silt Loam	7.10-7.50	0.40	7.50	2.2	21.58	4.71	39.34	0.12	0.73	0.03	0.05	0.001	0.140

600393034											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-3.70	3.60	3.70	1.78	17.46	27.55	27.55	0.120	0.73	0.25	0.30	0.075	0.075
PDBS	clay	3.70-9.50	5.80	9.50	1.62	15.89	35.28	62.82	0.820	1.58	1.84	0.19	0.357	0.432
Marsh	peat	9.50-9.60	0.10	9.60	1.45	14.22	0.44	63.26	4.720	7.69	0.05	0.00	0.0002	0.432
Prairie Loess	Silt Loam	9.60-10.40	0.80	10.40	2.2	21.58	9.42	72.68	0.12	0.73	0.06	0.05	0.003	0.435

600393035											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.40-5.20	4.80	5.20	1.78	17.46	36.73	36.73	0.120	0.73	0.33	0.30	0.100	0.100
PDBS	clay	5.20-10.80	5.60	10.80	1.62	15.89	34.06	70.79	0.820	1.58	1.78	0.17	0.304	0.404
Marsh	peat	10.80-11.00	0.20	11.00	1.45	14.22	0.88	71.67	4.720	7.69	0.11	0.01	0.001	0.404
Prairie Loess	Silt Loam	11.00-12.10	1.10	12.10	2.2	21.58	12.95	84.62	0.12	0.73	0.08	0.06	0.005	0.409

600393036											Sm COMPONENTS			
FACIES	LITHOLOGY	DEPTH	THICKNESS	BASAL DEPTH	BULK DENSITY	UNIT WEIGHT	OVERBURDEN	SUM PRESSURE	Cc	e0	STRAIN	PRESSURE	Sm	SUM Sm
		(m)	(m)	(m)	(g/ cm^3)	(KN/m^3)	(KN/m^2)	(KN/m^2)					(m)	(m)
NL	sand clay silt	0.10-4.40	4.30	4.40	1.78	17.46	32.90	32.90	0.120	0.73	0.30	0.30	0.090	0.090
PDBS	clay	4.40-5.80	1.40	5.80	1.62	15.89	8.52	41.42	0.820	1.58	0.44	0.08	0.036	0.126
Marsh	peat	5.80-6.30	0.50	6.30	1.45	14.22	2.21	43.63	4.720	7.69	0.27	0.02	0.006	0.132
PDBS	clay	6.30-10.00	3.70	10.00	1.62	15.89	22.50	66.13	0.820	1.58	1.18	0.13	0.150	0.281
Prairie Loess	Silt Loam	10.00-11.60	1.60	11.60	2.2	21.58	18.84	84.96	0.12	0.73	0.11	0.09	0.010	0.291