EVALUATING DYNAMIC SOIL CHANGE IN THE BARNES SOIL SERIES ACROSS EASTERN NORTH DAKOTA

A Thesis
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

Brandon Lee Montgomery

In Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE

Major Department:
Soil Science

December 2014

Fargo, North Dakota

North Dakota State University
Graduate School

Title

Evaluating Dynamic Soil Change in the Barnes Soil Series
Across Eastern North Dakota

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MASTER OF SCIENCE

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ABSTRACT

Quantifying long-term, global soil change is of the utmost importance as the human population continues growing and food security needs intensify. North Dakota presents a unique opportunity to study dynamic soil change because of its agricultural prominence and extensive soil survey data. A resampling method to characterize soil change from legacy soil survey data was utilized on a benchmark soil series, the Barnes, in North Dakota. Significant decreases ($p<0.05$) in soil organic carbon (SOC) were measured in surface horizons of three Barnes pedons, and depending upon management practices, morphologic changes ranged from highly eroded, with the complete loss of the A horizon, at two sites, to non-eroded conditions at sites returned to CRP 25 years ago. Additionally, using remotely sensed evapotranspiration (ET) data as a non-biased proxy for soil function shows modeling potential. These results serve as a proof of concept and demonstrate the need for more comprehensive research.

ACKNOWLEDGEMENTS

This research was funded by a grant from the United States Department of Agriculture-Natural Resources Conservation Service's National Soil Survey Center. I would like to extend a heartfelt thank you to my major advisor Dr. David Hopkins, for his patience, insight, knowledge, and assistance in every step of this research. I would also like to thank Elizabeth Burdolski, John Breker, and Darin Wilwand for their assistance with laboratory analysis and data management. Special thanks go out to Rodney Utter for his help in all aspects of field sampling and laboratory analysis. The remaining members of my committee: Dr. Tom Desutter, Dr. Amitava Chatterjee, and Dr. Dean Steele, also deserve recognition for always being available for guidance and a fresh perspective. I also would like to thank Sheldon Tuscherer for his expertise in processing the METRIC data for this work, and NRCS personnel Dr. Doug Wysocki, Alan Gulsivig, and Lance Duey for their help with laboratory analysis and soil sampling. To Brianna, thank you for being there with me through the good and bad, 38. Finally, I would like to thank my family and friends for always supporting me.

DEDICATION

To my parents, who have supported me whole-heartedly in everything I do.

TABLE OF CONTENTS

ABSTRACT iii

ACKNOWLEDGEMENTS iv

DEDICATION v

LIST OF TABLES xi

LIST OF FIGURES xii

INTRODUCTION 1

THESIS ORGANIZATION 3

LITERATURE REVIEW 4

Utilizing Legacy Soil Survey Data to Evaluate Soil Change 4

Natural Soil Formation and Soil Change 4

Human-Induced Soil Formation and Soil Change 5

Consequences of Soil Change 7

Conventional Methods for Measuring Soil Change 9

Justification and Explanation of the New Approach 11

Satellite Data and Assessment of Soil Function 12

Objectives 13

LIMITATIONS IN UTILIZING LEGACY SOIL SURVEY DATA TO ASSESS DYNAMIC SOIL CHANGE: A CASE STUDY ON A NORTHERN MOLLISOL 15

Abstract 15

Introduction 15

Dynamic Soil Properties....15

Evidence of Changes on Barnes landscapes....16

Importance of Long-Term Studies of Soil Function....17

Long-term Field Experiments....17

Space-for-Time Experiments....18

Materials and Methods....19

Study Area....19

Determination of Potential Sampling Locations....21

Surface Horizons....26

Site Location....26

Transect Design....26

Descriptions of Pedons....27

Laboratory Methods....27

Statistics....28

Results and Discussion....28

Chemical Changes in the Barnes Series over 50 years....28

Soil Organic Carbon....28

Soil Water Characteristics....31

Other Analyses....32

Morphologic Property Changes in the Barnes Series over 50 years....33

Highly Eroded 33

Slightly to Moderately Eroded..39

Not Eroded 43

Productivity Index Values...48

Summary 48

Evaluation of Resampling Method 49

Limitations of the Resampling Method 49

Database Fragmentation..49

Resampling Difficulties 49

Variation in Descriptions...50

Conclusion 51

ADDITIONAL MATERIALS AND METHODS UTILIZED 52

Soil Sampling Methods 52

Soil Core Descriptions...54

Soil Description Variations..55

Laboratory Methods...55

EVALUATION OF REMOTELY-SENSED EVAPOTRANSPIRATION DATA AS A PROXY FOR SOIL FUNCTION 64

Introduction...64

Materials and Methods 65

METRIC™ Model 67

Results....68

Discussion....68

Future Work....70

Suitability for Soil Landscape Studies....70

Calculating Pixel Spillover....70

Kriging....72

Conclusions....72

GENERAL CONCLUSIONS....73

REFERENCES....75

APPENDIX A. GENERAL INFORMATION FOR PRE-1960 PEDONS....90

APPENDIX B. TRANSCRIBED PEDON DESCRIPTIONS FOR ALL SITES.....118

APPENDIX C. NOTES TAKEN DURING FIELD DESCRIPTIONS OF PEDONS....393

APPENDIX D. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR DICKEY COUNTY 1....402

APPENDIX E. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR DICKEY COUNTY 3....403

APPENDIX F. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR STEELE COUNTY....404

APPENDIX G. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR WALSH COUNTY 1....405

APPENIDIX H. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR WALSH COUNTY 2....406

APPENDIX I. GPS LOCATIONS FOR CASS COUNTY PEDONS....407

APPENDIX J. GPS LOCATIONS FOR DICKEY COUNTY 1 PEDONS.............................408

APPENDIX K. GPS LOCATIONS FOR DICKEY COUNTY 2 PEDONS............................409

APPENDIX L. GPS LOCATIONS FOR DICKEY COUNTY 3 PEDONS 410

APPENDIX M. GPS LOCATIONS FOR STEELE COUNTY PEDONS 411

APPENDIX N. GPS LOCATIONS FOR WALSH COUNTY 1 PEDONS............................412

APPENDIX O. GPS LOCATIONS FOR WALSH COUNTY 2 PEDONS............................413

APPENDIX P. TABLE CORRELATING SAMPLE ID TO SITE, PEDON, HORIZON, AND HORIZON UPPER AND LOWER DEPTHS 414

APPENDIX Q. PARTICLE FRACTIONATION FROM PIPETTE PARTICLE SIZE ANALYSIS FOR HISTORIC AND CURRENT PEDONS 437

APPENDIX R. SOIL ORGANIC CARBON SOIL ORGANIC MATTER AND WATER CHARACTERISTIC INFORMATION FOR HISTORIC AND CURRENT PEDONS 440

APPENDIX S. TEXTURE, SOM, CCE, EC 1:1, ECE, PH 1:1, AND TOTAL CARBON, NITROGEN AND SULFUR FOR TRANSECT PEDONS...442

APPENDIX T. EXTRACTABLE CALCIUM, MAGNESIUM, POTASSIUM, SODIUM, CEC 7, AND CORRECTED GYPSUM %...473

APPENDIX U. SAS OUTPUT FOR MATCHED PAIRS T-TEST ON BARNES SURFACE HORIZON WALKLEY-BLACK SOIL ORGANIC CARBON % 504

APPENDIX V. SITE CORRELATION TABLE...505

APPENDIX W. CROPPING HISTORIES FOR ALL STUDY SITES FROM 1997-2013.....506

APPENDIX X. PEDON REPRESENTATIONS FOR THE THREE SAMPLE SITES NOT UTILIZED IN THE MAIN CHARACTERIZATION ANALYSIS 508

LIST OF TABLES

Table | Page

1. Soil Organic Carbon (SOC) values for historic and current pedons. 29

2. Soil organic matter (SOM) and selected morphologic data for the Cass County site. Data presented represent the catenary variation across the slope gradient at the site. 34

3. Soil organic matter (SOM) and selected morphologic data for the Walsh County 2 site. Data presented represent the catenary variation across the slope gradient at the site. 35

4. Soil organic matter (SOM) and selected morphologic data for the Dickey County 1 site. Data presented represent the catenary variation across the slope gradient at the site. 40

5. Soil organic matter (SOM) and selected morphologic data for the Dickey County 2 site. Data presented represent the catenary variation across the slope gradient at the site. 41

6. Soil organic matter (SOM) and selected morphologic data for the Steele County site. Data presented represent the catenary variation across the slope gradient at the site. 42

7. Soil organic matter (SOM) and selected morphologic data for the Dickey County 3 site. Data presented represent the catenary variation across the slope gradient at the site. 46

8. Soil organic matter (SOM) and selected morphologic data for the Walsh County 1 site. Data presented represent the catenary variation across the slope gradient at the site. 47

9. Chemical analyses completed by the Kellogg Soil Survey Laboratory and the laboratory method codes for those analyses. 59

10. Distribution of ETrF estimates by landscape position for six sites. 68

11. Reclassified pixel elements used to refine ETrF estimates for the six sites. 71

LIST OF FIGURES

Figure **Page**

1. North Dakota's Major Land Resource Areas (Soil Survey Staff, 2010b) 20

2. Barnes photograph published in the 1924 Cass County soil survey (Knobel et al., 1924). 23

3. Mollic epipedon thickness and a one standard deviation bar for 40 Barnes characterization pedons sampled in North Dakota before 1960. The thick, black horizontal line represents the mean (20 cm) of all historic pedons. 25

4. Pedon representations for the four main characterization sites in this study. Colors were converted from Munsell notation to RGB for these visualizations. The thin (3 cm) horizon visible between the Ap and Bk1 horizons on the present day Walsh County 2 pedon is a transitional Bk horizon too small to be labeled... 30

5. Detail of a pore lined with the historic Ap horizon residue at Cass County. This ped was found at the historic pedon location at a depth of approximately 5 cm. Photo courtesy of D. Hopkins. 37

6. Photograph of a Barnes silt loam, in the late 1930's in Foster County, ND. Photo Courtesy of the North Dakota Agricultural Experiment Station (NDAES) and William M. Johnson. 44

7. Schematic of transects for Cass County overlaid on a LiDAR digital elevation model. Distance from the central pedon (red) to ancillary points (green) is 45 m. Cass County Highway 18 is the obvious North-South feature shown on the image. Different colors represent 0.30 meter (1 foot) contour intervals. 53

8. Transect sampling with the Giddings probe at Dickey County 1. Photo courtesy of B. L. Montgomery. 54

9. Landsat 5 path coverage and potential sampling site locations. These satellite images are cloud free and could be utilized in modeling. It is important to note that the site furthest east above does not fall within the satellites path.. 66

10. Transect layout in relation to the ET map produced for the area. This map also shows the number of pedons located within one 30 x 30 m pixel. 69

INTRODUCTION

The world's soils are changing and being altered constantly; from natural soil erosion to soil restoration projects, many diverse processes change soil. An understanding of these changes and their causes is of the utmost importance to humankind. Humans are dependent upon soil for almost every aspect of their lives, many times in ways not readily apparent. From its uses as an engineering material for construction, a medium for plant growth, or a remediator of environmental pollution, soils are a vital resource. In order to protect and improve this resource for future generations, and halt the many negative changes occurring across the globe, soil change must be quantified.

Feeding the world's population has long been the most important function of the Earth's soils, and looking to the future, this will become even more critical. Long-term population estimates continue to rise and current worldwide agricultural outputs will not be able to provide the dietary requirements for increasing populations. In order to provide these requirements, growth in food production must be realized and preserving soil health will be crucial. Increasing these agricultural outputs is a critical undertaking and soil change must be recognized and understood as it decreases the potential for higher production.

One of the largest drivers of soil change in agroecosystems is tillage. Tillage erosion alters soil distribution across the landscape (Schumacher et al., 1999) and in turn affects diverse soil chemical and physical properties. These properties significantly affect management of the world's arable lands. Tillage has been correlated with diminished aggregate stability, lower water infiltration rates, decreased microbial biomass carbon, and significant losses in SOC (Andruschkewitsch et al., 2013; Donigian et al., 1994; Follet and Schimel, 1989; Kumar et al., 2012; Larney and Lindwall, 1995; Senthilkumar et al., 2009;

Silva et al., 2010). These changes decrease productivity, rendering sustainable production out of reach.

In order to study soil change, the soil science research community must view soils as dynamic systems and advocate for long-term soil experiments (Peterson et al. 2012; Tugel et al. 2005). The most common long-term soil experiments involve continual monitoring of soil properties on a yearly basis, but these types of studies have limitations. For example, the data collected from them are not readily applicable to a large number of locations, and maintenance and upkeep of such experiments have relatively high costs.

In order to quantify soil change, particularly long-term soil change, new methods of characterizing change need to be evaluated and utilized. One potential method for assessing change is to return to previously characterized locations and re-sample and re-characterize the soil. This resampling method has the potential to be more economical in characterizing the degree of change that has occurred at any given location, and, because original sampling was completed to accurately establish the soil physical, chemical, and morphologic properties from many soil series, a large dataset exists (Soil Survey Laboratory Staff, 2014).

This thesis will assess the usefulness of the resampling method as a viable tool to assess soil change at a given location. In addition, information regarding the kinds and degree of soil change measured on the Barnes soil series of eastern North Dakota will be quantified.

THESIS ORGANIZATION

This thesis is structured around six main components, a literature review, three chapters, general conclusions, and the appendices. The literature review describes soil change and its effects, and outlines methods of assessing soil change and the limitations of these methods. It also contains an additional section outlining the use of remotely sensed imagery to evaluate large-scale ET on the landscape. The first chapter focuses on the changes that have occurred within the Barnes soil series in eastern North Dakota, and evaluates the resampling methods used in the study. The second chapter contains the materials and methods utilized in this study that are not otherwise included in chapters one and three. The third chapter discusses the use of remotely sensed ET data to assess soil quality and function at the landscape level, and introduces potential methods of utilizing the ET dataset. Finally, the appendices contain an extensive amount of data that was collected during this study. Some of the data is not utilized in either of the two chapters, but is presented here to allow its utilization in further studies.

LITERATURE REVIEW

Utilizing Legacy Soil Survey Data to Evaluate Soil Change

Natural Soil Formation and Soil Change

Before human beings began altering soil, natural soil formation and degradation were long-term processes taking hundreds to thousands of years (Wakatsuki and Rasyidin, 1992). Although these processes have occurred for millennia, modern soil science, as a unique scientific discipline, did not emerge until the mid to late 1800s, and is generally attributed to Vasili Vasilevich Dokuchaev, the "father of soil science" (Schaetzl and Anderson, 2005), and Eugene Hilgard (Amundson, 2006). Dokuchaev, along with his students, developed mapping techniques, as well as the first scientific soil classification system (Buol et al., 1997). This system allows for comparisons of soil formation, or "changes" from one state to another, as a function of soil development.

Dokuchaev was also the first soil scientist to introduce the idea of soil forming factors (Jenny, 1961). This foundation was elaborated upon by Swiss scientist, Hans Jenny who is credited with the now famous soil formation equation $S = f\ (cl, o, r, p, t)$ where cl represents climate, o represents living organisms, r represents relief, p represents parent material, and t represents time. This equation encompasses the traditional theories of soil formation, and is considered the standard of the discipline. The factor with the largest influence in the equation is the "t" factor, because time is constant and cannot be altered or changed. Throughout the history of soil science, and the development of soil surveys, Jenny's equation was relied upon to provide a foundation for understanding soil development. Challenges to the Dokuchaev/Jenny model have been introduced that advocate for an additional, unique soil forming factor, the human (Bidwell and Hole, 1965; Dudal, 2004).

Human-Induced Soil Formation and Soil Change

Human-induced soil change is not a new concept. Before the start of the American Civil War, Eugene W. Hilgard stated that “no land can be permanently fertile, unless we restore to it, regularly, the mineral ingredients which our crops have withdrawn” (Hilgard, 1860); and as early as 1897, the effects of tillage on the landscape were being discussed (Ototskii, 1897). More than 100 years later, tillage erosion is even more widespread and is being evaluated globally (Choudhary et al., 1997; Malicki et al., 1997; Medeiros et al., 1996; Prasuhn, 2012). Due to technological advancements and ever-larger farming equipment, global soil change has the potential to occur more rapidly and across larger tracts of land. The use of larger equipment is not exclusive to agriculture, as construction and earth-moving equipment is continually being enlarged. An ever-increasing need for more goods and services translates to large quantities of soil being altered and disturbed daily on a global scale. These increasing disturbances support the case for a sixth soil forming factor, humans.

Soil change due to human interaction is complex, and many different attempts to incorporate humans as a factor in soil formation have been made. One attempt, labeled “metapedogenesis,” is defined as a naturally created soil that has then been acted upon by humans (Yaalon and Yaron, 1966). This idea, while decades old, has yet to be widely accepted within the field of pedology. Another potential method of incorporating humans into Jenny’s equation places an equal importance on humans in the original development of the soil (Dudal, 2004). This method has the potential to be more widely accepted because it allows humans to be equally important to the discussion of formation as opposed to merely being an afterthought to natural genetic processes. A more recent idea pertaining to human beings’ interaction with the soil as a whole has been penned “Anthropedology,” characterized as “the basic and applied science of how humans change soils and soil interactions with the wider environment and how soil changes impact humanity” (Richter et al., 2011). The inclusion of humans into Jenny’s equation as a potential sixth factor is supported by a number of scientists, and is recognized outside of soil science in the concept of the Anthropocene (Crutzen, 2002; Zalasiewicz et al., 2008; Certini and Scalenghe, 2011). The Anthropocene is the proposed name for the Earth’s current geological epoch, and acknowledges the role of humans in altering the face of the Earth.

The proposal of the Anthropocene demonstrates how widespread human interaction is globally, and the Food and Agricultural Organization of the United Nations has reiterated this in their most recent update of the World Reference Base (WRB). Within the most recent WRB soils that have been significantly altered by human interactions have been assigned to two new reference soil groups (FAO, 2014). These two groups represent soils with extensive and long-term anthropogenic use, resulting in significant changes. The Anthrosol soil group represents soils that have been used for a long period of time for intensive agricultural use, while the Technosols are soils that contain “significant amounts of artifacts” (FAO, 2014). The introduction of these two reference soil groups shows that soil scientists worldwide are cognizant of humanity’s impacts on soil resources and that these impacts do not represent a small-scale problem.

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has also adopted additional soil taxa to be used for human-modified soils. The NRCS developed two epipedons (Anthropic and Plaggen) to allow for classification of soils that have been severely altered by human use. The Anthropic epipedon in Soil Taxonomy (Soil Survey Staff, 1999) is described as a mollic epipedon formed through irrigation or the addition of significant amounts of calcium and phosphorus amendments, while the plaggen epipedon is classified based upon the presence of a half-meter or more thick, human-made surface, formed from long-term manuring practices (Soil Survey Staff, 1999). Both of these epipedons are rarely used in Soil Taxonomy; however, their presence is an indicator of potential changes to soil taxonomy in the future. These soil taxa serve as indicators of the importance of human-induced soil change.

Consequences of Soil Change

By tilling agricultural lands year-after-year, farmers have, and are, creating short-term and long-term problems. While soil erosion can take place in a short period of time, it is known to be a side-effect of tillage (De Alba et al., 2004; Govers et al., 1994; Li et al., 2008; Prasuhn, 2012). The NRCS estimates that 1 tonne of soil erodes per hectare per year on U.S. croplands. This translates to an overall soil erosion value of 1.57 billion tonnes in the U.S. every year (USDA-NRCS, 2010). A recent estimate of cultivation across the globe shows that of the Earth's total land surface area (15 billion hectares), approximately 1.5 billion hectares are cultivated (10%) (Dudal, 2004). This small proportion of the total is extremely important as it impacts global food production. Due to the growing human population, and the ever increasing importance of arable lands, even small decreases in production can have widespread consequences.

In order to detect changes in soil, methods of measuring change must exist. However there are obstacles within traditional soil science that make this somewhat difficult. A fundamental limitation is mapping of soils as static bodies in a static state (Tugel et al., 2005). Soil properties were initially mapped in a static state due to time and budget constraints on soil survey staff. Soils are still mapped in a static state, and classified into soil series regardless of the fact that a pedon rarely, if ever, matches the type location of a specific series. This mapping approach continues to be the most feasible method for characterizing soils due to the time and cost associated with mapping the true variability of soils as they are located on landscapes (Tugel, et al., 2005).

The knowledge that soils on the landscape are intergrades between actual described soil series is generally accepted as fact in soil mapping, but due to the way maps are made, delineations must exist. The customary method of mapping soils is related to the concept of the pedon and the polypedon. This concept is centered on the idea that soils "rarely exist as discrete individuals with clear boundaries" (Johnson, 1971). These boundaries help simplify the concept of soil on the landscape and allow interpretations and limitations to be fashioned. Unfortunately, oversimplifying soils this way makes assessing the degree of change on a landscape difficult because large "blocks" of soil are all classified with the same properties.

This traditional method is on the verge of being replaced with newer techniques of soil mapping and characterization, as the dynamic nature of soils are discussed and evaluated. Dynamic soil properties are defined as "soil properties that change within the human time scale" (Tugel et al., 2008), and classifying these changes is becoming more important. As such, methods of classifying soil change must be evaluated.

Additionally, there is no consistent definition of "long-term" within the soil science discipline. There are, however, many experiments that quantify the long-term changes occurring in soils. Intervals ranging from as short as five years to as long as 100 years have been chosen to represent long-term (Buyanovsky et al., 1997; West and Post, 2002). Suggestions have been presented requiring a minimum time interval of 20 years (Rasmussen et al., 1998), and long-term experiments are considered "classical" after a 50 year time interval has passed (Steiner and Herdt, 1995). These inconsistencies make quantifying long-term soil changes difficult, as some soil properties, such as microbial biomass and aggregate stability, respond quickly to management practices (Silva et al., 2010; Smettem et l., 1992), while others, such as soil moisture retention and bulk density, take much longer to display significant changes (Chang and Lindwall, 1992). As a whole, soil change data has no minimum time interval, and therefore, no widely accepted method to quantify soil change exists.

Conventional Methods for Measuring Soil Change

Currently, three methods are used to evaluate long-term soil change: long-term field experiments, space-for-time experiments, and chronosequences. Long-term field experiments are designed to monitor and evaluate soil change for many different treatments on a yearly basis. Experiments, such as the Broadbalk experiment at the Rothamsted Experiment Station in England, which was initiated in 1843, the Morrow plots experiment in Illinois (1876), and the Sanborn Field experiment in Missouri (1888), have provided soil scientists with data for almost two centuries. Long-term field experiments provide the most detailed and comprehensive data. For example, data from Sanborn Field and the Morrow plots were used to validate a model showing decreases in long-term SOC stocks due to yearly residue removal (Liang et al., 2008).

These studies cannot be established and maintained in numerous locations, however, and this is a major limitation because soil properties and environmental conditions are highly variable. Consequently, extrapolating the data to other locations is difficult. Long-term studies provide an abundance of valuable information, and are the best method for monitoring long-term changes; however, they are costly and not always practical. In situations where they are feasible they should be the preferred method of long-term research (Peterson et al, 2012), but in the many situations where they are not viable, alternatives must be considered.

The second type of experimental design used to monitor soil change is the space-for-time method, which is extensively used in soil change experiments. This approach utilizes variability within a system to analyze change, i.e. a set of common variables is found between soils, and change is analyzed based on differences between the soils. This method is more cost effective than long-term field experiments. The data, however, is considered by some to be less accurate due to a lack of sensitivity, which arises from uncertainties in the past, such as tectonic activity, flooding, or fire. Additionally, in space-for-time experiments, data is often analyzed homogenously, at a coarse scale, when spatial heterogeneity commonly exists at sample sites (Pickett, 1989). An example of this would be analyzing successional plant communities after a fire and ignoring the effects of different soil series across the landscape. The space-for-time method is limited as a tool for assessing soil change in that it is difficult to measure the impact of human interaction.

An extension of the space-for-time method commonly used to evaluate changes in soils across a landscape is the chronosequence. Chronosequences have long been utilized by soil scientists to explain differing levels of soil development on adjacent landscapes, and have proven to be a reliable tool in analyzing differences in soil formation on similar parent materials (Jenny, 1961). The chronosequence method is best reserved for less sensitive changes or long periods of time (hundreds to thousands of years). For example, a California chronosequence estimated variability in the age of soil parent material due to tectonic activity. The parent material ages reported ranged from 27,000 years to 700,000 years old (Kendrick and McFadden, 1996), highlighting the advantage of the chronosequence method, that drastic changes in soil formation, over long periods of time, can be documented. The limitation of a chronosequence, however, is quantifying small-scale spatial variability and decadal changes that occur from human interactions.

Justification and Explanation of the New Approach

Overall, the previous three methods can be used to gain a greater understanding of soil change; however, there are limitations within these methods, therefore, new methods to measure soil change need to be explored. Utilizing traditional soil survey data to analyze the degree of soil change is currently growing in its acceptance as a reliable method (Veenstra and Burras, 2012). Dokuchaev's work with soils in Russia, as well as the contributions of Eugene Hilgard and Milton Whitney in the United States, laid the foundation for the creation of soil surveys for the United States Geological Survey (Amundson, 2006). These surveys initially allowed for land evaluations based on productivity and potential productivity, and in states dominated economically by agriculture, these soil surveys remain invaluable. The surveys now have the potential to be used as a resource for assessing soil change nationwide, and North Dakota, because of its strong agricultural background and soil surveys reaching back to earlier than 1900, provides an excellent framework on which to study soil change, especially long-term soil change.

An immense network of data is represented in soil surveys, as physical, chemical, and occasionally even mineralogical data were routinely collected. However, the concept of utilizing previous characterization data, and comparing it to recently collected data, to determine the amount of soil change that has occurred is novel and has only been utilized a handful of times (David et al., 2009; DeClerck et al., 2003; DeClerck and Singer, 2003; Malo et al., 2005; Saey et al., 2009; Singer, 2003; Veenstra and Burras, 2012).

One reason why this method is in its infancy is related to the age of soil surveys. While surveys have long been produced, consistent, repeatable mapping techniques weren't widespread until the introduction of the 1951 Soil Survey Manual (Soil Survey Staff, 1951).

Following the introduction of this standard for description, and initiation of progressive soil surveys across the nation, a comprehensive dataset of soil information was developed. Due to the amount of time and effort required to complete a soil survey, mapping a single county took many years to accomplish; therefore, there is a discrepancy in the age of the data. An adequate amount of time following the completion of a survey must pass before it can be relied upon to quantify long-term soil change. This progression through time has now occurred for many survey areas; and hence, utilizing them and their supporting data to assess change is now feasible.

Using previously completed datasets and surveys, an accurate representation of the soil at a specific time exists and can be compared to the present day soil on the same landscape. This new method has the potential to be a more feasible option than long-term field experiments, more accurate than space-for-time experiments, and more applicable to human-related management practices than a chronosequence approach. In addition, by reducing research costs, different, less utilized methods to quantify soil change can be explored.

Satellite Data and Assessment of Soil Function

Remotely sensed data are a quick and effective proxy for assessing soil properties (Brady and Weil, 1999). While early remote sensing was completed utilizing aerial photography, improvements in quality and reliability and shorter data capture periods have allowed satellite data to become a preferred method. Many recent studies have shown the usefulness of remotely sensed satellite data in determining soil properties (Akpa et al., 2014; Silva et al., 2014; Vaudour et al., 2013; Zheng et al., 2013). For example, surface SOC levels were determined with 70% accuracy for a set of alfisols, mollisols, and inceptisols in northern France using Landsat remotely sensed data (Vaudour et al., 2013).

Recently, application of remotely sensed satellite data in assessing ET from the soil surface has been attempted (Allen et al., 2007a, 2007b; Bastiaanssen et al., 1998a, 1998b), and has the potential to serve as another tool to assess soil quality and condition (Steele et al., 2014). Soil quality and soil function are important, especially in agricultural systems, because how well a soil functions directly influences plant growth. Utilizing remotely sensed ET data and applying it as a proxy for soil function has the potential to be a valuable and effective tool.

The most recent advancement in ET assessment is the METRIC™ (mapping evapotranspiration with internalized calibration) model (Allen et al. 2007a). This model, based upon the widely utilized surface energy balance algorithm for land model (SEBAL) (Bastiaanssen et al., 1998), generates a 100 km^2 ET map allowing users to compare large areas of land. ET mapping uses a surface energy balance equation to produce ET information that can be utilized in calculating an ET value referenced to a well-watered alfalfa (*Medicago sativa*) crop (Allen et al., 2012). The METRIC™ model has been shown to be a reliable method for estimating ET in many different locations (Allen et al., 2007a, 2007b; Burkhalter et al., 2013; Gowda et al., 2008;), and remotely-sensed ET data have been utilized with success in the Devils Lake Basin of North Dakota (Steele et al., 2014), which is representative of Major Land Resource Area 55A, and as such was utilized here to quantify ET across the landscape on sites that were resampled.

Objectives

Agricultural land worldwide is heavily relied upon to provide sustenance for the Earth's growing population. In order to maintain adequate food production for this population soil degradation must be identified and where possible reversed. The first step in completing this process is assessing how soils are being altered or changed. In order to do so an adequate method of analyzing and collecting data must exist. While traditional methods of assessing soil change, such as, long-term field experiments and space-for-time measurements produce quality information they both contain serious limitations. The goals of this research are to 1) determine how the Barnes soil series has been altered chemically, physically, and morphologically over 50+ years, 2) evaluate if traditional soil survey data can be used to evaluate soil change with a resampling method, and 3) to determine if remotely sensed ET data can serve as a proxy for soil function, and be used as a metric for evaluating soil change.

Hypotheses

1. H_0: The Barnes soil series has not been altered chemically, physically, or morphologically over 50+ years

   $H\alpha$: The Barnes soil series has been negatively altered regarding chemical, physical, or morphological properties over 50+ years

2. H_0: Traditional soil survey data cannot be used to evaluate soil change using a resampling method.

   $H\alpha$: Traditional soil survey data can be used to evaluate soil change utilizing a resampling method.

3. H_0: Remotely sensed ET data cannot be used as a proxy for soil function and therefore is not a useful metric to assess soil change.

   $H\alpha$: Remotely sensed ET data can be used as a proxy for soil function and therefore is a useful metric to assess soil change.

LIMITATIONS IN UTILIZING LEGACY SOIL SURVEY DATA TO ASSESS DYNAMIC SOIL CHANGE: A CASE STUDY ON A NORTHERN MOLLISOL

Abstract

Quantifying long-term, global soil change is of the utmost importance as the human population continues to grow and the need for food security intensifies. North Dakota presents a unique opportunity to study dynamic soil change because of its agricultural prominence and an extensive set of soil survey data. A resampling method to characterize soil change based upon legacy soil survey data was utilized on a benchmark soil series, the Barnes, in North Dakota. Statistically significant decreases in SOC were measured in surface horizons of the Barnes, and depending upon management practices, morphologic change documented in the field ranged from highly eroded, with the complete loss of the A horizon, to non-eroded conditions at sites returned to CRP 25 years ago. These results serve as a proof of concept and demonstrate the need for more in-depth research.

Introduction

Dynamic Soil Properties

By tilling agricultural lands year-after-year, farmers have, and are, creating short-term and long-term problems. While soil erosion occurs from natural processes, such as water movement on the landscape, it is also known to be a consequence of tillage (De Alba et al., 2004; Govers et al., 1994; Kosmas et al., 2001; Li et al., 2008; Prasuhn, 2012; Schumacher et al., 2005). The Natural Resources Conservation Service (NRCS) estimates that 1 tonne of soil erodes per hectare per year on U.S. croplands. This translates to an overall soil erosion value of 1.57 billion tonnes in the U.S. every year (USDA-NRCS, 2010). A recent estimate of cultivation across the globe shows that of the Earth's total land surface area (15 billion hectares), approximately 1.5 billion hectares are cultivated (10%) (Dudal, 2004). This small proportion of the total is extremely important as it impacts global food production. Due to the growing human population, and the ever increasing importance of arable lands, even small decreases in production can have widespread consequences.

In order to detect changes in soil, methods of measuring change must be developed, and accepted within the scientific community. However, obstacles within traditional soil science make this difficult. A fundamental limitation is mapping of soils as static bodies in a static state (Tugel et al., 2005). Soil properties were initially mapped in a static state due to time and budget constraints on the National Cooperative Soil Survey (NCSS). Soils are still mapped in a static state and classified into soil series regardless of the fact that a pedon rarely, if ever, matches the type location of a specific series. This approach to mapping continues to be the most feasible method for characterizing soils due to the time and cost associated with mapping the true variability of soils as they are distributed on landscapes (Tugel, et al., 2005).

Evidence of Changes on Barnes landscapes

Soil series descriptions were designed to be broad enough to encompass landscape variability. This can be seen in the range in characteristics of any Official Series Description. However, as time has progressed, and soils change, challenges have arisen questioning the validity of current series descriptions (USDA, 2011). The NRCS field scientists in The Northern Black Glaciated Plains (Major Land Resource Area, MLRA 55A), in North Dakota, proposed reclassifying representative soil series in well-drained landscape positions due to fairly extensive changes observed in the field (USDA, 2011). The need to compile sufficient information before reclassifying over 10,000 hectares of MLRA 55A set the stage for this study, and a greater understanding of the long-term changes affecting North Dakota's soil resource was considered necessary.

Importance of Long-Term Studies of Soil Function

There is no consistent definition of “long-term” within the soil science discipline. There are, however, many experiments that quantify the long-term changes occurring in soils. Intervals ranging from as short as five years to as long as 100 years have been chosen to represent long-term (Buyanovsky et al., 1997; West and Post, 2002). Suggestions have been presented requiring a minimum time interval of 20 years (Rasmussen et al., 1998), and long-term experiments are considered “classical” after a 50 year time interval has passed (Steiner and Herdt, 1995). These inconsistencies make quantifying long-term soil change difficult, as some soil properties, such as microbial biomass and aggregate stability, respond quickly to management practices (Silva et al., 2010; Smettem et al., 1992), while others, such as soil moisture retention and bulk density, take longer to display significant changes (Chang and Lindwall, 1992). As a whole, soil change data has no minimum time interval, and therefore, no widely accepted method to quantify soil change exists. Currently, the most utilized methods for evaluating long-term soil change are long-term field experiments and space-for-time experiments.

Long-term Field Experiments

Long-term field experiments are designed to monitor and evaluate soil change for many different treatments on a yearly basis. Experiments, such as the Broadbalk experiment at the Rothamsted Experiment Station in England, which was initiated in 1843, the Morrow plots experiment in Illinois (1876), and the Sanborn Field experiment in Missouri (1888), have provided soil scientists with data for almost two centuries. These studies cannot be established and maintained in numerous locations, however. This is a major limitation because soil properties and environmental conditions are highly variable, which complicates extrapolating data to other locations. Long-term studies provide a significant amount of soil physical, chemical, and biological information, depending on their experimental design, and are the best method for monitoring long-term changes; however, they are costly and not always practical. In situations where they are feasible they should be the preferred method of long-term research (Peterson et al., 2012), but in the many situations where they are not viable, alternatives are required.

Space-for-Time Experiments

The most extensively used experimental design for monitoring soil change is the space-for-time method. This approach utilizes variability within a system to analyze change, i.e. a set of common variables is found between soils, and change is analyzed based on differences between the soils. This method is more cost effective than long-term field experiments. The data, however, is considered, in certain cases to be less accurate due to a lack of sensitivity, which arises from uncertainties in the past, such as flooding, or fire. Additionally, in space-for-time experiments, data is often analyzed homogenously, at coarse scales, when spatial heterogeneity often characterizes sample sites (Pickett, 1989). An example would be analyzing successional plant communities after a fire and ignoring the effects of different soil series on edaphic properties.

In this paper, we discuss how the chemical and morphologic properties of a northern mollisol have been altered over a half century. Additionally, we look briefly at the catenary variation at our sample locations and use morphologic, physical, and chemical properties from these catenas as supporting data to discuss soil change. Finally, we examine the efficiency of a resampling method to analyze changes in dynamic soil properties and discuss the potential for this method to serve as a tool for future soil scientists and land managers.

Materials and Methods

Study Area

The study area is located in the Northern and Central Black Glaciated Plains of eastern North Dakota (Fig. 1). The Glaciated Plains cover much of North Dakota's land area and consist mainly of gently rolling glaciated landscapes. The relief in the area is generally low, usually less than 30 meters; however, end moraines and streams exist with relief ranging up to 100 meters (Bluemle, 2000). Glacial drift, in the region, consist of a loamy calcareous till with predominately smectitic clay mineralogy (Fullerton et al., 2003). The climate of the region is continental with a mean annual air temperature (MAT) ranging from 2 to 6 °C (36-44 °F). The frost-free period is between 112 and 152 days. The mean annual precipitation (MAP) ranges from 30 cm in the northwest corner of the state to 61 cm in the southeastern corner, with the study area receiving between 46 cm and 61 cm. Most of the state's precipitation (75%) occurs between the months of April and September, and the winter snowpack usually persists from December through March (Enz, 2003; North Dakota State Climate Office, 2010).

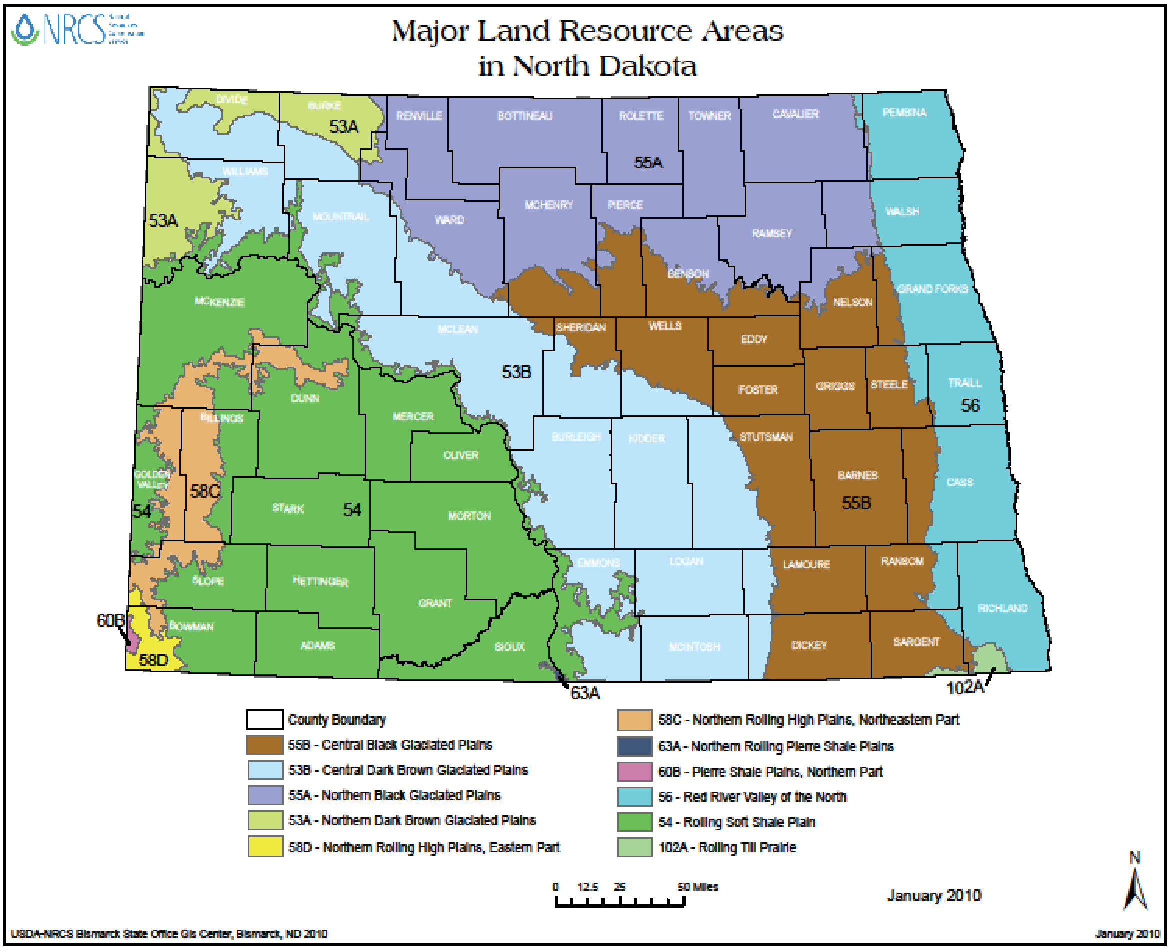


Figure 1. North Dakota's Major Land Resource Areas (Soil Survey Staff, 2010b).

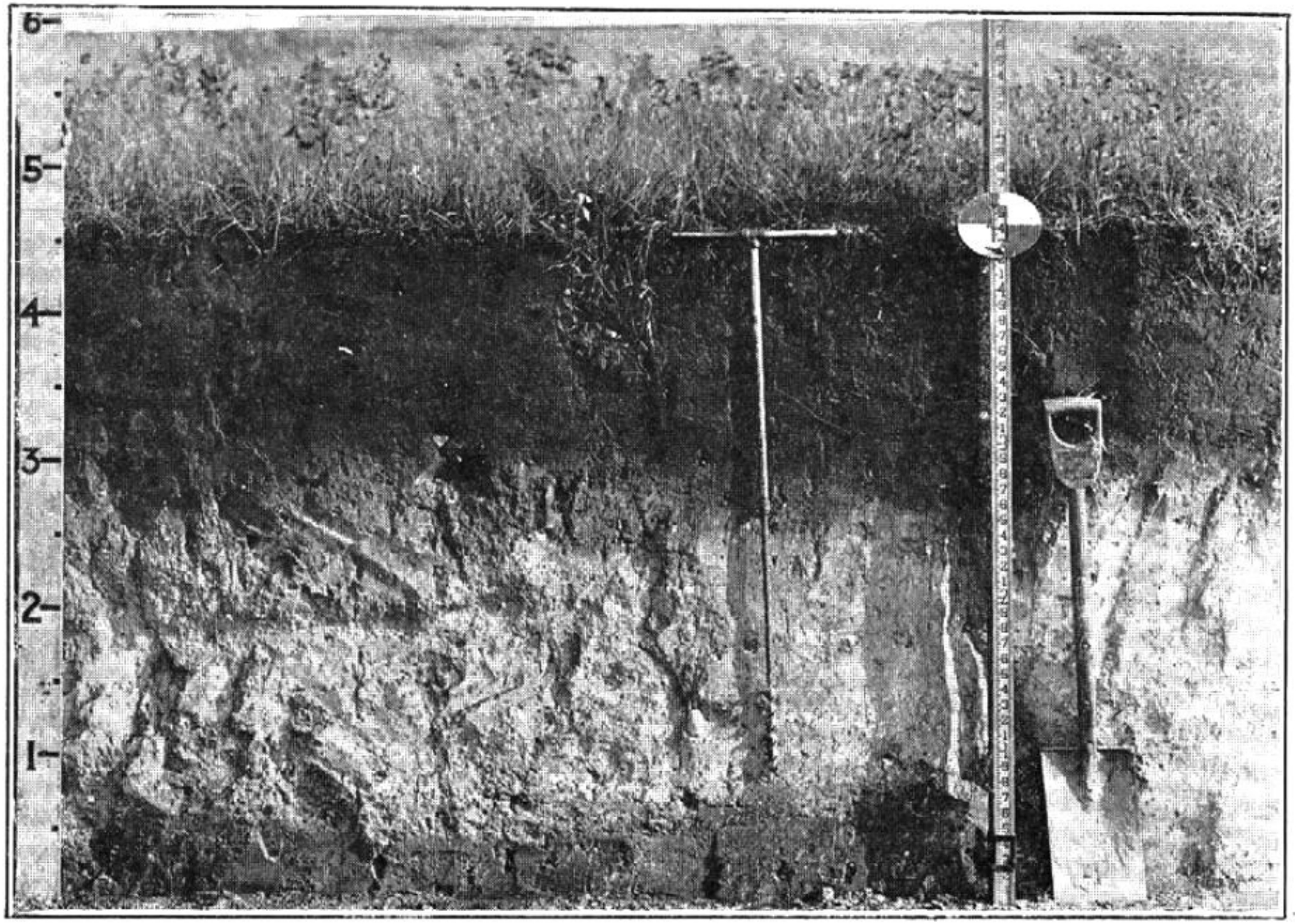
Agricultural settlement began in 1868 when the first homestead claim was filed; with the majority of settlement in the region occurring from the late 1800's to the mid-1910's (Robinson, 1966). The major land use across the state is agricultural, meaning a majority of the state has been involved in agricultural production for about 140 years. The major crops in the state, based on hectares planted, are spring wheat (Triticum Aestivum), soybean (Glycine max), and corn (Zea mays), with canola (Brassica napus L.), barley (Hordeum vulgare), dry beans (Phaseolus vulgaris L.), and sunflower (Helianthus annuus) also representing significant hectares planted (USDA-NASS, 2013). Corn and soybean land area have increased rapidly in recent years, but for the majority of the time interval encompassed by this study, spring wheat and other small grains were the dominant crops (U.S. Bureau of the Census, 1960; U.S. Bureau of the Census, 1972; U.S. Bureau of the Census, 1980; U.S. Bureau of the Census, 1989; USDA-NASS, 1999).

Determination of Potential Sampling Locations

Long-term is defined in this study as an interval of 53 to 61 years, allowing a significant temporal interval to bracket sampling dates. In relation to the traditional long-term studies, a "classical" designation would be appropriate for this study (Steiner and Herdt, 1995). In addition, the sampling dates for the historic data coincide with the publication of the 1951 Soil Survey Manual (Soil Survey Staff, 1951), which standardized methods for collecting and reporting soil survey data and ensures the integrity of the soil survey legacy data.

The soil series utilized in this study was the Barnes series (Fine-Loamy, mixed, superactive, frigid Calcic Hapludolls) (Soil Survey Staff, 1999). This series was selected due to its status as a benchmark soil in North Dakota and because it represents an extensive land area in the selected study area. Approximately 1.5 million hectares of Barnes are mapped in North Dakota, Minnesota, and South Dakota, with 1.2 million hectares in North Dakota (Soil Survey Staff, 2010b). The Barnes series is also representative of the typical "prairie profile" (Thompson, 1992) that develops in the mixed grass prairie characteristic of eastern and central North Dakota (Barker and Whitman, 1988; Dix and Smeins, 1967). A 1924 photograph (Fig. 2) of the Barnes Series has been published globally, on numerous occasions, as it is so representative of a typical prairie soil (Thompson, 1992). The series was initially identified and mapped in 1917 in Lamoure and Bottineau counties, and since then, has been included in soil survey legends of an additional 35 North Dakota county soil surveys.

Report of Bureau of Soils, 1924 PLATE 2



A, Profile of Barnes loam, showing the highly calcareous subsoil

Figure 2. Barnes photograph published in the 1924 Cass County soil survey (Knobel et al., 1924).

In preparation for field sampling, a comprehensive database of all Barnes soils sampled before 1960 was compiled. This task was achieved utilizing soil characterization records within the National Soil Information System (NASIS) database, and North Dakota Agricultural Experiment Station records stored at North Dakota State University (NDSU). Additional entries for the database were collected from theses completed at NDSU and South Dakota State University in the 1950s (Sweeney, 1953; Olson, 1959; Redmond, 1959), and a Soil Conservation Service (now the NRCS) correlation report completed in 1960 (Aandahl et al., 1960) also provided pedon sites used in the database; 40 relevant pedons were identified. These pedons were used to quantify the mean mollic epipedon thickness and mean depth to carbonates in the "modal" Barnes profile before 1960. Information for these 40 pedons can be found in Appendix A. Mollic epipedons were identified based on soil color, as some pedons lacked the base saturation and organic carbon content data required to meet diagnostic criteria (Soil Survey Staff, 2010). Only pedons within one standard deviation of both means of the modal Barnes were considered (n=22)(Fig. 3). A few pedons were removed from consideration because they lacked laboratory characterization data, this was the basis for the matched pairs statistical analysis adopted for this work. The number of potential pedons for the field study was further reduced to four based on logistics, i.e. travel and labor costs. The four sites were distributed to span the geographic extent of the Barnes series in North Dakota and to ensure that all potential site locations were suitable for ancillary research. Three additional sites were sampled because they represented pasture or Conservation Reserve Program (CRP) land use; however, they lacked characterization data and were not statistically analyzed.

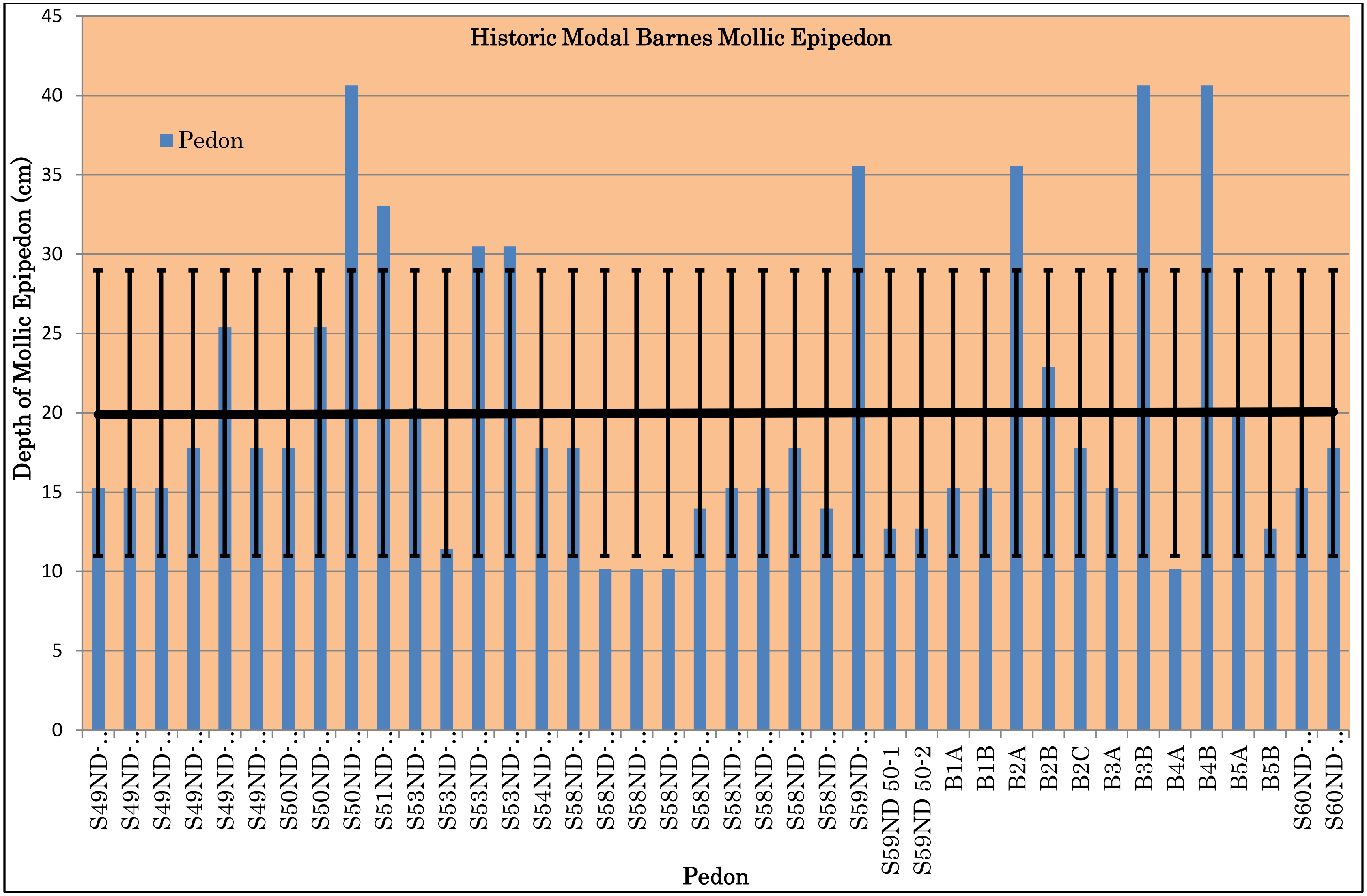


Figure 3. Mollic epipedon thickness and a one standard deviation bar for 40 Barnes characterization pedons sampled in North Dakota before 1960. The thick, black horizontal line represents the mean (20 cm) of all historic pedons.

Surface Horizons

While a large quantity of data was collected in this work, only the surface horizons (traditionally A or Ap horizons) were utilized in this study. This is due to their role as a critical nurturing environment in the soil, specifically in relation to early crop growth, because seed placement depth, in traditional row cropping systems, are limited to the upper few centimeters of soil.

Site Location

Adequately determing the precise sampling location of the pre-1960 (historic) pedon descriptions was challenging due to the lack of global position data in the historic narratives. Therefore, site location was identified using measured distances found on the old descriptions, and was aided by the highly detailed descriptions that were previously completed by trained soil scientists. Because of the level of detail practiced by the previous pedologists and soil scientists, we are confident that we accurately located the sites to within 3 meters.

Transect Design

Transects were specifically designed for an ancillary remote sensing study, however, they also provided chemical and morphologic data at the catena scale, thus characterizing soil spatial variability at each site. The transect design consisted of two transect paths. One path captured the spatial variabilty present upslope and downslope of the historic pedon, while the second transect ran perpendicular to the slope gradient and conformed to the same contour as the historic pedon. This was done to increase the number of samples located on the same landscape position as the historic Barnes. In total, 21 samples were taken at each of the seven sites unless a full transect design was not possible due to sampling obstructions. The total number of cores taken was 138.

Descriptions of Pedons

Soil morphologic descriptions were completed using standards of the National Cooperative Soil Survey (Schoenberger et al., 2012), and an experienced pedologist was present for all field descriptions at the resampled historic pedons. Samples from the soil pits were collected directly from the pit wall and immediately bagged and returned to NDSU. Soil transect cores were taken with a hydraulic probe and were contained using acetate sleeves. Sleeves were capped on both ends to reduce drying and then returned to the laboratory. The transect cores remained unopened until soil morphologic descriptions were completed. All samples were air dried after descriptions were taken and ground to pass a No. 10 (2 mm) sieve before being stored in plastic bags.

Soil structure was determined using the standard NRCS descriptors and was completed for the resampled historic pedons, in the field, with in-situ soil. Transect core structural analysis was also completed using the standard NRCS descriptors on the soil within the acetate sleeves. The depth to carbonates in each sample was determined by applying 10% hydrochloric acid to the soil and recording the subsequent reaction.

Laboratory Methods

To ensure integrity, every effort was made to replicate the historic analytical methods. As such, soil samples were analyzed for SOC based on the traditional Walkley-Black method (Walkley and Black, 1934), with a few modifications to the original method and calculations (Peech, 1947; Walkley, 1947). A full description of the method used can be located in the Obsolete Methods section of the KSSL Methods Manual (Soil Survey Laboratory Staff, 2014). Soil organic matter was also measured for all samples by loss on ignition (LOI) (Combs and Nathan, 1998).

Statistics

Basic summary statistics, such as mean, standard deviation, calculation of the data range, and the maximum and the minimum values was completed using the built-in functionality of Microsoft Excel (Microsoft Excel, 2010, Seattle, WA). Matched pairs t-tests were completed using SAS® Enterprise Guide 4.3 (SAS Institute, 2011). This method analyzes the differences between experimental "pairs" (in this case each pair is the historic value versus the present day value), and is useful for datasets acquired for this research because it reduces variations in the population standard deviation. This technique is also more useful than an independent samples experiment for this data because it generates more information (McClave and Sincich, 2013).

Results and Discussion

Chemical Changes in the Barnes Series over 50 years

Soil Organic Carbon

The SOC in surface horizons of the Barnes soil series, and across all sites, significantly decreased ($p<0.05$)(Appendix S) (Table 1). This result was generated from the matched pairs t-test for the main characterization sites, with the exception of Dickey County 1. The present day description of Dickey County 1 included a Bw horizon and it was not until chemical and textural analyses were completed that the presence of an E horizon was determined (Fig. 4). Additionally, after interferometric synthetic aperture radar (IFSAR) Digital Elevation Models (DEMs) for the site were processed, the presence of a subtle landscape concavity, that was not easily detectable during site location, was discovered. For these reasons, the Dickey County 1 site was excluded, as the exact sample position of the historic pedon was not located.

Table 1. Soil Organic Carbon (SOC) values for historic and current pedons.

Site	Historic Pedon SOC	Current Pedon SOC
	%	
Dickey County 1	5.2	3.7
Steele County†	3.5	2.7
Walsh County 1†	4.0	3.3
Walsh County 2†	3.2	2.1

† Sites are currently classified as the Barnes soil series

The decrease in carbon at sites investigated is likely due to losses from erosional forces, mainly tillage and water movement on these landscapes (De Alba et al., 2004; Malo et al., 2005; Papiernik et al., 2005; Schumacher et al., 2005), combined with losses from microbial respiration (Brady and Weil, 1999). This loss of SOC is not unexpected as many studies have shown net losses of carbon resulting from tillage in the Northern Great Plains (Bauer and Black, 1981; David et al., 2009; Donigian et al., 1994; Eynard et al., 2005; Haas et al., 1957; Malo et al., 2005).

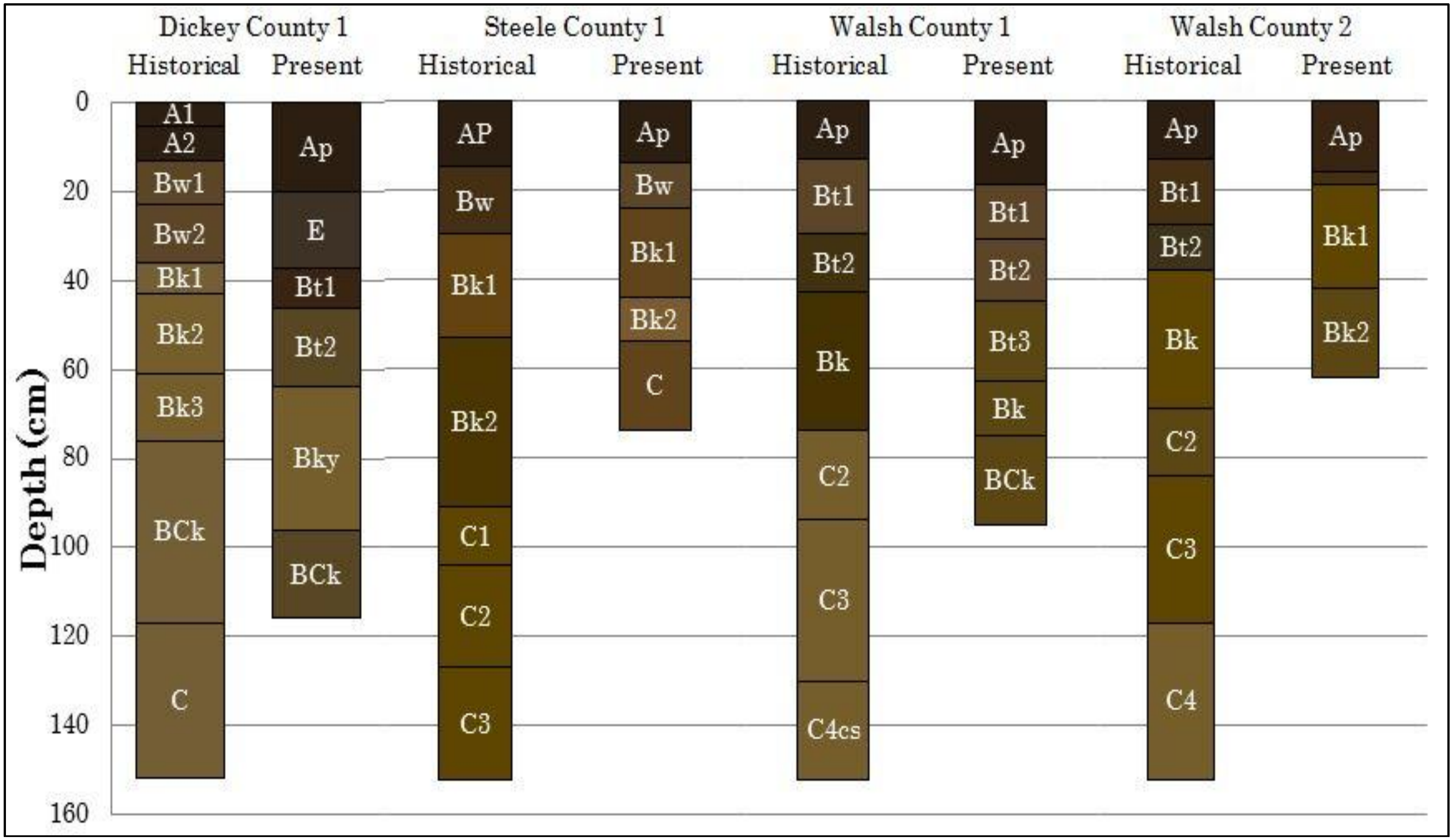


Figure 4. Pedon representations for the four main characterization sites in this study. Colors were converted from Munsell notation to RGB for these visualizations. The thin (3 cm) horizon visible between the Ap and Bk1 horizons on the present day Walsh County 2 pedon is a transitional Bk horizon too small to be labeled.

Regardless, loss of carbon at the study sites is alarming due to the critical role that carbon plays in agricultural production (Bauer and Black, 1994). Soil organic carbon has been directly related to many beneficial edaphic properties, and losses in SOC translate to lower yields or increased inputs to maintain yields. Because of the intrinsically high charge density associated with soil organic matter, decreases in SOC greatly impact overall cation exchange capacity. This loss in CEC translates to lower quantities of plant available cations (Brady and Weil, 1999). Additionally, most of the micronutrients required by plants are supplied through interactions with SOC (Stevenson, 1991). Losses of SOC are directly correlated to losses in yield.

Changes in the dynamics of water infiltration and movement through the soil system are important, and water movement and water holding capacity within the soil are intrinsically related to SOC because of the effects of carbon on the aggregation of soil separates (Eynard et al., 2005; Smettem et al., 1992). By increasing aggregate strength and the number of soil aggregates, water infiltration occurs much more rapidly, and soil profiles have the ability to absorb greater quantities of water, which can in turn translate to yield increases in non-irrigated fields. This greater water holding capacity is especially important in areas such as North Dakota where rainfall is limited and often sporadic throughout the growing season (Enz, 2003). However, decreased available water capacity as documented by Bauer and Black (1992) for glacial till soils in central North Dakota, is not due to lower SOC content in long-term tillage comparisons.

Soil Water Characteristics

In an effort to quantify the potential changes in available water in the Barnes series, water retention data were determined. Statistical analysis revealed no significant change in the water holding capacity of the Barnes series at 10 kPa, 33 kPa, or 1500 kPa. Due to the significant decrease in SOC this result suggests that the majority of the water holding capacity for the soil is controlled by the clay content rather than organic matter, although an alternative hypothesis could be that SOC, while decreasing, still remain high enough in surface horizons to maintain the level of water holding capacity measured in the historic pedons.

Other Analyses

Additional analyses showed no significant differences from historic pedon values in pipette particle size, inorganic carbon, electrical conductivity (EC) (1:1 and saturated paste), pH (1:1 and saturated paste), saturation extract sodium and potassium, saturation extract water content, CEC, and extractable Ca, Mg, Na, K, and acidity. Overall, the only significant chemical change documented in the Barnes soil series over 50 years was for SOC.

The lack of significant chemical changes in the Barnes series mirrors the results from two studies that found no significant changes in the soils across the state of California over a time interval >50 years (DeClerck et al., 2003; DeClerck and Singer, 2003). This is encouraging as it shows that tillage is not affecting soils as drastically as previously thought in relation to other chemical properties. The most interesting conclusion from our study is that SOC levels that were thought to stabilize approximately 40 years after initial cultivation in conventional and stubble mulch tillage systems are continuing to significantly decrease (Bauer and Black, 1981). The lack of significant changes in all other soil properties contrasts a South Dakota study utilizing a similar resampling method on Northern Great Plains soils that found many significant decreases in surface soil properties (Malo et al., 2005), and an Iowa study that concluded soil changes were drastic enough to warrant re-classification of many state soils at the Order level of Soil Taxonomy (Veenstra and Burras, 2012). The cause of this inconsistency across the region warrants additional research.

Morphologic Property Changes in the Barnes Series over 50 years

Highly Eroded

Morphologic profiles were not analyzed statistically, but instead were compared based on observation and field descriptions. The most drastically altered profiles were Cass County (Table 2) and Walsh County 2 (Table 3). Both sites are currently producing soybeans and wheat in bi-annual rotations. These sites were both described in the field as highly eroded due to the morphologic indicators present, and would be described as class 4 and class 3, respectively, under the Soil Survey Manual accelerated erosion definitions (Soil Survey Division Staff, 1993). Degree of erosion is generally determined based on the amount of topsoil loss by measuring solum thickness, the change in depth to the base of a subsurface Bw or Bt horizon, or increases in clay content (Soil Survey Division Staff, 1993, Mokma et al., 1996).

Table 2. Soil organic matter (SOM) and selected morphologic data for the Cass County site. Data presented represent the catenary variation across the slope gradient at the site.

Landscape Position	Depth to Carbonates	Depth of A†	SOM	Current Structure	Previous Structure
	cm	cm	%		
Summit	0	13	2.2		
Shoulder	0	9	2.0		
Shoulder	0	13	2.1		
Backslope	12	12	2.3		
Backslope	0	11	2.3		
Backslope	0 (37) ‡	14 (21)	2.3	2 CO Pr¶	---------
Backslope	0§	32	2.9		
Backslope	0§	28	3.2		
ToeSlope	49	28	3.3		

† All described A horizons were included, in cases where multiple A horizons exist they were averaged
‡ Values within parentheses represent historic pedon data
§ Carbonates at the surface with leached, non effervescent horizons beneath
¶ Moderate coarse prismatic

Table 3. Soil organic matter (SOM) and selected morphologic data for the Walsh County 2 site. Data presented represent the catenary variation across the slope gradient at the site.

Landscape Position	Depth to Carbonates	Depth of A†	SOM	Current Structure	Previous Structure
	cm		%		
Summit	0	12	2.6		
Shoulder	0	13	2.9		
Shoulder	18	18	3.0		
Backslope	0 (40)‡	16 (13)	3.5 (5.5)	2 M/CO SBK§	2 M SBK¶
Backslope	11	11	3.3		
Backslope	28	10	3.2		
Backslope	17	17	3.4		
Backslope	14	14	3.9		
ToeSlope	26	49	4.4		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged
‡ Values within parentheses represent historic pedon data
§ Moderate medium to coarse subangular blocky
¶ Moderate medium subangular blocky

The Cass County site has lost the entirety of its previous A horizon, as well as a portion of the previously underlying Bw horizon, and the historic Bw horizon is now serving as the Ap horizon. The lower boundary of the Bw horizon for the historic pedon was located 37 cm below the soil surface, while the current lower boundary is located at 14 cm. This indicates a loss of approximately 23 cm of soil from the profile. The thickness of the historic Ap horizon was 21 cm, as seen in Table 2, as such, the entire A horizon has eroded. The site is therefore classified as class 4 and would be in a severe erosion phase (Fenton, 2012).

Additionally, loss of topsoil was verified morphologically based upon root and pore channel fillings (Fig. 5), and would be classified as ped and void surface features. Within the matrix of the current Ap horizon (Munsell 10YR 3/2 moist color), older material, with a higher organic matter content, was found. The presence of this material verifies that the previous topsoil, characterized by Munsell 10YR 2/1 moist color, existed at the site, and has disappeared. Other pedologists, attempting to quantify erosion on agricultural landscapes stress the importance of the recognition of these "unconformable deposits" as proof of redistribution of genetically developed structures (Conacher and Dalrymple, 1977).

The Walsh County 2 site was also severely eroded. At this site, remnants of the previous Bt horizon were located at the base of the current Ap horizon in a discontinuous 3 cm thick horizon, with the bottom depth of the horizon at 19 cm. The original Bt1 bottom depth was 28 cm and the lower boundary of the Bt2 horizon was 38 cm. Based on the loss of both Bt horizons, with a total thickness of 25 cm, the Ap horizon has been slowly eroded and the previous Bt horizons have been incorporated upwards in the profile to become the current Ap horizon. A similar process is occurring on three additional pedons on the backslope location at the site. These pedons lack Bw or Bt horizons, and it is likely that this is due to erosion based on their geomorphic position.

Figure 5. Detail of a pore lined with the historic Ap horizon residue at Cass County. This ped was found at the historic pedon location at a depth of approximately 5 cm. Photo courtesy of D.Hopkins.

Another indicator of topsoil loss at both the Cass County and Walsh County 2 sites is the depth to carbonates. In the historic morphologic descriptions, depth to carbonates was 37 cm at Cass County and 40 cm at Walsh County 2 (Tables 2 and 3). Currently, both sites have carbonates at the surface. Given that these are well-drained soils on backslope landscape positions, this is not due to a higher groundwater status and accumulation of carbonates from ET. Instead, this is a function of an eroded profile that has been tilled to incorporate effervescent material with whatever may remain from the original leached horizons, as is commonly seen in eroded-prairie landscapes (De Alba et al., 2004; Papiernik et al., 2005). The reason for the presence of surface carbonates is supported by transect pedon descriptions at the sites.

Of the four closest transect pedons to the Walsh County 2 resampled historic pedon location, the pedon directly upslope, located on the shoulder position, is the only one that has surficial carbonates. The Cass County site transect pedons also show that the presence of carbonates at the surface is controlled by erosion. The pedon immediately upslope has surficial carbonates, indicating this erosional trend is relevant on the landscape scale.

The two lowest backslope positions of the Cass County site are effervescent at the surface, while this is the same as the pedon directly upslope. These two lower pedons have leached horizons below the horizons containing carbonates. Which is an indicator of the translocation of calcareous material from upslope positions, specifically the pedon described in the previous paragraph, located directly upslope. This process is termed "profile inversion," and has been observed in other studies on soil tillage and erosion, also in lower positions on the landscape (De Alba et al., 2004).

While the inverted profiles may still exhibit a developed profile conducive to very reasonable yields in the study area, the addition of the translocated material may reduce yields on otherwise productive soils. Increases in the surface pH because of the presence of carbonates would decrease the availability of Fe, Mn, and Zn in the soil as the availability of these elements is inversely correlated with pH (Lindsay, 1991). Additionally, the loss of SOM at the Walsh County 2 historic location, from 5.5% to 3.5% would translate to a direct loss in crop production (Bauer and Black, 1994).

The Cass County and Walsh County 2 sites are eroded to an alarming degree. Morphologically these two sites are representative of the large-scale erosional changes described by the NRCS (USDA, 2011). Although yields at these sites are still adequate according to the producers, adjustments to current management practices should be considered.

Slightly to Moderately Eroded

Cass County and Walsh County 2 are severely eroded and, Dickey County 1 (Table 4), Dickey County 2 (Table 5), and Steele County (Table 6) all appear to be eroded but to a lesser degree, and are in class 1 for accelerated erosion. Class 1 sites would also be within the slight to moderately eroded phases (Fenton, 2012). Dickey County 1 and Steele County show some erosion, largely in a loss of organic carbon from the A horizons, as seen in Tables 4 and 6. Additionally, transect pedons at these sites show minimal evidence of profile truncation, and as a whole, all three sites appear to be more representative of the historic pedons than the Cass County and Walsh County 2.

Table 4. Soil organic matter (SOM) and selected morphologic data for the Dickey County 1 site. Data presented represent the catenary variation across the slope gradient at the site.

Landscape Position	Depth to Carbonates	Depth of A†	SOM	Current Structure	Previous Structure
	cm		%		
Summit	19	19	4.5		
Shoulder	25	4	4.3		
Shoulder	36	12	4.7		
Backslope	41	10	5.6		
Backslope	64 (43)‡	20 (13)	6.4 (9.0)	2 CO Sbk§	1 F/M GR¶
Backslope	70	18	6.6		
ToeSlope	80	15	6.2		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged

‡Values within parentheses represent historic pedon data

§ Moderate coarse subangular blocky

¶ Weak fine to medium granular

Table 5. Soil organic matter (SOM) and selected morphologic data for the Dickey County 2 site. Data presented represent the catenary variation across the slope gradient at the site.

Landscap e Position	**Depth to Carbonates**	**Depth of A†**	**SOM**	**Current Structure**	**Previous Structure**
	——cm——		%		
Summit	29	16	3.6		
Shoulder	17	17	3.5		
Backslope	19 (30)‡	19 (18)	3.2	2 F/M PR to 2 F/M GR§	1 F GR¶
Backslope	31	15	3.4		
Backslope	39	13	3.6		
ToeSlope	13	13	3.5		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged
‡Values within parentheses represent historic pedon data
§ Moderate fine to medium prismatic parting to moderate fine to medium granular
¶ Weak fine granular

Table 6. Soil organic matter (SOM) and selected morphologic data for the Steele County site. Data presented represent the catenary variation across the slope gradient at the site.

Landscape Position	**Depth to Carbonates**	**Depth of A†**	**SOM**	**Current Structure**	**Previous Structure**
	——cm——		%		
Summit	35	16	5.0		
Shoulder	24 (26)‡	14 (15)	4.4 (6.0)	2 CO SBK to 2 F/M GR§	2 VF GR¶
Backslope	27	12	4.0		
Backslope	61	26	4.8		
Backslope	97	30	5.1		
ToeSlope	100	22	5.9		
ToeSlope	26	26	5.6		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged
‡Values within parentheses represent historic pedon data
§ Moderate coarse subangular blocky parting to moderate fine to medium granular
¶ Moderate very-fine granular

These three sites appear to have been managed adequately to maintain high production levels, and losses of soil material are within the NRCS soil loss guidelines. Soil Surveys contain estimates of acceptable soil erosion. This value, the “T Factor,” is defined as “the maximum rate of annual soil erosion that will permit crop productivity to be sustained economically and indefinitely” (Soil Survey Division Staff, 1993). The Barnes soil series has a high T factor at 1.84 tonnes per hectare (5 tons per acre) per year assuming a bulk density of 1.3 g/cm3 (Soil Survey Staff, 2010b), meaning that since the date of the historic pedon descriptions 4.8 cm of erosional loss would be considered acceptable. At these three slightly to moderately eroded sites this appears to be true.

Not Eroded

Based on their current morphologic descriptions, the Dickey County 3 (Table 7) and Walsh County 1 (Table 8) do not appear to have suffered negative consequences from crop production, and tillage,. In fact, they may have even improved. Dickey County 1 supports perennial grasses and is grazed, and based on the landowner’s experience, historic aerial photography, and the historic and current morphologic descriptions, it is likely the site has never been tilled. Morphological evidence for this hypothesis is that the horizon boundary distinctness at the base of the current A horizon is gradual. Traditionally, the boundary between the A horizon and Bw horizon of the Barnes series was gradual and wavy, and photographs taken by William Johnson, who went on to become the head of the Soil Survey Division (Helms, 2008), of native, un-tilled Barnes also show gradual and wavy boundary conditions (Fig. 6).

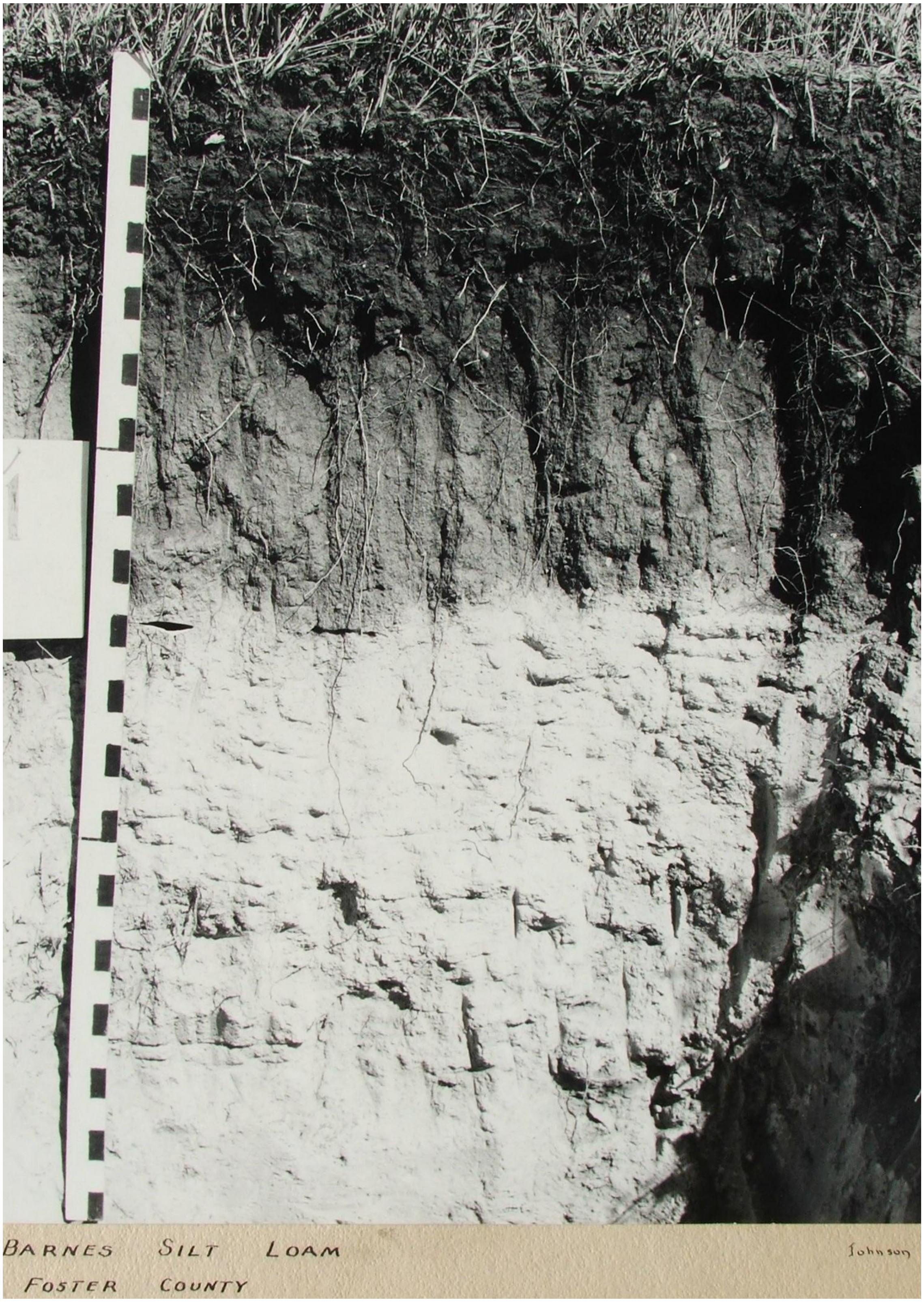


Figure 6. Photograph of a Barnes silt loam, in the late 1930's in Foster County, ND. Photo Courtesy of the North Dakota Agricultural Experiment Station (NDAES) and William M. Johnson.

An additional morphologic indicator that Dickey County 3 is a native site is the fine granular structure present in the A horizons. The granular structure is very well-defined across all transect pedon descriptions, and is currently stronger than it was in 1960. Granular or "crumb" structure is characteristic of high organic matter prairie soils (Brady and Weil, 1999) as found at this site (Table 7). Organic matter is not a morphologic property; however, it has a direct influence on the aggregate stability and their size in a soil (Andruschkewitsch et al., 2014; Eynard et al., 2005).

The other site that showed little to no erosion was the Walsh County 1 site. This site has been in the Conservation Reserve Program (CRP) for 25-30 years as was determined using historic imagery. There is well-defined granular structure at the site, and like Dickey County 3, structure is stronger as of 2013 than it was in 1959 (Table 8). This site shows a recovery of structure from coarse subangular blocky, that formed from previous tillage events, to a strong, fine to medium granular structure. Although structural improvements demonstrate that tilled and eroded sites have the ability to recover, changes in management practices are necessary. Conceptually, recovering or improving sites that have degraded due to conventional tillage, without removing land from agricultural production, is addressed with the adoption of no-till systems, and an abundance of research detailing the benefits of no-till systems compared to conventional tillage has been produced (Abdollahi and Munkholm, 2013; Andruschkewitsch et al., 2014; Helgason et al., 2009; Karlen et al., 2013; Kumar et al., 2012; Kumar et al., 2012b; Mahboubi and Lal, 1998).

Table 7. Soil organic matter (SOM) and selected morphologic data for the Dickey County 3 site. Data presented represent the catenary variation across the slope gradient at the site.

Landscap e Position	Depth to Carbonates	Depth of A†	SOM	Current Structure	Previous Structure
	cm		%		
Summit	43	22	8.8		
Backslope	52	15	6.1		
Backslope	59 (37)‡	11 (21)	7.6	2 F/M GR§	1 F GR¶
Backslope	54	16	8.3		
Backslope	46	14	6.6		
Backslope	39	18	5.2		
Backslope	61	18	8.0		
ToeSlope	67	19	6.0		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged
‡ Values within parentheses represent historic pedon data
§ Moderate fine to medium granular
¶ Weak fine granular

Table 8. Soil organic matter (SOM) and selected morphologic data for the Walsh County 1 site. Data presented represent the catenary variation across the slope gradient at the site.

Landscape Position	Depth to Carbonates	Depth of A†	SOM	Current Structure	Previous Structure
	—— cm	——	%		
Summit	34	19	5.5		
Shoulder	31	15	5.0		
Backslope	45 (43)‡	19 (13)	5.4 (6.8)	3 F/M GR§	1 CO SBK¶
Backslope	65	20	4.7		
Backslope	65	32	5.5		
Backslope	22	40	5.5		
ToeSlope	66	19	5.8		

† All described A horizons were included, in cases were multiple A horizons exist they were averaged
‡Values within parentheses represent historic pedon data
§ Strong fine to medium granular
¶ Weak coarse subangular blocky

Productivity Index Values

The productivity index (PI) value for the Barnes soil series on 0-3% slopes as determined by the North Dakota Cooperative Soil Survey is 85 on a scale ranging from 0-100 for all North Dakota soils. This high PI value indicates the importance of the series to agricultural production in the state of North Dakota, and due to the extensive nature of the Barnes soil, changes to the series PI will drastically alter the state's agricultural output. Reclassification of the Barnes PI value across the state is necessary due to the site-by-site morphologic changes documented here, as well as the statistically significant decrease in SOC measured for topsoil. The two sites that were highly eroded, and have lost their entire, original, A horizon material, should no longer have PI values of 85. They now more closely represent the Buse (Fine-loamy, mixed, superactive, frigid Typic Calciudolls) or Langhei (Fine-loamy, mixed, superactive, frigid Typic Eutrudepts) soil series and should have PI values ranging from 50-60.

An additional concern for many landowners is land assessment and property taxes. In the state of North Dakota, agricultural property value assessments are based on PI values of the land, and tax burden is directly related to these assessments. Given the obvious decreases in potential PIs shown here, do property value assessments and subsequent taxes assessed to the land owners need to be reevaluated?

Summary

Due to the complex nature of soil systems, and variability within sampling techniques, statistically significant chemical differences in the Barnes soil series were only confirmed for a net loss of SOC in the surface horizon. While there were differences in morphologic descriptions between the historic and current pedons, the Barnes soil series has not been significantly altered. Limitations within the resampling scheme used in this study may be obscuring the true change in the Barnes series, and should be more fully explored.

Evaluation of Resampling Method

The purpose of this work was to evaluate whether one soil series, the Barnes, had been altered chemically and morphologically over at least a 50 year time interval. While others have managed to discover broad, statewide trends in soil change (DeClerck et al., 2003; Malo et al., 2005; Veenstra, 2010; Veenstra and Burras, 2012), our goal was to isolate a single, highly productive benchmark soil, and to the best of our knowledge we are the first to attempt this. As discussed, changes in the Barnes series were constrained to a loss of SOC in the surface horizons, and morphologic changes present on a site-by-site basis. The largest limitations encountered in this work dealt with data availability, and the feasibility of resampling a larger number of sites.

Limitations of the Resampling Method

Database Fragmentation

The first limitation encountered in this work was the number of sites that could be feasibly sampled. Given adequate resources, resampling all 40 Barnes characterized before 1960 would have been preferred. Increasing sample size would increase statistical reliability, and would more accurately represent the changes to the Barnes series across North Dakota. Therefore, increasing sample size should be the first priority for any subsequent or related studies.

Resampling Difficulties

An additional issue encountered while sampling was the exact location of the historic pedon. While we were confident that samples were located to 3 m accuracy, that distance was too large for the Dickey County site. Additionally, based on the variability in the transect descriptions, there are large difference in soil conditions within a small area on the eastern North Dakota landscape. The greatest area of concern in site determination is in relation to the slope gradient. While variations exist in descriptions on similar landscape positions, they are minimal in comparison to the changes observed as the slope gradient is traversed, and this up and down slope variability in soil chemical properties has been documented in North Dakota (Franzen et al., 2006; Wu et al., 2002). The issue then becomes whether reported changes are a product of inherent landscape variability, or are truly representative of changes that occurred through an interval of time.

Variation in Descriptions

Another issue that must be addressed is the differences introduced by the pedologists describing the study sites for both historic and current pedons. Rarely do two pedologists describe properties equally while viewing the same soil, with differences in horizon depth and soil colors being the two most frequently disagreed upon properties. The colloquial term “lumper verses splitter” applies to this situation. These potential differences in individual pedon descriptions confound the ability of the researchers to speak with confidence regarding the accuracy of the datasets. This will continue to be a limitation as long as description techniques are subjective, hence confounding relevant statistical analysis of morphologic properties.

Even with the above difficulties, this method of resampling to determine long-term change remains a viable option, and will continue to be more financially prudent than setting up and maintaining a long-term field experiment. Resampling has the potential to be more accurate than the space-for-time method so long as the exact location is being resampled.

Conclusion

As a whole, assessing the amount or degree of change in one soil series is a difficult task. Without the ability to sample and compile a large dataset, and with so many confounding variables, great care must be taken in the implementation of such a study. The results for this project showed that management has a profound effect on the amount of change within the series. These management differences must be accounted for in any future work and constraining the resampling locations to one management type would allow for more valid conclusions to be reached for a single series.

Determining changes occurring in physical and chemical properties for a single series is best done with a large dataset, as statistically significant changes, such as the significant decrease in surface horizon SOC in the Barnes series, are easily calculated. Morphologic changes occurring in the series were more accurately determined on a site-by-site basis as there were too many potential variables between sites. These variables complicate tests of statistical significance as a valid method of comparison between the historic and current descriptions; such tests do not seem prudent.

Overall, this study shows that a resampling method based on legacy soil survey data has the potential to effectively measure changes for one specific soil series, but realistically, this study only serves as a proof of concept for these methods. Limitations hindered our ability to adequately answer research questions in full, but instead lay the foundation for future work in multiple areas. Hopefully, with continued research, the answers to these questions can be resolved.

ADDITIONAL MATERIALS AND METHODS UTILIZED

Soil Sampling Methods

On-site descriptions were made utilizing a traditional soil pit at four locations where previous characterization data had been collected (one in Dickey County, one in Steele County, and both Walsh County sites). Additionally, the site in Cass County was similarly described; however, historical laboratory data does not exist for the site. Soil pit descriptions were made using the standard Field Book for Describing Soils (Schoeneberger et al., 2012), and soil pits were sampled and described to a depth of 100 cm unless a C horizon was encountered at shallower depths. The site location data and soil descriptions were completed in the field on the standard NRCS 232 form for describing soils, and a transcribed version of each pedon can be found in Appendix B. Additionally, supplementary notes were taken at each site regarding the sampling scheme, landscape description, and any other general properties that were deemed relevant at the time of sampling; a copy of these notes can be found in Appendix C.

The distribution of Barnes and associated soils on the landscape was evaluated using a series of transects. After the original pedon was located, two transects were established, one oriented with the slope gradient and one perpendicular to the slope, following the same contour line as shown in Figure 7.

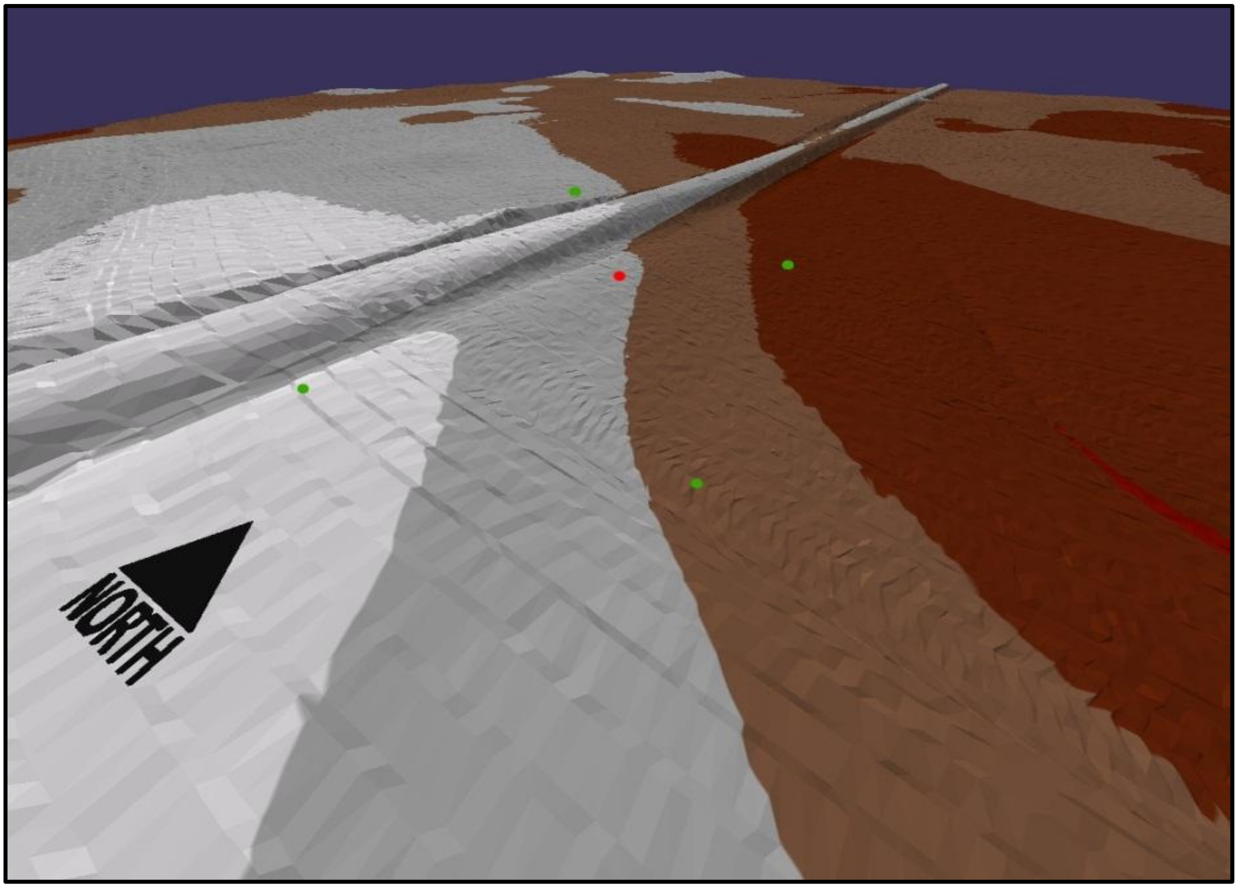


Figure 7. Schematic of transects for Cass County overlaid on a LiDAR digital elevation model. Distance from the central pedon (red) to ancillary points (green) is 45 m. Cass County Highway 18 is the obvious North-South feature shown on the image. Different colors represent 0.30 meter (1 foot) contour intervals.

In order to ensure that the sampling footprint was large enough to allow ET modeling, the distance from the central pedon to the end of each transect was set at 45 m. Ten, seven cm diameter, cores were taken along each transect at 9 m intervals to a depth of 120 cm using a truck mounted hydraulic soil sampling unit (Gidding's Machine Company, Windsor, CO) (Fig. 8).

Figure 8. Transect sampling with the Giddings probe at Dickey County 1. Photo courtesy of B.L. Montgomery.

Additionally, two cores were taken at the center location, one as a check for the central pit, the other served as an archival core. A full site comprised 22 soil cores unless roads or field-trails were encountered. A total of 137 cores were taken, transported to the laboratory, and described.

Soil Core Descriptions

Transect descriptions were described in a manner similar to the central pedons. For all pedons described, data were recorded regarding: horizon designations, depth of horizons, rock fragments, structure, consistence, mottles, redoximorphic features, concentrations, roots, pores, and ped and void surface features. Additionally, dry and moist soil colors were determined by using a Munsell Soil Color Book. The soil cores were also tested with 10% hydrochloric acid to determine the depth of effervescence and consequently the depth to carbonates. Soil textures for each horizon within each core were estimated using the traditional "feel" method employed by soil scientists, and a percentage of clay estimated for each horizon was also recorded.

Soil Description Variations

While care was taken to accurately quantify and characterize the soil sores in this study, there is undoubtedly a small degree of variation present in the data. These variations are due to differences between soil classifiers' preferences, and are most pronounced in subjective data, such as soil colors, percentage of rock fragments, percentage of roots and pores, quantity of redoximorphic features and mottles and their associated colors, and the appropriate depth for horizon differentiation. The majority of the errors are minimal and have no effect on interpretation of the data, but these variations should be acknowledged by users of the data.

Laboratory Methods

In completing the laboratory analysis for this project every effort was made to adhere to the methods used in the original characterization data. This was challenging due to the variability in methods used in the original analyses, but was carried out as completely and thoroughly as possible when feasible.

Samples from the soil pits were collected directly from the pit wall and immediately bagged and returned to NDSU. Soil transect cores taken with the Giddings probe were obtained using acetate sleeves, capped on both ends to reduce drying, and transported to the laboratory. The cores remained unopened until soil morphologic descriptions could be completed. All samples were air dried after morphologic descriptions occurred and ground with a flail grinder to pass a No. 10 (2 mm) sieve, before being packaged for storage until analysis.

A check soil, to verify accuracy and ensure quality data, was created from a soil located on a similar landscape as the Barnes series. This check soil is an A horizon from a Hamerly map unit. In order to produce a reliable, consistent check a large quantity (approx. 70 kgs) of the soil was passed through a No. 10 sieve (2 mm) and then homogenized in a cement mixer for 24 hours. The check soil was run with all analyses at a ratio of 10 samples to 1 check. This is in addition to any checks used to verify the accuracy of a method in relation to other soil testing laboratories, or other data sets.

Samples from the central pedons were run in triplicate on all completed analyses. This was done to ensure a high quality and accurate comparative dataset could be generated. Sample replication was not used for the transect core dataset analyses as logistically this would have been difficult due to the large number of samples and high analytical cost.

Datasets were analyzed for basic statistics (mean and standard deviation) as the data were collected; thus, allowing data to be quality checked immediately, and re-runs to occur as necessary. Transect core analyses could not be quality checked in the same manner as the central pedons however, therefore, an alternative method was utilized. The Hamerly check soil analyzed with all historical analyses was run a large number of times ($n \geq 30$) before the start of the transect core analysis. This allowed an in-house "standard" to be generated and run with the samples, allowing for comparison between any run of an analysis, and the standard. Therefore, a determination could be made if re-runs were needed. In addition, random duplications were completed and compared to determine the repeatability of the test and serve as an internal calibration within the analyses.

All samples from the central pedons (n=25), as well as all transect samples that had a horizon beginning within 50 cm of the soil surface (n=471) were sent to the Kellogg Soil Survey Laboratory (KSSL) for analyses. Those samples were analyzed for extractable bases, cation exchange capacity (CEC), gypsum, extractable acidity, and calculation of the air dry to oven dry ratio (AD/OD). Due to the KSSL having a much larger laboratory and staff, this allowed for more analyses to be completed on the dataset (Table. 9). The AD/OD was calculated by the KSSL for all samples sent, allowing standardization of results on an oven-dry basis (Method 3D1, National Soil Survey Center 2004) (Soil Survey Laboratory Staff, 2004).

Soil texture (particle size < 2 mm) for all pedons, and all horizons within each pedon, was determined via the traditional "feel" method. In addition, soil texture for the central pedons was verified according to the pipette method (Gee and Baulder, 1986). Briefly, 10 g of sample was treated with 25 ml of deionized (DI) water ,and 10 ml of 1M sodium acetate (NaOAc) adjusted to pH 5, and allowed to stand overnight. The samples were then diluted with 150 ml DI water and shaken for 10 min at 140 revolutions per minute (RPM) centrifuged for 10 min at 1500 RPM, decanted, and repeated until dispersion occurred. Excess supernatant was evaporated at 105 °C and the organic fraction was removed by heating the samples at 90 °C on a hotplate while treating with 5 ml incremental amounts of 30% hydrogen peroxide (H2O2). Samples were oven-dried at 105 °C for 24hrs and dispersed with sodium hexametaphosphate (NaPO3)6, then shaken at 140 RPM for 3 hrs. The sand fraction was separated from the silt and clay using a 0.47 mm sieve and oven-dried at 105 °C; sand fractionation was completed using nested sieves (1.0, 0.40, 0.25, 0.105, 0.044 mm). The percentage of silt and clay was determined gravimetrically using a pipette and sampling after two separate settling periods. The silt readings were taken at a depth of 10 cm after approximately 4 min, this number varied based on the solution temperature. Clay readings were determined at a depth of 5 cm, with the time also dependant on the temperature of the solution. A 25 ml volume of the solution was extracted at the appropriate time, weighed, and oven-dried at 105 °C for 24 hours. After drying and re-weighing the sample, a final determination of the silt and clay for was calculated (Gee and Bauder, 1986).

An estimation of coarse fragments was made during field descriptions for the central pedons, as well as in descriptions for the transect cores. In addition, the percentage by weight coarse fragments was calculated for the central pedons. To calculate this, each sample was weighed and then passed through a No. 10 (2 mm) sieve, the sample retained in the sieve was classified as coarse fragments and a percentage by weight value was calculated. It is important to note that this analysis was completed before the use of the flail grinder, as grinding would have altered the size distribution and percentage of coarse fragments by potentially destroying the fragments.

Table 9. Chemical analyses completed by the Kellogg Soil Survey Laboratory and the laboratory method codes for those analyses.

Analysis	Method Code†
Total Carbon (C)	4H2a
Total Nitrogen (N)	4H2a
Total Sulfur (S)	4H2a
NH_4OAc Extractable Calcium (Ca)	4B1a1a
NH_4OAc Extractable Magnesium (Mg)	4B1a1a
NH_4OAc Extractable Potassium (K)	4B1a1a
NH_4OAc Extractable Sodium (Na)	4B1a1a
NH_4OAc Cation Exchange Capacity (CEC)‡	4B1a1a
Gypsum	4E2a1a

† All methods can be found in the Soil Survey Laboratory Methods Manual (Soil Survey Laboratory Staff, 2004)

‡ This method is commonly referred to as CEC 7.

Additionally, the Kellogg soil survey laboratory analyzed extractable acidity on the subset of samples they received. The method utilized by the laboratory uses barium chloride-triethanolamine (BaCl2-TEA) replacement to estimate the quantity of extractable acidity in a sample (Method 4B2, National Soil Survey Center) (Soil Survey Laboratory Staff, 2004).

Soil Organic Matter (SOM) was determined for all samples using loss on ignition (LOI). The procedure for this involved placing approximately five grams of sample into tared ceramic crucibles using a standard five gram scoop; the crucibles were placed in a 105 °C drying oven overnight to ensure dryness of gypsiferous soils (Combs and Nathan, 1998), and re-weighed after the removal of water. After which, samples were placed in a muffle furnace and heated to 360 °C for two hours, cooled, and reweighed, with the difference between weights representing the SOM (Combs and Nathan, 1998).

Saturated pastes were prepared only for the central pedons for this research. Deionized water was added to the samples in small increments until a paste was created, samples were then covered and allowed to equilibrate overnight. Following this equilibration the pastes were placed on Buchner funnels and suction was applied, allowing the soil water to be extracted (Method 4F2, National Soil Survey Center) (Soil Survey Laboratory Staff, 2004). This extract was then analyzed for: pH, EC, Na, K, $CO32^{-}$, $HCO3^{-}$, Cl, and $SO42^{-}$.

The pH was determined by a number of different methods depending on the sample, but all samples were analyzed for pH 1:1. In addition, the central pedon samples were analyzed for saturated paste extract pH. Also, a small subset of the central pedons were analyzed for pH 1:5 and pH 1:10 in order to match the previous characterization data. All analysis was completed using a Fisher Scientific Accument Basic AB15 pH meter, calibrated with pH 4 and pH 7 standards. The pH 1:1 values were calculated by mixing 10 grams of sample with 10 ml of DI water. These samples were hand-shaken directly following the initial mixing and then stirred with a glass rod every 10 minutes for a period of 30 minutes. The pH reading was taken immediately following the 30 minute stirring.

Saturated paste pH was determined for the central samples following the extraction of the soil water from the saturated paste mixtures. The pH 1:5 and pH 1:10 data were only measured for the central pedons in Steele and Walsh Counties to match the dataset from the pre-1960's work. These analyses were conducted by mixing two grams of sample with 10 ml and 20 ml of DI water to achieve the desired ratio. Samples were hand-shaken periodically over a 3 hour period, and a final agitation was completed directly before the measurements were performed.

Electrical Conductivity was measured on the same samples analyzed for pH above. These measurements were made immediately preceding the pH measurements and were measured on a SensIon 378 (Hach, Loveland, CO). Calibration of the electrode was made using a range of standards (0.1, 0.5, 1, and 5 dS/m) as well as the deionized water used in the mixture. Electrical conductivity values for the samples were corrected for the EC registered in the deionized water. In addition, EC 1:1 values were converted to saturated paste EC (ECe) values, using equations correlating texture and EC (Hogg and Henry, 1984), to allow for comparisons between textural samples collected within this study and broader regional surveys of salinity as a function of texture.

Sodium and K concentrations were determined on saturation extracts from the central pedons. This analysis was completed by diluting samples to a range of values where the 210VGP atomic absorption spectrophotometer (AAS) (Buck Scientific, East Norwalk, CT) could analyze the solution. The AAS was calibrated for each element and a standardized curve was generated based on known standards. The samples were then analyzed based upon absorption and the output was multiplied by the dilution factor to produce the concentration in mg/L^{-1} (ppm).

Saturated paste extract samples were analyzed for carbonate (CO_3^{2-}) by adding two drops of phenolphthalein and then titrating with 0.05N sulfuric acid (H_2SO_4). Titration only occurs if a pink hue is produced by the addition of the phenolphthalein. Carbonate, if present, is then calculated based on the amount of sulfuric acid required to neutralize the carbonate and render a clear solution (Method 6I1a) (Soil Conservation Service Staff, 1967).

Bicarbonate analysis was run for the saturation paste extracts; however, due to an error in the method, no usable data was generated.

Chloride (Cl) concentrations for the saturation extracts were analyzed. This analysis was completed on the same sample as the carbonate and bicarbonate. Chloride was determined by adding 6 drops of a potassium chromate indicator (K_2CrO_4) and then titrating with 0.05N silver nitrate ($AgNO_3$) solution. The sample is titrated until a reddish-orange endpoint appears, and the concentration is calculated based on the amount of titrant used (Method, 6K1a) (Soil Conservation Service Staff, 1967).

The saturation extracts were also analyzed for sulfate (SO_4) concentration. This was completed using a flow injection analyzer (FIAlab-2500, FIAlab Instruments Inc. Bellevue, WA). The sample was mixed with a $BaCl_2$ solution and based upon the amount of light allowed to pass through the precipitation within the solution an impedance value was produced. This value was then correlated to a standard curve created with known standard concentrations (Method 4F2c1b, National Soil Survey Center) (Soil Survey Laboratory Staff, 2004).

The percentage by weight calcium carbonate ($CaCO_3$), or inorganic carbon, was calculated for all samples. This was done following the method used by the KSSL (Method 4E1a1, National Soil Survey Center) (Soil Survey Laboratory Staff, 2004). The analysis is completed by combining 1, 2, or 4 g of sample with 10 ml of 3N hydrochloric acid (HCl) in a closed glass container, with the amount of sample utilized being dependent upon the reaction class described in the morphologic description. The resulting reaction causes carbon dioxide (CO_2) to be produced and the pressure generated by the CO_2 is representative of the amount of $CaCO_3$ present. Pressure was measured manometrically and correlated to the percentage by weight $CaCO_3$ within the sample.

Permanent wilting point (1500 kPa) and field capacity (33 kPa) water were calculated for central pedon samples. Additionally, 10 kPa water was determined for a smaller subset in order to match the pre-1960 characterization data. These analyses were completed by wetting the samples, applying the appropriate pressure, and allowing the sample to equilibrate. After equilibrium was achieved the samples were weighed and dried at 105 °C for 24 hours. After drying, samples were re-weighed, and the percentage by weight water content was calculated. Pressure cooker style apparatus were used to determine 33 kPa and 10 kPa water (Method 3C1, National Soil Survey Center); 1500 kPa water utilized a more traditional pressure plate and a cellulose membrane to keep the soil within the system (Method 3C2a, National Soil Survey Center) (Soil Survey Laboratory Staff, 2004)

Certain values are calculated indirectly following analyses, and many simple ratios are calculated via division. These ratios and values are traditionally found in soil surveys, and are utilized in soil taxonomy in the determination of several soil interpretations. The data collected by this manner are: carbon/nitrogen ratio (C/N), sum of bases, ratio air dry/oven dry soil, base saturation, ratio of CEC/clay, exchangeable sodium percentage (ESP), sodium adsorption ratio (SAR), ratio of 1500 kPa water/clay, and ratio of 1500 kPa water minus % organic carbon/clay.

EVALUATION OF REMOTELY-SENSED EVAPOTRANSPIRATION DATA AS A PROXY FOR SOIL FUNCTION

Introduction

Remotely sensed data can be a rapid and effective proxy for assessing soil properties (Brady and Weil, 1999). While early soil survey based remote sensing was conducted utilizing aerial photography, improvements in quality and reliability, the number of orbiting satellites, and decreased sensing periods have allowed satellite-based remote sensing technologies to be widely adopted for both agricultural and hydrological resource issues. Many recent studies have shown the usefulness of remotely sensed satellite data to determine soil properties (Akpa et al., 2014; Silva et al., 2014; Vaudour et al., 2013; Zheng et al., 2013). For example, surface SOC levels were determined with 70% accuracy for a set of alfisols, mollisols, and inceptisols in northern France using Landsat remotely sensed data (Vaudour et al., 2013).

Recently, application of remotely sensed satellite data to assess ET from the soil surface has been successful in a wide range of climatic and vegetation regimes (Allen et al., 2007a, 2007b; Bastiaanssen et al., 1998a, 1998b). The amount of water evapo-transpired not only depends upon soil water storage, but is also reflective of the overall edaphic conditions on site. Consequently remotely sensed ET data has the potential to serve as an additional tool to assess soil quality and condition, i.e. soil function.

The most recent advancement in ET assessment is the METRIC™ model (mapping evapotranspiration at high resolution with internalized calibration) (Allen et al. 2007a). This model, based upon the widely utilized surface energy balance algorithm for land model (SEBAL) (Bastiaanssen et al., 1998), generates an accurate ET map allowing users to compare water loss over large areas of land (approximately 300 km^2). The ET information generated is referenced to a well-watered alfalfa (Medicago sativa) crop, which provides flexibility when making comparisons across different crops or native vegetation (Allen et al., 2012). The METRIC™ model has been shown to provide reliable estimates of ET in many different locations (Allen et al., 2007a, 2007b; Burkhalter et al., 2013; Gowda et al., 2008;). Recently, remotely-sensed ET data were utilized by North Dakota Agricultural Experiment Station researchers to characterize soil water use for a variety of crops over three growing seasons (2006-2008) in the Devils Lake Basin of North Dakota (Steele et al., 2014). The Devils Lake Basin is centrally located in Major Land Resource Area 55A, the Northern Black Glaciated Plains, consequently the methods of Steele et al., (2014) were adopted to quantify ET at the sites in eastern North Dakota where the historic Barnes soil characterization pedons were re-sampled.

Materials and Methods

Landsat 5 imaging was utilized to generate maps of estimated ET. Landsat 5 pixels are 30 x 30 m which was an important factor in the pedon transect design. Utilizing multiple pixels indicates the spatial variability of ET, hence transects were designed to span multiple pixels. Evapotranspiration mapping constraints included available satellite data, cloud free images on the satellite capture date, and proximity to North Dakota Agricultural Weather Network (NDAWN) weather stations. Additionally, the decision was made to use only one Landsat 5 path (Fig. 9), allowing all images to be collected from one day allowing for more reliable comparisons. Suitable imagery was then identified and NDAWN rainfall data were analyzed to ensure that relatively dry conditions existed for one week before image capture.

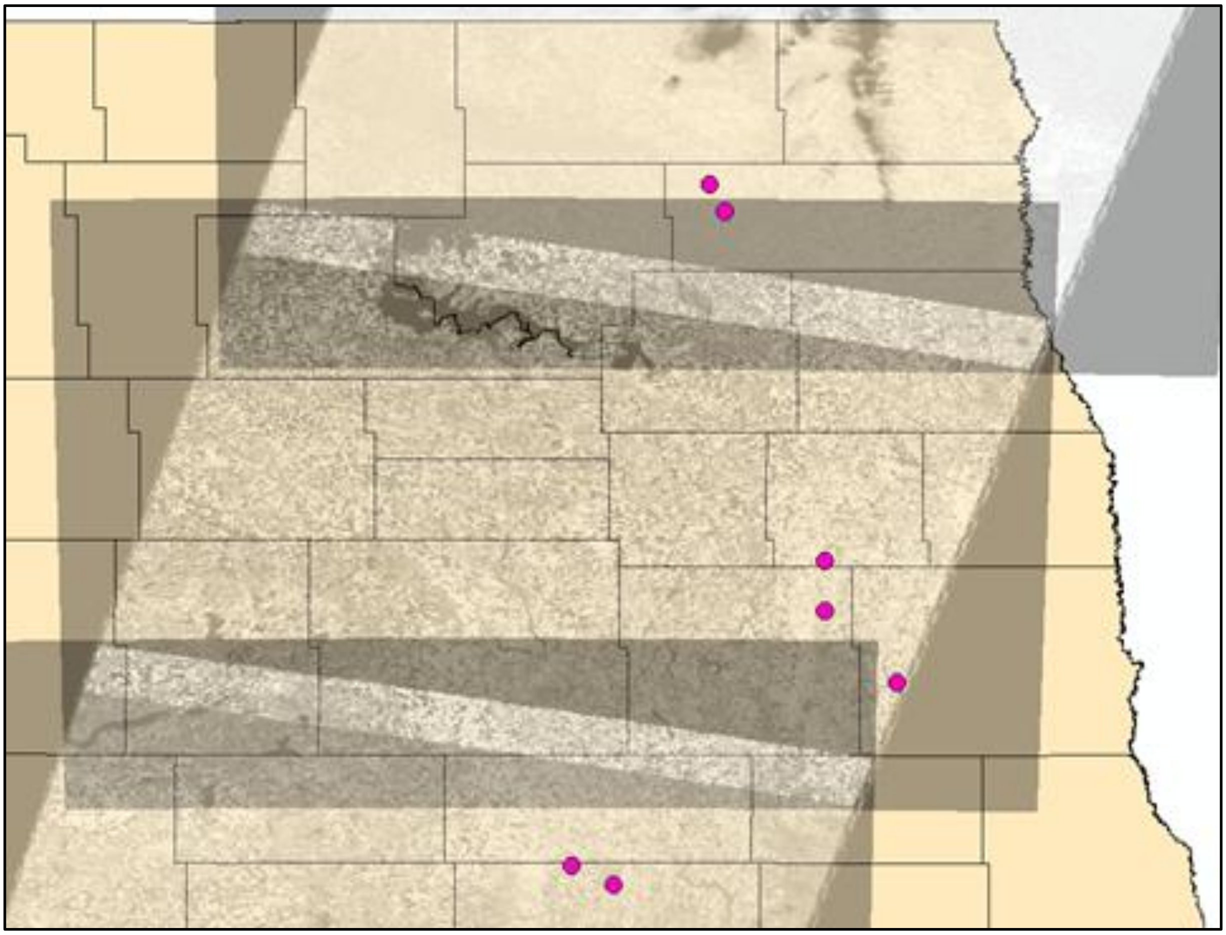


Figure 9. Landsat 5 path coverage and potential sampling site locations. These satellite images are cloud free and could be utilized in modeling. It is important to note that the site furthest east above does not fall within the satellites path.

By ensuring dry antecedent conditions, ET overestimations, induced by excess evaporation from either canopy or soil surfaces, are minimized. Weather data from the NDAWN stations were checked using physically-based data integrity assessment procedures for solar radiation, relative humidity (or dew point temperature), wind speed, and air temperature published by the American Society of Civil Engineers. The data from all stations were acceptable for reference ET calculations. Satellite data were downloaded from the United States Geological Survey (USGS) data portal and processed using ERDAS Imagine (a remote sensing analysis program) and ArcMap at the Department of Agricultural and Biosystems Engineering at NDSU.

METRIC™ Model

In order to calculate ET on a landscape scale an understanding of the energy balance equation: LE=Rn-G-H is necessary. In this equation LE (W/m2) is the latent energy consumed by ET, Rn (W/m2) is the net radiation, G (W/m2) is the sensible heat flux conducted into the soil and vegetation, and H (W/m2) is the sensible heat flux conducted into the air (Allen et al., 2012). The METRIC model attempts to overcome the shortcomings of other remotely sensed ET data by focusing errors into the H term and then calibrating the entire model for these errors producing more reliable ET estimates (Allen et al., 2007a).

This internal calibration previously described is specific for each user and determined based on the selection of both a “hot” and “cold” pixel. These pixels represent the calculated extremes of ET generated by the method, with the hot pixel chosen as bare earth surface, and the cold pixel representing an area of well-watered alfalfa (Medicago sativa) or a similar crop. Because the model is standardized for an alfalfa crop, crop type and development information are not necessary in order to calculate ET across the study area (Allen et al., 2007a).

The resulting dataset for the model spans a range from 0 at the hot pixel to 1.05 at the well-watered alfalfa, i.e., the cold pixel, which provides a reference ET, or ETr value. The data for each pixel is reported as the instantaneous ET, which is then divided by ETr for the entire image to produce the final output, the reference fraction ET (ETrF) which is “internally calibrated” based upon the cold pixel of the image. This ETrF value is equivalent to the commonly accepted crop coefficient value, KC; where KC=ETcrop/ETr (Allen et al., 2007a).

Results

The METRIC™ model results for this work have been completed; however, correlating ET data to soil properties has not taken place. The ETrF values for the six sites investigated in this study are shown based on landscape position in Table 10. Note that some landscape positions share ETrF values. For example, the shoulder and summit positions at Dickey County 2 both have an ETrF value of 0.88.

Table 10. Distribution of ETrF estimates by landscape position for six sites.

	Landscape Position				
Site	Run-on	Toe Slope	Back Slope	Shoulder	Summit
Dickey County 1	0.56	0.56	0.62	0.63	0.68
Dickey County 2	0.92	0.92	0.93	0.88	0.88
Dickey County 3	----------	0.82	0.72	0.72	0.72
Steele County	----------	0.47	0.45	0.45	0.45
Walsh County 1	0.57	0.57	0.57	0.56	0.56
Walsh County 2	----------	0.38	0.30	0.26	0.26

Maps displaying the spatial distribution of the transects at each site in relation to the ET mapping results can be found in the following appendices: Appendix D– Dickey County 1, Appendix E– Dickey County 3, Appendix F– Steele County, Appendix G– Walsh County 1, and Appendix H–Walsh County 2. The spatial distribution of Dickey County 2 and ET results are seen in Figure 10.

Discussion

While the soil pedologic information and METRIC™ results look promising separately, combining the datasets to evaluate if ET mapping can serve as a proxy for soil function has been problematic. As of now, the biggest limiting factor involves the coarse scale of the METRIC™ data in relation to soil variability. Results for the ET data (30x30 m pixel size) worked well for implementation of ET models to analyze field scale ET in irrigated areas of the Devils Lake Basin (Steele et al., 2014), as well as in other semi-arid locations throughout the U.S. (Allen et al., 2007b, Choi et al., 2009; Tasumi et al., 2005; Trezza et al., 2013) An example illustrating the disparity in scales is shown in Figure 13. This map portrays the many cores, i.e. potentially different pedons that are located within one pixel. Essentially, an aggregate of soil properties are being represented as one ETrF value. This is problematic as no meaningful method for correlating soil properties to ET has been developed. One possibility may be to generate a weighted average of all soil properties within one pixel to use for comparisons. This was ruled out as it would not provide a consistent measure of soil variability in the pixel. Additionally, generating this average could obscure any potential soil properties controlling ET in a pixel.

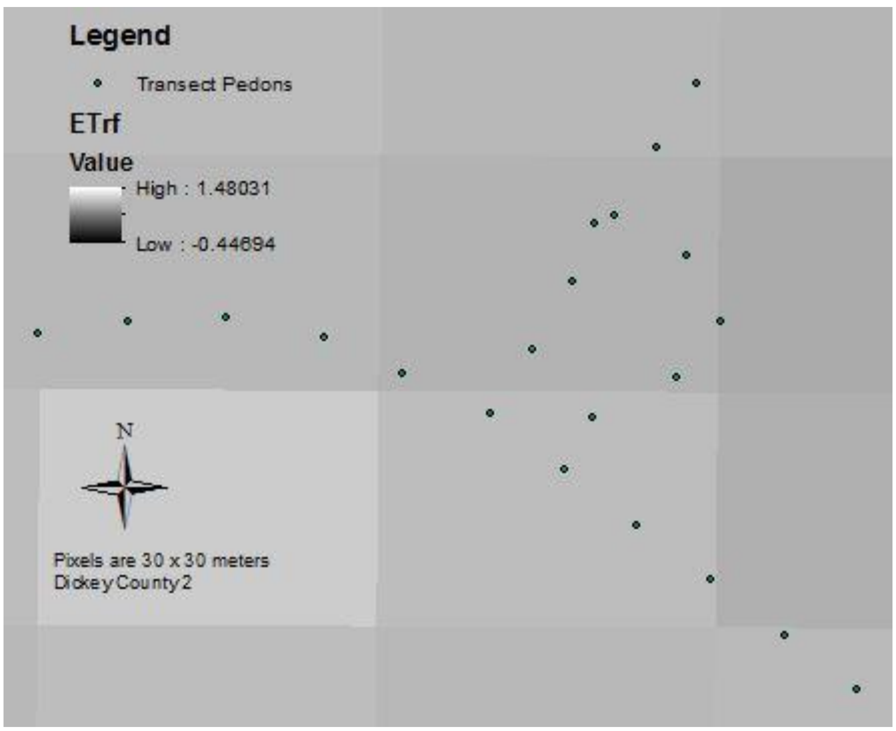


Figure 10. Transect layout in relation to the ET map produced for the area. This map also shows the number of pedons located within one 30 x 30 m pixel.

An additional idea was to take the centermost pedon in each pixel and use that to complete the analysis. This idea was dismissed, as it ignores the wealth of soil data available for analysis, and seems to be an arbitrary method to determine which soil properties are driving ET measurements. An alternative would be the use of multivariate analysis which would be tentatively completed by combing the entire soils dataset and ET data into a statistical package and allowing the program to determine what soil property or properties is most responsible for changes in ET. This idea is still being explored, however, the appropriate statistical design has not been determined.

One additional potential analysis is to quantify the proportion of each landscape position within each pixel. For example 60 percent of a given pixel might be classified as backslope, while 75 percent of an adjacent pixel may be toeslope. This quantification technique could be a feasible option with geostatistical tools and the detailed LiDAR and IFSAR datasets at each site. This has not been fully explored, however, and even if each pixel can be quantified by geomorphic position stratification, determining which pedons to utilize for each pixel would need to be determined. Therefore, this ET data is being presented as a means to foster discussion of how to integrate remotely sensed ET data in relation to soils and their spatial distribution.

Future Work

Suitability for Soil Landscape Studies

The largest obstacle to be addressed for remotely sensed ET data to be useful as a proxy for soil function is image size. Recently high resolution (1-4 m pixel size) ET mapping has been attempted utilizing IKONOS imagery (Yang et al., 2014). The availability of reliable, high resolution, IKONOS ET maps would allow for ET values to be correlated to soils data.

Calculating Pixel Spillover

Development of METRIC™ model ET maps is well documented, however, due to post processing used to calculate ETrF values there are still limitations. Landsat 5 produces thermal pixels that are 120x120 meters. These pixels are then sub sampled by the USGS to produce 30x30 meter thermal pixels. Due to this sub sampling there is a definite possibility for spillover from adjacent pixels.

In order to minimize spillover error, a moving 7x7 pixel window was developed by Agricultural and Biosystems Engineering Department scientists at NDSU. This pixel reclassification generates a density value for each ETrF pixel on the landscape, and is an indicator of the “purity” of the pixel. The range and distribution of pixel density values for the six sites utilized in this study is shown in Table 11. These pixel densities are calculated as a sum of the pixels in the surrounding 7x7 window that share the same land cover class as the center pixel. If all cells or pixels in the window are identical, a value of 49 is returned. For every cell that is not identical the pixel density value decreases.

Table 11. Reclassified pixel elements used to refine ETrF estimates for the six sites.

Site	Pixel Density based on 2006 NLCD†	NLCD 2006- Land Cover class
Dickey County 1	49	Hay/Pasture
Dickey County 2	49	Hay/Pasture
Dickey County 3	41	Hay/Pasture
Steele County	30	Cultivated Crops
Walsh County 1	36	Herbaceous
Walsh County 2	42	Cultivated Crops

†National Land Cover Dataset

This method of quantifying the purity of a pixel on the landscape gives the user a higher level of confidence in calculated values, however there is no objective statistical basis to this method and it is not known at what pixel density value a user should start to question the ETrF value for a pixel. Because of this lack in confidence the method needs to be further explored.

Kriging

Another method that is being utilized, by the developers of the METRIC™ model is a standard deviation calculation based on the 7x7 moving window and the National Land Cover Database (NLCD) classification value. This method is suspect due to the values assigned to pixels in the NLCD. Higher and lower numbers are arbitrarily assigned to a specific land cover class; therefore, large standard deviations can be recorded for a pixel based on the class code assigned. This is a limitation and part of the reason the density technique described above was developed.

Additionally, remotely sensed data could be analyzed utilizing kriging to enhance the moving window. This method could potentially serve as a method of creating a pixel density function that has a higher degree of statistical validity. To accomplish this task a NCLD land class value is established at the center of each 30 m pixel and then semivariogram analysis and kriging is completed for each 7x7 window. This analysis generates a statistical value for each pixel that places greater weight on closer pixels.

Conclusions

Overall, utilizing remotely sensed ET data to serve as a proxy for soil function shows promise. This is a novel idea but issues remain that must be addressed, specifically the spatial resolution of the ET maps. However, once resolution differences between ET and soil data are reconciled this method may provide an appropriate assessment of soil function.

GENERAL CONCLUSIONS

Soil organic carbon significantly decreased in surface horizons, and no other measured physical or chemical property revealed any statistical significance. This was unexpected, given morphologic changes documented by NRCS personnel in the National Soils Handbook exhibit 608.5 (USDA, 2011) for MLRA, 55A as well as the morphologic changes noted in field descriptions at the study sites.

Site-by-site comparisons of morphology revealed drastic changes in two of the sites with one site having its entire A horizon truncated, while the other lost nearly all of the A horizon. However, three additional sites showed minimal morphologic change, and erosion at the sites was within the NRCS T factor value for the Barnes soil series. Due to the limited sample size of the study statistical methods were not utilized to analyze the degree of morphologic change occurring over the past half century. Nevertheless, these sites appear to reflect management practices that would be classified as sustainable.

The remaining two sites are representative of what may occur if the Barnes series remains unplowed or is returned to perennial grasses. These sites show improvements in structure and, upon visual inspection, were more representative of Barnes than any of the other sites. These two sites represent ideal management situations and clearly do not constitute a significant proportion of the Barnes soils in eastern North Dakota.

The resampling method utilized in this study was shown to have limitations, but has been effectively utilized to determine long-term soil change in studies designed to classify change on a state level with large and complete legacy soil survey datasets. Our current study, based on a single benchmark soil, however, had a pre-1960 database that was inconsistent and a limited number of sites were re-sampled. Additionally, variations between pedologists' descriptive skills, and difficulties in precisely locating the historic pedon location compromised the resampling effort. Regardless of these limitations, the method does show promise for future studies, but great care must be taken in design and implementation.

Finally, utilizing remotely sensed ET data as a proxy for soil function was introduced here as an ancillary study, and the data collected is presented. While no conclusions were reached regarding the usefulness of the METRIC™ model to serve as a proxy, a general discussion of experiences gained during the study is presented. Also, information regarding the potential processing of this data and advancements for the METRIC™ model as a whole were introduced.

Overall, this study shows that a resampling method based on legacy soil survey data has the potential to effectively measure the soil change for one specific soil series, and that it is possible to utilize remotely sensed ET data to serve as a proxy for soil function in determining soil change. Realistically, this study serves as a proof of concept for these methods. Limitations hindered our ability to adequately answer research questions in full, but instead lay the foundation for future work in multiple areas; hopefully, with continued research, the answers to these questions can be resolved.

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APPENDIX A. GENERAL INFORMATION FOR PRE-1960 PEDONS

S49ND-075-003

Renville County

Originally S49-ND-38-3

B.L. Matzek

Date: September 20, 1949

Location: SW ¼ of SE ¼ Section 14, T.161 N, R.87 W

Vegetation or Crop: Fallow

Notes: Area contains numerous small rocks exposed on the surface; very little erosion evident

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 41 cm

Description - Yes

Characterization Data – Yes

S49ND-075-004

Renville County

Originally S-49-ND-38-4

B.L. Matzek

Date: September 20, 1949

Location: ¼ mile W of SE corner and 100' N of road, Section 17, T.161N, R.84W

Vegetation or Crop: Summer fallow

Notes: No erosion evident

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

S49ND-075-011

Renville County

Originally 49ND38-11

B.L. Matzek

Description Date: October 1949

Location: NW of NE of Section 34, T.163 N, R.87 W, S. of road

Vegetation or Crop: Burned over idle ground

Notes: Associated with Sioux, Fordville, Deering, and Benoit soils

Mollic Epipedon: 18 cm thick

Depth to Carbonates: 33 cm

Description - Yes

Characterization Data – Yes

S50ND-075-002

Renville County

Originally S50-ND-38-2

Clint Mogen

Date: September 18, 1950

Location: NE of NE Section 34, T. 163N, R. 84W; 70 paces S and 15 paces W of NE corner

Vegetation or Crop: Hayfield; quack grass

Notes:

Mollic Epipedon: 18 cm thick

Depth to Carbonates: 41 cm

Description - Yes

Characterization Data – Yes

S50ND-075-003

Renville County

Originally S50-ND-38-3

Clint Mogen

Description Date: September 18, 1950

Location: NE of NE, Section 20, T.163 N, R.84 W; 16 paces W, 27 paces S of NE corner

Vegetation or Crop: Grain stubble

Notes:

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 46 cm

Description - Yes

Characterization Data – Yes

S50ND-075-011

Renville County

Originally S50-ND-38-11

Clint Mogen

Date: November 1, 1950

Location: SE1/4 of SE1/4 of Section 2, T.161 N, R.85 W; 1320' N and 990' W of the S ¼ corner

Vegetation or Crop: Good small grain stubble

Notes:

Mollic Epipedon: 18 cm thick

Depth to Carbonates: 41 cm

Description - Yes

Characterization Data – Yes

S53ND-003-001

Barnes County

Originally S53-ND-2-1

William M. Johnson

Description Date: 1953

Location: 400 feet north and 90 feet west of the SE corner Section 20, T.142 N, R.56 W

Vegetation or Crop: Fallow land following wheat

Notes: ---

Mollic Epipedon: 20 cm thick

Depth to Carbonates: 41 cm

Description - Yes

Characterization Data – Yes

S53ND-021-002

Dickey County

Originally S53-ND-11-2

Clint Mogen

Description Date: September 18, 1953

Location: 840' E, 340' N of W ¼ corner Section 8, T.129 N, R.60 W

2300' S and 840'E of NW corner of Section 8, T.129 N, R.60 W

Vegetation or Crop: Weedy flax

Notes: ---

Mollic Epipedon: 11 cm thick

Depth to Carbonates: 38 cm

Description - Yes

Characterization Data – Yes

S53ND-091-001

Steele County

Originally S53-ND-46-1

William M. Johnson

Description Date: 1953

Location: 270 feet north and 75 feet east of SE corner of Section 28, T.144 N, R.56 W, Steel County, ND

Vegetation or Crop: Hard spring wheat

Notes: The layer C1, 36-41", probably indicated slight stratification due to water reworking of the parent

till. Bk at 12" – 23% $CaCO_3$ equivalent, but C1 = 20% $CaCO_3$ equivalent

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 30 cm

Description - Yes

Characterization Data – Yes

S53ND-103-002

Wells County

Originally S53-ND-52-2

No Surveyor Listed

Description Date: September 16, 1953

Location: 80' NW of SE corner Section 30, T.149 N, R.73 W

Vegetation or Crop: Wheat stubble

Notes: A heavy lime seam (1/4" across) extends from 30" to 50" in this profile.

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 30 cm

Description - Yes

Characterization Data – Yes

S58ND-021-001

Dickey County

Originally S58-ND-11-1

Hollis W. Omodt and Ordell P. Olson

Description Date: August 11, 1958

Location: 530' S, 530' W of E ¼ corner, Section 3, T.129 N, R.62 W

Vegetation or Crop: Native grasses, Western wheatgrass, blue grama, fringed sagewart, false plantain

Notes: Barnes-like loam; The C horizon had some lignite fragments; Organic tonguing to 18"

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

S58ND-021-002

Dickey County

Originally S58-ND-11-2

Hollis W. Omodt and Ordell P. Olson

Description Date: August 13, 1958

Location: 435' west and 600' north of south quarter corner, Section 20, T.130 N, R.62 W

Vegetation or Crop: Native grasses, western wheatgrass, blue grama, and wild sunflower are present, but gumweed has invaded almost 100% coverage

Notes: Sandstones well weathered, held together by $CaCO_3$. C horizon had some lignite fragments. Organic tonguing to 18 inches

Mollic Epipedon: 10 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

B1A

Barnes County

Charles E. Redmond

Description Date: 1958

Location: 75’ N, 135’ W of E ¼ corner, Section 5, T.137 N, R. 60 W

Vegetation or Crop: None listed

Notes: Reddish hues in B.

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 53 cm

Description - Yes

Characterization Data – Yes

B1B

Barnes County

Charles E. Redmond

Description Date: 1958

Location: 145’N, 0.2 mi E of SW corner, Section 9, T.138 N, R.60 W

Vegetation or Crop: None listed

Notes: Very similar to B1A

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 56 cm

Description - Yes

Characterization Data – Yes

B2A

Cass County

Charles E. Redmond

Description Date: 1958

Location: 200' S, 500' W of N 1/4 corner, Section 23, T.138 N, R.55 W

Vegetation or Crop: None listed

Notes: Till is partially water-worked, with a stone line at 28" (71 cm)

Mollic Epipedon: 23 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

B2B

Cass County

Charles E. Redmond

Description Date: 1958

Location: 450’ N, 140’ E of SW corner, Section 6, T.138 N, R.55 W

Vegetation or Crop: None listed

Notes: Too deep to lime for good Barnes. Till may be water worked

Mollic Epipedon: 23 cm thick

Depth to Carbonates: 61 cm

Description - Yes

Characterization Data – Yes

B2C

Cass County

Charles E. Redmond

Description Date: 1958

Location: 1150' N, 60' E of SW corner, Section 7, T.139 N, R. 54 W

Vegetation or Crop: None listed

Notes: Amount of well drained soil is limited in the immediate area

Mollic Epipedon: 18 cm thick

Depth to Carbonates: 38 cm

Description - Yes

Characterization Data – Yes

B3A

Steele County

Originally S53ND-46-1

Charles E. Redmond

Description Date: 1958

Location: 270' N, 75' E of SW corner, Section 28, T.144 N, R.56 W

Vegetation or Crop: None listed

Notes: At site of S53ND-46-1

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 31 cm

Description - Yes

Characterization Data – Yes

B3B

Barnes County

Charles E. Redmond

Description Date: 1958

Location: 400' N, 90' W of SE corner, Section 20, T.142 N, R.56 W

Vegetation or Crop: None listed

Notes: The original type location for Barnes. Now site is destroyed by widening road. At site of S53ND-2-1

Mollic Epipedon: 20 cm thick

Depth to Carbonates: 41 cm

Description - Yes

Characterization Data – Yes

B4A

Nelson County

Charles E. Redmond

Description Date: 1958

Location: 120’ N, 410’ W of SE corner, Section 18, T.150 N, R.57 W

Vegetation or Crop: None listed

Notes: none

Mollic Epipedon: 10 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

B4B

Nelson County

Charles E. Redmond

Description Date: 1958

Location: 1200’ N, 140’ E of SW corner, Section 30, T.158 N, R.58 W

Vegetation or Crop: None listed

Notes: Pebble line between B and Cca indicates stratification.

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 51 cm

Description - Yes

Characterization Data – Yes

B5A

Walsh County

Charles E. Redmond

Description Date: 1958

Location: 50' S, 400' W of NE corner, Section 31, T.158 N, R. 58 W

Vegetation or Crop: None listed

Notes: Some development seems to have started in the upper B; till is quite shaley

Mollic Epipedon: 20 cm thick

Depth to Carbonates: 43 cm

Description - Yes

Characterization Data – Yes

B5B

Walsh County

Charles E. Redmond

Description Date: 1958

Location: 300’ N, 400’ E of SW corner, Section 27, T.157 N, R.58 W

Vegetation or Crop: None listed

Notes: Reddish hues in B.

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 36 cm

Description - Yes

Characterization Data – Yes

S59ND-017-MS3

Cass County

M.D.S.-3

Michael D. Sweeney

Description Date: September 5, 1959

Location: 150' N, 500' W of SE corner, Section 25, T.140 N, R.54 W

Vegetation or Crop: Small grain stubble

Notes: Tonguing between A1-B, B-BD, BD-Dca and Dca-Dcs; The use of the D horizon symbols are used

to indicate an observed difference in the sequence of materials

Mollic Epipedon: 36 cm thick

Depth to Carbonates: 46 cm

Description - Yes

Characterization Data – Yes

S59ND-50-1

Walsh County

Originally S-59-ND-50-1

Charles E. Redmond

Description Date: 1959

Location: 200 ft. W, 50 ft. S of NE corner, Section 31, T.158 N, R.58 W

Vegetation or Crop: Grain stubble

Notes: from "Some Till-Derived Chernozem Soils in Eastern North Dakota: I. Morphology, Genesis, and Classification" C.E. Redmond and H. W. Omodt

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 43 cm

Description - Yes

Characterization Data – Yes

S59ND-50-2

Walsh County

Originally S-59-ND-50-2

Charles E. Redmond

Description Date: August 26, 1959

Location: 280 ft. E, 200 ft. N of SW corner, Section 27, T.157 N, R.58 W

Vegetation or Crop: Wheat

Notes: from "Some Till-Derived Chernozem Soils in Eastern North Dakota: I. Morphology, Genesis, and Classification" C.E. Redmond and H. W. Omodt

Mollic Epipedon: 13 cm thick

Depth to Carbonates: 38 cm

Description - Yes

Characterization Data – Yes

S60ND-021-05

Dickey County

Originally S60-ND-11-5

Ordell P. Olson

Description Date: September 8, 1960

Location: 475' south and 350' west of northeast corner, Section 31, T.132 N, R.62 W

Vegetation or Crop: Cultivated

Notes: Organic tonguing into B2 horizon

Mollic Epipedon: 15 cm thick

Depth to Carbonates: 33 cm

Description - Yes

Characterization Data – No

S60ND-021-07

Dickey County

Originally S60-ND-11-7

Ordell P. Olson

Description Date: September 9, 1960

Location: 0.6 miles east of northwest corner, Section 7, T.132N, R.63W

Vegetation or Crop: Native grasses, blue grama, buffalograss, silver sage, Junegrass; gumweed invading

Notes: Organic tonguing into B3ca

Mollic Epipedon: 18 cm thick

Depth to Carbonates: 38 cm

Description - Yes

Characterization Data – No

APPENDIX B. TRANSCRIBED PEDON DESCRIPTIONS FOR ALL SITES.

Site: R12ND-017-MM1 Center-1

Described by: Brandon L. Montgomery

Date: 01-28-13

Apk – 0 to 11 cm; very dark brown (10YR 2/2) loam (24% clay), grayish brown (10YR 5/2) dry; weak, fine to medium subangular blocky structure parting to weak, fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common, very fine to fine roots; few, very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk1 – 11 to 35 cm; light olive brown (2.5Y 5/3) loam (22% clay), pale brown (2.5Y 7/3) dry; weak, fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 35 to 56 cm; light olive brown (2.5Y 5/4) loam (22% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; many very fine to fine pores; common very fine to fine, distinct light gray (2.5Y 7/2) carbonate masses; common distinct light olive brown (2.5Y 5/3) clay films on all ped faces; strong effervescence

Bk3 – 56 to 78 cm; light olive brown (2.5Y 5/3) loam (26% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common very fine to fine, distinct light gray (2.5Y 7/1) carbonate masses; common distinct light olive brown (2.5Y 5/3) clay films on all ped faces; strong effervescence

BC – 78 to 93 cm; light olive brown (2.5Y 5/4) loam (27% clay), light yellowish brown (2.5Y 6/3) dry; few very fine red (2.5YR 5/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common very fine to fine, distinct light gray (2.5Y 7/1) carbonate masses; common distinct light olive brown (2.5Y 5/3) clay films on all ped faces; strong effervescence

C – 93 to 152 cm; olive brown (2.5Y 4/4) loam (32% clay), light yellowish brown (2.5Y 6/3) dry; few very fine to fine red (2.5YR 5/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium light brownish gray (2.5Y 6/2) iron depletions; slight effervescence; At the very bottom of horizon (approx. 110 cm) beginning to see signs of a sand lens; Till is slightly water worked

Site: R12ND-017-MM1 1-1

Described by: Brandon L. Montgomery

Date: 12-19-13

Notes: Spoil (krotovina) at bottom of core not described

Apk – 0 to 10 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate, fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; finely disseminated carbonates; slight effervescence

A – 10 to 32 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

Bw – 32 to 67 cm; very dark grayish brown (2.5Y 3/2) loam (23% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 67 to 84 cm; olive brown (2.5Y 4/3) loam (22% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; many very fine to fine pores; common very fine to fine, distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 84 to 152 cm; light olive brown (2.5Y 5/3) loam (23% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common very fine to fine, distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R12ND-017-MM1 1-2

Described by: Brandon L. Montgomery

Date: 01-27-14

Ap – 0 to 6 cm; very dark brown (10YR 2/2) loam (23% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; very slight effervescence

A – 6 to 28 cm; black (10YR 2/1) loam (23% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bw – 28 to 62 cm; very dark brown (10YR 2/2) loam (25% clay), dark gray (10YR 4/1) dry; moderate, fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bky – 62 to 90 cm; light olive brown (2.5Y 5/3) loam (25% clay), pale brown (2.5Y 8/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few, very fine to fine roots; many very fine to fine pores; many fine to medium pale brown (2.5Y 8/2) gypsum crystals; finely disseminated carbonates; strong effervescence

BCk – 90 to 111 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), pale brown (2.5Y 7/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; many very fine to fine pores;

many fine to medium distinct light gray (2.5Y 7/1) iron depletions; finely disseminated carbonates; strong effervescence

C – 111 to 152 cm; light olive brown (2.5Y 5/4) clay loam (35% clay), pale yellow (2.5Y 7/4) dry; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) iron depletions; finely disseminated carbonates; strong effervescence; Evidence of water worked till

Site: R12ND-017-MM1 1-3

Described by: Brandon L. Montgomery

Date: 01-24-14

Ap – 0 to 8 cm; black (10YR 2/1) loam (22% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

A – 8 to 28 cm; black (10YR 2/1) loam (26% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 28 to 49 cm; very dark gray (10YR 3/1) loam (26% clay), grayish brown (10YR 5/2) dry; moderate, fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many faint continuous very dark brown (10YR 2/2) organic stains on vertical ped faces; very few, very fine to fine roots; common very fine to fine pores; no effervescence

Bk – 49 to 71 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; many very fine to fine pores; few fine, distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence; 2 cm gypsum layer at bottom of horizon

C – 71 to 152 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), pale brown (2.5Y 7/3) dry; weak fine to medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; many fine to medium distinct light gray (2.5Y 7/1) iron depletions; many prominent fine to medium strong brown (7.5YR 5/6) noncemented iron (Fe^{+3}) masses; finely disseminated carbonates; slight effervescence; Appearance of water worked till; RMF's follow stratifications

Site: R12ND-017-MM1 1-4

Described by: Brandon L. Montgomery

Date: 01-24-13

Ap – 0 to 13 cm; black (10YR 2/1) loam (22% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

A – 13 to 33 cm; black (10YR 2/1) loam (21% clay), dark gray (10YR 4/1) dry; moderate, fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; very few, very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 33 to 50 cm; very dark brown (10YR 2/2) loam (26% clay), grayish brown (10YR 5/2) dry; moderate, fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; very few, very fine to fine roots; few very fine to fine pores; no effervescence

Bk – 50 to 70 cm; grayish brown (2.5Y 5/2) loam (23% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 70 to 85 cm; light olive brown (2.5Y 5/3) loam (24% clay), pale brown (2.5Y 8/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; many very fine to fine pores; few fine to medium distinct light gray (2.5Y 7/1) iron depletions; finely disseminated carbonates; strong effervescence

C – 85 to 152 cm; olive brown (2.5Y 4/4) clay loam (28% clay), pale brown (2.5Y 7/3) dry; weak fine to medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine to medium distinct light gray (2.5Y 7/1) iron depletions; few prominent fine to medium reddish yellow (7.5YR 6/6) noncemented iron (Fe^{+3}) masses; few fine to medium, distinct light gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R12ND-017-MM1 1-4.1

Described by: Brandon L. Montgomery

Date: 01-24-13

Notes: Point is listed as (4-1); could be a second core

Ap – 0 to 25 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence; First 4 cm have strong fine to medium granular structure

Bk1 – 25 to 39 cm; light yellowish brown (2.5Y 6/3) clay loam (29% clay), light gray (2.5Y 7/2) dry; moderate, fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; very few, very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; strong effervescence

Ap – 39 to 53 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; weak, fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, moderately sticky and moderately plastic; very few, very fine to fine roots; common very fine to fine pores; no effervescence; Krotovina, very large

Bk2 – 53 to 82 cm; light brownish gray (2.5Y 6/2) clay loam (27% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk3 – 82 to 152 cm; light olive brown (2.5Y 5/4) loam (23% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; many very fine to fine pores; few fine, distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; strong effervescence

Site: R12ND-017-MM1 1-5

Described by: Brandon L. Montgomery

Date: 01-28-14

Ap – 0 to 9 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

A – 9 to 28 cm; black (10YR 2/1) clay loam (28% clay), very dark gray (10YR 3/1) dry; moderate, fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few, very fine to fine roots; few very fine to fine pores; many faint continuous black (10YR 2/1) clay films on all ped faces; no effervescence

Bw – 28 to 53 cm; very dark brown (10YR 2/2) clay loam (32% clay), grayish brown (10YR 5/2) dry; moderate, fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; very few, very fine to fine roots; common very fine to fine pores; no effervescence

Bk – 53 to 79 cm; grayish brown (2.5Y 5/2) clay loam (27% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine, faint white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 79 to 101 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), pale brown (2.5Y 8/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; slight effervescence

C – 101 to 152 cm; olive brown (2.5Y 4/4) clay loam (29% clay), pale brown (2.5Y 7/3) dry; few fine yellowish red (5YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; common fine to medium, distinct light gray (2.5Y 7/1) iron depletions; common prominent fine to medium brownish yellow (10YR 6/8) noncemented iron (Fe^{+3}) masses; slight effervescence

Site: R12ND-017-MM1 2-1

Described by: Brandon L. Montgomery

Date: 01-15-14

Ap – 0 to 14 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, nonsticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 14 to 38 cm; dark brown (10YR 3/3) loam (24% clay), grayish brown (10YR 5/2) dry; moderate, fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few, very fine to fine roots; many very fine to fine pores; many faint continuous distinct very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence

Bk1 – 38 to 65 cm; light olive brown (2.5Y 5/3) loam (23% clay), light gray (2.5Y 7/2) dry; moderate, fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 65 to 89 cm; light olive brown (2.5Y 5/3) loam (26% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine to fine, distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 89 to 102 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence; Krotovina at top of BC horizon

C – 102 to 152 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/4) dry; very few fine to medium prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; common very fine to fine pores; slight effervescence; Water-worked till

Site: R12ND-017-MM1 2-2

Described by: Brandon L. Montgomery

Date: 01-15-14

Ap – 0 to 17 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw1 – 17 to 37 cm; dark brown (10YR 3/3) loam (24% clay), brown (10YR 5/3) dry; moderate, fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few, very fine to fine roots; common very fine to fine pores; common faint discontinuous dark brown (10YR 3/3) clay films on all ped faces; no effervescence

Bw2 – 37 to 53 cm; very dark gray (2.5Y 3/3) loam (23% clay), light yellowish brown (2.5Y 6/3) dry; moderate, fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bk – 53 to 82 cm; light yellowish brown (2.5Y 6/3) loam (26% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; soft, very friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many very fine to fine, distinct light gray (2.5Y 7/1) carbonate masses; strong effervescence

BCk – 82 to 96 cm; light olive brown (2.5Y 5/3) loam (29% clay), light gray (2.5Y 7/2) dry; few very fine to fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine to fine distinct light gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence; Light presence of water-worked till

C – 96 to 152 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/4) dry; few very fine to fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; common very fine to fine pores; slight effervescence; Shale evident in lower C horizon

Site: R12ND-017-MM1 2-3

Described by: Brandon L. Montgomery

Date: 01-28-14

Ap – 0 to 16 cm; black (10YR 2/1) loam (26% clay), dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

Bw1 – 16 to 37 cm; very dark brown (10YR 2/2) loam (23% clay), brown (10YR 4/1) dry; moderate, fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few, very fine to fine roots; common very fine to fine pores; common fine distinct black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bw2 – 37 to 55 cm; olive brown (2.5Y 4/3) loam (25% clay), light olive brown (2.5Y 5/3) dry; weak, fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bw3 – 55 to 79 cm; light olive brown (2.5Y 5/4) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; no effervescence

Bk – 79 to 102 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common very fine to fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C – 102 to 152 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), light gray (2.5Y 7/4) dry; few very fine to fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; few very fine distinct light gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R12ND-017-MM1 2-4

Described by: Brandon L. Montgomery

Date: 01-28-14

Notes: Ap and Ak could be old Bw

Ap – 0 to 7 cm; very dark brown (10YR 2/2) loam (23% clay), brown (10YR 4/1) dry; weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; finely disseminated carbonates; very slight effervescence

Ak – 7 to 31 cm; very dark gray (10YR 3/1) loam (25% clay), light gray (10YR 5/1) dry; weak fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; few, very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; strong effervescence; Bottom 6 cm of horizon: krotovina with odd mixing pattern

Bk1 – 31 to 56 cm; light olive brown (2.5Y 5/3) loam (25% clay), white (2.5Y 8/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Bottom 5 cm of horizon: old krotvina

Bk2 – 56 to 74 cm; light olive brown (2.5Y 5/3) loam (26% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 74 to 93 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 93 to 152 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), pale brown (2.5Y 7/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct light gray (2.5Y 7/1) iron depletions; few very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Appearance of lightly water-worked till

Site: R12ND-017-MM1 2-5

Described by: Brandon L. Montgomery

Date: 01-23-14

Ap – 0 to 13 cm; very dark grayish brown (10YR 3/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; very slight effervescence; Old Bw

Bw – 13 to 25 cm; olive brown (2.5Y 4/4) loam (23% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few, very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; very slight effervescence

Bk – 25 to 53 cm; light olive brown (2.5Y 5/3) loam (24% clay), light gray (2.5Y 7/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 53 to 67 cm; light olive brown (2.5Y 5/4) loam (26% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 67 to 152 cm; olive brown (2.5Y 4/3) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; few very fine yellowish red (5YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; few very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; slight effervescence; Slight appearance of water-worked till; Redox depletions in between water-worked sheets

Site: R12ND-017-MM1 3-1

Described by: Brandon L. Montgomery

Date: 01-23-14

Apk – 0 to 11 cm; very dark brown (10YR 2/2) loam (23% clay), grayish brown (10YR 5/2) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; finely disseminated carbonates; strong effervescence; Old Bw

Bw – 11 to 23 cm; olive brown (2.5Y 4/4) loam (21% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; very slight effervescence

Bk1 – 23 to 40 cm; light olive brown (2.5Y 5/3) loam (21% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 40 to 70 cm; light yellowish brown (2.5Y 6/3) loam (22% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence; 57-70 cm krotovina

Bk3 – 70 to 97 cm; light yellowish brown (2.5Y 6/4) loam (22% clay), pale brown (2.5Y 7/3) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine pores; finely disseminated carbonates; slight effervescence; Redox factors on perched water table at bottom of horizon

C – 97 to 152 cm; olive brown (2.5Y 4/4) clay loam (30% clay), pale brown (2.5Y 7/3) dry; common very fine to fine strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine to medium distinct gray (2.5Y 5/1) iron depletions; slight effervescence

Site: R12ND-017-MM1 3-2

Described by: Brandon L. Montgomery

Date: 01-23-14

Ap – 0 to 12 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Old Bw

Bw – 12 to 33 cm; olive brown (2.5Y 4/4) loam (23% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; very slight effervescence

Bk1 – 33 to 65 cm; light olive brown (2.5Y 5/3) loam (23% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C – 65 to 152 cm; olive brown (2.5Y 4/4) clay loam (28% clay), pale brown (2.5Y 7/3) dry; common very fine to fine strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/2) iron depletions; common fine to medium distinct light gray (2.5Y 7/2) carbonate masses; strong effervescence; Iron depletions are oriented along planes between strongly water-worked till

Site: R12ND-017-MM1 3-3

Described by: Brandon L. Montgomery

Date: 01-24-14

Ap – 0 to 13 cm; very dark brown (10YR 2/2) loam (23% clay), light gray (10YR 5/1) dry; weak fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; slight effervescence; Old Bw

Bw – 13 to 32 cm; olive brown (2.5Y 4/4) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many distinct discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; very few very fine to fine roots; common very fine to fine pores; very slight effervescence

Bk1 – 32 to 53 cm; light olive brown (2.5Y 5/4) loam (25% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common distinct discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; very few very fine to fine roots; many very fine to fine pores; few medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; finely disseminated carbonates; strong effervescence; Organic stains in top 6 cm of horizon

Bk2 – 53 to 72 cm; light olive brown (2.5Y 5/4) loam (26% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 72 to 152 cm; olive brown (2.5Y 4/4) clay loam (30% clay), light yellowish brown (2.5Y 6/4) dry; few fine brown (7.5YR 4/5) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/2) carbonate masses; slight effervescence; Slightly water-worked till

Site: R12ND-017-MM1 3-4

Described by: Brandon L. Montgomery

Date: 01-23-14

Apk – 0 to 9 cm; very dark grayish brown (10YR 3/2) loam (21% clay), light gray (10YR 5/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; slight effervescence; Old Bw horizon

Bk – 9 to 37 cm; olive brown (2.5Y 4/4) loam (23% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct very dark gray (2.5Y 3/4) clay films on all ped faces; common very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 37 to 63 cm; light olive brown (2.5Y 5/3) loam (25% clay), pale brown (2.5Y 7/3) dry; few very fine yellowish red (5YR 4/6) mottles; moderate fine to medium prismatic structure parting to moderate fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C – 63 to 152 cm; olive brown (2.5Y 4/4) clay loam (30% clay), pale yellow (2.5Y 7/4) dry; few very fine yellowish red (5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine to medium distinct gray (2.5Y 6/1) iron depletions; slight effervescence; Very weakly water-worked till

Site: R12ND-017-MM1 3-5

Described by: Brandon L. Montgomery

Date: 12-19-13

Apk – 0 to 13 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; slight effervescence

Bk1 – 13 to 39 cm; light olive brown (2.5Y 5/3) loam (21% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 39 to 52 cm; olive brown (2.5Y 4/3) loam (21% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk3 – 52 to 84 cm; light olive brown (2.5Y 5/3) loam (25% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct clay films on all ped faces; few very fine to fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 84 to 97 cm; light olive brown (2.5Y 5/4) loam (26% clay), light gray (2.5Y 7/2) dry; few very fine yellowish red (5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C – 97 to 152 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), pale brown (2.5Y 7/3) dry; few very fine to fine strong brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; slight effervescence; Indications of a water-worked till

Site: R13ND-021-MM1-Center-1

Described by: Brandon L. Montgomery

Date: 9-27-13

Notes: From a microlow? Bw has the appearance of an E with bleached sand grains and fulvic humic accumulation in Bt

Ap – 0 to 14 cm; very dark brown (10YR 2/2) clay loam (28% clay), very dark grayish brown (10YR 3/2) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Structure not conducive for pores

BE – 14 to 30 cm; dark brown (10YR 3/3) loam (26% clay), grayish brown (10YR 5/2) dry; moderate fine to medium prismatic structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence; Bleached sand grains and weak platy structure forming on Bw horizon

Bt – 30 to 44 cm; dark brown (10YR 3/3) clay (44% clay), dark brown (10YR 4/3) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many distinct black (10YR 2/1) organic stains on vertical ped faces; many distinct continuous dark brown (10YR 3/3) clay films on all ped faces; no effervescence

Bty – 44 to 72 cm; olive brown (2.5Y 4/4) clay (41% clay), light yellowish brown (2.5Y 6/4) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint distinct continuous olive brown (2.5Y 4/3) clay films on all ped faces; many fine to medium distinct gypsum crystals; slight effervescence

Bky – 72 to 86 cm; light olive brown (2.5Y 5/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; many very fine to fine pores; many distinct discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; few fine distinct carbonate masses; common fine to medium distinct gypsum crystals; finely disseminated carbonates; strong effervescence

BCk – 86 to 108 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few very fine yellowish red (5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine distinct gray (2.5Y 6/1) iron depletions; few fine distinct carbonate masses; finely disseminated carbonates; strong effervescence

C – 108 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light olive brown (2.5Y 5/3) dry; few very fine to fine light yellowish gray (10YR 6/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct carbonate masses; slight effervescence; Water-worked till

Site: R13ND-021-MM1 1-1

Described by: Brandon L. Montgomery

Date: 10-01-13

Ap – 0 to 18 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

E – 18 to 31 cm; dark grayish brown (10YR 4/2) loam (20% clay), light brownish gray (10YR 6/2) dry; moderate fine to medium platy structure; very hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

Bt – 31 to 54 cm; dark brown (10YR 3/3) clay (47% clay), dark grayish brown (10YR 4/2) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and very plastic; few very fine to fine roots; common very fine to fine pores; many faint continuous black (10YR 2/1) clay films on all ped faces; many fine very dark brown (10YR 2/2) organic stains; no effervescence

Bty1 – 54 to 70 cm; very dark brown (10YR 2/2) clay (43% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; many faint continuous black (10YR 2/1) clay films on all ped faces; many fine black (10YR 2/1) organic stains; common fine distinct light gray (10YR 7/1) gypsum crystals; very slight effervescence

Bty2 – 70 to 95 cm; very dark gray (2.5Y 3/3) clay (41% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure parting to moderate fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; common fine very dark gray (10YR 3/1) organic stains; common fine distinct light gray (10YR 7/1) gypsum crystals; very slight effervescence

BCy – 95 to 105 cm; olive brown (2.5Y 4/3) clay (40% clay), light olive brown (2.5Y 5/4) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common faint discontinuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; few very fine to fine distinct light gray (2.5Y 7/1) gypsum crystals; very slight effervescence

C – 105 to 152 cm; dark gray (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine faint gray (2.5Y 5/1) iron depletions; few very fine distinct light gray (2.5Y 7/1) gypsum crystals; slight effervescence

Site: R13ND-021-MM1 1-2

Described by: Brandon L. Montgomery

Date: 10-01-13

Notes: Core only 42" or 106 cm

Ap – 0 to 15 cm; very dark brown (10YR 2/2) clay loam (28% clay), grayish brown (10YR 5/2) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, firm, not sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

BE – 15 to 38 cm; very dark grayish brown (10YR 3/2) silt loam (25% clay), light brownish gray (10YR 6/2) dry; weak fine to medium prismatic structure parting to moderate fine to medium platy; hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence; Quasi BE horizon, Bw converting to E horizon

Bt1 – 38 to 68 cm; black (10YR 2/1) clay (48% clay), very dark gray (10YR 3/1) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous black (10YR 2/1) clay films on all ped faces; many fine black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bt2 – 68 to 80 cm; very dark grayish brown (2.5Y 3/2) clay (42% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; common distinct continuous clay films on all ped faces; common distinct very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bk – 80 to 98 cm; olive brown (2.5Y 4/4) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure parting to moderate fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine prominent strong brown (7.5YR 4/6) iron oxidations; common fine clay films on vertical ped faces; few fine distinct light gray (2.5Y 7/1) carbonate masses; very slight effervescence; Noneffervescent except for concentrations

BC – 98 to 106 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light olive brown (2.5Y 5/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium prominent strong brown (7.5YR 4/6) iron oxidation; few fine distinct light gray (2.5Y 7/1) carbonate masses; Pedogenic fabric still present; little indication of any C horizon; noneffervescent except for concentrations

Site: R13ND-021-MM1 1-3

Described by: Brandon L. Montgomery

Date: 09-26-13

Notes: soil is an intergrade between Tonka and Barnes with features of both

Ap – 0 to 15 cm; black (10YR 2/1) clay loam (30% clay), very dark gray (10YR 3/1) dry; weak fine to medium granular structure; soft, very friable, not sticky and moderately plastic; common very fine to fine roots; no effervescence; Structure so loose no pores are visible

BE – 15 to 31 cm; very dark grayish brown (10YR 3/2) loam (25% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common distinct very dark gray (10YR 3/1) organic stains on vertical ped faces; no effervescence; Grading towards E, downslope positions will be more developed

Bw – 31 to 56 cm; dark brown (10YR 3/3) loam (26% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few prominent olive brown (2.5Y 4/3) clay films on all ped faces; noneffervescent/slight effervescence; Carbonate line extends 5 cm into this horizon probably from water movement; structure and texture do not vary though

Bk1 – 56 to 79 cm; very dark brown (10YR 2/2) clay (26% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; few distinct discontinuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; few fine distinct light gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 79 to 97 cm; very dark gray (2.5Y 3/3) clay loam (27% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct light gray (2.5Y 7/1) carbonate masses; strong effervescence

BC – 97 to 108 cm; olive brown (2.5Y 4/3) clay loam (34% clay), light olive brown (2.5Y 5/4) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium subangular blocky structure; hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; slight effervescence; Blending of structure and water-worked till plus pedogenic fabrics

C – 108 to 152 cm; dark gray (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; hard, friable, slightly sticky and moderately plastic; common very fine to fine pores; many fine to medium distinct gray (2.5Y 5/1) iron depletions; slight effervescence; Water-worked till

Site: R13ND-021-MM1 1-4

Described by: Brandon L. Montgomery

Date: 09-26-13

Notes: Compaction beginning at 94 cm; Hole was 122 cm but core ends at 114 cm; Extremely gravelly horizon beginning 31 cm to 53 cm approximately 35% gravels; Another slightly less gravelly layer at 67-79 cm

Ap – 0 to 14 cm; very dark brown (10YR 2/2) clay loam (29% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly, friable, not sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

EB – 14 to 31 cm; dark brown (10YR 3/3) clay loam (27% clay), dark gray (10YR 4/1) dry; weak thin to medium platy structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bt – 31 to 53 cm; dark brown (2.5Y 3/3) very gravelly clay (44% clay), olive brown (2.5Y 4/3) dry; strong fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; many prominent continuous clay films on all ped faces; no effervescence; Gravel layer, discontinuity, gravel is listed as 35%

Bk1 – 53 to 67 cm; olive brown (2.5Y 4/3) clay loam (32% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; very few very fine to fine roots; common very fine to fine pores; common distinct discontinuous clay films on all ped faces; common fine to medium distinct carbonate masses; strong effervescence

Bk2 – 67 to 79 cm; light olive brown (2.5Y 5/3) gravelly clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common very fine to fine faint gray (2.5Y 6/1) iron depletions; common fine distinct carbonate masses; strong effervescence; Another less gravelly discontinuity, gravel is listed as 20%

BCk – 79 to 94 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; common fine distinct brown (7.5YR 4/4) mottles; weak fine to medium subangular blocky structure; hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; common fine faint gray (2.5Y 6/1) iron depletions; common fine distinct carbonate masses; strong effervescence; Mixture of water-worked till with features of pedogenic origin

C – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light olive brown (2.5Y 5/4) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; very hard, firm, slightly sticky and moderately plastic; common very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct carbonate masses; few fine distinct gypsum crystals; slight effervescence; Water-worked till

Site: R13ND-021-MM1 1-5

Described by: Brandon L. Montgomery

Date: 09-25-13

Ap – 0 to 15 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, firm, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

E – 15 to 31 cm; very dark gray (10YR 3/1) loam (22% clay), light gray (10YR 5/1) dry; moderate fine to medium prismatic structure; hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; no effervescence; common distinct skeletans – cleaned sand grains; There is a 6 cm transition horizon between E and Bt that was not broken out due to the nature of this work

Bt – 31 to 56 cm; dark brown (10YR 3/3) clay loam (37% clay), dark grayish brown (10YR 4/2) dry; strong fine to medium prismatic structure; very hard, firm, slightly sticky and very plastic; common very fine to fine roots; many very fine to fine pores; many distinct continuous dark grayish brown (10YR 4/2) clay films on all ped faces; common distinct continuous very dark gray (10YR 3/1) organic stains; no effervescence

Btk – 56 to 79 cm; very dark brown (10YR 2/2) clay loam (36% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; common very fine to fine roots; common very fine to fine pores; common faint discontinuous dark grayish brown (10YR 4/2) clay films on all ped faces; common fine to medium distinct carbonate masses; slight effervescence

Bky – 79 to 97 cm; very dark gray (2.5Y 3/3) clay loam (32% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure parting to moderate fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few very fine to fine faint iron depletions; few fine to medium distinct gypsum crystals; finely disseminated carbonates; strong effervescence

BCy – 97 to 108 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light olive brown (2.5Y 5/4) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few very fine to fine distinct iron depletions; few fine distinct gypsum crystals; slight effervescence

C – 108 to 152 cm; dark gray (2.5Y 4/4) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine pores; common very fine to fine distinct iron depletions; few fine faint gypsum crystals; slight effervescence

Site: R13ND-021-MM1 2-1

Described by: Brandon L. Montgomery

Date: 10-3-13

Ap – 0 to 11 cm; very dark brown (10YR 2/2) loam (23% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

BE – 11 to 25 cm; very dark grayish brown (10YR 3/2) loam (20% clay), grayish brown (10YR 5/2) dry; weak fine to medium prismatic structure parting to weak fine to medium platy; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence; Bw conversion into E, very light at bottom of horizon

Bt – 25 to 47 cm; dark brown (10YR 3/3) clay loam (34% clay), dark brown (10YR 4/3) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; top: many distinct continuous very dark brown (10YR 2/2) clay films on all ped faces; bottom: common faint discontinuous very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence; Heavy translocation at top of horizon lose very fast

Bky – 47 to 80 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light gray (2.5Y 7/2) dry; strong fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark gray (2.5Y 3/3) clay films on all ped faces; common fine to medium distinct light gray (2.5Y 7/2) gypsum crystals; finely disseminated carbonates; strong effervescence

BCy – 80 to 107 cm; olive brown (2.5Y 4/4) -- (33% clay), light yellowish brown (2.5Y 6/3) dry; few faint fine prominent strong brown (7.5YR 5/6) mottles; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 5/1) iron depletions; few fine to medium distinct light gray (2.5Y 7/2) gypsum crystals; slight effervescence

C – 107 to 152 cm; olive brown (2.5Y 4/3) -- (34% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 5/1) iron depletions; slight effervescence; Very light evidence of water-worked till

Site: R13ND-021-MM1 2-2

Described by: Brandon L. Montgomery

Date: 10-02-13

Ap – 0 to 8 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium to coarse granular structure; slightly hard, firm, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 8 to 26 cm; dark brown (10YR 3/3) clay loam (27% clay), dark brown (10YR 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common very fine faint very dark brown (10YR 2/2) organic satins on vertical ped faces; no effervescence

Bk1 – 26 to 47 cm; light olive brown (2.5Y 5/3) loam (26% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 47 to 71 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; few faint prominent olive brown (2.5Y 4/4) clay films on vertical ped faces; finely disseminated carbonates; strong effervescence; Very, very old crotovina that has begun to lose OM at bottom of horizon

Bk3 – 71 to 94 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; slight effervescence

BC – 94 to 110 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light olive brown (2.5Y 5/3) dry; few very fine to fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; slight effervescence

C – 110 to 152 cm; olive brown (2.5Y 4/3) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; slight effervescence

Site: R13ND-021-MM1 2-3

Described by: Brandon L. Montgomery

Date: 09-30-13

Ap – 0 to 14 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, firm, not sticky and moderately plastic; common very fine to fine roots; very few very fine to fine pores; no effervescence

BE –14 to 29 cm; dark brown (10YR 3/3) loam (26% clay), grayish brown (10YR 5/2) dry; weak fine to medium subangular blocky structure parting to weak fine to medium platy structure; slightly hard, firm, not sticky and moderately plastic; few very fine to fine roots; very few very fine to fine pores; ; no effervescence; Transitioning towards an E horizon, physical structure is weakly present and humic/fulvic acid front can be seen.

Bw – 29 to 50 cm; dark brown (10YR 4/3) loam (25% clay), yellowish brown (10YR 5/4) dry; strong fine to medium prismatic structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many distinct continuous very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence

Bk1 – 50 to 67 cm; olive brown (2.5Y 4/4) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; common distinct discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; common fine distinct white (2.5Y 8/1) calcite crystals; violent effervescence

Bk2 – 67 to 87 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), light yellowish brown (2.5Y 6/3) dry; moerdate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few distinct discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; few medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 87 to 101 cm; olive brown (2.5Y 4/4) loam (25% clay), light olive brown (2.5Y 5/4) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) carbonate masses; slight effervescence

C – 101 to 152 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light olive brown (2.5Y 5/3) dry; few very fine to fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct light brownish gray (2.5Y 6/2) iron depletions; few fine distinct light gray (2.5Y 7/1) carbonate masses; slight effervescence

Site: R13ND-021-MM1 2-4

Described by: Brandon L. Montgomery

Date: 10-08-13

Ap – 0 to 18 cm; black (10YR 2/1) clay loam (27% clay), very dark gray (10YR 3/1) dry; moderate medium to coarse granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 18 to 41 cm; dark brown (10YR 4/3) clay loam (29% clay), brown (10YR 5/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous dark brown (10YR 3/3) clay films on all ped faces; many fine very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence

Bk1 – 41 to 64 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine prominent light olive brown (2.5Y 5/3) clay films on all ped faces; few fine distinct gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 64 to 84 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; few faint disctinct gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCy – 84 to 111 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; many fine to medium distinct gypsum crystals; finely disseminated carbonates; slight effervescence

C – 111 to 152 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct gray (2.5Y 5/1) iron depletions; few fine distinct gray (2.5Y 6/1) carbonate masses; finely disseminated carbonates; slight effervescence; Lightly water-worked till

Site: R13ND-021-MM1 2-5

Described by: Brandon L. Montgomery

Date: 10-03-13

Ap – 0 to 10 cm; very dark brown (10YR 2/2) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 10 to 24 cm; dark brown (10YR 3/3) loam (25% clay), dark brown (10YR 4/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

Bk1 – 24 to 42 cm; light yellowish brown (2.5Y 6/3) clay loam (27% clay), light gray (2.5Y 7/2) dry; weak fine to medium subangular blocky structure; slightly hard, very friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

Bk2 – 42 to 71 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

BCy – 71 to 92 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct light gray (2.5Y 7/2) gypsum crystals; slight effervescence

C – 92 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/4) dry; massive; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct light gray (2.5Y 7/2) carbonate masses; slight effervescence

Site: R13ND-021-MM1 3-1

Described by: Brandon L. Montgomery

Date: 09-27-13

Notes: Very thin layer of Bw exists 1-2 cm between current Ap and Bt, looks like Bw incorporation and erosion

Ap – 0 to 10 cm; very dark brown (10YR 2/2) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangluar blocky structure parting to weak fine granular; hard, firm, not sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt – 10 to 41 cm; dark yellowish brown (10YR 3/4) clay (45% clay), brown (10YR 5/3) dry; moderate fine to medium granular structure; very hard, firm, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous dark brown (10YR 3/3) clay films on all ped faces; common distinct very dark brown (10YR 2/2) organic stains on vertical ped faces; ; no effervescence; Worm castings in Bt

Bk – 41 to 67 cm; olive brown (2.5Y 4/4) clay loam (38% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; soft, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; few very fine to fine distinct carbonate masses; finely disseminated carbonates; violent effervescence

Bky – 67 to 91 cm; olive brown (2.5Y 4/3) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct carbonate masses; common medium distinct gypsum crystals; finely disseminated carbonates; strong effervescence

C – 91 to 152 cm; olive brown (2.5Y 4/3) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine strong brown (7.5YR 5/6) mottles; massive; slightly hard, firm, slightly sticky and very plastic; common very fine to fine pores; few fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct carbonate masses; few medium distinct gypsum crystals; very slight effervescence; Till is water-worked

Site: R13ND-021-MM1 3-2

Described by: Brandon L. Montgomery

Date: 10-02-13

Ap – 0 to 18 cm; very dark brown (10YR 2/2) clay loam (27% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; ; no effervescence; Structure not conducive to pores

Bt– 18 to 41 cm; dark yellowish brown (10YR 3/4) clay loam (36% clay), brown (10YR 5/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; many faint continuous dark yellowish brown (10YR 3/4) clay films on all ped faces; no effervescence

Bk1 – 41 to 64 cm; light olive brown (2.5Y 5/4) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) carbonate masses; violent effervescence

Bk2 – 64 to 84 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few very fine to fine disctinct light gray (2.5Y 7/1) carbonate masses; strong effervescence

BCy – 84 to 111 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/4) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) gypsum crystals; slight effervescence

C – 111 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; few very fine to fine distinct light gray (2.5Y 7/1) carbonate masses; slight effervescence; Water-worked till

Site: R13ND-021-MM1 3-3

Described by: Brandon L. Montgomery

Date: 10-01-13

Ap – 0 to 4 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 4 to 25 cm; dark brown (10YR 3/3) loam (26% clay), dark brown (10YR 4/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bk1 – 25 to 60 cm; light olive brown (2.5Y 5/3) loam (25% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

Bk2 – 60 to 83 cm; light olive brown (2.5Y 5/3) loam (26% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few faint distinct olive brown (2.5Y 4/3) clay films on all ped faces; few very fine distinct light gray (2.5Y 7/1) carbonate masses; strong effervescence

By – 83 to 96 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine to medium distinct gray (2.5Y 6/1) gypsum crystals; slight effervescence

BC –96 to 108 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct light gray (2.5Y 7/1) carbonate masses; slight effervescence

C – 108 to 152 cm; olive brown (2.5Y 4/3) clay loam (37% clay), light olive brown (2.5Y 5/3) dry; few fine prominent brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) gypsum crystals; slight effervescence

Site: R13ND-021-MM1 3-4

Described by: Brandon L. Montgomery

Date: 10-01-13

Ap – 0 to 19 cm; very dark brown (10YR 2/2) clay loam (30% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; very few very fine to fine pores; no effervescence

Bk1 – 19 to 39 cm; light olive brown (2.5Y 5/3) loam (25% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many very fine to fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

Bk2 – 39 to 60 cm; light olive brown (2.5Y 5/4) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common very fine to fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

Bk3 – 60 to 82 cm; light olive brown (2.5Y 5/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few faint distinct olive brown (2.5Y 4/3) clay films on all ped faces; common fine to medium distinct gray (2.5Y 6/1) gypsum crystals; strong effervescence

BCk –82 to 102 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct gypsum crystals; slight effervescence

C – 102 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine pores; very slight effervescence

Site: R13ND-021-MM1 3-5

Described by: Brandon L. Montgomery

Date: 10-02-13

Ap – 0 to 15 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; Structure not conducive of pores

Bw – 15 to 39 cm; dark yellowish brown (10YR 3/4) sandy clay loam (25% clay), light olive brown (2.5Y 5/4) dry; strong fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint continuous very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence

Bk1 – 39 to 053cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few very fine distinct light gray (2.5Y 7/1) carbonate masses; strong effervescence

Bk2 – 53 to 86 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common very fine to fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

BC –86 to 104 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence; Water-worked till and pedogenic fabric

C – 104 to 152 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence; Water-worked till, sand lens at very bottom of horizon

Site: R13ND-021-MM1 4-1

Described by: Brandon L. Montgomery

Date: 10-03-13

Ap – 0 to 14 cm; very dark brown (10YR 2/2) loam (23% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

EB – 14 to 30 cm; dark grayish brown (10YR 4/2) loam (20% clay), light gray (10YR 6/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium platy; soft, very friable, moderately sticky and moderately plastic; few very fine to fine roots; very few very fine to fine pores; no effervescence

Bt – 30 to 48 cm; black (10YR 2/1) clay (42% clay), black (10YR 2/1) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and very plastic; few fine roots; many very fine to fine pores; very many faint continuous black (10YR 2/1) clay films on all ped faces; no effervescence

Bty – 48 to 71 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; few fine roots; many very fine to fine pores; common faint continuous light olive brown (2.5Y 5/3) clay films on all ped faces; common distinct dark brown (10YR 4/3) organic stains on vertical ped faces; many fine to medium distinct light gray (2.5Y 7/2) gypsum crystals; very slight effervescence

Bky – 71 to 89 cm; light olive brown (2.5Y 5/4) clay loam (34% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct light gray (2.5Y 7/2) gypsum crystals; slight effervescence; Sand lens on boundary with BC horizon

BC – 89 to 105 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct light brownish gray (2.5Y 6/2) iron depletions; slight effervescence

C – 105 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common fine distinct light gray (2.5Y 6/2) iron depletions; slight effervescence; Water-worked till

Site: R13ND-021-MM1 4-2

Described by: Brandon L. Montgomery

Date: 10-03-13

Ap – 0 to 14 cm; black (10YR 2/1) loam (23% clay), very dark gray (10YR 3/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bt1 – 14 to 36 cm; dark brown (10YR 4/3) clay loam (29% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous dark brown (10YR 4/3) clay films on all ped faces; no effervescence

Bt2 –36 to 50 cm; olive brown (2.5Y 4/4) clay loam (30% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bk – 50 to 87 cm; light olive brown (2.5Y 5/4) loam (25% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BC – 87 to 107 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct light gray (2.5Y 6/1) iron depletions; slight effervescence

C – 107 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct light gray (2.5Y 6/1) iron depletions; few fine distinct light gray (2.5Y 7/2) gypsum crystals; slight effervescence

Site: R13ND-021-MM1 4-3

Described by: Brandon L. Montgomery

Date: 09-26-13

Ap – 0 to 15 cm; black (10YR 2/1) clay loam (31% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, not sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Worm castings visible

Bw1 – 15 to 35 cm; dark brown (10YR 3/3) clay loam (28% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; common distinct very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence

Bw2 – 35 to 51 cm; very dark gray (2.5Y 3/3) clay loam (27% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 51 to 73 cm; olive brown (2.5Y 4/4) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; soft, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few very fine distinct carbonate masses; finely disseminated carbonates; violent effervescence; Gravel line at bottom of horizon 68-73 cm

Bk2 – 73 to 96 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; soft, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous dark grayish brown (2.5Y 4/2) clay films on all ped faces; common fine distinct carbonate masses; finely disseminated carbonates; strong effervescence

BCy – 96 to 112 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and very plastic; many very fine to fine pores; few fine distinct carbonate masses; common fine to medium distinct gypsum crystals; slight effervescence; Prismatic structure has weak signs of water-worked till

C – 112 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; few very fine distinct carbonate masses; common fine distinct gypsum crystals; slight effervescence; Water-worked till present

Site: R13ND-021-MM1 4-4

Described by: Brandon L. Montgomery

Date: 09-25-13

Ap – 0 to 20 cm; black (10YR 2/1) loam (23% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few fine pores; no effervescence; Worm castings present

Bt1 – 20 to 38 cm; dark brown (10YR 3/3) clay loam (32% clay), dark brown (10YR 4/3) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bt2 – 38 to 54 cm; dark brown (10YR 4/3) clay loam (31% clay), dark brown (10YR 4/3) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 54 to 75 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct white carbonate masses; strong effervescence; Crotovena intersects core from 67-75 cm, rendering that section useless

Bk2 – 75 to 90 cm; olive brown (2.5Y 4/4) clay loam (28% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct light gray (2.5Y 6/1) iron depletions; few fine distinct white carbonate masses; strong effervescence

Bk3 – 90 to 109 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and very plastic; very few very fine to fine roots; common very fine to fine pores; many distinct continuous olive brown (2.5Y 4/3) clay films on vertical ped faces; few very fine faint light gray (2.5Y 6/1) iron depletions; strong effervescence

BC – 109 to 152 cm; olive brown (2.5Y 4/4) sandy clay loam (31% clay), light olive brown (2.5Y 5/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; few very fine faint light gray (2.5Y 6/1) iron depletions; slight effervescence; Starting to look like parent material, however some structure is still present

Site: R13ND-021-MM1 4-5

Described by: Brandon L. Montgomery

Date: 09-30-13

Notes: Core only 106 cm or 42 inches

Ap – 0 to 14 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, friable, not sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Worm castings present

Bw – 14 to 29 cm; very dark brown (10YR 2/2) loam (24% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium prismatic structure; soft, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Btk1 – 29 to 54 cm; dark yellowish brown (10YR 3/4) clay loam (35% clay), grayish brown (10YR 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common faint continuous very dark grayish brown (10YR 3/2) clay films on all ped faces; few very fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence; Very light upward movement of carbonates into bottom of B

Btk2 – 54 to 71 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light gray (2.5Y 7/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; many fine to medium distinct white (2.5Y 8/1) carbonate masses; violent effervescence

2BCk – 71 to 93 cm; olive brown (2.5Y 4/3) sandy clay loam (32% clay), grayish brown (2.5Y 5/2) dry; weak medium to coarse subangular blocky structure parting to single grain; slightly hard, very friable, slightly sticky and moderately plastic; many very fine to fine pores; few very fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

2C – 93 to 106 cm; light olive brown (2.5Y 5/4) gravelly loamy sand (8% clay), light olive brown (2.5Y 5/3) dry; single grain; loose, loose, not sticky, and not plastic; slight effervescence; 15% gravel in horizon

Site: R13ND-091-MM1 C-1

Described by: Brandon L. Montgomery

Date: 06-18-13

Notes: Core description in lab

Ap1 – 0 to 4 cm; black (10YR 2/1) clay loam (33% clay); moderate coarse subangular blocky structure parting to fine granular; friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Ap2 – 4 to 14 cm; very dark grayish brown (10YR 3/2) clay loam (36% clay); moderate medium subangular blocky structure; friable, slightly sticky and moderately plastic; common very fine to fine roots; common very fine pores; no effervescence

Bw – 14 to 27 cm; dark brown (10YR 4/3) clay loam (35% clay); strong coarse prismatic structure; friable, moderately sticky and moderately plastic; common very fine roots; many very fine pores; few faint organic stains on all ped faces; no effervescence

Bk1 – 27 to 46 cm; brown (10YR 5/3) clay loam (32% clay); weak coarse prismatic structure parting to moderate medium subangular blocky; friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine pores; common faint clay films on all ped faces; few very fine distinct yellowish red (5YR 4/6) iron depletions; few fine carbonate masses; finely disseminated carbonates; slight effervescence

Bk2 – 46 to 71 cm; yellowish brown (10YR 5/4) clay loam (32% clay); moderate medium subangular blocky structure; firm, moderately sticky and moderately plastic; few very fine roots; many very fine pores; common faint clay films on all ped faces; very few distinct yellowish red (5 YR 4/6) iron depletions; many very fine to fine carbonate masses; finely disseminated carbonates; strong effervescence

BC – 71 to 87 cm; olive brown (2.5Y 4/3) clay loam (31% clay); few very fine yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; friable, moderately sticky, and moderately plastic; many very fine pores; common faint clay films on all ped faces; few fine carbonate masses; very slight effervescence

C – 87 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay); few very fine yellowish red (5YR 4/6) mottles; massive; friable, slightly sticky, and moderately plastic; many very fine pores; few fine carbonate masses; slight effervescence

Site: R13ND-091-MM1 1-1

Described by: Brandon L. Montgomery

Date: 02-27-14

Ap – 0 to 11 cm; black (10YR 2/1) loam (26% clay), very dark gray (10YR 3/1) dry; weak fine to medium granular structure; hard, friable, moderately sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt – 11 to 21 cm; very dark grayish brown (10YR 3/2) clay loam (31% clay), dark brown (10YR 4/3); moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bk1 – 21 to 44 cm; light olive brown (2.5Y 5/4) loam (25% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; many faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; common fine to medium pale brown (2.5Y 8/2) carbonate masses; strong effervescence; Krotovina in upper 5 cm of horizon

Bk2 – 44 to 70 cm; light olive brown (2.5Y 5/4) loam (26% clay), light gray (2.5Y 7/2) dry; few very fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium subangular blocky structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; many fine to medium pale brown (2.5Y 8/2) carbonate masses; violent effervescence; Parts to an almost platy look, may be a perched water table here, or was at one point

BCk – 70 to 87 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; weak fine to medium subangular blocky structure; slightly hard, firm, very sticky, and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; very slight effervescence

C – 87 to 152 cm; olive brown (2.5Y 4/4) clay (41% clay), light yellowish brown (2.5Y 6/3) dry; few very fine yellowish red (5YR 4/6) mottles; massive; hard, firm, moderately sticky, and very plastic; many very fine to fine pores; few fine to medium distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; slight effervescence; Slightly water-worked till

Site: R13ND-091-MM1 1-2

Described by: Brandon L. Montgomery

Date: 03-18-14

Ap – 0 to 14 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

Bt – 14 to 36 cm; very dark grayish brown (10YR 3/2) clay loam (30% clay), dark grayish brown (10YR 4/2); moderate fine to medium prismatic structure; hard, firm, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint distinct very dark grayish brown (10YR 3/2) clay films on all ped faces; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bk – 36 to 62 cm; light yellowish brown (2.5Y 6/3) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium subangular blocky structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 62 to 77 cm; light olive brown (2.5Y 5/4) clay loam (38% clay), pale brown (2.5Y 7/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; very hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; few very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence; Extremely dense from 70-80 cm

C2 – 77 to 152 cm; olive brown (2.5Y 4/4) clay (41% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; very slight effervescence; Slightly water-worked till

Site: R13ND-091-MM1 1-3

Described by: Brandon L. Montgomery

Date: 03-19-14

Ap – 0 to 11 cm; black (10YR 2/1) loam (23% clay), very dark brown (10YR 2/2) dry; moderate fine to medium granular structure; slightly hard, very friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 11 to 29 cm; very dark grayish brown (10YR 3/2) clay loam (28% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and very plastic; common very fine to fine roots; common very fine to fine pores; common faint discontinuous very dark grayish brown (10YR 3/2) clay films on all ped faces; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence; Bw leaning towards Bt

Btk1 – 29 to 42 cm; olive brown (2.5Y 4/3) clay loam (33% clay), light olive brown (2.5Y 5/3); moderate fine to medium prismatic structure; hard, friable, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common distinct continuous olive brown (2.5Y 4/3) clay films on all ped faces; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Btk2 – 42 to 64 cm; light olive brown (2.5Y 5/4) loam (31% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous light olive brown (2.5Y 5/3) clay films on all ped faces; many fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 64 to 97 cm; light olive brown (2.5Y 5/3) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence; Water-worked till

C2 – 97 to 152 cm; olive brown (2.5Y 4/3) clay (41% clay), light yellowish brown (2.5Y 6/4) dry; common fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; very slight effervescence

Site: R13ND-091-MM1 1-4

Described by: Brandon L. Montgomery

Date: 03-19-14

Ap – 0 to 13 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 13 to 27 cm; dark brown (10YR 3/3) clay loam (29% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark grayish brown (10YR 3/2) clay films on all ped faces; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Btk – 27 to 40 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk – 40 to 61 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 61 to 81 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), pale brown (2.5Y 7/3) dry; moderate fine subangular blocky structure; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 81 to 101 cm; light olive brown (2.5Y 5/4) clay (40% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/6) mottles; massive; hard, firm, slightly sticky, and very plastic; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C2 – 101 to 152 cm; olive brown (2.5Y 4/4) clay (42% clay), light olive brown (2.5Y 5/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, slightly sticky, and very plastic; many very fine to fine pores; finely disseminated carbonates; very slight effervescence

Site: R13ND-091-MM1 1-5

Described by: Brandon L. Montgomery

Date: 03-19-14

Ap1 – 0 to 14 cm; black (10YR 2/1) loam (24% clay), black (10YR 2/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Ap2 – 14 to 26 cm; very dark brown (10YR 2/2) clay loam (29% clay), dark grayish brown (10YR 4/2) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence

Bt – 26 to 48 cm; olive brown (2.5Y 4/3) clay loam (33% clay), light olive brown (2.5Y 5/3); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common prominent discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence

Bk – 48 to 83 cm; light olive brown (2.5Y 5/4) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 83 to 102 cm; olive brown (2.5Y 4/4) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 102 to 152 cm; olive brown (2.5Y 4/4) clay (42% clay), pale brown (2.5Y 7/3) dry; few fine prominent reddish yellow (7.5YR 6/6) mottles; massive; hard, firm, slightly sticky, and very plastic; many very fine to fine pores; common fine to medium gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R13ND-091-MM1 2-1

Described by: Brandon L. Montgomery

Date: 03-20-14

Ap – 0 to 12 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 12 to 27 cm; very dark gray (2.5Y 3/3) loam (23% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Btk1 – 27 to 49 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous light olive brown (2.5Y 5/4) clay films on all ped faces; finely disseminated carbonates; violent effervescence

Btk2 – 49 to 69 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light yellowish brown (2.5Y 6/4) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 69 to 94 cm; olive brown (2.5Y 4/3) clay loam (37% clay), light olive brown (2.5Y 5/3) dry; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct gray (2.5Y 5/1) iron depletions; very slight effervescence; Shaley till

C2 – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (39% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and very plastic; many very fine to fine pores; very slight effervescence

Site: R13ND-091-MM1 2-2

Described by: Brandon L. Montgomery

Date: 03-20-14

Ap – 0 to 13 cm; black (10YR 2/1) loam (21% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to strong fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

A – 13 to 26 cm; black (10YR 2/1) loam (23% clay), very dark gray (10YR 3/1) dry; moderate fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

Bw1 – 26 to 44 cm; very dark grayish brown (10YR 3/2) loam (24% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bw2 – 44 to 61 cm; olive brown (2.5Y 4/3) clay loam (29% clay), dark grayish brown (2.5Y 4/2); moderate fine to medium prismatic structure; hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common distinct discontinuous dark brown (10YR 4/3) organic stains on vertical ped faces; no effervescence

Bk – 61 to 82 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many faint continuous light olive brown (2.5Y 5/4) clay films on all ped faces; finely disseminated carbonates; strong effervescence

C1 – 82 to 113 cm; light olive brown (2.5Y 5/3) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, slightly sticky, and very plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; very slight effervescence

C2 – 113 to 152 cm; olive brown (2.5Y 4/3) clay loam (38% clay), light olive brown (2.5Y 5/3) dry; common fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, slightly sticky, and moderately plastic; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct light gray (2.5Y 7/2) carbonate masses; slight effervescence

Site: R13ND-091-MM1 2-3

Described by: Brandon L. Montgomery

Date: 03-20-14

Ap – 0 to 14 cm; black (10YR 2/1) loam (23% clay), black (10YR 2/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

A – 14 to 30 cm; black (10YR 2/1) loam (24% clay), black (10YR 2/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

BE – 30 to 50 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common prominent discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

EB – 50 to 64 cm; very dark gray (10YR 3/1) sandy loam (18% clay), light gray (10YR 5/1); weak fine to medium subangular blocky structure parting to weak fine to medium platy; hard, friable, not sticky and slightly plastic; few very fine to fine roots; few very fine to fine pores; many very fine white (10YR 8/1) sand coats on all ped faces; no effervescence

Bth – 64 to 76 cm; black (10YR 2/1) clay (40% clay), black (10YR 2/1) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; few very fine to fine pores; many faint continuous very dark brown (10YR 2/2) clay films on all ped faces; common very fine white (10YR 8/1) sand coats on all ped faces; no effervescence; Very very thick clay films on horizon

Bt – 76 to 97 cm; dark grayish brown (2.5Y 4/2) clay (44% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky, and very plastic; common very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine to medium prominent brownish yellow (10YR 6/6) iron (Fe^{+3}) masses; many faint continuous dark grayish brown (2.5Y 4/2) clay films on all ped faces; common distinct discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence; Very very thick clay films on horizon

BCy – 97 to 152 cm; olive brown (2.5Y 4/4) clay (41% clay), light olive brown (2.5Y 5/4) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and very plastic; common very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine to medium prominent brownish yellow (10YR 6/6) iron (Fe^{+3}) masses; many faint continuous olive brown (2.5Y 4/4) clay films on all ped faces; common prominent discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; very slight effervescence; Very very thick clay films on horizon

Site: R13ND-091-MM1 2-4

Described by: Brandon L. Montgomery

Date: 03-23-14

Ap – 0 to 9 cm; black (10YR 2/1) loam (21% clay), dark gray (10YR 4/1) dry; moderate very fine to fine granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

A –9 to 22 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; no effervescence

Bw – 22 to 36 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

EB – 36 to 47 cm; very dark grayish brown (10YR 3/2) loam (18% clay), light gray (10YR 7/1) dry; moderate thin to medium platy structure; soft, very friable, not sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

E – 47 to 59 cm; light gray (10YR 5/1) sandy loam (13% clay), light gray (10YR 7/1); moderate thin to medium platy structure; hard, friable, not sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bth – 59 to 74 cm; black (10YR 2/1) clay (49% clay), black (10YR 2/1) dry; strong fine to medium prismatic structure; hard, firm, slightly sticky and very plastic; few very fine to fine roots; common very fine to fine pores; very many faint continuous black (10YR 2/1) clay films on all ped faces; no effervescence; Very thick clay films and accumulation of humic material

Bt – 74 to 100 cm; very dark grayish brown (2.5Y 3/2) clay (47% clay), dark gray (2.5Y 4/1) dry; strong fine to medium prismatic structure; hard, firm, slightly sticky, and very plastic; common very fine to fine pores; common medium prominent gray (2.5Y 6/1) iron depletions; common fine to medium prominent strong brown (7.5YR 5/6) iron (Fe^{+3}) masses; very many distinct continuous black (10YR 2/1) clay films on all ped faces; many prominent continuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence; Very thick clay films and accumulation of humic material

BC – 100 to 152 cm; olive brown (2.5Y 4/3) clay (47% clay), light olive brown (2.5Y 5/4) dry; moderate fine to medium prismatic structure; hard, firm, slightly sticky, and moderately plastic; common very fine to fine pores; many medium distinct gray (2.5Y 6/1) iron depletions; many fine to medium prominent strong brown (7.5YR 5/6) iron (Fe^{+3}) masses; many distinct continuous very dark brown (10YR 2/2) clay films on all ped faces; common prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; finely disseminated carbonates; very slight effervescence; Very thick clay films and accumulation of humic material; C horizon on its way to becoming a Bt horizon

Site: R13ND-091-MM1 2-5

Described by: Brandon L. Montgomery

Date: 03-23-14

Ap – 0 to 9 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

A – 9 to 26 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 26 to 44 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 44 to 67 cm; light yellowish brown (2.5Y 6/3) clay loam (28% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light yellowish brown (2.5Y 6/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

C1 – 67 to 97 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

C2 – 97 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light olive brown (2.5Y 5/3) dry; few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm, slightly sticky, and moderately plastic; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; very slight effervescence

Site: R13ND-091-MM1 3-1

Described by: Brandon L. Montgomery

Date: 08-29-13

Ap – 0 to 14 cm; black (10YR 2/1) clay loam (33% clay), very dark gray (10YR 3/1) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; moderately hard, firm, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; very slight effervescence; Upper 5 cm of horizon granular

Bk1 – 14 to 32 cm; olive brown (2.5Y 4/3) loam (26% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; strong effervescence; Very faint clay films present in both Bk horizons; Bk1 appears to resemble a Bw horizon that has carbonates introduced from the bottom

Bk2 – 32 to 57 cm; light olive brown (2.5Y 5/3) loam (26% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; moderately hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common very fine to fine distinct carbonate masses; strong effervescence; Very faint clay films present in both Bk horizons

BCk – 57 to 86 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few very fine to fine distinct strong brown (7.5YR 5/6) mottles; weak fine to medium subangular blocky structure; moderately hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; common very fine to fine pores; common fine to medium carbonate masses; strong effervescence

C – 86 to 152 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; common fine to medium prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/8) mottles; massive; moderately hard, firm, slightly sticky, and very plastic; very few very fine to fine pores; common very fine to fine faint gray (2.5Y 5/1) iron depletions; few very fine to fine distinct carbonate masses; slight effervescence; Water-worked till; Sand lens at 88 cm

Site: R13ND-091-MM1 3-2

Described by: Brandon L. Montgomery

Date: 08-30-13

Ap – 0 to 12 cm; black (10YR 2/1) loam (25% clay), very dark brown (10YR 2/2) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; 4 cm transitional boundary

Bt1 – 12 to 33 cm; dark brown (10YR 3/3) clay loam (31% clay), dark brown (10YR 4/3) dry; moderate very fine to fine prismatic structure; slightly hard, firm, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many distinct continuous clay films on all ped faces; no effervescence; Organic staining present along crack faces and fill areas

Bt2 – 33 to 43 cm; dark yellowish brown (10YR 3/4) clay loam (31% clay), brown (10YR 5/3) dry; moderate very fine to fine prismatic structure; slightly hard, firm, slightly sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous clay films on all ped faces; very slight effervescence; Organic staining present along crack faces and fill areas

Bk1 – 43 to 65 cm; olive brown (2.5Y 4/4) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium subangular blocky structure; moderately hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine prominent white (10YR 8/1) carbonate masses; strong effervescence

Bk2 – 65 to 82 cm; light olive brown (2.5Y 5/4) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (10YR 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 82 to 104 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light olive brown (2.5Y 5/3) dry; few fine to medium distinct yellowish red (5YR 4/6) mottles; weak medium to coarse subangular blocky structure; moderately hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; strong effervescence; Very weak evidence of water-worked till; Massive structure mixing together to create massive subangular blocky features

C – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light olive brown (2.5Y 5/4) dry; common very fine to fine distinct strong brown (7.5YR 4/6) mottles; massive; moderately hard, firm, moderately sticky, and moderately plastic; common very fine to fine pores; few very fine to fine distinct gray (2.5Y 5/1) iron depletions; slight effervescence

Site: R13ND-091-MM1 3-3

Described by: Brandon L. Montgomery

Date: 09-16-13

Ap – 0 to 23 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; weak very fine to fine subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

Bw – 23 to 40 cm; very dark brown (10YR 2/2) loam (22% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; very few distinct black (10YR 2/1) organic stains on surfaces along root channels; very slight effervescence

Bk1 – 40 to 65 cm; olive brown (2.5Y 4/4) loam (27% clay), light olive brown (2.5Y 5/3); moderate very fine to fine prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 65 to 80 cm; olive brown (2.5Y 4/3) loam (26% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many very fine to fine carbonate masses and nodules; strong effervescence

BCk – 80 to 108 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; hard, friable, moderately sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; common very fine to fine carbonate masses; strong effervescence; Blending of water-worked till and sbk for structure

C – 108 to 152 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; slight effervescence; Water influence seems to die out before C starts; Perched water table possible

Site: R13ND-091-MM1 3-4

Described by: Brandon L. Montgomery

Date: 09-18-14

Ap – 0 to 20 cm; black (10YR 2/1) clay loam (31% clay), very dark gray (10YR 3/1) dry; moderate fine to medium subangular blocky structure; slightly hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; very few fine pores; no effervescence

AB– 20 to 30 cm; dark grayish brown (10YR 4/2) clay loam (30% clay), dark brown (10YR 4/3) dry; weak fine to medium prismatic structure parting to weak fine to medium subangular blocky; slightly hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; few faint clay films on all ped faces; common distinct black (10YR 2/1) organic stains on vertical ped faces; no effervescence; Visually many more clean sand grains than Ap, skins not developed quite yet

Bw – 30 to 44 cm; dark brown (10YR 4/3) clay loam (32% clay), brown (10YR 5/3); moderate fine to medium prismatic structure; slightly hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common distinct continuous clay films on all ped faces; no effervescence

Bk1 – 44 to 63 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine carbonate masses; finely disseminated carbonates strong effervescence

Bk2 – 63 to 87 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light yellowish brown (2.5Y 6/4) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; common very fine to fine pores; few fine carbonate masses; finely disseminated carbonates; strong effervescence

C – 87 to 152 cm; olive brown (2.5Y 4/3) clay loam (39% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; hard, very firm, moderately sticky, and moderately plastic; very few very fine to fine pores; slight effervescence; Core is compacted at bottom of a zone appears to be BCk from previous cores but is not large enough to break out approximately 3 cm

Site: R13ND-091-MM1 3-5

Described by: Brandon L. Montgomery

Date: 09-18-13

Ap1 – 0 to 13 cm; black (10YR 2/1) clay loam (28% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; Some worm castings present

Ap2 – 13 to 29cm; black (10YR 2/1) clay loam (29% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 29 to 42 cm; very dark gray (10YR 3/1) loam (25% clay), dark gray (10YR 4/1); weak fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bt1 – 42 to 60 cm; very dark grayish brown (10YR 3/2) clay loam (30% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; few faint discontinuous clay films on all ped faces; no effervescence

Bt2 – 60 to 85 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct light brownish gray (10YR 6/2) iron (Fe^{+3}) masses; few faint discontinuous clay films on all ped faces; few faint dark brown (10YR 3/3) organic stains on vertical ped faces; no effervescence; 4 cm zone at bottom of horizon that shows an inch higher level of redox, some sort of preferential flow?

BCk – 85 to 106 cm; light olive brown (2.5Y 5/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, firm, moderately sticky, and very plastic; few very fine to fine roots; many very fine to fine pores; common fine carbonate masses; strong effervescence

C – 106 to 152 cm; light olive brown (2.5Y 5/3) clay (41% clay), olive brown (2.5Y 4/3) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, slightly sticky, and very plastic; many very fine to fine pores; slight effervescence

Site: R13ND-091-MM1 4-1

Described by: Brandon L. Montgomery

Date: 03-19-14

Ap – 0 to 16 cm; black (10YR 2/1) loam (21% clay), very dark gray (10YR 3/1) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 16 to 35 cm; olive brown (2.5Y 4/3) loam (24% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bk1 – 35 to 56 cm; light olive brown (2.5Y 5/3) loam (24% clay), light olive brown (2.5Y 5/3); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 56 to 79 cm; light yellowish brown (2.5Y 6/3) sandy clay loam (25% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, not sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine faint pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence; Very fine and fine sand

BC – 79 to 94 cm; light yellowish brown (2.5Y 6/4) sandy clay loam (28% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; slightly hard, friable, not sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence; Very fine and fine sand

C – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (38% clay), light yellowish brown (2.5Y 6/4) dry; massive; hard, friable, slightly sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; very slight effervescence

Site: R13ND-099-MM2 C-2

Described by: Brandon L. Montgomery

Date: 02-13-14

Apk – 0 to 15 cm; very dark brown (10YR 2/2) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure (top 5 cm), moderate fine to medium subangular blocky structure (lower 10 cm); slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; very slight effervescence; Upper 5 cm granular, lower 10 cm subangular blocky

Bk1 – 15 to 44 cm; light yellowish brown (2.5Y 6/3) loam (21% clay), pale brown (2.5Y 7/3); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

Bk2 – 44 to 63 cm; light olive brown (2.5Y 5/3) loam (22% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 63 to 82 cm; olive brown (2.5Y 4/3) clay loam (27% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; common very fine to fine pores; iron depletions; few very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; strong effervescence; Krotovina at 60-62 cm, Krotovina at 87-91 cm

C – 82 to 152 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light olive brown (2.5Y 5/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine pores; few fine to medium distinct gray (2.5Y 6/1) iron depletions few very fine to fine distinct light gray (2.5Y 7/2) carbonates masses; slight effervescence; Till appears lightly water-worked

Site: R13ND-099-MM2 1-1

Described by: Brandon L. Montgomery

Date: 02-25-14

Ap – 0 to 18 cm; very dark brown (10YR 2/2) loam (26% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure (upper 6 cm), moderate fine to medium subangular blocky structure (lower 12 cm); slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Upper 6 cm granular structure, lower 12 cm subangular blocky structure

Bk1 – 18 to 33 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence; Upper 3 cm is old Bw, now thoroughly mixed with Bk

Krotovina – 33 to 43 cm

Bk2 – 43 to 73 cm; light yellowish brown (2.5Y 6/4) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine prominent olive brown (2.5Y 4/4) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Krotovena – 73 to 88 cm; This horizon showed stratification, but the variability in the horizon made it impossible to describe, horizon can be seen in picture

C – 88 to 152 cm; light olive brown (2.5Y 5/4) silt loam (26% clay), pale brown (2.5Y 7/3) dry; massive; slightly hard, friable, slightly sticky, and moderately plastic; common very fine to fine pores; few fine distinct light gray (2.5Y 7/1) iron depletions; finely disseminated carbonates; slight effervescence; Water-worked till, grus formed in place

Site: R13ND-099-MM2 1-2

Described by: Brandon L. Montgomery

Date: 03-19-14

Apk – 0 to 13 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; finely disseminated carbonates; slight effervescence; Ap looks like old is w, upper 4 cm 2 fine to medium granular structure

Bw – 13 to 27 cm; dark grayish brown (2.5Y 4/2) loam (24% clay), gray (2.5Y 5/1) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common faint discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; finely disseminated carbonates; slight effervescence

Bk1 – 27 to 42 cm; light olive brown (2.5Y 5/3) loam (24% clay), light olive brown (2.5Y 5/3); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

Bk2 – 42 to 60 cm; light yellowish brown (2.5Y 6/3) loam (23% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BCk – 60 to 77 cm; light yellowish brown (2.5Y 6/4) clay loam (27% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; common very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; strong effervescence

C – 77 to 152 cm; olive brown (2.5Y 4/4) clay loam (30% clay), light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine pores; few fine to medium distinct light gray (2.5Y 7/1) iron depletions; few fine to medium prominent strong brown (7.5YR 4/6) iron (Fe^{3+}) masses; slight effervescence; Water-worked till

Site: R13ND-099-MM2 1-3

Described by: Brandon L. Montgomery

Date: 02-25-14

Apk – 0 to 12 cm; very dark grayish brown (10YR 3/2) loam (23% clay), light gray (10YR 5/1) dry; weak fine to medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; slight effervescence; Worm castings present, but appear to be older

Bw – 12 to 27 cm; very dark brown (10YR 2/2) loam (14% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

Bk – 27 to 52 cm; light olive brown (2.5Y 5/3) loam (12% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; soft, friable, very sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous dark grayish brown (10YR 4/2) organic stains on vertical ped faces; finely disseminated carbonates; violent effervescence

Krotovina – 52 to 82 cm; Badger or other animal created a krotovina

C2 – 82 to 152 cm; olive brown (2.5Y 4/3) loamy sand (8% clay), light yellowish brown (2.5Y 6/3) dry; single grain; loose, loose, not sticky, and not plastic; very few very fine to fine roots; finely disseminated carbonates; slight effervescence

Site: R13ND-099-MM2 1-4

Described by: Brandon L. Montgomery

Date: 02-25-14

Apk – 0 to 13 cm; very dark grayish brown (10YR 3/2) loam (18% clay), light gray (10YR 5/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; finely disseminated carbonates; slight effervescence

Bk1 – 13 to 27 cm; light olive brown (2.5Y 5/3) sandy loam (14% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

Bk2 – 27 to 42 cm; light yellowish brown (2.5Y 6/3) loamy sand (11% clay), light yellowish brown (2.5Y 6/3); weak fine to medium prismatic structure; soft, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common prominent light olive brown (2.5Y 5/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

Bk3 – 42 to 60 cm; light olive brown (2.5Y 5/4) sandy loam (12% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; soft, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; common fine distinct olive brown (2.5Y 4/4) clay films on all ped faces; few fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

C – 60 to 77 cm; olive brown (2.5Y 4/4) sandy loam (15% clay), light brownish gray (2.5Y 6/2) dry; massive; soft, friable, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Shaley

2C – 77 to 152 cm; light yellowish brown (2.5Y 6/3) sandy loam (9% clay), light gray (2.5Y 7/2) dry; single grain; loose, loose, not sticky, and not plastic; few very fine to fine pores; very slight effervescence; Shaley

Site: R13ND-099-MM2 1-5

Described by: Brandon L. Montgomery

Date: 02-25-14

Apk – 0 to 16 cm; very dark brown (10YR 2/2) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to strong fine to medium granular; hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; slight effervescence; Good granular structure and worm casts present

Bk1 – 16 to 41 cm; very dark gray (2.5Y 3/3) loam (21% clay), grayish brown (2.5Y 5/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; finely disseminated carbonates; strong effervescence; Appears to be old Bw

Bk2 – 41 to 63 cm; olive brown (2.5Y 4/3) loam (21% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine to medium faint gray (2.5Y 6/1) carbonate masses; finely disseminated carbonates; violent effervescence

Bk3 – 63 to 85 cm; olive brown (2.5Y 4/3) loam (22% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; few fine faint gray (2.5Y 6/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 85 to 152 cm; olive brown (2.5Y 4/4) sandy loam (19% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; soft, friable, slightly sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Site: R13ND-099-MM2 2-1

Described by: Brandon L. Montgomery

Date: 01-30-14

Ap1 – 0 to 8 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; Looks like erosional deposition from above due to color difference between Ap1 and Ap2

Ap2 – 8 to 20 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 20 to 38 cm; olive brown (2.5Y 4/3) loam (24% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous dark gray (10YR 4/1) organic stains on vertical ped faces; finely disseminated carbonates; very slight effervescence

Bk – 38 to 53 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), white (2.5Y 8/1); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium faint light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

2Bk – 53 to 72 cm; light olive brown (2.5Y 5/3) sandy loam (14% clay), pale yellow (2.5Y 7/3); weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; very few very fine to fine roots; finely disseminated carbonates; strong effervescence

2C – 72 to 88 cm; light olive brown (2.5Y 5/4) silt loam (26% clay), pale yellow (2.5Y 7/3); weak fine to medium subangular blocky structure; slightly hard, very friable, slightly sticky, and moderately plastic; common very fine to fine pores; few fine faint gray (2.5Y 6/1) iron depletions; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

3C1 – 88 to 106 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3); massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; few fine faint gray (2.5Y 5/1) iron depletions; slight effervescence

3C2 – 106 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), pale yellow (2.5Y 7/3); massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/1) iron depletions; slight effervescence; Water-worked till

Site: R13ND-099-MM2 2-2

Described by: Brandon L. Montgomery

Date: 02-25-14

Ap – 0 to 14 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bt – 14 to 31 cm; olive brown (2.5Y 4/3) clay loam (29% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 31 to 54 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 54 to 71 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

C1 – 71 to 103 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light gray (2.5Y 7/2) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 103 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), pale brown (2.5Y 7/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few fine distinct light gray (2.5Y 7/1) iron depletions; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; very slight effervescence

Site: R13ND-099-MM2 2-3

Described by: Brandon L. Montgomery

Date: 02-27-14

Ap – 0 to 14 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Worm casts present

Bw – 14 to 24 cm; very dark grayish brown (2.5Y 3/2) loam (20% clay), grayish brown (2.5Y 5/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous black (2.5Y 2/2) organic stains on vertical ped faces; finely disseminated carbonates; slight effervescence; Mixture of Bw and Bk still showing characteristic Bw at the very top

Bk1 – 24 to 48 cm; light olive brown (2.5Y 5/3) loam (18% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

Bk2 – 48 to 69 cm; light olive brown (2.5Y 5/4) loam (19% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 69 to 80 cm; olive brown (2.5Y 4/4) loam (21% clay), light gray (2.5Y 7/2) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C – 80 to 152 cm; olive brown (2.5Y 4/4) clay loam (29% clay), pale brown (2.5Y 7/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; very slight effervescence

Site: R13ND-099-MM2 2-4

Described by: Brandon L. Montgomery

Date: 02-13-14

Ap1 – 0 to 5 cm; very dark gray (2.5Y 3/2) loam (24% clay), very dark gray (10YR 3/1) dry; strong fine to medium granular structure; hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; Looks like erosion from above, surprised it wasn't calcareous, good structure

Ap2 – 5 to 13 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

Bw – 13 to 22 cm; olive brown (2.5Y 4/3) loam (24% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence; All that's left of Bw

Bk1 – 22 to 41 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; many very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; strong effervescence

Bk2 – 41 to 69 cm; light olive brown (2.5Y 5/4) clay loam (28% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 7/2) carbonate masses; strong effervescence

C1 – 69 to 102 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light gray (2.5Y 7/2) dry; few very fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; common very fine to fine distinct light gray (2.5Y 7/2) carbonate masses; strong effervescence

C2 – 102 to 152 cm; olive brown (2.5Y 4/4) clay loam (32% clay), pale brown (2.5Y 7/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) gypsum crystals; slight effervescence

Site: R13ND-099-MM2 2-5

Described by: Brandon L. Montgomery

Date: 02-24-14

Ap – 0 to 15 cm; black (10YR 2/1) loam (26% clay), very dark gray (10YR 3/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; no effervescence; Decent looking Ap compared to the rest of the site

Bw – 15 to 28 cm; dark grayish brown (2.5Y 4/2) clay loam (28% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous very dark gray (2.5Y 3/3) clay films on all ped faces; finely disseminated carbonates; very slight effervescence

Bk – 28 to 53 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

BCk – 53 to 73 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

C1 – 73 to 103 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, slightly sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C2 – 103 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, slightly sticky, and moderately plastic; many very fine to fine pores; few fine to medium faint light gray (2.5Y 7/1) iron depletions; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses on surfaces along root channels; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; very slight effervescence

Site: R13ND-099-MM2 3-1

Described by: Brandon L. Montgomery

Date: 01-28-14

Ap1 – 0 to 11 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bk1 – 11 to 26 cm; light olive brown (2.5Y 5/3) loam (24% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few faint dark grayish brown (2.5Y 4/2) organic stains on vertical ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 26 to 44 cm; light olive brown (2.5Y 5/3) loam (23% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few very fine to fine faint light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

Btk – 44 to 71 cm; olive brown (2.5Y 4/4) clay loam (29% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/4) clay films on all ped faces; few very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Btky – 71 to 94 cm; olive brown (2.5Y 4/3) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent brown (7.5YR 4/6) mottles; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; few fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; slight effervescence

C – 94 to 152 cm; olive brown (2.5Y 4/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium prominent olive yellow (2.5Y 6/6) iron (Fe^{3+}) masses; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; slight effervescence; Till is shaley

Site: R13ND-099-MM2 3-2

Described by: Brandon L. Montgomery

Date: 02-24-14

Ap – 0 to 10 cm; very dark brown (10YR 2/2) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure (Upper 4 cm), moderate fine to medium subangular blocky structure (Lower 6 cm); slightly hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Upper 4 cm granular structure, lower 6 cm subangular blocky structure

Bw – 10 to 28 cm; olive brown (2.5Y 4/4) loam (24% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint continuous olive brown (2.5Y 4/4) clay films on all ped faces; no effervescence

Bk – 28 to 48 cm; light olive brown (2.5Y 5/3) loam (24% clay), pale brown (2.5Y 7/3); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

BCk – 48 to 74 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light yellowish brown (2.5Y 6/3); few very fine prominent reddish brown (5YR 4/4) mottles; moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence; Predominantly Bk characteristics with C, leaning indications still

C1 – 74 to 93 cm; light olive brown (2.5Y 5/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C2 – 93 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/4) dry; few very fine prominent reddish brown (5YR 4/4) mottles; massive; hard, firm, slightly sticky, and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/1) gypsum crystal clusters; very slight effervescence; Shaley till

Site: R13ND-099-MM2 3-3

Described by: Brandon L. Montgomery

Date: 01-29-14

Ap – 0 to 17 cm; very dark brown (10YR 2/2) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; many faint discontinuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence; Old Bt/Bw

Bw – 17 to 29 cm; olive brown (2.5Y 4/3) loam (24% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; slight effervescence

Bk – 29 to 54 cm; light olive brown (2.5Y 5/3) loam (23% clay), pale brown (2.5Y 8/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence; Krotovina from 41-45 cm

BCk – 54 to 68 cm; olive brown (2.5Y 4/3) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 68 to 152 cm; olive brown (2.5Y 4/3) gravelly clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, firm, moderately sticky and very plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence; Till is shaley, gravel listed as 15%

Site: R13ND-099-MM2 3-4

Described by: Brandon L. Montgomery

Date: 01-30-14

Ap – 0 to 14 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence;

Bw – 14 to 33 cm; very dark grayish brown (10YR 3/2) loam (26% clay), light brownish gray (10YR 6/2) dry; moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous dark gray (10YR 4/1) organic stains on vertical ped faces; common very fine to fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence; Carbonates in Bw appear to be from most recent wet cycle

Bk – 33 to 53 cm; light olive brown (2.5Y 5/3) loam (26% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 53 to 69 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), pale yellow (2.5Y 8/3) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 69 to 100 cm; olive brown (2.5Y 4/4) clay loam (31% clay), pale yellow (2.5Y 7/3) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/1) iron depletions; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C2 – 100 to 152 cm; olive brown (2.5Y 4/3) clay loam (33% clay), pale yellow (2.5Y 7/3) dry; few fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, slightly sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/1) iron depletions; slight effervescence

Site: R13ND-099-MM2 3-5

Described by: Brandon L. Montgomery

Date: 01-29-14

Ap – 0 to 26 cm; black (10YR 2/1) loam (21% clay), very dark gray (10YR 3/1) dry; moderate medium to coarse subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Old A appears to be buried by additional A horizon/material

Ak – 26 to 49 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk – 49 to 80 cm; grayish brown (2.5Y 5/2) clay loam (29% clay), white (2.5Y 8/1); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common prominent discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; finely disseminated carbonates; violent effervescence

C1 – 80 to 103 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light gray (2.5Y 7/2) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; common fine to medium faint gray (2.5Y 6/1) iron depletions; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C2 – 103 to 152 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; common fine to medium faint gray (2.5Y 6/1) iron depletions; many fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

Site: R13ND-099-MM2 4-1

Described by: Brandon L. Montgomery

Date: 02-24-14

Ap – 0 to 14 cm; very dark brown (10YR 2/2) loam (24% clay), dark gray (10YR 4/1) dry; moderate medium prismatic structure; slightly hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; No granular structure, appears to be old Bw

Apk – 14 to 23 cm; very dark grayish brown (2.5Y 3/2) loam (22% clay), gray (2.5Y 5/1) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Odd structure and mixing appears to be old Bw and Bk mixed

Bk1 – 23 to 44 cm; light olive brown (2.5Y 5/3) loam (22% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; strong effervescence

Bk2 – 44 to 64 cm; light olive brown (2.5Y 5/4) silt loam (24% clay), pale brown (2.5Y 7/3); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/4) clay films on all ped faces; finely disseminated carbonates; strong effervescence

BC – 64 to 77 cm; olive brown (2.5Y 4/4) clay loam (29% clay), pale brown (2.5Y 7/3); strong fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C1 – 77 to 97 cm; olive brown (2.5Y 4/3) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few very fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; very slight effervescence; Grus present

C2 – 97 to 152 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; very hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; very slight effervescence; Shaley till

Site: R13ND-099-MM2 4-2

Described by: Brandon L. Montgomery

Date: 01-29-14

Ap – 0 to 17 cm; very dark brown (10YR 2/2) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; finely disseminated carbonates; slight effervescence; Old Bt

Bk – 17 to 37 cm; light olive brown (2.5Y 5/3) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BC– 37 to 63 cm; olive brown (2.5Y 4/3) clay loam (27% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 63 to 99 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 99 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; common very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; slight effervescence; Till is shaley

Site: R13ND-099-MM2 4-3

Described by: Brandon L. Montgomery

Date: 01-30-14

Ap – 0 to 16 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bk1 – 16 to 40 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), white (2.5Y 8/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 40 to 59 cm; light olive brown (2.5Y 5/3) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine to medium faint pale brown (2.5Y 8/2) carbonate masses; strong effervescence

BCk – 59 to 74 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 74 to 98 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct light gray (2.5Y 7/1) iron depletions; few fine faint light brownish gray (2.5Y 6/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 98 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), pale brown (2.5Y 7/3) dry; massive; slightly hard, firm, moderately sticky, and moderately plastic; common very fine to fine pores; common fine to medium distinct light gray (2.5Y 7/1) iron depletions; slight effervescence

Site: R13ND-099-MM2 4-4

Described by: Brandon L. Montgomery

Date 01-29-14

Ap – 0 to 10 cm; very dark brown (10YR 2/2) clay loam (27% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; hard, firm, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence; Most likely old Bt horizon

Bw – 10 to 31 cm; very dark brown (10YR 2/2) loam (26% clay), dark gray (10YR 4/1) dry; strong fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence; Most likely old Bt horizon

Bk1 – 31 to 53 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 53 to 71 cm; light olive brown (2.5Y 5/3) loam (25% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine faint light gray (2.5Y 7/1) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 71 to 84 cm; olive brown (2.5Y 4/4) loam (25% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium subangular blocky structure; slightly hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine faint light gray (2.5Y 7/1) carbonate masses; slight effervescence

C – 84 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few very fine to fine distinct pale brown (2.5Y 8/2) carbonate masses; few fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; slight effervescence; Water-worked till

Site: R13ND-099-MM2 4-5

Described by: Brandon L. Montgomery

Date: 01-29-14

Ap – 0 to 10 cm; very dark grayish brown (10YR 3/2) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Old Bw/Bt

Bk1 – 10 to 30 cm; light olive brown (2.5Y 5/3) loam (26% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 30 to 56 cm; light olive brown (2.5Y 5/3) loam (24% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BC – 56 to 69 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; slight effervescence

C1 – 69 to 91 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; hard, friable, slightly sticky, and moderately plastic; many very fine to fine pores; very slight effervescence; Till is shaley

C2 – 91 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, slightly sticky, and moderately plastic; common very fine to fine pores; few fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; very slight effervescence; Till is shaley

Site: R13ND-099-MM1 Center-2

Described by: Brandon L. Montgomery

Date: 03-23-14

A – 0 to 16 cm; black (10YR 2/1) loam (25% clay), very dark gray (10YR 3/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bt – 16 to 35 cm; dark brown (10YR 3/3) clay loam (32% clay), dark grayish brown (2.5Y 4/2) dry; strong fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; many faint continuous clay films on all ped faces; common distinct discontinuous organic stains on vertical ped faces; no effervescence

Btk – 35 to 56 cm; olive brown (2.5Y 4/3) clay loam (30% clay), grayish brown (2.5Y 5/2); moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; common faint discontinuous clay films on all ped faces; finely disseminated carbonates; slight effervescence

Bk – 56 to 79 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BCk – 79 to 94 cm; light olive brown (2.5Y 5/3) loam (26% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; slightly hard, friable, mdoerately sticky, and moderately plastic; common very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

C – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, firm, slightly sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

Site: R13ND-099-MM1 1-1

Described by: Brandon L. Montgomery

Date: 03-27-14

A – 0 to 15 cm; very dark brown (10YR 2/2) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 15 to 31 cm; olive brown (2.5Y 4/3) clay loam (27% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bk – 31 to 49 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; soft, very friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common prominent light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

BCk – 49 to 65 cm; light yellowish brown (2.5Y 6/3) clay loam (33% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous light yellowish brown (2.5Y 6/3) clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

C – 65 to 96 cm; light olive brown (2.5Y 5/3) clay loam (34% clay), pale brown (2.5Y 7/3); few fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence; Shaley till

2C – 96 to 152 cm; olive brown (2.5Y 4/3) sandy clay loam (29% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, firm, slightly sticky, and moderately plastic; very few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; slight effervescence; Increase in sand %

Site: R13ND-099-MM1 1-2

Described by: Brandon L. Montgomery

Date: 03-27-14

A – 0 to 19 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence; 4 cm of compaction from section line road at top of profile

Bw – 19 to 34 cm; very dark grayish brown (2.5Y 3/2) clay loam (28% clay), dark gray (2.5Y 4/1) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; no effervescence; May be a very old Ap horizon, very abrupt horizon change at bottom of horizon

Bk – 34 to 59 cm; olive brown (2.5Y 4/3) loam (24% clay), light yellowish brown (2.5Y 6/3); weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 59 to 78 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 78 to 94 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; slight effervescence

C2 – 94 to 152 cm; olive brown (2.5Y 4/3) sandy clay loam (28% clay), light olive brown (2.5Y 5/3) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; common very fine to fine pores; finely disseminated carbonates; strong effervescence

Site: R13ND-099-MM1 1-4

Described by: Brandon L. Montgomery

Date: 03-28-14

A – 0 to 23 cm; black (10YR 2/1) clay loam (27% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 23 to 41 cm; very dark brown (10YR 2/2) loam (24% clay), dark grayish brown (10YR 4/2); moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence

Bt – 41 to 57 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light brownish gray (2.5Y 6/2); strong fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common faint discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence

Bk – 57 to 72 cm; light gray (2.5Y 7/2) clay loam (28% clay), pale brown (2.5Y 8/2); weak fine to medium prismatic structure; slightly hard, firm, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BCk – 72 to 92 cm; light olive brown (2.5Y 5/3) clay loam (36% clay), light gray (2.5Y 7/2) dry; weak fine to medium subangular blocky structure; hard, firm, very sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Slightly water-worked till and slightly shaley till

C – 92 to 152 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light brownish gray (2.5Y 6/2) dry; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-099-MM1 1-5

Described by: Brandon L. Montgomery

Date: 03-28-14

A1 – 0 to 20 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

A2 – 20 to 37 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bt – 37 to 66 cm; very dark gray (2.5Y 3/3) clay loam (29% clay), dark grayish brown (2.5Y 4/2); strong fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; many faint continuous very dark gray (2.5Y 3/3) clay films on all ped faces; common faint discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bk – 66 to 82 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 82 to 97 cm; light yellowish brown (2.5Y 6/3) clay loam (34% clay), light gray (2.5Y 7/2); few fine prominent strong brown (7.5YR 5/6) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C – 97 to 152 cm; light olive brown (2.5Y 5/3) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R13ND-099-MM1 2-1

Described by: Brandon L. Montgomery

Date: 03-28-14

A1 – 0 to 19 cm; black (10YR 2/1) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 19 to 32 cm; light olive brown (2.5Y 5/3) loam (23% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 32 to 48 cm; light olive brown (2.5Y 5/3) loam (21% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 48 to 70 cm; olive brown (2.5Y 4/3) loam (22% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 70 to 98 cm; light yellowish brown (2.5Y 6/3) clay loam (32% clay), light gray (2.5Y 7/2); few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 98 to 152 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky, and moderately plastic; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; very slight effervescence

Site: R13ND-099-MM1 2-2

Described by: Brandon L. Montgomery

Date: 03-28-14

A1 – 0 to 16 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; very slight effervescence

Bk1 – 16 to 33 cm; dark grayish brown (2.5Y 4/2) loam (22% clay), gray (2.5Y 5/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 33 to 52 cm; olive brown (2.5Y 4/3) loam (21% clay), gray (2.5Y 6/1); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk3 – 52 to 70 cm; olive brown (2.5Y 4/3) loam (24% clay), light gray (2.5Y 7/1); weak fine to medium prismatic structure; soft, very friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

BCk – 70 to 84 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; soft, very friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 84 to 102 cm; very dark grayish brown (2.5Y 3/2) clay loam (29% clay), light gray (2.5Y 7/1) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Old krotovina from 87-90, very dark horizon for its depth

C2 – 102 to 152 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), pale brown (2.5Y 7/3) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence

Site: R13ND-099-MM1 2-3

Described by: Brandon L. Montgomery

Date: 03-28-14

A – 0 to 14 cm; black (10YR 2/1) clay loam (27% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence; Looks as if very old Ap horizon, very abrupt horizon change

Bk1 – 14 to 26 cm; olive brown (2.5Y 4/3) loam (22% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 26 to 40 cm; light olive brown (2.5Y 5/3) loam (23% clay), light gray (2.5Y 7/1); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

Bk3 – 40 to 59 cm; olive brown (2.5Y 4/3) loam (26% clay), light gray (2.5Y 7/1); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C – 59 to 70 cm; olive brown (2.5Y 4/3) clay loam (32% clay), light gray (2.5Y 7/2); massive; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Slightly water-worked till

2C – 70 to 99 cm; light yellowish brown (2.5Y 6/3) sandy loam (15% clay), pale brown (2.5Y 8/2) dry; massive; loose, loose, slightly sticky, and slightly plastic; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

3C2 – 99 to 115 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light gray (2.5Y 7/2) dry; few fine prominent yellowish red (5YR 5/6) mottles; massive; slightly hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; very slight effervescence; Water-worked till

3C2 – 115 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light gray (2.5Y 7/2) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; common very fine to fine pores; finely disseminated carbonates; very slight effervescence

Site: R13ND-099-MM1 2-4

Described by: Brandon L. Montgomery

Date: 03-28-14

A – 0 to 17 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bt1 – 17 to 33 cm; very dark grayish brown (2.5Y 3/2) clay loam (31% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bt2 – 33 to 46 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 46 to 63 cm; olive brown (2.5Y 4/3) clay loam (28% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common fin distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 63 to 89 cm; light olive brown (2.5Y 5/3) loam (26% clay), pale brown (2.5Y 8/2); weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

C – 89 to 152 cm; olive brown (2.5Y 4/3) clay loam (33% clay), light gray (2.5Y 7/2) dry; massive; hard, firm, moderately sticky, and moderately plastic; many very fine to fine pores; common distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-099-MM1 2-5

Described by: Brandon L. Montgomery

Date: 03-29-14

A – 0 to 17 cm; very dark brown (10YR 2/2) loam (26% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 17 to 28 cm; very dark grayish brown (10YR 3/2) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bt – 28 to 42 cm; olive brown (2.5Y 4/3) gravelly clay loam (33% clay), light olive brown (2.5Y 5/3); moderate fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films from all ped faces; no effervescence; Gravelly horizon with a 1 cm layer at the bottom filled in with A material, gravel listed as 25%

Bk – 42 to 61 cm; light olive brown (2.5Y 5/3) clay loam (30% clay), light brownish gray (2.5Y 6/2); weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

BCk – 61 to 75 cm; light olive brown (2.5Y 5/3) clay loam (30% clay), light gray (2.5Y 7/2); weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 75 to 103 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), pale brown (2.5Y 7/3); few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C2 – 103 to 152 cm; olive brown (2.5Y 4/3) clay loam (32% clay), pale brown (2.5Y 7/3); few very fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, slightly sticky and moderately plastic; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; very slight effervescence

Site: R13ND-099-MM1 3-1

Described by: Brandon L. Montgomery

Date: 03-29-14

A – 0 to 20 cm; black (10YR 2/1) clay loam (28% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 20 to 42 cm; olive brown (2.5Y 4/3) loam (26% clay), olive brown (2.5Y 4/3) dry; strong fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bt – 42 to 65 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light olive brown (2.5Y 5/3); strong fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 65 to 77 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence; Krotovina from 72-75 cm

BCk – 77 to 94 cm; light olive brown (2.5Y 5/3) clay loam (35% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; soft, very friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 94 to 110 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light yellowish brown (2.5Y 6/3); massive; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 110 to 152 cm; olive brown (2.5Y 4/3) clay loam (34% clay), light yellowish brown (2.5Y 6/3); few fine prominent strong brown (7.5YR 5/6) mottles; massive; slightly hard, firm, slightly sticky and moderately plastic; common very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

Site: R13ND-099-MM1 3-2

Described by: Brandon L. Montgomery

Date: 03-29-14

A1 – 0 to 19 cm; black (10YR 2/1) clay loam (28% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

A2 – 19 to 32 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; soft, very friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bw – 32 to 46 cm; very dark gray (2.5Y 3/3) loam (26% clay), dark grayish brown (2.5Y 4/2); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bt – 46 to 65 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light olive brown (2.5Y 5/3); strong fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 65 to 77 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

C1 – 77 to 100 cm; light olive brown (2.5Y 5/3) clay loam (35% clay), light gray (2.5Y 7/2); few very fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C2 – 100 to 152 cm; olive brown (2.5Y 4/3) clay loam (37% clay), light yellowish brown (2.5Y 6/3); few fine prominent strong brown (7.5YR 4/6) mottles; massive; slightly hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

Site: R13ND-099-MM1 3-3

Described by: Brandon L. Montgomery

Date: 03-29-14

A – 0 to 22 cm; black (10YR 2/1) loam (26% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Ak – 22 to 40 cm; black (10YR 2/1) loam (25% clay), light gray (10YR 5/1) dry; moderate fine to medium subangular blocky structure; soft, very friable, moderately sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence; May be a perched water table

Bt – 40 to 57 cm; very dark gray (2.5Y 3/3) clay loam (34% clay), dark grayish brown (2.5Y 4/2); moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark grayish brown (2.5Y 3/3) clay films on all ped faces; finely disseminated carbonates; very slight effervescence

Bk – 57 to 79 cm; light olive brown (2.5Y 5/3) clay loam (27% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence; Krotovina from 62-68 cm

Krotovina – 79 to 94 cm; very dark grayish brown (2.5Y 3/2) clay loam (30% clay), gray (2.5Y 5/1); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Strong evidence of mixing

C – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (38% clay), light yellowish brown (2.5Y 6/3); massive; hard, firm, moderately sticky and moderately plastic; common very fine to fine pores; few fine distinct light brownish gray (2.5Y 6/2) carbonate masses; slight effervescence; Slightly shaley till

Site: R13ND-099-MM1 3-4

Described by: Brandon L. Montgomery

Date: 03-29-14

A – 0 to 19 cm; black (10YR 2/1) loam (26% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

BE – 19 to 31 cm; very dark brown (10YR 2/2) loam (26% clay), grayish brown (10YR 5/2) dry; weak fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence; Showing very slight signs of E horizonation

Bt1 – 31 to 42 cm; very dark grayish brown (10YR 3/2) clay loam (32% clay), dark gray (10YR 4/1); moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous very dark grayish brown (10YR 3/2) clay films on all ped faces; many distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bt2 – 42 to 66 cm; olive brown (2.5Y 4/3) clay loam (36% clay), grayish brown (2.5Y 5/2); strong fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 66 to 84 cm; light olive brown (2.5Y 5/3) loam (26% clay), white (2.5Y 8/1); weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 84 to 104 cm; olive brown (2.5Y 4/3) clay loam (31% clay), light gray (2.5Y 7/2); few very fine prominent reddish yellow (5YR 6/6) mottles; massive; hard, firm, very sticky and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Slightly water-worked till

C2 – 104 to 152 cm; olive brown (2.5Y 4/4) clay (41% clay), pale brown (2.5Y 7/3); few fine prominent strong brown (7.5YR 5/6) mottles; massive; very hard, firm, moderately sticky and very plastic; few very fine to fine pores; common fine to medium distinct light brownish gray (2.5Y 6/2) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R13ND-099-MM1 3-5

Described by: Brandon L. Montgomery

Date: 04-01-14

A – 0 to 21 cm; black (10YR 2/1) clay loam (28% clay), very dark gray (10YR 3/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 21 to 47 cm; very dark gray (10YR 3/1) clay loam (31% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous very dark gray (10YR 3/1) clay films on all ped faces; common faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bk1 – 47 to 65 cm; light brownish gray (2.5Y 6/2) clay loam (30% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many faint continuous light brownish gray (2.5Y 6/2) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 65 to 82 cm; light yellowish brown (2.5Y 6/3) clay loam (28% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, very sticky, and moderately plastic; many very fine to fine pores; finely disseminated carbonates; strong effervescence

2C – 82 to 94 cm; olive brown (2.5Y 4/4) extremely gravelly sandy clay loam (25% clay), light yellowish brown (2.5Y 6/3) dry; massive; loose, loose, slightly sticky and slightly plastic; common very fine to fine pores; finely disseminated carbonates; slight effervescence; Gravelly horizon, gravel listed as 45%

3C – 94 to 152 cm; olive brown (2.5Y 4/4) sandy clay loam (33% clay), pale yellow (2.5Y 7/3) dry; massive; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; few fine prominent yellowish brown (10YR 5/6) iron (Fe^{3+}) masses; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; very slight effervescence; Compaction in layer

Site: R13ND-099-MM1 4-1

Described by: Brandon L. Montgomery

Date: 03-26-14

A – 0 to 19 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence; Upper 3 cm highly compacted from section line road traffic

Bw1 – 19 to 34 cm; very dark grayish brown (10YR 3/2) loam (25% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; few faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bw2 – 34 to 51 cm; olive brown (2.5Y 4/3) loam (26% clay), light grayish brown (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint distinct olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 51 to 79 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C – 79 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light gray (2.5Y 7/2); few fine prominent yellowish red (5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence; Slightly water-worked till

Site: R13ND-099-MM1 4-2

Described by: Brandon L. Montgomery

Date: 03-26-14

A – 0 to 20 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; hard, firm, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence; Upper 3 cm highly compacted from section line road traffic

Bt1 – 20 to 44 cm; very dark grayish brown (10YR 3/2) clay loam (32% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium subangular blocky structure parting to weak fine to medium granular; very hard, firm, moderately sticky and moderately plastic; many very fine to fine roots; common very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bt2 – 44 to 59 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 59 to 72 cm; olive brown (2.5Y 4/3) loam (26% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 72 to 85 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence; Slightly shaley till

C – 85 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3); massive; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

Site: R13ND-099-MM1 4-3

Described by: Brandon L. Montgomery

Date: 03-26-14

A – 0 to 19 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence; Upper 3 cm heavily compacted from road

Bt – 19 to 45 cm; olive brown (2.5Y 4/3) clay loam (29% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; many faint continuous dark grayish brown (2.5Y 4/2) clay films on all ped faces; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Btk – 45 to 61 cm; olive brown (2.5Y 4/3) clay loam (33% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk – 61 to 77 cm; light gray (2.5Y 7/2) clay loam (27% clay), pale brown (2.5Y 8/2); weak fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 77 to 102 cm; olive brown (2.5Y 4/4) gravelly clay loam (33% clay), light gray (2.5Y 7/2); massive; slightly hard, friable, very sticky and moderately plastic; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence; Shaley till, water-worked till, gravel is listed as 15%

C2 – 102 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3); few fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; common very fine to fine pores; finely disseminated carbonates; very slight effervescence; Sand lens from 102 to 104 cm

Site: R13ND-099-MM1 4-4

Described by: Brandon L. Montgomery

Date: 03-26-14

Notes: Krotovina – 14 to 20 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; hard, firm, slightly sticky, and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; Krotovina sampled seperately

A1 – 0 to 24 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence; Krotovina filled with Bt type material from 14-20 cm

A2 – 24 to 50 cm; black (10YR 2/1) loam (24% clay), very dark gray (10YR 3/1) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bt – 50 to 85 cm; olive brown (2.5Y 4/3) clay loam (33% clay), light olive brown (2.5Y 5/3) dry; strong fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; few prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Btk – 85 to 98 cm; olive brown (2.5Y 4/3) clay loam (31% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; hard, friable, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

2C – 98 to 152 cm; light olive brown (2.5Y 5/3) sandy loam (8% clay), pale brown (2.5Y 7/3); single grain; loose, loose, not sticky, and not plastic; very few very fine to fine roots; no effervescence

Site: R13ND-099-MM1 4-5

Described by: Brandon L. Montgomery

Date: 03-26-14

A1 – 0 to 20 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; strong fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

A2 – 20 to 35 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 35 to 51 cm; very dark gray (10YR 3/1) loam (21% clay), light gray (10YR 5/1) dry; moderate fine to medium prismatic structure; soft, very friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; no effervescence

Bt – 51 to 66 cm; olive brown (2.5Y 4/3) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 66 to 92 cm; light brownish gray (2.5Y 6/2) sandy loam (13% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; slight effervescence; Old krotovina from 76-83 cm

BCk – 92 to 107 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Water-worked slightly

C – 107 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light brownish gray (2.5Y 6/2); massive; hard, firm, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; very slight effervescence; Water-worked till

Site: R13ND-021-MM2 C-1

Described by: Brandon L. Montgomery

Date: 04-01-14

Ap – 0 to 19 cm; very dark brown (10YR 2/2) clay loam (29% clay), very dark gray (10YR 3/1) dry; moderate fine to medium prismatic structure parting to moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bk1 – 19 to 31 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence; Looks more Bw/Btish but is hot, most likely from water movement

Bk2 – 31 to 45 cm; light yellowish brown (2.5Y 6/4) clay loam (28% clay), pale brown (2.5Y 7/3) dry; strong fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous light olive brown (2.5Y 5/3) clay films on all ped faces; finely disseminated carbonates; violent effervescence

BCk – 45 to 56 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), pale brown (2.5Y 8/2) dry; weak fine to medium subangular blocky structure; slightly hard, very friable, very sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; finely disseminated carbonates; violent effervescence

C1 – 56 to 75 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; many fine distinct light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 75 to 94 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light gray (2.5Y 7/2) dry; massive; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; many fine distinct light gray (2.5Y 7/2) carbonate masses; finely disseminated carbonates; strong effervescence

C3 – 94 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light gray (2.5Y 7/2) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM2 1-1

Described by: Brandon L. Montgomery

Date: 04-02-14

Ap – 0 to 17 cm; very dark brown (10YR 2/2) loam (26% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 17 to 25 cm; olive brown (2.5Y 4/3) clay loam (28% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces and surfaces of root channels; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; finely disseminated carbonates; very slight effervescence

Bk – 25 to 41 cm; light olive brown (2.5Y 5/3) loam (26% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; slightly hard, friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 41 to 72 cm; light yellowish brown (2.5Y 6/3) clay loam (29% clay), light yellowish brown (2.5Y 6/3); massive; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence; Evidence of water-worked till from here down, almost appears to be hundreds of sedimentary layers

C2 – 72 to 104 cm; light yellowish brown (2.5Y 6/3) clay loam (30% clay), pale brown (2.5Y 7/3); massive; very hard, very firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C3 – 104 to 152 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, very firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM2 1-2

Described by: Brandon L. Montgomery

Date: 04-02-14

Notes: There was a badger in the area which was evident from the holes left on the landscape. This core went into one of his old holes. Large area from 43 cm to 86 cm where there is a significant amount of mixing and the soil is still very loose feeling like fill. Not Not described as it is not representative

Ap – 0 to 16 cm; very dark brown (10YR 2/2) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 16 to 29 cm; olive brown (2.5Y 4/3) clay loam (29% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; common faint olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 29 to 43 cm; light olive brown (2.5Y 5/3) loam (22% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C1 – 43 to 112 cm; light olive brown (2.5Y 5/4) loam (26% clay), light yellowish brown (2.5Y 6/3); massive; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

C2 – 112 to 152 cm; olive brown (2.5Y 4/4) clay loam (29% clay), light yellowish brown (2.5Y 6/3); massive; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM2 1-3

Described by: Brandon L. Montgomery

Date: 04-02-14

Ap – 0 to 15 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 15 to 33 cm; dark brown (10YR 3.3) loam (26% clay), dark brown (10YR 3/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; common faint discontinuous dark brown (10YR 3/3) clay films on all ped faces; no effervescence

Bw2 – 33 to 48 cm; dark olive brown (2.5Y 3/3) loam (23% clay), olive brown (2.5Y 4/3); strong fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bw3 – 48 to 64 cm; olive brown (2.5Y 4/3) sandy loam (16% clay), olive brown (2.5Y 4/3); moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

BCk – 64 to 90 cm; light olive brown (2.5Y 5/3) sandy loam (16% clay), light yellowish brown (2.5Y 6/3); weak fine to medium prismatic structure; slightly hard, friable, slightly sticky, and slightly plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 90 to 116 cm; light olive brown (2.5Y 5/3) sandy loam (14% clay), light yellowish brown (2.5Y 6/3); massive; hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

C2 – 116 to 152 cm; light olive brown (2.5Y 5/3) sandy loam (15% clay), light yellowish brown (2.5Y 6/3); massive; hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM2 1-4

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 17 cm; very dark brown (10YR 2/2) clay loam (28% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; no effervescence

Bt – 17 to 34 cm; olive brown (2.5Y 4/3) clay loam (36% clay), olive brown (2.5Y 4/3) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and very plastic; few very fine to fine roots; common very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 34 to 56 cm; light yellowish brown (2.5Y 6/3) clay loam (29% clay), pale brown (2.5Y 8/2); moderate fine to medium prismatic structure; slightly hard, firm, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 56 to 76 cm; light olive brown (2.5Y 5/4) clay loam (27% clay), light yellowish brown (2.5Y 6/3); few fine prominent brownish yellow (10YR 6/8) mottles; weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

2C1 – 76 to 83 cm; light olive brown (2.5Y 5/4) sandy loam (18% clay), light yellowish brown (2.5Y 6/3); few fine prominent brownish yellow (10YR 6/8) mottles; massive; soft, friable, slightly sticky, and slightly plastic; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

2C2 – 83 to 100 cm; light olive brown (2.5Y 5/3) sandy loam (14% clay), light olive brown (2.5Y 5/3); single grain; loose, loose, not sticky and not plastic; no effervescence

2C3 – 100 to 152 cm; light olive brown (2.5Y 5/4) loamy sand (5% clay), light olive brown (2.5Y 5/4); single grain; loose, loose, not sticky and not plastic; no effervescence; Gravel layer from 100-103 cm

Site: R13ND-021-MM2 1-5

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 19 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 19 to 35 cm; very dark grayish brown (10YR 3/2) clay loam (29% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; many faint discontinuous very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence

Bk – 35 to 58 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), light yellowish brown (2.5Y 6/3); moderate fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 58 to 74 cm; light olive brown (2.5Y 5/3) sandy clay loam (24% clay), light yellowish brown (2.5Y 6/3); weak fine to medium prismatic structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine to fine to medium roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; strong effervescence; Evidence of slightly water-worked till

2C1 – 74 to 94 cm; olive brown (2.5Y 4/4) sandy clay loam (23% clay), light gray (2.5Y 7/2); massive; slightly hard, very friable, slightly sticky, and slightly plastic; few very fine to fine to medium roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; slight effervescence; Evidence of water-worked till, fine and very fine sand

2C2 – 94 to 106 cm; light olive brown (2.5Y 5/4) sandy clay loam (21% clay), light yellowish brown (2.5Y 6/3); few fine prominent brownish yellow (10YR 6/8) mottles; massive; soft, very friable, slightly sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; strong effervescence; Evidence of water-worked till

2C3 – 106 to 152 cm; olive brown (2.5Y 4/4) sandy clay loam (28% clay), light olive brown (2.5Y 6/3); massive; slightly hard, friable, slightly sticky, and slightly plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; slight effervescence; Evidence of water-worked till

Site: R13ND-021-MM2 2-1

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 15 cm; black (10YR 2/1) loam (26% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt – 15 to 32 cm; brown (10YR 4/3) clay loam (34% clay), brown (10YR 4/3) dry; strong fine to medium prismatic structure; hard, firm, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; few faint discontinuous black (10YR 2/1) organic stains on vertical ped faces; many faint continuous brown (10YR 4/3) clay films on all ped faces; no effervescence

Bk1 – 32 to 55 cm; light yellowish brown (2.5Y 6/3) loam (24% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonates masses; violent effervescence

Bk2 – 55 to 71 cm; light olive brown (2.5Y 5/3) loam (25% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/2) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonates masses; strong effervescence

BCk – 71 to 82 cm; light brownish gray (2.5Y 6/2) clay loam (27% clay), light gray (2.5Y 7/2); massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 82 to 104 cm; olive brown (2.5Y 4/3) clay loam (30% clay), light gray (2.5Y 7/2); few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence; Water-worked till looks almost sedimentary

C2 – 104 to 152 cm; olive brown (2.5Y 4/3) clay loam (31% clay), light yellowish brown (2.5Y 6/3); few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence; Water-worked till looks almost sedimentary

Site: R13ND-021-MM2 2-2

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 15 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bt – 15 to 36 cm; olive brown (2.5Y 4/3) clay loam (32% clay), light olive brown (2.5Y 5/3) dry; strong fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 36 to 55 cm; light brownish gray (2.5Y 6/2) loam (25% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, firm, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light olive brown (2.5Y 5/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

Bk2 – 55 to 72 cm; light olive brown (2.5Y 5/3) loam (26% clay), light gray (2.5Y 7/2); moderate fine to medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) carbonates masses; strong effervescence

C1 – 72 to 96 cm; olive brown (2.5Y 4/4) clay loam (29% clay), light yellowish brown (2.5Y 6/3); few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct white (2.5Y 8/1) carbonate masses; strong effervescence; Water-worked till

C2 – 96 to 152 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3); few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence; Water-worked till

Site: R13ND-021-MM2 2-3

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 17 cm; black (10YR 2/1) clay loam (29% clay), dark gray (10YR 4/1) dry; weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 17 to 32 cm; dark brown (10YR 3/3) loam (26% clay), brown (10YR 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bk1 – 32 to 48 cm; olive brown (2.5Y 4/3) loam (22% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence; Looks like there may be a very old krotovina from 37-40 cm

Bk2 – 48 to 69 cm; light brownish gray (2.5Y 6/2) loam (24% clay), pale brown (2.5Y 8/2); moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BCk – 69 to 92 cm; olive brown (2.5Y 4/4) loam (24% clay), light brownish gray (2.5Y 6/2); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonates masses; finely disseminated carbonates; strong effervescence; Slight accumulation of organic matter may have been a brief discontinuity in time

C1 – 92 to 115 cm; light olive brown (2.5Y 5/3) silt loam (25% clay), light brownish gray (2.5Y 6/2); massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 115 to 152 cm; light olive brown (2.5Y 5/3) silt loam (23% clay), light olive brown (2.5Y 5/3); massive; hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM2 2-4

Described by: Brandon L. Montgomery

Date: 04-06-14

Ap – 0 to 14 cm; black (10YR 2/1) loam (26% clay), dark gray (10YR 4/1) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 14 to 33 cm; olive brown (2.5Y 4/3) loam (26% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; no effervescence

Bk1 – 33 to 56 cm; light olive brown (2.5Y 5/3) loam (24% clay), light brownish gray (2.5Y 6/2); moderate fine to medium prismatic structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 56 to 70 cm; light brownish gray (2.5Y 6/2) loam (24% clay), pale brown (2.5Y 8/2); weak fine to medium prismatic structure; slightly hard, very friable, very sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 70 to 82 cm; light brownish gray (2.5Y 6/2) loam (22% clay), light gray (2.5Y 7/2); massive; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C2 – 82 to 103 cm; olive brown (2.5Y 4/3) loam (20% clay), light gray (2.5Y 7/2); massive; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

C3 – 103 to 152 cm; olive brown (2.5Y 4/3) loam (21% clay), light yellowish brown (2.5Y 6/3); massive; slightly hard, very friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

Site: R13ND-021-MM2 2-5

Described by: Brandon L. Montgomery

Date: 04-09-14

Ap – 0 to 16 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 16 to 34 cm; olive brown (2.5Y 4/3) loam (22% clay), olive brown (2.5Y 4/3) dry; strong fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bw2 – 34 to 50 cm; olive brown (2.5Y 4/3) sandy loam (22% clay), light olive brown (2.5Y 5/3); strong fine to medium prismatic structure; slightly hard, very friable, moderately sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 50 to 69 cm; light yellowish brown (2.5Y 6/3) sandy loam (14% clay), light gray (2.5Y 7/2); moderate fine to medium prismatic structure; loose, friable, moderately sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 69 to 82 cm; light olive brown (2.5Y 5/3) sandy loam (13% clay), light gray (2.5Y 7/2); weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonates masses; finely disseminated carbonates; slight effervescence

C1 – 82 to 98 cm; light olive brown (2.5Y 5/4) sandy loam (8% clay), light gray (2.5Y 7/2); massive; slightly hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence; Many layers looks almost sedimentary

C2 – 98 to 116 cm; olive brown (2.5Y 4/3) sandy loam (11% clay), light yellowish brown (2.5Y 6/3); massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; very slight effervescence; Many layers looks almost sedimentary

C3 – 116 to 152 cm; light olive brown (2.5Y 5/4) sandy loam (13% clay), light brownish gray (2.5Y 6/2); massive; hard, firm, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; very slight effervescence

Site: R13ND-021-MM2 3-1

Described by: Brandon L. Montgomery

Date: 04-09-14

Ap1 – 0 to 15 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bt – 15 to 31 cm; olive brown (2.5Y 4/3) clay loam (29% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; many distinct continuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; no effervescence

Btk1 – 31 to 46 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Btk2 – 46 to 63 cm; light olive brown (2.5Y 5/3) clay loam (34% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 63 to 77 cm; olive brown (2.5Y 4/3) clay loam (32% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium subangular blocky structure; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; slight effervescence

C1 – 77 to 108 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine prominent gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 108 to 152 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; very slight effervescence

Site: R13ND-021-MM2 3-2

Described by: Brandon L. Montgomery

Date: 04-09-14

Ap – 0 to 13 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; no effervescence

Bt1 – 13 to 26 cm; dark olive brown (2.5Y 3/3) clay loam (32% clay), dark olive brown (2.5Y 3/3) dry; strong fine to medium prismatic structure; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; many distinct continuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence

Bt2 – 26 to 39 cm; olive brown (2.5Y 4/3) clay loam (31% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 39 to 64 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; common faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

Bk2 – 64 to 80 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; many fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C1 – 80 to 98 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; very slight effervescence

C2 – 98 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; common fine to medium distinct white (2.5Y 8/1) gypsum crystals; very slight effervescence; Small amount of shale in horizon

Site: R13ND-021-MM2 3-3

Described by: Brandon L. Montgomery

Date: 04-09-14

Ap – 0 to 13 cm; black (10YR 2/1) loam (23% clay), very dark gray (10YR 3/1) dry; moderate fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw – 13 to 30 cm; very dark grayish brown (10YR 3/2) clay loam (27% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; light brownish gray (2.5Y 6/2) finely disseminated carbonates on surfaces along root channels; slight effervescence

Bk1 – 30 to 43 cm; light olive brown (2.5Y 5/3) loam (25% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, very friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; strong effervescence

Bk2 – 43 to 61 cm; light olive brown (2.5Y 5/3) loam (22% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, very friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; violent effervescence

BC – 61 to 79 cm; light olive brown (2.5Y 5/4) loam (23% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; few fine prominent brownish yellow (10YR 6/6) iron (Fe+3) masses; finely disseminated carbonates; slight effervescence

C1 – 79 to 99 cm; olive brown (2.5Y 4/4) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; few fine prominent brownish yellow (10YR 6/6) iron (Fe+3) masses; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 99 to 152 cm; olive brown (2.5Y 4/3) clay loam (31% clay), light olive brown (2.5Y 5/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; common fine prominent brownish yellow (10YR 6/6) iron (Fe+3) masses; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; very slight effervescence

Site: R13ND-021-MM2 3-4

Described by: Brandon L. Montgomery

Date: 04-09-14

A – 0 to 15 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; no effervescence

AE – 15 to 23 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; moderate thin to medium platy structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

BE – 23 to 48 cm; dark olive brown (2.5Y 3/3) clay loam (31% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure parting to moderate thin to medium platy; slightly hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron ($Fe3+$) masses; many distinct continuous gray (2.5Y 5/1) silica on vertical ped faces; no effervescence

Bt – 48 to 69 cm; very dark gray (2.5Y 3/1) clay (42% clay), dark gray (2.5Y 4/1) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; very few very fine to fine roots; many very fine to fine pores; many faint continuous very dark gray (2.5Y 3/1) clay films on all ped faces; no effervescence

BCg – 69 to 84 cm; olive brown (2.5Y 4/3) clay loam (30% clay), grayish brown (2.5Y 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; common distinct discontinuous gray (2.5Y 5/1) silica on vertical ped faces; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Cg1 – 84 to 108 cm; olive brown (2.5Y 4/3) clay loam (35% clay), light gray (2.5Y 7/1) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; few fine distinct black (10YR 2/1) manganese masses; many distinct continuous gray (2.5Y 5/1) silica on vertical ped faces; no effervescence

Cg2 – 108 to 152 cm; grayish brown (2.5Y 5/2) clay loam (36% clay), light gray (2.5Y 7/1) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; common very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; many distinct continuous gray (2.5Y 5/1) silica on vertical ped faces; no effervescence

Site: R13ND-021-MM2 3-5

Described by: Brandon L. Montgomery

Date: 04-12-14

A1 – 0 to 13 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; slightly hard, very friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

A2 – 13 to 28 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

AE – 28 to 37 cm; black (10YR 2/1) loam (19% clay), gray (10YR 5/1) dry; moderate thin to medium platy structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; common very fine to fine pores; no effervescence

E – 37 to 59 cm; grayish brown (10YR 5/2) loam (11% clay), light gray (10YR 7/1) dry; moderate thin to medium platy structure; slightly hard, friable, not sticky and slightly plastic; few very fine to fine roots; common very fine to fine pores; many fine to medium prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence

Bt1 – 59 to 84 cm; olive brown (10YR 2/1) clay (43% clay), grayish brown (10YR 4/1) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; common very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; very many faint continuous black (10YR

2/1) clay films on all ped faces; few faint continuous sand coats on vertical ped faces; no effervescence

Bt2 – 84 to 102 cm; dark grayish brown (2.5Y 4/2) clay (40% clay), grayish brown (2.5Y 5/2) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; few very fine to fine pores; common fine to medium prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; many faint continuous very dark gray (2.5Y 3/1) clay films on all ped faces; no effervescence; Clay films must have filled in many/most of the pores

C – 102 to 152 cm; olive brown (2.5Y 4/3) clay loam (28% clay), grayish brown (2.5Y 5/2) dry; massive; hard, firm, moderately sticky and moderately plastic; few very fine to fine pores; common fine to medium prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence; Clay films have filled in many/most of the pores

Site: R13ND-021-MM2 4-1

Described by: Brandon L. Montgomery

Date: 04-12-14

Ap – 0 to 12 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; no effervescence

Bw – 12 to 42 cm; olive brown (2.5Y 4/3) loam (22% clay), dark gray (2.5Y 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bk – 42 to 63 cm; olive brown (2.5Y 4/3) loam (21% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

2BCk – 63 to 76 cm; light olive brown (2.5Y 5/3) sandy loam (16% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent yellowish brown (10YR 5/8) iron (Fe^{+3}) masses; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; slight effervescence

2C1 – 76 to 91 cm; light olive brown (2.5Y 5/3) sandy clay loam (24% clay), light olive brown (2.5Y 5/3) dry; massive; slightly hard, friable, slightly sticky, and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent yellowish brown (10YR 5/8) iron (Fe+3) masses; no effervescence

2C2 – 91 to 107 cm; light olive brown (2.5Y 5/4) sandy loam (17% clay), light olive brown (2.5Y 5/4) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe+3) masses; common fine to medium distinct light gray (2.5Y 7/1) iron depletions; no effervescence

3C – 107 to 152 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light olive brown (2.5Y 5/3) dry; massive; hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium prominent yellowish brown (10YR 5/8) iron (Fe+3) masses; common fine to medium distinct gray (2.5Y 6/1) iron depletions; no effervescence; Water-worked till

Site: R13ND-021-MM2 4-2

Described by: Brandon L. Montgomery

Date: 04-12-14

Ap – 0 to 16 cm; black (10YR 2/1) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 16 to 36 cm; brown (10YR 4/3) loam (20% clay), brown (10YR 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bw2 – 36 to 65 cm; very dark grayish brown (10YR 4/2) loam (24% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common faint discontinuous clay films on all ped faces; no effervescence

BC – 65 to 79 cm; light olive brown (2.5Y 5/3) loam (21% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium prominent yellow (10YR 7/8) iron (Fe^{+3}) masses; no effervescence

2C1 – 79 to 95 cm; grayish brown (2.5Y 5/2) loam (18% clay), grayish brown (2.5Y 5/2) dry; massive; slightly hard, friable, slightly sticky, and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence; Increase in sand but not enough to be sandy loam

2C2 – 95 to 108 cm; light olive brown (2.5Y 5/3) loam (12% clay), light olive brown (2.5Y 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence; Increase in sand but not enough to be sandy loam

3C – 108 to 152 cm; olive brown (2.5Y 4/4) clay loam (28% clay), light brownish gray (2.5Y 6/2) dry; massive; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; few fine to medium distinct gray (2.5Y 6/1) iron depletions; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM2 4-3

Described by: Brandon L. Montgomery

Date: 04-12-14

Ap – 0 to 13 cm; black (10YR 2/1) loam (24% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 13 to 31 cm; brown (10YR 4/3) loam (23% clay), grayish brown (10YR 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence; Starting to develop E like features, very weak still though

Bw2 – 31 to 54 cm; very dark brown (10YR 2/2) loam (19% clay), very dark brown (10YR 2/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (10YR 2/2) clay films on all ped faces; no effervescence

2BC – 54 to 66 cm; light olive brown (2.5Y 5/4) loam (16% clay), light olive brown (2.5Y 5/4) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence

2C1 – 66 to 86 cm; light brownish gray (2.5Y 6/2) sandy loam (13% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, not sticky, and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence; Fine sandy loam

2C2 – 86 to 95 cm; light olive brown (2.5Y 5/4) sandy loam (12% clay), light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, not sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium prominent yellowish brown (10YR 5/8) iron (Fe^{+3}) masses; no effervescence

3C1 – 95 to 111 cm; olive brown (2.5Y 4/4) loam (22% clay), olive brown (2.5Y 4/4) dry; massive; slightly hard, friable, slightly sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent yellowish brown (10YR 5/8) iron (Fe^{+3}) masses; no effervescence; Transitional 2C-3C

3C2 – 111 to 152 cm; olive brown (2.5Y 4/4) clay loam (31% clay), olive brown (2.5Y 4/4) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent yellowish brown (10YR 5/8) iron (Fe^{+3}) masses; common fine distinct gray (2.5Y 6/1) iron depletions; no effervescence

Site: R13ND-021-MM2 4-4

Described by: Brandon L. Montgomery

Date: 04-12-14

Ap – 0 to 15 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 15 to 34 cm; very dark grayish brown (10YR 3/2) loam (22% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bw2 – 34 to 57 cm; very dark brown (10YR 2/2) loam (21% clay), very dark brown (10YR 2/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

BC – 57 to 80 cm; light olive brown (2.5Y 5/3) loam (24% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine prominent yellow (10YR 7/8) iron (Fe^{+3}) masses; no effervescence

C1 – 80 to 98 cm; olive brown (2.5Y 4/3) clay loam (29% clay), olive brown (2.5Y 4/3) dry; massive; slightly hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe+3) masses; no effervescence

C2 – 98 to 108 cm; light brownish gray (2.5Y 6/2) clay loam (28% clay), light gray (2.5Y 7/2) dry; massive; hard, friable, moderately sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe+3) masses; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C3 – 108 to 118 cm; olive brown (2.5Y 4/4) clay loam (32% clay), light brownish gray (2.5Y 6/2) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe+3) masses; common fine distinct gray (2.5Y 6/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

C4 – 118 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light brownish gray (2.5Y 6/2) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe+3) masses; common fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Increase in sand/gravels in layer

Site: R13ND-021-MM2 4-5

Described by: Brandon L. Montgomery

Date: 04-12-14

Ap – 0 to 17 cm; black (10YR 2/1) loam (25% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to moderate fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bw1 – 17 to 40 cm; brown (10YR 4/3) loam (25% clay), brown (10YR 5/3) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bw2 – 40 to 64 cm; very dark brown (10YR 2/2) loam (27% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

BC – 64 to 76 cm; olive brown (2.5Y 4/4) loam (29% clay), olive brown (2.5Y 4/4) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence

C1 – 76 to 94 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light olive brown (2.5Y 5/3) dry; massive; slightly hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence

C2 – 94 to 112 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), light olive brown (2.5Y 5/4) dry; massive; hard, firm, moderately sticky and slightly plastic; very few very fine to fine roots; many very fine to fine pores; few fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; no effervescence; Layer from 102-106 cm with many fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses

C3 – 112 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light olive brown (2.5Y 5/4) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine prominent brownish yellow (10YR 6/8) iron (Fe^{+3}) masses; common fine distinct gray (2.5Y 6/1) iron depletions; no effervescence

Site: R13ND-021-MM3 C-1

Described by: Brandon L. Montgomery

Date: 04-15-14

A – 0 to 11 cm; very dark brown (10YR 2/2) loam (19% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure; soft, very friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

Bw – 11 to 21 cm; very dark grayish brown (10YR 3/2) loam (18% clay), dark grayish brown (10YR 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; no effervescence

2E – 21 to 28 cm; brown (10YR 5/3) sandy loam (17% clay), light brownish gray (10YR 6/2) dry; single grain; slightly hard, loose, not sticky and slightly plastic; not effervescence; Bottom of E almost looks like biscuit tops, old natric?

3Bt – 28 to 45 cm; olive brown (2.5Y 4/3) clay (44% clay), grayish brown (2.5Y 5/2) dry; strong fine to medium subangular blocky structure; very hard, very firm, moderately sticky, and very plastic; many very fine to fine roots; few very fine to fine pores; many distinct continuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; no effervescence

4Bt – 45 to 59 cm; olive brown (2.5Y 4/4) sandy clay loam (28% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; slightly hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores;

common faint discontinuous olive brown (2.5Y 4/4) clay films on all ped faces; no effervescence

4Bk – 59 to 85 cm; olive brown (2.5Y 4/4) sandy loam (11% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; loose, loose, not sticky, and not plastic; common very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

4C – 85 to 104 cm; light olive brown (2.5Y 5/4) loamy sand (7% clay), light yellowish brown (2.5Y 6/3) dry; single grain; loose, loose, not sticky and not plastic; common very fine to fine pores; no effervescence

5C – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), pale yellow (2.5Y 7/3) dry; massive; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; few fine prominent yellowish brown (10YR 5/6) iron (Fe^{3+}) masses; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; very slight effervescence; Compaction in layer

Site: R13ND-021-MM3 1-1

Described by: Brandon L. Montgomery

Date: 04-15-14

A – 0 to 15 cm; black (10YR 2/1) loam (18% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine to fine roots; few very fine to fine pores; no effervescence

Bt1 –15 to 32 cm; brown (10YR 4/3) clay loam (36% clay), brown (10YR 4/3) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; common very fine to fine pores; many faint continuous clay films on all ped faces; no effervescence

Bt2 – 32 to 52 cm; olive brown (2.5Y 4/3) clay (48% clay), light olive brown (2.5Y 5/3) dry; strong fine to medium prismatic structure; very hard, very firm, moderately sticky and very plastic; common very fine to fine roots; common very fine to fine pores; many faint continuous clay films on all ped faces; no effervescence

Bk – 52 to 76 cm; light olive brown (2.5Y 5/3) clay loam (32% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous clay films on all ped faces; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 76 to 87 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C – 87 to 104 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light gray (2.5Y 7/2) dry; massive; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Cy – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), pale brown (2.5Y 7/3) dry; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) gypsum crystal clusters; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM3 1-2

Described by: Brandon L. Montgomery

Date: 04-15-14

A1 – 0 to 10 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; moderate fine to medium granular structure parting to weak fine to medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; no effervescence

A2 –10 to 22 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; many very fine to fine pores; no effervescence

Bw – 22 to 43 cm; dark grayish brown (2.5Y 4/2) loam (25% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; no effervescence

Bk1 – 43 to 58 cm; light olive brown (2.5Y 5/3) loam (26% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence

Bk2 – 58 to 82 cm; light brownish gray (2.5Y 6/2) loam (21% clay), light gray (2.5Y 7/2) dry; weak fine to medium subangular blocky structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

C – 82 to 104 cm; light olive brown (2.5Y 5/3) clay loam (30% clay), light gray (2.5Y 7/2) dry; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

Cy – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few very fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct pale brown (2.5Y 8/2) gypsum crystal clusters; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

Site: R13ND-021-MM3 1-3

Described by: Brandon L. Montgomery

Date: 04-15-14

A1 – 0 to 10 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium granular structure; soft, very friable, slightly sticky and moderately plastic; many very fine to fine roots; no effervescence

A2 –10 to 22 cm; very dark brown (10YR 2/2) loam (26% clay), dark gray (10YR 4/1) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; no effervescence

Bw – 22 to 42 cm; dark grayish brown (10YR 4/2) loam (26% clay), grayish brown (10YR 5/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous dark grayish brown (2.5Y 4/2) clay films on all ped faces; no effervescence

Bk – 42 to 59 cm; olive brown (2.5Y 4/3) clay loam (29% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common distinct discontinuous very dark grayish brown (2.5Y 3/2) organic stains on vertical ped faces; common fine distinct white (2.5Y 8/1) carbonate masses; strong effervescence

BCk – 59 to 82 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; violent effervescence

C – 82 to 108 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 4/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

Cy – 108 to 152 cm; olive brown (2.5Y 4/4) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine to medium prominent pale brown (2.5Y 8/2) gypsum crystal clusters; few fine distinct white (2.5Y 8/1) carbonate masses; slight effervescence

Site: R13ND-021-MM3 1-4

Described by: Brandon L. Montgomery

Date: 05-14-14

A – 0 to 10 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium subangular blocky structure parting to weak fine to medium granular; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Compaction layer at top from cattle

Bt –10 to 22 cm; olive brown (2.5Y 4/3) clay loam (29% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 22 to 43 cm; light olive brown (2.5Y 5/3) loam (23% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

Bk2 – 43 to 58 cm; light olive brown (2.5Y 5/3) loam (25% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores;

common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 58 to 82 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light brownish gray (2.5Y 6/2) dry; very few very fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 82 to 104 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; very few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; very slight effervescence

Site: R13ND-021-MM3 1-5

Described by: Brandon L. Montgomery

Date: 05-14-14

A – 0 to 13 cm; very dark brown (10YR 2/2) loam (19% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure parting to weak fine granular; slightly hard, very friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Upper 3 cm almost duff like layer

Bw –13 to 32 cm; olive brown (2.5Y 4/3) loam (23% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many distinct continuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous very dark brown (2.5Y 2/2) clay films on all ped faces; no effervescence

Bt – 32 to 56 cm; light olive brown (2.5Y 5/3) clay loam (39% clay), light gray (2.5Y 7/2) dry; strong fine to medium prismatic structure; very hard, very firm, moderately sticky and very plastic; common very fine to fine roots; common very fine to fine pores; many faint continuous dark olive brown (2.5Y 3/3) clay films on all ped faces; many distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence

Bk – 56 to 74 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light brownish gray (2.5Y 6/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 74 to 87 cm; light olive brown (2.5Y 5/4) clay loam (32% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 87 to 109 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C2 – 109 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent yellowish brown (10YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; common fine to medium distinct gray (2.5Y 5/1) iron depletions; many medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 2-1

Described by: Brandon L. Montgomery

Date: 05-16-14

A – 0 to 15 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure parting to weak fine to medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Upper 4 cm compacted

Bt1 –15 to 27 cm; olive brown (2.5Y 4/4) clay loam (32% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; very hard, very firm, moderately sticky and moderately plastic; many very fine to fine roots; common very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; common faint discontinuous olive brown (2.5Y 4/4) clay films on all ped faces; no effervescence; A few bleached sand grains and the beginning of an E horizon at the top of Bt1 horizon

Bt2 – 27 to 47 cm; olive brown (2.5Y 4/4) loam (36% clay), olive brown (2.5Y 4/4) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and very plastic; many very fine to fine roots; common very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/4) clay films on all ped faces; many distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence

Bk – 47 to 75 cm; light olive brown (2.5Y 5/3) loam (28% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; common very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 75 to 89 cm; light olive brown (2.5Y 5/3) clay loam (33% clay), light olive brown (2.5Y 5/3) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 89 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/4) dry; very few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 2-2

Described by: Brandon L. Montgomery

Date: 05-16-14

A – 0 to 14 cm; black (10YR 2/1) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure parting to weak fine to medium granular; slightly hard, very friable, slightly sticky and moderately plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Upper 4 cm compacted

Bw –14 to 29 cm; olive brown (2.5Y 4/3) clay loam (26% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; no effervescence

Bt – 29 to 51 cm; olive brown (2.5Y 4/3) loam (38% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; few faint distinct white (2.5Y 8/1) carbonates masses; no effervescence; Carbonates only present in bottom 3 cm

Bk1 – 51 to 65 cm; light olive brown (2.5Y 5/3) loam (27% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

Bk2 – 65 to 85 cm; olive brown (2.5Y 4/3) clay loam (31% clay), pale brown (2.5Y 7/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; few fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 85 to 103 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C – 103 to 152 cm; light olive brown (2.5Y 5/3) clay loam (34% clay), pale brown (2.5Y 7/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; common fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 2-3

Described by: Brandon L. Montgomery

Date: 05-17-14

A – 0 to 16 cm; very dark brown (10YR 2/2) loam (22% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Upper 4 cm compacted

Bw1 –16 to 32 cm; very dark grayish brown (10YR 3/2) loam (23% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; no effervescence

Bw2 – 32 to 56 cm; brown (10YR 4/3) loam (26% clay), brown (10YR 4/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few distinct discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; common faint discontinuous brown (10YR 4/3) clay films on all ped faces; no effervescence

Bk1 – 56 to 79 cm; light olive brown (2.5Y 5/3) clay loam (28% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence; Krotovina from 71-75 not sampled

Bk2 – 79 to 92 cm; light brownish gray (2.5Y 6/2) clay loam (28% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 92 to 104 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/6) mottles; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (34% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, friable, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence; Slightly water-worked till

Site: R13ND-021-MM3 2-4

Described by: Brandon L. Montgomery

Date: 05-17-14

A – 0 to 15 cm; very dark brown (10YR 2/2) loam (22% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Compaction layer upper 3 cm

Bw –15 to 33 cm; very dark grayish brown (10YR 3/2) loam (24% clay), very dark grayish brown (10YR 3/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; no effervescence

Bt – 33 to 50 cm; olive brown (2.5Y 4/3) clay loam (36% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; hard, very firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; few faint discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 50 to 64 cm; light brownish gray (2.5Y 6/2) loam (26% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; slightly hard, firm, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

Bk2 – 64 to 83 cm; light olive brown (2.5Y 5/5) clay loam (30% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Gravel lens from 65-69 cm

BCk – 83 to 100 cm; olive brown (2.5Y 4/4) clay loam (31% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C – 100 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 2-5

Described by: Brandon L. Montgomery

Date: 05-17-14

A – 0 to 14 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw –14 to 26 cm; very dark grayish brown (2.5Y 3/2) loam (25% clay), dark grayish brown (2.5Y 4/2) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; few prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; common faint discontinuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; no effervescence

Bt – 26 to 43 cm; olive brown (2.5Y 4/3) clay loam (34% clay), light olive brown (2.5Y 5/3) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk1 – 43 to 60 cm; light brownish gray (2.5Y 6/2) loam (26% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; violent effervescence

Bk2 – 60 to 85 cm; light yellowish brown (2.5Y 6/4) clay loam (30% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 85 to 104 cm; light olive brown (2.5Y 5/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence; More like a C horizon than a B horizon changes are _________

C – 104 to 152 cm; light olive brown (2.5Y 5/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; very slight effervescence

Site: R13ND-021-MM3 3-1

Described by: Brandon L. Montgomery

Date: 05-18-14

A – 0 to 16 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; Upper 4 cm are a compacted, duff like layer

Bw –16 to 33 cm; dark brown (10YR 3/3) loam (25% clay), dark brown (10YR 3/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; no effervescence

Bt – 33 to 54 cm; light olive brown (2.5Y 5/3) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium prismatic structure; very hard, very firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

2BCk – 54 to 75 cm; light olive brown (2.5Y 5/4) sandy loam (15% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/8) mottles; single grain; loose, loose, slightly sticky, and slightly plastic; few very fine to fine roots; finely disseminated carbonates; slight effervescence; A small amount of subangular blocky structure formed by mostly single grain

3C1 – 75 to 101 cm; olive brown (2.5Y 4/4) clay loam (33% clay), light gray (2.5Y 7/2) dry; common fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, very sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; many fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Slightly water-worked till

3C2 – 101 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; common fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; finely disseminated carbonates; strong effervescence

Site: R13ND-021-MM3 3-2

Described by: Brandon L. Montgomery

Date: 05-18-14

A – 0 to 14 cm; very dark brown (10YR 2/2) loam (21% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw –14 to 26 cm; brown (10YR 4/3) loam (23% clay), brown (10YR 4/3) dry; moderate fine to medium prismatic structure; slightly hard, very friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; few prominent discontinuous black (10YR 2/1) organic stains on vertical ped faces; no effervescence; Has a very weak E horizon look to it

Bt – 26 to 46 cm; light olive brown (2.5Y 5/3) clay loam (32% clay), light yellowish brown (2.5Y 6/3) dry; strong fine to medium prismatic structure parting to moderate fine to medium subangular blocky; very hard, very firm, moderately sticky and very plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence; Upper 3 cm 10YR 2/1 has the appearance of a B horizon _____ an E.

Bk – 46 to 69 cm; light brownish gray (2.5Y 6/2) loam (26% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, friable, very sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 69 to 87 cm; light brownish gray (2.5Y 6/2) clay loam (31% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 87 to 104 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, friable, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C2 – 104 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), pale brown (2.5Y 7/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 3-3

Described by: Brandon L. Montgomery

Date: 05-19-14

A – 0 to 18 cm; very dark brown (10YR 2/2) loam (23% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt –18 to 39 cm; olive brown (2.5Y 4/3) clay loam (38% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence; Very thin 2 cm E horizon at top of Bt horizon not large enough to sample/describe but clearly visible

Bky – 39 to 59 cm; light olive brown (2.5Y 5/3) clay loam (31% clay), light brownish gray (2.5Y 6/2) dry; weak fine to medium prismatic structure; slightly hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Bk – 59 to 73 cm; light olive brown (2.5Y 5/3) clay loam (34% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y

6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BCk – 73 to 84 cm; light olive brown (2.5Y 5/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 6/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 84 to 105 cm; olive brown (2.5Y 4/4) clay loam (37% clay), pale brown (2.5Y 7/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2/5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) gypsum crystal clusters; finely disseminated carbonates; strong effervescence

C2 – 105 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2.5Y 5/1) iron depletions; few fine distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 3-4

Described by: Brandon L. Montgomery

Date: 05-20-14

A – 0 to 18 cm; black (10YR 2/1) loam (22% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure parting to weak fine to medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

BE –18 to 30 cm; very dark grayish brown (10YR 3/2) loam (21% clay), gray (10YR 5/1) dry; weak fine to medium prismatic structure; hard, friable, slightly sticky and slightly plastic; common very fine to fine roots; many very fine to fine pores; no effervescence

Bt1– 30 to 45 cm; dark olive brown (2.5Y 3/3) clay loam (33% clay), very dark grayish brown (2.5Y 3/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous black (10YR 2/1) organic stains on vertical ped faces; many faint continuous dark olive brown (2.5Y 3/3) clay films on all ped faces; no effervescence

Bt2 – 45 to 61 cm; olive brown (2.5Y 4/3) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; moderate fine to medium prismatic structure; very hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; many faint continuous olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

2Bk – 61 to 75 cm; light olive brown (2.5Y 5/3) sandy clay loam (30% clay), light olive brown (2.5Y 5/4) dry; weak fine to medium prismatic structure; very hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; few fine distinct light gray (2.5Y 7/1) iron depletions; finely disseminated carbonates; slight effervescence; Sandier horizon, related to the discontinuity found upslope

2BCk – 75 to 96 cm; olive brown (2.5Y 4/3) clay loam (32% clay), pale brown (2.5Y 7/3) dry; few fine prominent yellowish brown (10YR 5/8) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct gray (2/5Y 6/1) iron depletions; many fine to medium distinct pale brown (2.5Y 8/2) carbonate masses; strong effervescence

3C – 96 to 152 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct gray (2.5Y 5/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; slight effervescence

Site: R13ND-021-MM3 3-5

Described by: Brandon L. Montgomery

Date: 05-21-14

AE – 0 to 19 cm; dark gray (10YR 4/1) sandy loam (15% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; soft, very friable, not sticky and slightly plastic; common very fine to fine roots; common very fine to fine pores; no effervescence; Looks like the A horizon of the side, bur the organic matter has been leadched, leading to the AE designation, small duff layer ____ from 0-3 cm

E –19 to 30 cm; light brownish gray (10YR 6/2) loamy sand (13% clay), light brownish gray (10YR 6/2) dry; moderate thin to medium platy structure; soft, very friable, not sticky and not plastic; common very fine to fine roots; common very fine to fine pores; no effervescence

Bt1 – 30 to 58 cm; black (10YR 2/1) clay (48% clay), black (10YR 2/1) dry; strong fine to medium prismatic structure; very hard, very firm, moderately sticky and very plastic; few very fine to fine roots; common very fine to fine pores; very many faint continuous black (10YR 2/1) clay films on all ped faces; common distinct continuous light gray (10YR 7/1) silica on vertical ped faces; no effervescence

Bt2 – 58 to 67 cm; olive brown (2.5Y 4/3) clay (44% clay), light olive brown (2.5Y 5/3) dry; moderate fine to medium prismatic structure; very hard, firm, moderately sticky, and very plastic; few very fine to fine roots; common very fine to fine pores; common fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine to medium distinct yellowish brown (10YR 5/6) iron (Fe^{3+}) masses; many distinct continuous olive brown (2.5Y 4/3) clay films on all ped faces; common prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; few fine distinct white (2.5Y 8/1) silica masses; no effervescence

Bk – 67 to 95 cm; light olive brown (2.5Y 5/3) clay loam (39% clay), light yellowish brown (2.5Y 6/3) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine to medium prominent yellowish brown (10YR 5/6) iron (Fe^{3+}) masses; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

BC – 95 to 109 cm; light olive brown (2.5Y 5/4) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/8) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and very plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct gray (2.5Y 6/1) iron depletions; common fine to medium prominent yellowish brown (10YR 5/6) iron (Fe^{3+}) masses; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; slight effervescence

C – 109 to 152 cm; olive brown (2.5Y 4/4) clay loam (38% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; many fine to medium distinct gray (2.5Y 5/1) iron depletions; finely disseminated carbonates; very slight effervescence

Site: R13ND-021-MM3 4-1

Described by: Brandon L. Montgomery

Date: 05-21-14

A – 0 to 13 cm; very dark brown (10YR 2/2) loam (22% clay), very dark grayish brown (10YR 3/2) dry; weak fine to medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence; 2 cm duff layer, A feels compacted

Bw1 –13 to 25 cm; brown (10YR 4/3) loam (26% clay), dark brown (10YR 3/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; no effervescence; Has a very weak E horizon look to it

Bw2 – 25 to 40 cm; light olive brown (2.5Y 5/3) loam (24% clay), light olive brown (2.5Y 5/3) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; few faint olive brown (2.5Y 4/3) clay films on all ped faces; no effervescence

Bk – 40 to 69 cm; pale brown (2.5Y 7/3) clay loam (28% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, firm, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium prominent white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 69 to 88 cm; light yellowish brown (2.5Y 6/3) clay loam (34% clay), light gray (2.5Y 7/2) dry; few fine prominent yellowish red (5YR 5/6) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 88 to 107 cm; light olive brown (2.5Y 5/4) clay loam (38% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish red (5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; slight effervescence

C2 – 107 to 152 cm; light olive brown (2.5Y 5/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine to medium distinct white (2.5Y 8/1) gypsum crystal clusters; finely disseminated carbonates; slight effervescence

Site: R13ND-021-MM3 4-2

Described by: Brandon L. Montgomery

Date: 05-21-14

A – 0 to 13 cm; very dark brown (10YR 2/2) loam (23% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt –13 to 32 cm; olive brown (2.5Y 4/3) clay loam (35% clay), olive brown (2.5Y 4/3) dry; moderate fine to medium prismatic structure; slightly hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many distinct continuous dark olive brown (2.5Y 3/3) clay films on all ped faces; no effervescence

Bk1 – 32 to 44 cm; light yellowish brown (2.5Y 6/3) clay loam (30% clay), light gray (2.5Y 7/2) dry; strong fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common faint discontinuous light yellowish brown (2.5Y 6/3) clay films on all ped faces; finely disseminated carbonates; strong effervescence

Bk2 – 44 to 65 cm; pale brown (2.5Y 7/3) clay loam (29% clay), pale brown (2.5Y 8/2) dry; moderate fine to medium prismatic structure; slightly hard, firm, very sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 65 to 84 cm; olive brown (2.5Y 4/4) clay loam (33% clay), pale brown (2.5Y 7/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 84 to 110 cm; olive brown (2.5Y 4/4) clay loam (34% clay), pale brown (2.5Y 7/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence; Gravel layer from 100-103 cm

C2 – 110 to 152 cm; light olive brown (2.5Y 5/4) clay loam (36% clay), light gray (2.5Y 7/2) dry; few fine prominent brownish yellow (10YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; common fine distinct pale brown (2.5Y 8/2) gypsum crystal clusters; finely disseminated carbonates; strong effervescence; Gypsum only from 117 cm down

Site: R13ND-021-MM3 4-3

Described by: Brandon L. Montgomery

Date: 05-21-14

A – 0 to 16 cm; very dark brown (10YR 2/2) loam (18% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt1 –16 to 35 cm; very dark grayish brown (2.5Y 3/2) clay loam (38% clay), very dark grayish brown (2.5Y 3/2) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common prominent discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; no effervescence; Very thin E like horizon from 15-18 cm

Bt2 – 35 to 49 cm; olive brown (2.5Y 4/3) clay loam (34% clay), ____________ (2.5Y ___) dry; moderate fine to medium prismatic structure parting to moderate fine to medium subangular blocky; hard, friable, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark grayish brown (10YR 3/2) organic stains on vertical ped faces; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; common fine distinct pale brown (2.5Y 8/2) silica masses; no effervescence

Bk1 – 49 to 67 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; slightly hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

Bk2 – 67 to 84 cm; light olive brown (2.5Y 5/4) clay loam (34% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; hard, friable, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 84 to 105 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; finely disseminated carbonates; very slight effervescence

C2 – 105 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; few fine to medium distinct pale brown (2.5Y 8/2) gypsum crystal clusters; very slight effervescence

Site: R13ND-021-MM3 4-4

Described by: Brandon L. Montgomery

Date: 05-21-14

A – 0 to 12 cm; very dark gray (10YR 3/1) loam (20% clay), dark gray (10YR 4/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bt –12 to 33 cm; very dark grayish brown (2.5Y 3/2) clay (41% clay), very dark grayish brown (2.5Y 3/2) dry; strong fine to medium prismatic structure; very hard, firm, moderately sticky and moderately plastic; common very fine to fine roots; many very fine to fine pores; many faint continuous very dark grayish brown (2.5Y 3/2) clay films on all ped faces; no effervescence

Bk1 – 33 to 51 cm; olive brown (2.5Y 4/3) clay loam (32% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky and moderately plastic; few very fine to fine roots; many very fine to fine pores; common distinct discontinuous very dark brown (2.5Y 2/2) organic stains on vertical ped faces; common faint discontinuous olive brown (2.5Y 4/3) clay films on all ped faces; many fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; no effervescence

Bk2 – 51 to 72 cm; light olive brown (2.5Y 5/4) clay loam (29% clay), light gray (2.5Y 7/2) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

BCk – 72 to 83 cm; light olive brown (2.5Y 5/4) clay loam (33% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; strong effervescence

C1 – 83 to 99 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; few fine distinct pale brown (2.5Y 8/2) carbonate masses; finely disseminated carbonates; very slight effervescence

C2 – 99 to 152 cm; olive brown (2.5Y 4/4) clay loam (36% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent reddish yellow (7.5YR 6/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 6/1) iron depletions; common fine to medium distinct pale brown (2.5Y 8/2) gypsum crystal clusters; finely disseminated carbonates; very slight effervescence

Site: R13ND-021-MM3 4-5

Described by: Brandon L. Montgomery

Date: 05-21-14

A – 0 to 12 cm; black (10YR 2/1) loam (22% clay), very dark gray (10YR 3/1) dry; weak fine to medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine to fine roots; few very fine to fine pores; no effervescence

Bw –12 to 24 cm; very dark grayish brown (10YR 3/2) clay loam (24% clay), very dark grayish brown (10YR 3/2) dry; weak fine to medium prismatic structure; slightly hard, friable, slightly sticky and moderately plastic; many very fine to fine roots; many very fine to fine pores; no effervescence

Bt – 24 to 42 cm; olive brown (2.5Y 4/3) clay loam (38% clay), olive brown (2.5Y 4/3) dry; strong fine to medium prismatic structure; very hard, very firm, moderately sticky and very plastic; common very fine to fine roots; many very fine to fine pores; common faint discontinuous very dark brown (10YR 2/2) organic stains on vertical ped faces; many faint continuous very dark grayish brown (10YR 3/2) clay films on all ped faces; no effervescence

Bk – 42 to 64 cm; light olive brown (2.5Y 5/3) clay loam (29% clay), light gray (2.5Y 7/2) dry; moderate fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; many fine to medium distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

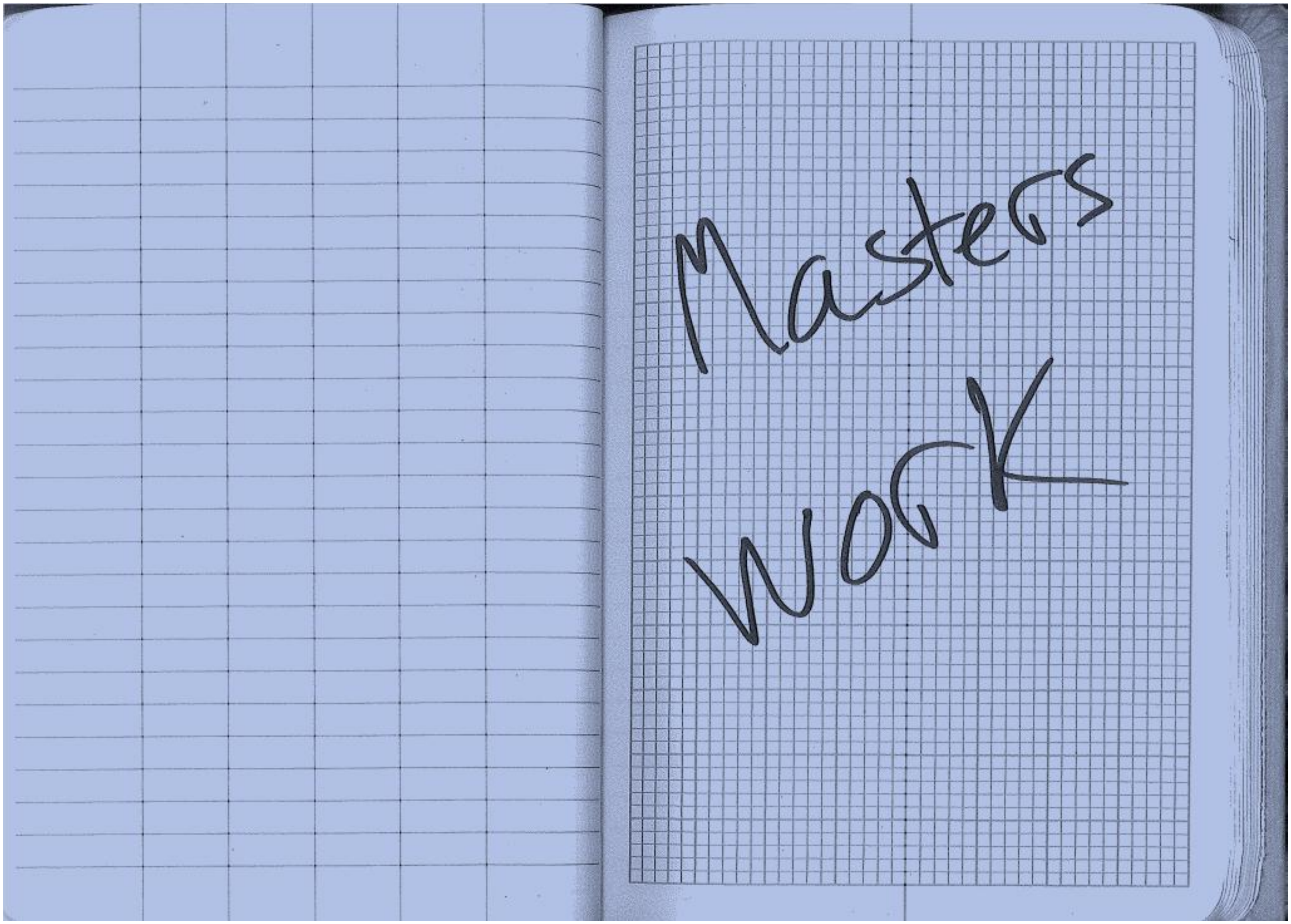
Bk2 – 64 to 76 cm; light olive brown (2.5Y 5/4) clay loam (30% clay), pale brown (2.5Y 7/3) dry; weak fine to medium prismatic structure; hard, firm, moderately sticky, and moderately plastic; few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; violent effervescence

C1 – 76 to 95 cm; olive brown (2.5Y 4/4) clay loam (35% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish brown (10YR 5/8) mottles; massive; hard, firm, moderately sticky, and moderately plastic; very few very fine to fine roots; many very fine to fine pores; common fine distinct white (2.5Y 8/1) carbonate masses; finely disseminated carbonates; strong effervescence

C2 – 95 to 112 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent yellowish brown (10YR 5/8) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 5/1) iron depletions; common fine to medium distinct pale brown (2.5Y 8/2) gypsum crystal clusters; finely disseminated carbonates; very slight effervescence

C3 – 112 to 152 cm; olive brown (2.5Y 4/4) clay loam (37% clay), light yellowish brown (2.5Y 6/3) dry; few fine prominent strong brown (7.5YR 5/6) mottles; massive; hard, firm, moderately sticky and moderately plastic; many very fine to fine pores; few fine distinct gray (2.5Y 5/1) iron depletions; few fine distinct pale brown (2.5Y 8/2) gypsum crystal clusters; slight effervescence

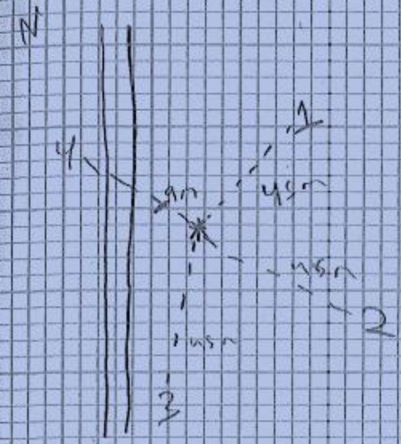
APPENDIX C. NOTES TAKEN DURING FIELD DESCRIPTIONS OF PEDONS


Masters
work

R12ND-017-MM1
Cass County T139N R54W Sec 7
SW corner 115.6' N 60' E

Arrived at site around 12pm 11/14/12
Marked site 115.6' N and 66ft E of SW corner of Section 7 T139N R54W. The east marking is 66' from center of road as exact measuring location in old days unknown center of road or edge. Field is a harvested Soybean field approx 3/4 of a mile South of I94. Parent material is Glacial till most likely late Mankato. The site is located on a 120M long slope, 65m from the bottom, 55m from the top. The slope aspect is 45°. Tillage practices are evident on the field. Few cobbles and stones present on the surface. The surface is moist from recent snowfall that has melted, but is drying out. Frost is evident in upper 2-3in.
Transect 1 faces 45° transect 2 135°
Transect 3 faces 190°, transect 4 315°
Transect 3 is not on typical aspect due to road disturbance.

Transect 4 only has 1 point due to Road. Possible ditch effect on center point and transect 3. Definite ditch effect on Transect 4.



Transect 4 not sampled on 11/14/12 due to ditch and no one call. resample when pit is dug. Flag left in site

Tube used for cores had spacer ring

Located on a 4% slope.
Temp is 36°F, wind speed 5mph from the SW.

Located at location of Redmond 1998 B26 site

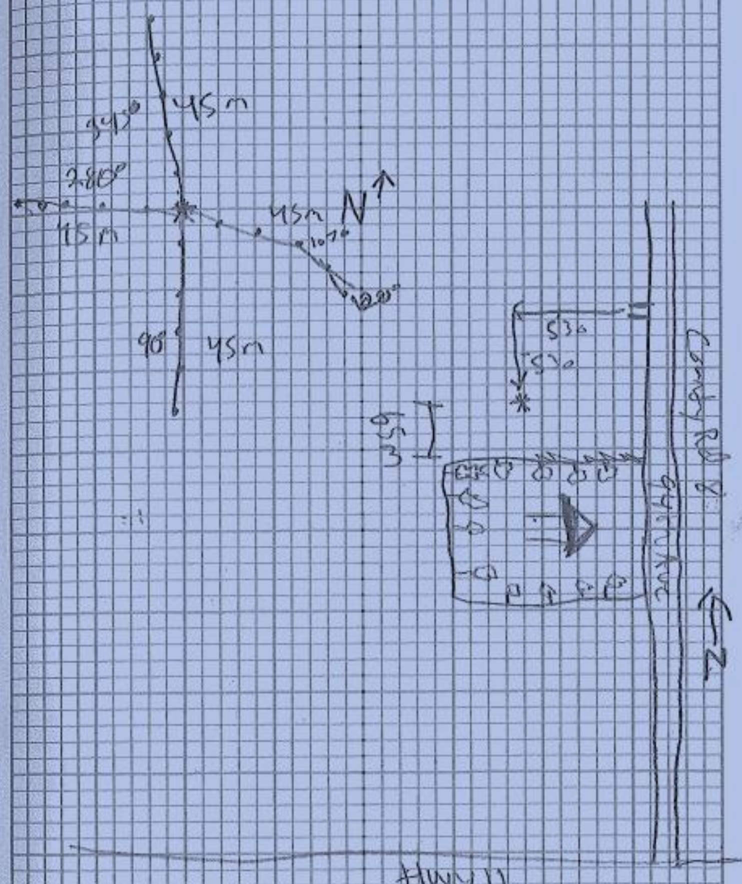
Sampled with Rodney Wolter

R12 ND-021-MM1
at site of SS8ND-021-001
SE 1/4 sec
located 530' W + 530' S of E 1/4 corner
located on 80m long backslope
45m from summit, 3% slope

Arrived at site at 11:15 11/21/12
Temp 54°F wind 5mph SSE
Sunny

The site was marked from the middle of the road, W first then S. Slope aspect is 345°. All transects are measured 45m from center. The surface is covered 75% with corn stubble, there was a deep rip practice on the field approx 2 weeks prior to sampling, it was also rolled. Shelter belt is located 65 m to the S.
Transect 1 faces 345°, transect 2 points 1, 2, and 3 are 105° from center, 4-112° from center + 5-120° from center. After point 3 the transect turns to 158°. Transect 3 faces 190° from center, Transect 4 faces 288° from center.

Surface is dry, frost very weakly evident in upper 10".



Sampled with Rodney Wider

RI3ND-091-MMI

Marked 270'N + 75ft east of SW corner. Did not match slope + aspect of original description. Site location moved based off description + clues an Dr Hopkins input new location is 344ft N of section + 111 ft east of section line.

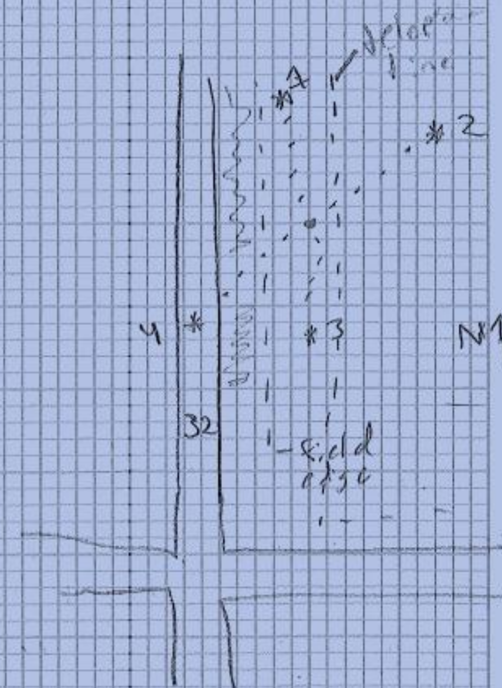
located at site of S53ND-091-001 Model Barnes

also site of Redmond B3A

The site was marked from the middle of the road on the section line. All transects measured 45m from center. Transect 4 only sampled at one location 6m from center pit as roadway is infringing. Transect 2 point 1 sampled at 10m due to presence of buried telephone cable. Cord 32 is 110ft to the west. unnamed road 394ft south of pit. telephone line is 15ft east of pit + runs N/S. Transect 1 - 358° from center, Transect 2 - 45° from center, transect 3 - 180° from center transect 4 - 235° from center

Pit 24ft East of edge of field.

Transects taken by Rodney Witter.

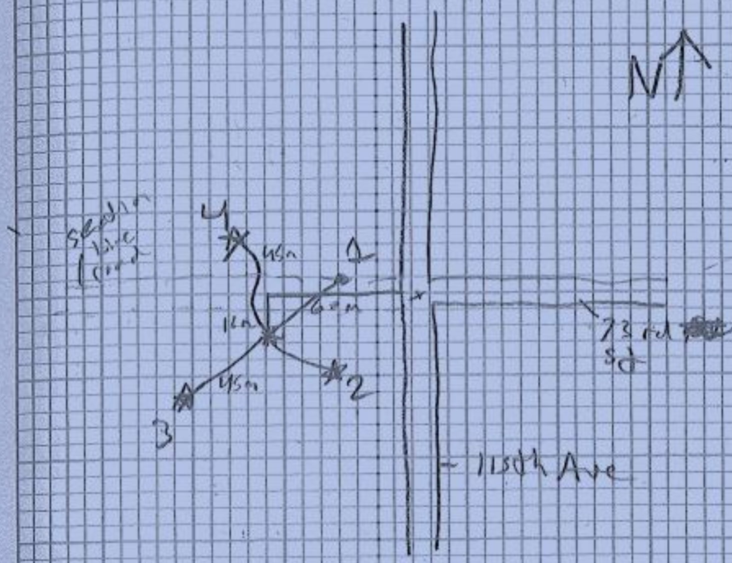


R13ND-099-MM1

Marked 60m/195ft West and 16m/52ft S of NE corner. 3% slope to the SW. located at the site of Redmond B5A and S59-SO-1, Site was marked from the Corner of the section. All transects were marked 45m from the central pit, located on a slope with a length of 90 m. located 20 m from summit.

Transect 1 is upslope at 60°. point 3. ~~[illegible]~~ was not sampled due to section line road. Transect 2 is across slope at SE 135°. Transect 3 is downslope at SW 225°. Transect 4 is across slope at 345°, point 2 is on section line road, was sampled, points 4 and 5 are in neighbors field and were ~~[illegible]~~ sampled.

Transects taken by Rodney [illegible]
Pit described with NRCS personell,
Dr. Hopkins, Brandon Montgomery, Alan, Lance, Sukhbinder, Dr. Boyraz.



R13ND-099-MM2
8-22-13

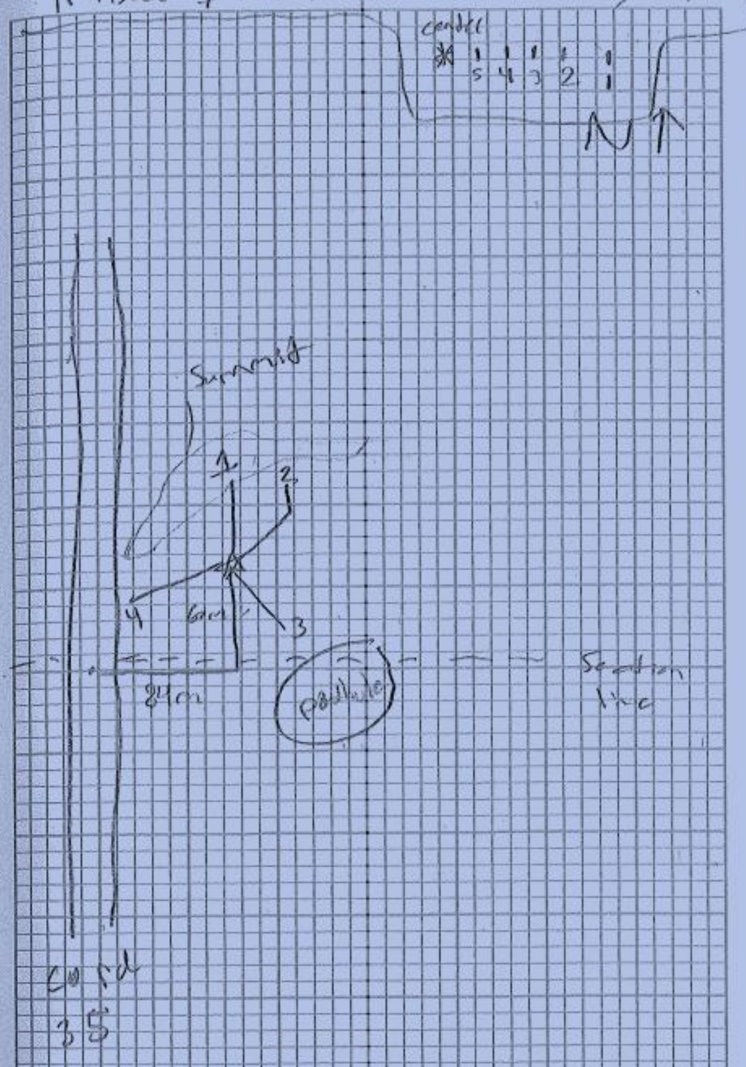
located at the side of pedmond B5B and S59-50-2. Site located 84m east and 60m north of section line. Marked from corner of section, middle of road. All transects marked 45 m from center pit. Slope is 100m long aspect to the NNE, 345°. Site is located 45 m from summit. Site was planted to soybeans during sampling. owner larry granted permission to sample cropped field on 8-21-13. Needs results slope is 4° aspect N

Transect 1 is upslope 0°, N.
Transect 2 is across slope 45° then 10°
Transect 3 is down slope SSE, 150°
Transect 4 is across slope 240°

Transects taken by Rodney Utter
pit done with NRCS personnel, Alan Dr Hopkins, Brandon Montgomery, Sukhwinder Dr Boyruz

Field is [illegible] to glyphosate maps.

Transect 1 was labeled backwards 1=5, 5=1

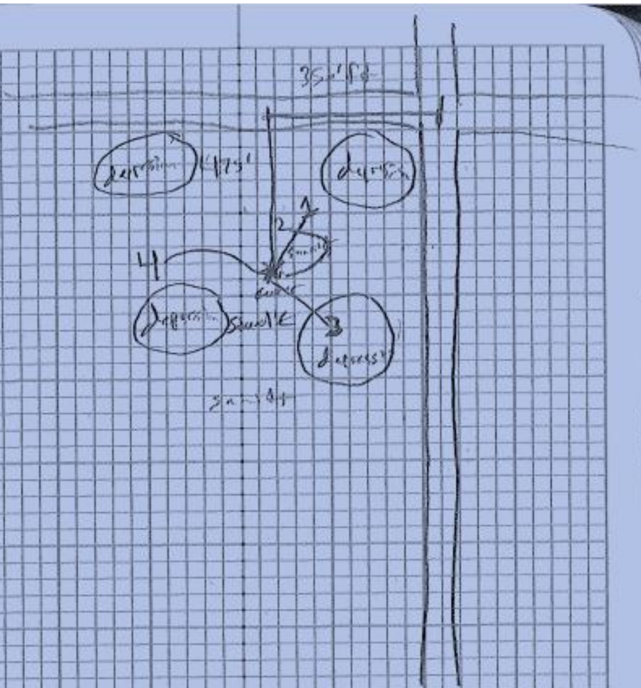


RI3ND-021-MM2
182N 62W Sec 31 350'W+475'E of NE corner
At side of S60ND-11-05, sampled
on 9-12-13 with Rodney utter. Transects
only. Sunny 70° 5mph NW.

Site is located in CRP that was planted in
2009. located on a 2% slope to the SE,
3/4 of the way up the slope. approx 13 m from
summit. 55m to depression low. Transects are all
45m from center. Slope length ~ 72m

Transect 1 upslope 20° from center
Transect 2 across slope 75° from center but bends
Transect 3 downslope 135° from center
Transect 4 across slope 250° but follows slope

Transect 2 starts at 75° but follows hilltop
around, based on the slope position. due to the
proximity to the hilltop curve is very sharp
and ends up ending right by transect 1
point 3. See drawing for better description

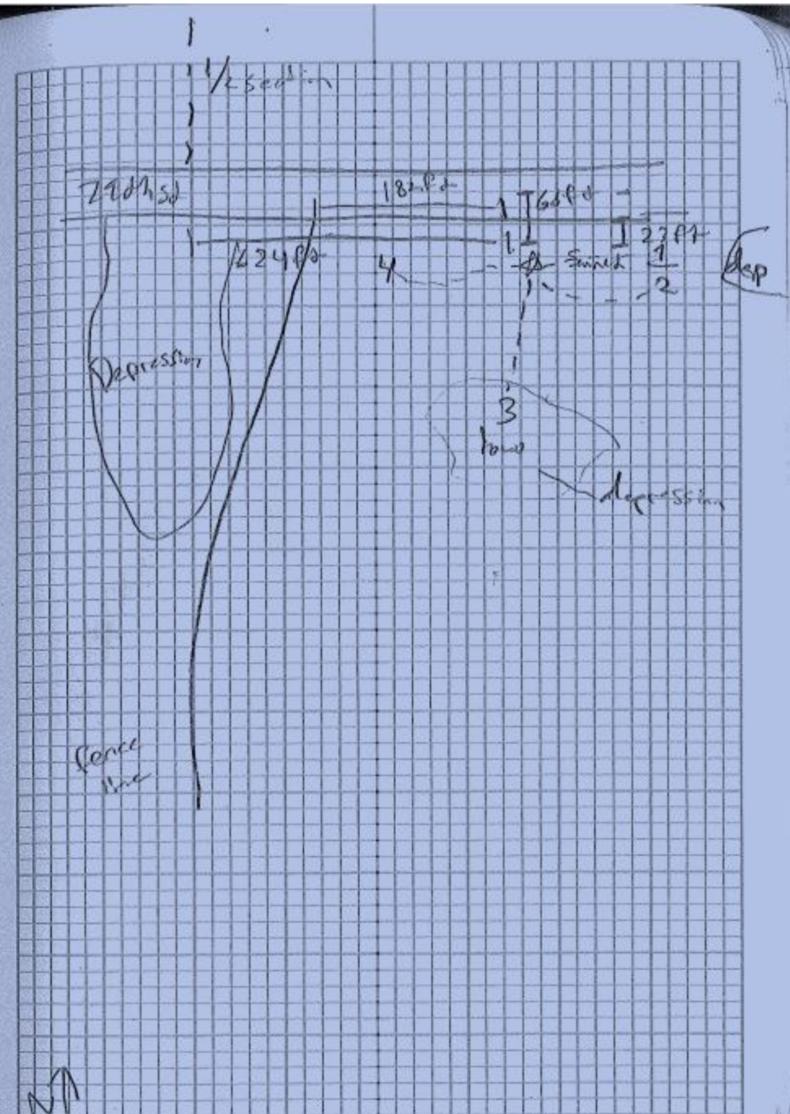


R13ND-021-MM3
at site of S60ND-011-07
Site is located 624 ft East of 1/2 Section
line of 132N 63W Sec 7, or approx 0.6 miles
east of NW corner. Site is located on slope
450 ft long ending in a slough to the SW. The
Site is on flat spot 45 ft from the crest,
the fence line on the west of the pasture is
not the 1/2 section line, from the corner however
site is 182 ft East and 23 ft S of fence. This
is 66 ft S of Road center

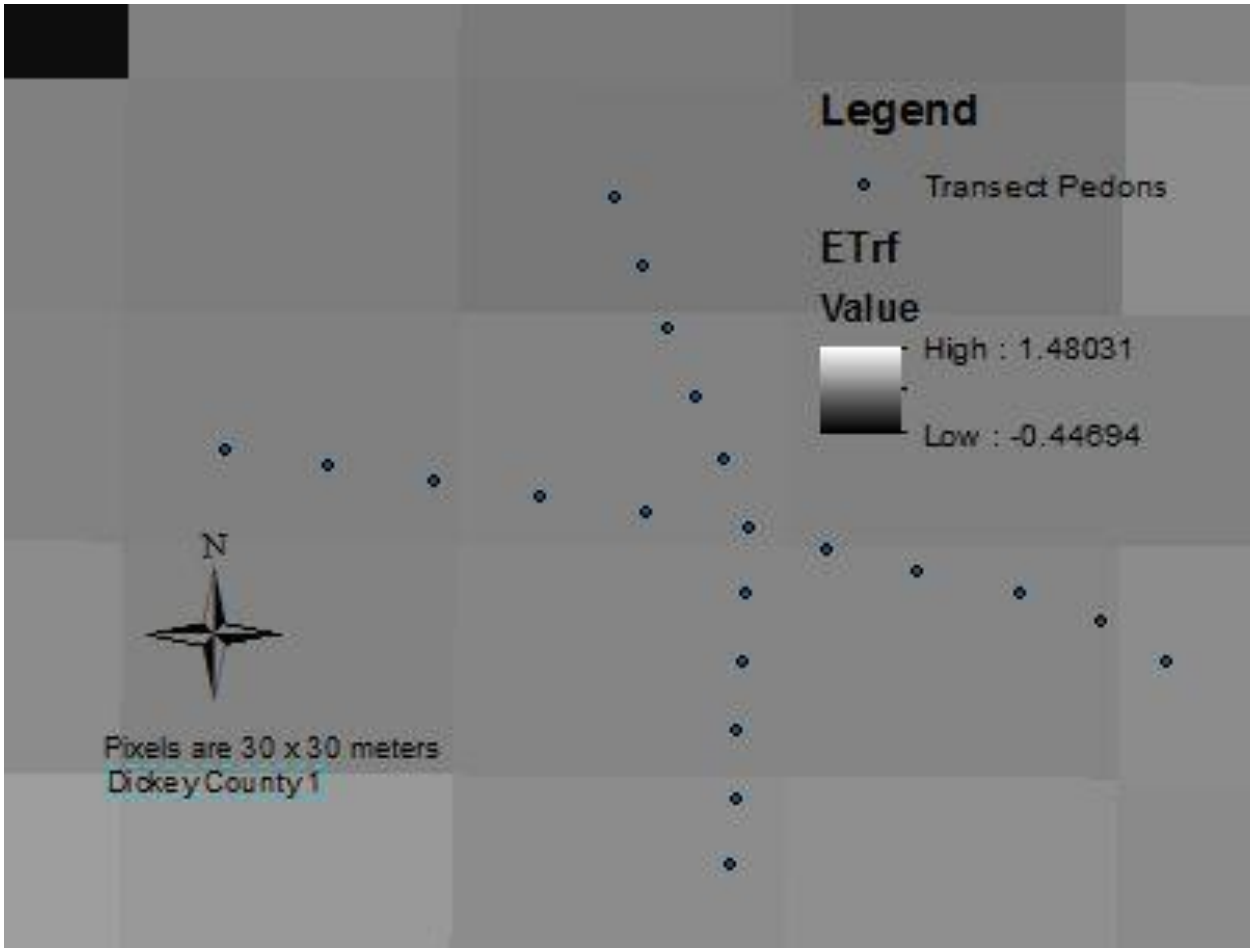
Sampled 9-12-13 by BLM and Rodney Udder.
78° Sunny No wind.

Transect 1 is upslope 75
Transect 2 is across slope 135-90-90-45-45
Transect 3 is down slope 185
Transect 4 is across slope 245-245-260-270-290

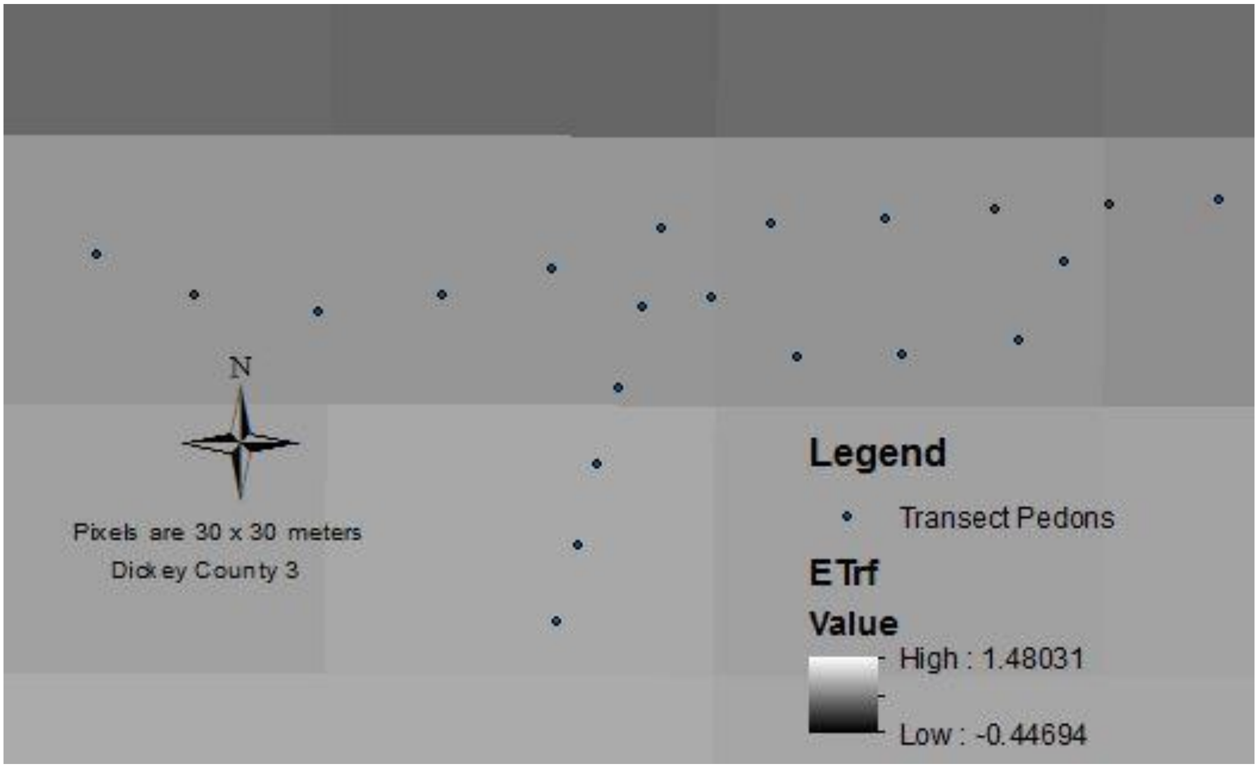
Site location was picked based off description of
S60-11-07 due to lack of accuracy in measurement
originally.



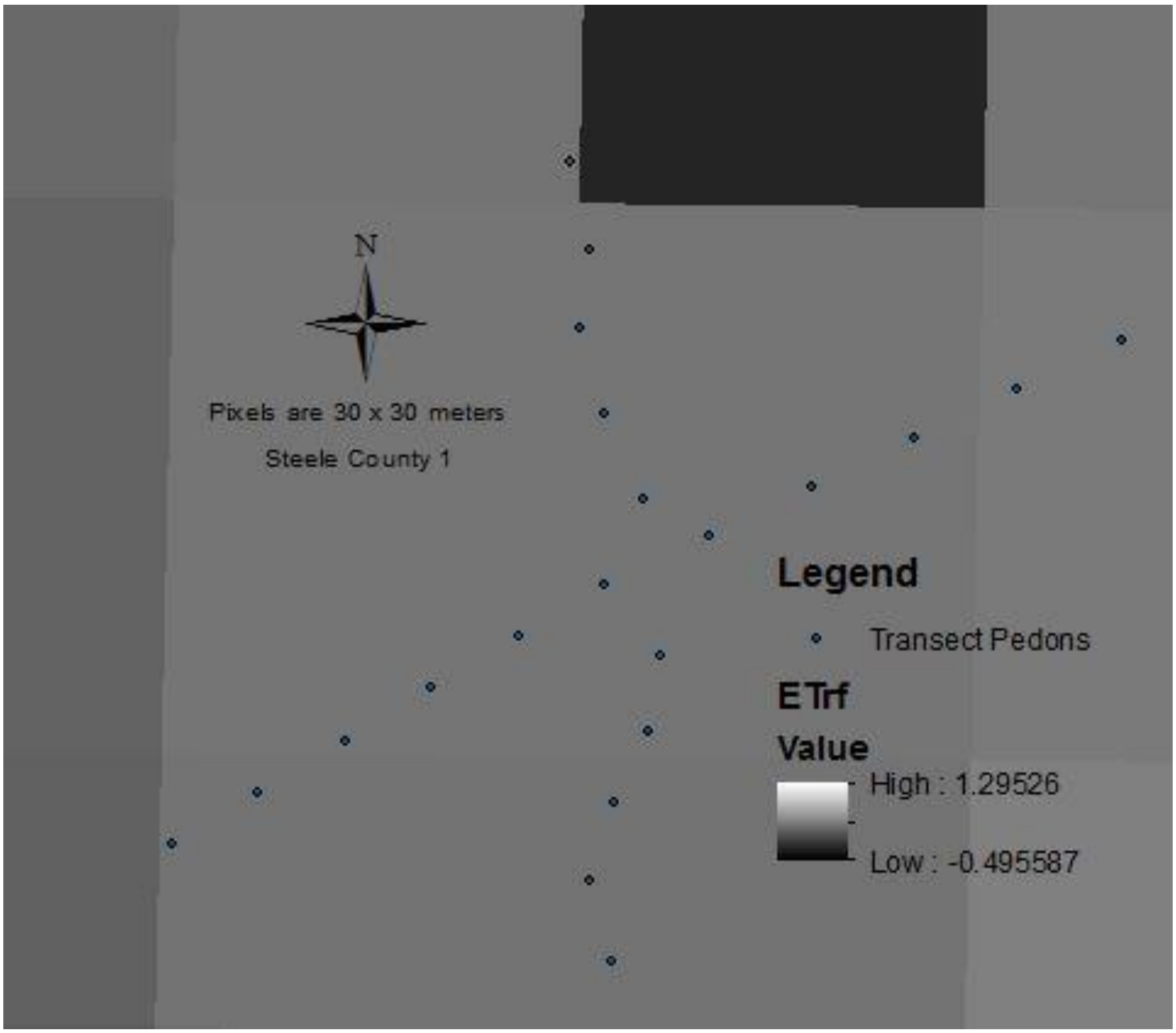
APPENDIX D. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR DICKEY COUNTY 1



APPENDIX E. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR DICKEY COUNTY 3

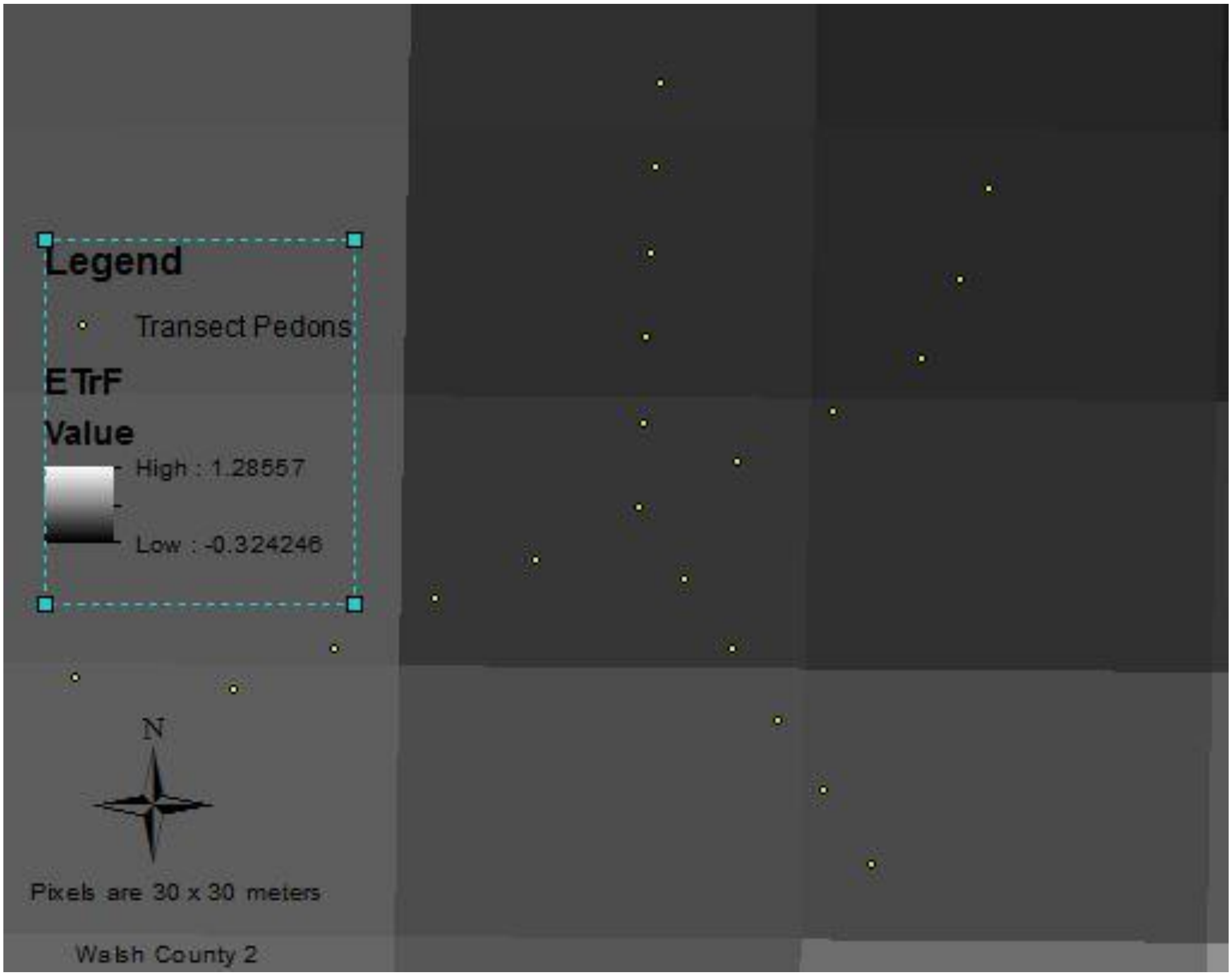


APPENDIX F. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR STEELE COUNTY



APPENDIX G. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR WALSH COUNTY 1

APPENIDIX H. MAP DISPLAYING TRANSECT PEDON LOCATIONS AND EVAPOTRANSPIRATION MAP FOR WALSH COUNTY 2



APPENDIX I. GPS LOCATIONS FOR CASS COUNTY PEDONS

Site	Transect	Point	Latitude	Longitude
Cass County	Center	1	46°51'52.62"N	97°33'20.13"W
Cass County	1	1	46°51'52.86"N	97°33'19.94"W
Cass County	1	2	46°51'53.11"N	97°33'19.75"W
Cass County	1	3	46°51'53.35"N	97°33'19.56"W
Cass County	1	4	46°51'53.60"N	97°33'19.37"W
Cass County	1	5	46°51'53.84"N	97°33'19.18"W
Cass County	2	1	46°51'52.44"N	97°33'19.81"W
Cass County	2	2	46°51'52.25"N	97°33'19.49"W
Cass County	2	3	46°51'52.07"N	97°33'19.18"W
Cass County	2	4	46°51'51.88"N	97°33'18.86"W
Cass County	2	5	46°51'51.70"N	97°33'18.54"W
Cass County	3	1	46°51'52.33"N	97°33'20.16"W
Cass County	3	2	46°51'52.04"N	97°33'20.19"W
Cass County	3	3	46°51'51.74"N	97°33'20.22"W
Cass County	3	4	46°51'51.45"N	97°33'20.25"W
Cass County	3	5	46°51'51.16"N	97°33'20.28"W
Cass County	4	1	46°51'52.80"N	97°33'20.49"W
Cass County	4	2	46°51'52.98"N	97°33'20.86"W
Cass County	4	3	46°51'53.17"N	97°33'21.22"W
Cass County	4	4	46°51'53.35"N	97°33'21.59"W
Cass County	4	5	46°51'53.53"N	97°33'21.95"W

APPENDIX J. GPS LOCATIONS FOR DICKEY COUNTY 1 PEDONS

Site	Transect	Point	Latitude	Longitude
Dickey County 1	Center	1	46° 0'53.11"N	98°25'30.01"W
Dickey County 1	1	1	46° 0'53.39"N	98°25'30.12"W
Dickey County 1	1	2	46° 0'53.66"N	98°25'30.23"W
Dickey County 1	1	3	46° 0'53.94"N	98°25'30.35"W
Dickey County 1	1	4	46° 0'54.21"N	98°25'30.46"W
Dickey County 1	1	5	46° 0'54.49"N	98°25'30.57"W
Dickey County 1	2	1	46° 0'53.02"N	98°25'29.68"W
Dickey County 1	2	2	46° 0'52.93"N	98°25'29.31"W
Dickey County 1	2	3	46° 0'52.83"N	98°25'28.88"W
Dickey County 1	2	4	46° 0'52.72"N	98°25'28.54"W
Dickey County 1	2	5	46° 0'52.55"N	98°25'28.26"W
Dickey County 1	3	1	46° 0'52.83"N	98°25'30.03"W
Dickey County 1	3	2	46° 0'52.54"N	98°25'30.04"W
Dickey County 1	3	3	46° 0'52.26"N	98°25'30.06"W
Dickey County 1	3	4	46° 0'51.97"N	98°25'30.07"W
Dickey County 1	3	5	46° 0'51.69"N	98°25'30.09"W
Dickey County 1	4	1	46° 0'53.17"N	98°25'30.45"W
Dickey County 1	4	2	46° 0'53.24"N	98°25'30.89"W
Dickey County 1	4	3	46° 0'53.30"N	98°25'31.33"W
Dickey County 1	4	4	46° 0'53.37"N	98°25'31.77"W
Dickey County 1	4	5	46° 0'53.43"N	98°25'32.21"W

APPENDIX K. GPS LOCATIONS FOR DICKEY COUNTY 2 PEDONS

Site	Transect	Point	Latitude	Longitude
Dickey County 2	Center	1	46°12'40.61"N	98°29'1.83"W
Dickey County 2	1	1	46°12'40.88"N	98°29'1.66"W
Dickey County 2	1	2	46°12'41.16"N	98°29'1.49"W
Dickey County 2	1	3	46°12'41.43"N	98°29'1.32"W
Dickey County 2	1	4	46°12'41.71"N	98°29'1.15"W
Dickey County 2	1	5	46°12'41.98"N	98°29'0.98"W
Dickey County 2	2	1	46°12'40.60"N	98°29'1.41"W
Dickey County 2	2	2	46°12'40.76"N	98°29'1.06"W
Dickey County 2	2	3	46°12'40.99"N	98°29'0.88"W
Dickey County 2	2	4	46°12'41.27"N	98°29'1.02"W
Dickey County 2	2	5	46°12'41.40"N	98°29'1.40"W
Dickey County 2	3	1	46°12'40.38"N	98°29'1.53"W
Dickey County 2	3	2	46°12'40.15"N	98°29'1.23"W
Dickey County 2	3	3	46°12'39.93"N	98°29'0.92"W
Dickey County 2	3	4	46°12'39.70"N	98°29'0.62"W
Dickey County 2	3	5	46°12'39.47"N	98°29'0.32"W
Dickey County 2	4	1	46°12'40.78"N	98°29'2.20"W
Dickey County 2	4	2	46°12'40.93"N	98°29'2.52"W
Dickey County 2	4	3	46°12'41.01"N	98°29'2.92"W
Dickey County 2	4	4	46°12'40.99"N	98°29'3.33"W
Dickey County 2	4	5	46°12'40.94"N	98°29'3.70"W

APPENDIX L. GPS LOCATIONS FOR DICKEY COUNTY 3 PEDONS

Site	Transect	Point	Latitude	Longitude
Dickey County 3	Center	1	46°16'17.08"N	98°37'5.43"W
Dickey County 3	1	1	46°16'17.10"N	98°37'5.03"W
Dickey County 3	1	2	46°16'17.12"N	98°37'4.62"W
Dickey County 3	1	3	46°16'17.15"N	98°37'4.22"W
Dickey County 3	1	4	46°16'17.17"N	98°37'3.81"W
Dickey County 3	1	5	46°16'17.19"N	98°37'3.41"W
Dickey County 3	2	1	46°16'16.83"N	98°37'5.25"W
Dickey County 3	2	2	46°16'16.62"N	98°37'4.94"W
Dickey County 3	2	3	46°16'16.63"N	98°37'4.56"W
Dickey County 3	2	4	46°16'16.68"N	98°37'4.14"W
Dickey County 3	2	5	46°16'16.96"N	98°37'3.97"W
Dickey County 3	3	1	46°16'16.80"N	98°37'5.50"W
Dickey County 3	3	2	46°16'16.51"N	98°37'5.58"W
Dickey County 3	3	3	46°16'16.23"N	98°37'5.66"W
Dickey County 3	3	4	46°16'15.94"N	98°37'5.73"W
Dickey County 3	3	5	46°16'15.66"N	98°37'5.81"W
Dickey County 3	4	1	46°16'16.94"N	98°37'5.82"W
Dickey County 3	4	2	46°16'16.84"N	98°37'6.22"W
Dickey County 3	4	3	46°16'16.78"N	98°37'6.67"W
Dickey County 3	4	4	46°16'16.84"N	98°37'7.11"W
Dickey County 3	4	5	46°16'16.99"N	98°37'7.47"W

APPENDIX M. GPS LOCATIONS FOR STEELE COUNTY PEDONS

Site	Transect	Point	Latitude	Longitude
Steele County	Center	1	47°15'20.74"N	97°47'27.51"W
Steele County	1	1	47°15'21.04"N	97°47'27.37"W
Steele County	1	2	47°15'21.34"N	97°47'27.51"W
Steele County	1	3	47°15'21.64"N	97°47'27.59"W
Steele County	1	4	47°15'21.92"N	97°47'27.56"W
Steele County	1	5	47°15'22.23"N	97°47'27.63"W
Steele County	2	1	47°15'20.91"N	97°47'27.14"W
Steele County	2	2	47°15'21.08"N	97°47'26.78"W
Steele County	2	3	47°15'21.26"N	97°47'26.41"W
Steele County	2	4	47°15'21.43"N	97°47'26.05"W
Steele County	2	5	47°15'21.60"N	97°47'25.68"W
Steele County	3	1	47°15'20.49"N	97°47'27.31"W
Steele County	3	2	47°15'20.22"N	97°47'27.35"W
Steele County	3	3	47°15'19.97"N	97°47'27.47"W
Steele County	3	4	47°15'19.70"N	97°47'27.56"W
Steele County	3	5	47°15'19.41"N	97°47'27.48"W
Steele County	4	1	47°15'20.56"N	97°47'27.81"W
Steele County	4	2	47°15'20.38"N	97°47'28.12"W
Steele County	4	3	47°15'20.19"N	97°47'28.42"W
Steele County	4	4	47°15'20.01"N	97°47'28.73"W
Steele County	4	5	47°15'19.83"N	97°47'29.03"W

APPENDIX N. GPS LOCATIONS FOR WALSH COUNTY 1 PEDONS

Site	Transect	Point	Latitude	Longitude
Walsh County 1	Center	1	48°28'14.64"N	98°10'1.44"W
Walsh County 1	1	1	48°28'14.81"N	98°10'1.06"W
Walsh County 1	1	2	48°28'14.99"N	98°10'0.68"W
Walsh County 1	1	3	48°28'15.17"N	98°10'0.31"W
Walsh County 1	1	4	48°28'15.34"N	98° 9'59.93"W
Walsh County 1	1	5	48°28'15.52"N	98° 9'59.55"W
Walsh County 1	2	1	48°28'14.41"N	98°10'1.08"W
Walsh County 1	2	2	48°28'14.17"N	98°10'0.85"W
Walsh County 1	2	3	48°28'13.97"N	98°10'0.53"W
Walsh County 1	2	4	48°28'13.81"N	98°10'0.18"W
Walsh County 1	2	5	48°28'13.54"N	98° 9'59.97"W
Walsh County 1	3	1	48°28'14.46"N	98°10'1.72"W
Walsh County 1	3	2	48°28'14.27"N	98°10'1.99"W
Walsh County 1	3	3	48°28'14.09"N	98°10'2.27"W
Walsh County 1	3	4	48°28'13.90"N	98°10'2.54"W
Walsh County 1	3	5	48°28'13.72"N	98°10'2.82"W
Walsh County 1	4	1	48°28'14.92"N	98°10'1.58"W
Walsh County 1	4	2	48°28'15.15"N	98°10'1.84"W
Walsh County 1	4	3	48°28'15.37"N	98°10'1.69"W
Walsh County 1	4	4	48°28'15.65"N	98°10'1.76"W
Walsh County 1	4	5	48°28'15.95"N	98°10'2.16"W

APPENDIX O. GPS LOCATIONS FOR WALSH COUNTY 2 PEDONS

Site	Transect	Point	Latitude	Longitude
Walsh County 2	Center	1	48°23'4.22"N	98° 7'17.88"W
Walsh County 2	1	1	48°23'4.52"N	98° 7'17.86"W
Walsh County 2	1	2	48°23'4.83"N	98° 7'17.85"W
Walsh County 2	1	3	48°23'5.13"N	98° 7'17.83"W
Walsh County 2	1	4	48°23'5.44"N	98° 7'17.82"W
Walsh County 2	1	5	48°23'5.74"N	98° 7'17.80"W
Walsh County 2	2	1	48°23'4.38"N	98° 7'17.52"W
Walsh County 2	2	2	48°23'4.56"N	98° 7'17.18"W
Walsh County 2	2	3	48°23'4.75"N	98° 7'16.86"W
Walsh County 2	2	4	48°23'5.04"N	98° 7'16.72"W
Walsh County 2	2	5	48°23'5.36"N	98° 7'16.62"W
Walsh County 2	3	1	48°23'3.96"N	98° 7'17.71"W
Walsh County 2	3	2	48°23'3.71"N	98° 7'17.54"W
Walsh County 2	3	3	48°23'3.45"N	98° 7'17.38"W
Walsh County 2	3	4	48°23'3.20"N	98° 7'17.21"W
Walsh County 2	3	5	48°23'2.94"N	98° 7'17.04"W
Walsh County 2	4	1	48°23'4.03"N	98° 7'18.25"W
Walsh County 2	4	2	48°23'3.89"N	98° 7'18.61"W
Walsh County 2	4	3	48°23'3.71"N	98° 7'18.97"W
Walsh County 2	4	4	48°23'3.56"N	98° 7'19.33"W
Walsh County 2	4	5	48°23'3.61"N	98° 7'19.90"W

APPENDIX P. TABLE CORRELATING SAMPLE ID TO SITE, PEDON, HORIZON, AND HORIZON UPPER AND LOWER DEPTHS

ID	Site	Pedon	Horizon	Top Depth	Bottom Depth
1	S58ND-021-001	Historic	A1	0	5
2	S58ND-021-001	Historic	A2	5	13
3	S58ND-021-001	Historic	Bw1	13	23
4	S58ND-021-001	Historic	Bw2	23	36
5	S58ND-021-001	Historic	Bk1	36	43
6	S58ND-021-001	Historic	Bk2	43	61
7	S58ND-021-001	Historic	Bk3	61	76
8	S58ND-021-001	Historic	BCk	76	117
9	S58ND-021-001	Historic	C	117	152
10	S53ND-091-001	Historic	A1P	0	15
11	S53ND-091-001	Historic	B2	15	30
12	S53ND-091-001	Historic	CCA1	30	53
13	S53ND-091-001	Historic	CCA2	53	91
14	S53ND-091-001	Historic	C1	91	104
15	S53ND-091-001	Historic	C2	104	127
16	S53ND-091-001	Historic	C3	127	152
17	S59ND-50-1	Historic	Ap	0	13
18	S59ND-50-1	Historic	B21	13	30
19	S59ND-50-1	Historic	B22	30	43
20	S59ND-50-1	Historic	Cca	43	74
21	S59ND-50-1	Historic	C2	74	94
22	S59ND-50-1	Historic	C3	94	130
23	S59ND-50-1	Historic	C4cs	130	152
24	S59ND-50-2	Historic	Ap	0	13
25	S59ND-50-2	Historic	B21	13	28
26	S59ND-50-2	Historic	B22	28	38
27	S59ND-50-2	Historic	Cca	38	69
28	S59ND-50-2	Historic	C2	69	84
29	S59ND-50-2	Historic	C3	84	117
30	S59ND-50-2	Historic	C4	117	152
31	R12ND-017-MM1	Current	Ap	0	14
32	R12ND-017-MM1	Current	Bk1	14	33
33	R12ND-017-MM1	Current	Bk2	33	59
34	R12ND-017-MM1	Current	C	59	+
35	R13ND-021-MM1	Current	Ap	0	20

36	R13ND-021-MM1	Current	Bw	20	37
37	R13ND-021-MM1	Current	Bt1	37	46
38	R13ND-021-MM1	Current	Bt2	46	64
39	R13ND-021-MM1	Current	Bky	64	96
40	R13ND-021-MM1	Current	BCk	96	+
41	R13ND-091-MM1	Current	Ap	0	14
42	R13ND-091-MM1	Current	Bw	14	24
43	R13ND-091-MM1	Current	Bk1	24	44
44	R13ND-091-MM1	Current	Bk2	44	54
45	R13ND-091-MM1	Current	C	54	+
46	R13ND-099-MM1	Current	Ap	0	19
47	R13ND-099-MM1	Current	Bt1	19	31
48	R13ND-099-MM1	Current	Bt2	31	45
49	R13ND-099-MM1	Current	Bt3	45	63
50	R13ND-099-MM1	Current	Bk	63	75
51	R13ND-099-MM1	Current	BCk	75	+
52	R13ND-099-MM2	Current	Ap	0	16
53	R13ND-099-MM2	Current	Transitional Bk	16	19
54	R13ND-099-MM2	Current	Bk1	19	42
55	R13ND-099-MM2	Current	Bk2	42	+
56	R13ND-017-MM1	Center-1	Apk	0	11
57	R13ND-017-MM1	Center-1	Bk1	11	35
58	R13ND-017-MM1	Center-1	Bk2	35	56
59	R13ND-017-MM1	Center-1	Bk3	56	78
60	R13ND-017-MM1	Center-1	BC	78	93
61	R13ND-017-MM1	Center-1	C	93	+
62	R13ND-017-MM1	1-1	Apk	0	10
63	R13ND-017-MM1	1-1	A	10	32
64	R13ND-017-MM1	1-1	Bw	32	67
65	R13ND-017-MM1	1-1	Bk1	67	84
66	R13ND-017-MM1	1-1	Bk2	84	+
67	R13ND-017-MM1	1-2	Ap	0	6
68	R13ND-017-MM1	1-2	A	6	28
69	R13ND-017-MM1	1-2	Bw	28	62
70	R13ND-017-MM1	1-2	Bky	62	90
71	R13ND-017-MM1	1-2	BCk	90	111
72	R13ND-017-MM1	1-2	C	111	+
73	R13ND-017-MM1	1-3	Ap	0	8
74	R13ND-017-MM1	1-3	A	8	28
75	R13ND-017-MM1	1-3	Bw	28	49
76	R13ND-017-MM1	1-3	Bk	49	71
77	R13ND-017-MM1	1-3	C	71	+

78	R13ND-017-MM1	1-4	Ap	0	13
79	R13ND-017-MM1	1-4	A	13	33
80	R13ND-017-MM1	1-4	Bw	33	50
81	R13ND-017-MM1	1-4	Bk	50	70
82	R13ND-017-MM1	1-4	BCk	70	85
83	R13ND-017-MM1	1-4	C	85	+
84	R13ND-017-MM1	1-4.1	Ap	0	25
85	R13ND-017-MM1	1-4.1	Bk1	25	39
86	R13ND-017-MM1	1-4.1	Ap	39	53
87	R13ND-017-MM1	1-4.1	Bk2	53	82
88	R13ND-017-MM1	1-4.1	Bk3	82	+
89	R13ND-017-MM1	1-5	Ap	0	9
90	R13ND-017-MM1	1-5	A	9	28
91	R13ND-017-MM1	1-5	Bw	28	53
92	R13ND-017-MM1	1-5	Bk	53	79
93	R13ND-017-MM1	1-5	BC	79	101
94	R13ND-017-MM1	1-5	C	101	+
95	R13ND-017-MM1	2-1	Ap	0	14
96	R13ND-017-MM1	2-1	Bw	14	38
97	R13ND-017-MM1	2-1	Bk1	38	65
98	R13ND-017-MM1	2-1	Bk2	65	89
99	R13ND-017-MM1	2-1	BC	89	102
100	R13ND-017-MM1	2-1	C	102	+
101	R13ND-017-MM1	2-2	Ap	0	17
102	R13ND-017-MM1	2-2	Bw1	17	37
103	R13ND-017-MM1	2-2	Bw2	37	53
104	R13ND-017-MM1	2-2	Bk	53	82
105	R13ND-017-MM1	2-2	BCk	82	96
106	R13ND-017-MM1	2-2	C	96	+
107	R13ND-017-MM1	2-3	Ap	0	16
108	R13ND-017-MM1	2-3	Bw1	16	37
109	R13ND-017-MM1	2-3	Bw2	37	55
110	R13ND-017-MM1	2-3	Bw3	55	79
111	R13ND-017-MM1	2-3	Bk	79	102
112	R13ND-017-MM1	2-3	C	102	+
113	R13ND-017-MM1	2-4	Ap	0	7
114	R13ND-017-MM1	2-4	Ak	7	31
115	R13ND-017-MM1	2-4	Bk1	31	56
116	R13ND-017-MM1	2-4	Bk2	56	74
117	R13ND-017-MM1	2-4	BCk	74	93
118	R13ND-017-MM1	2-4	C	93	+
119	R13ND-017-MM1	2-5	Ap	0	13

120	R13ND-017-MM1	2-5	Bw	13	25
121	R13ND-017-MM1	2-5	Bk	25	53
122	R13ND-017-MM1	2-5	BCk	53	67
123	R13ND-017-MM1	2-5	C	67	+
124	R13ND-017-MM1	3-1	Apk	0	11
125	R13ND-017-MM1	3-1	Bw	11	23
126	R13ND-017-MM1	3-1	Bk1	23	40
127	R13ND-017-MM1	3-1	Bk2	40	70
128	R13ND-017-MM1	3-1	Bk3	70	97
129	R13ND-017-MM1	3-1	C	97	+
130	R13ND-017-MM1	3-2	Ap	0	12
131	R13ND-017-MM1	3-2	Bw	12	33
132	R13ND-017-MM1	3-2	Bk	33	65
133	R13ND-017-MM1	3-2	C	65	+
134	R13ND-017-MM1	3-3	Ap	0	13
135	R13ND-017-MM1	3-3	Bw	13	32
136	R13ND-017-MM1	3-3	Bk1	32	53
137	R13ND-017-MM1	3-3	Bk2	53	72
138	R13ND-017-MM1	3-3	C	72	+
139	R13ND-017-MM1	3-4	Apk	0	9
140	R13ND-017-MM1	3-4	Bk	9	37
141	R13ND-017-MM1	3-4	BC	37	63
142	R13ND-017-MM1	3-4	C	63	+
143	R13ND-017-MM1	3-5	Apk	0	13
144	R13ND-017-MM1	3-5	Bk1	13	39
145	R13ND-017-MM1	3-5	Bk2	39	52
146	R13ND-017-MM1	3-5	Bk3	52	84
147	R13ND-017-MM1	3-5	BC	84	97
148	R13ND-017-MM1	3-5	C	97	+
149	R13ND-021-MM1	Center-1	Ap	0	14
150	R13ND-021-MM1	Center-1	BE	14	30
151	R13ND-021-MM1	Center-1	Bt	30	44
152	R13ND-021-MM1	Center-1	Bty	44	72
153	R13ND-021-MM1	Center-1	Bky	72	86
154	R13ND-021-MM1	Center-1	BCk	86	108
155	R13ND-021-MM1	Center-1	C	108	+
156	R13ND-021-MM1	1-1	Ap	0	18
157	R13ND-021-MM1	1-1	E	18	31
158	R13ND-021-MM1	1-1	Bt	31	54
159	R13ND-021-MM1	1-1	Bty1	54	70
160	R13ND-021-MM1	1-1	Bty2	70	95
161	R13ND-021-MM1	1-1	Bcy	95	105

162	R13ND-021-MM1	1-1	C	105	+
163	R13ND-021-MM1	1-2	Ap	0	15
164	R13ND-021-MM1	1-2	BE	15	38
165	R13ND-021-MM1	1-2	Bt1	38	68
166	R13ND-021-MM1	1-2	Bt2	68	80
167	R13ND-021-MM1	1-2	Bk	80	98
168	R13ND-021-MM1	1-2	BC	98	+
169	R13ND-021-MM1	1-3	Ap	0	15
170	R13ND-021-MM1	1-3	BE	15	31
171	R13ND-021-MM1	1-3	Bw	31	56
172	R13ND-021-MM1	1-3	Bk1	56	79
173	R13ND-021-MM1	1-3	Bk2	79	97
174	R13ND-021-MM1	1-3	BC	97	108
175	R13ND-021-MM1	1-3	C	108	+
176	R13ND-021-MM1	1-4	Ap	0	14
177	R13ND-021-MM1	1-4	EB	14	31
178	R13ND-021-MM1	1-4	Bt	31	53
179	R13ND-021-MM1	1-4	Bk1	53	67
180	R13ND-021-MM1	1-4	Bk2	67	79
181	R13ND-021-MM1	1-4	BCk	79	94
182	R13ND-021-MM1	1-4	C	94	+
183	R13ND-021-MM1	1-5	Ap	0	14
184	R13ND-021-MM1	1-5	E	14	31
185	R13ND-021-MM1	1-5	Bt	31	55
186	R13ND-021-MM1	1-5	Btk	55	68
187	R13ND-021-MM1	1-5	Bky	68	86
188	R13ND-021-MM1	1-5	BCy	86	100
189	R13ND-021-MM1	1-5	C	100	+
190	R13ND-021-MM1	2-1	Ap	0	11
191	R13ND-021-MM1	2-1	BE	11	25
192	R13ND-021-MM1	2-1	Bt	25	47
193	R13ND-021-MM1	2-1	Bky	47	80
194	R13ND-021-MM1	2-1	BCy	80	107
195	R13ND-021-MM1	2-1	C	107	+
196	R13ND-021-MM1	2-2	Ap	0	8
197	R13ND-021-MM1	2-2	Bw	8	26
198	R13ND-021-MM1	2-2	Bk1	26	47
199	R13ND-021-MM1	2-2	Bk2	47	71
200	R13ND-021-MM1	2-2	Bk3	71	94
201	R13ND-021-MM1	2-2	BC	94	110
202	R13ND-021-MM1	2-2	C	110	+
203	R13ND-021-MM1	2-3	Ap	0	14

204	R13ND-021-MM1	2-3	BE	14	29
205	R13ND-021-MM1	2-3	Bw	29	50
206	R13ND-021-MM1	2-3	Bk1	50	67
207	R13ND-021-MM1	2-3	Bk2	67	87
208	R13ND-021-MM1	2-3	BC	87	101
209	R13ND-021-MM1	2-3	C	101	+
210	R13ND-021-MM1	2-4	Ap	0	18
211	R13ND-021-MM1	2-4	Bw	18	41
212	R13ND-021-MM1	2-4	Bk1	41	64
213	R13ND-021-MM1	2-4	Bk2	64	84
214	R13ND-021-MM1	2-4	BCy	84	111
215	R13ND-021-MM1	2-4	C	111	+
216	R13ND-021-MM1	2-5	Ap	0	10
217	R13ND-021-MM1	2-5	Bw	10	24
218	R13ND-021-MM1	2-5	Bk1	24	42
219	R13ND-021-MM1	2-5	Bk2	42	71
220	R13ND-021-MM1	2-5	BCy	71	92
221	R13ND-021-MM1	2-5	C	92	+
222	R13ND-021-MM1	3-1	Ap	0	10
223	R13ND-021-MM1	3-1	Bt	10	41
224	R13ND-021-MM1	3-1	Bk	41	67
225	R13ND-021-MM1	3-1	Bky	67	91
226	R13ND-021-MM1	3-1	C	91	+
227	R13ND-021-MM1	3-2	Ap	0	12
228	R13ND-021-MM1	3-2	Bt	12	36
229	R13ND-021-MM1	3-2	Bk1	36	60
230	R13ND-021-MM1	3-2	Bk2	60	91
231	R13ND-021-MM1	3-2	BCy	91	108
232	R13ND-021-MM1	3-2	C	108	+
233	R13ND-021-MM1	3-3	Ap	0	4
234	R13ND-021-MM1	3-3	Bw	4	25
235	R13ND-021-MM1	3-3	Bk1	25	60
236	R13ND-021-MM1	3-3	Bk2	60	83
237	R13ND-021-MM1	3-3	By	83	96
238	R13ND-021-MM1	3-3	BC	96	108
239	R13ND-021-MM1	3-3	C	108	+
240	R13ND-021-MM1	3-4	Ap	0	19
241	R13ND-021-MM1	3-4	Bk1	19	39
242	R13ND-021-MM1	3-4	Bk2	39	60
243	R13ND-021-MM1	3-4	Bk3	60	82
244	R13ND-021-MM1	3-4	BCk	82	102
245	R13ND-021-MM1	3-4	C	102	+

246	R13ND-021-MM1	3-5	Ap	0	15
247	R13ND-021-MM1	3-5	Bw	15	39
248	R13ND-021-MM1	3-5	Bk1	39	53
249	R13ND-021-MM1	3-5	Bk2	53	86
250	R13ND-021-MM1	3-5	BC	86	104
251	R13ND-021-MM1	3-5	C	104	+
252	R13ND-021-MM1	4-1	Ap	0	14
253	R13ND-021-MM1	4-1	EB	14	30
254	R13ND-021-MM1	4-1	Bt	30	48
255	R13ND-021-MM1	4-1	Bty	48	71
256	R13ND-021-MM1	4-1	Bky	71	89
257	R13ND-021-MM1	4-1	BC	89	105
258	R13ND-021-MM1	4-1	C	105	+
259	R13ND-021-MM1	4-2	Ap	0	14
260	R13ND-021-MM1	4-2	Bt1	14	36
261	R13ND-021-MM1	4-2	Bt2	36	50
262	R13ND-021-MM1	4-2	Bk	50	87
263	R13ND-021-MM1	4-2	BC	87	107
264	R13ND-021-MM1	4-2	C	107	+
265	R13ND-021-MM1	4-3	Ap	0	15
266	R13ND-021-MM1	4-3	Bw1	15	35
267	R13ND-021-MM1	4-3	Bw2	35	51
268	R13ND-021-MM1	4-3	Bk1	51	73
269	R13ND-021-MM1	4-3	Bk2	73	96
270	R13ND-021-MM1	4-3	BCy	96	112
271	R13ND-021-MM1	4-3	C	112	+
272	R13ND-021-MM1	4-4	Ap	0	20
273	R13ND-021-MM1	4-4	Bt1	20	38
274	R13ND-021-MM1	4-4	Bt2	38	54
275	R13ND-021-MM1	4-4	Bk1	54	67
276	R13ND-021-MM1	4-4	Bk2	75	90
277	R13ND-021-MM1	4-4	Bk3	90	109
278	R13ND-021-MM1	4-4	BC	109	+
279	R13ND-021-MM1	4-5	Ap	0	14
280	R13ND-021-MM1	4-5	Bw	14	29
281	R13ND-021-MM1	4-5	Btk1	29	54
282	R13ND-021-MM1	4-5	Btk2	54	71
283	R13ND-021-MM1	4-5	2BCk	71	93
284	R13ND-021-MM1	4-5	2C	93	+
285	R13ND-021-MM2	Center-1	Ap	0	19
286	R13ND-021-MM2	Center-1	Bk1	19	31
287	R13ND-021-MM2	Center-1	Bk2	31	45

288	R13ND-021-MM2	Center-1	BCk	45	56
289	R13ND-021-MM2	Center-1	C1	56	75
290	R13ND-021-MM2	Center-1	C2	75	94
291	R13ND-021-MM2	Center-1	C3	94	+
292	R13ND-021-MM2	1-1	Ap	0	17
293	R13ND-021-MM2	1-1	Bw	17	25
294	R13ND-021-MM2	1-1	Bk	25	41
295	R13ND-021-MM2	1-1	C1	41	72
296	R13ND-021-MM2	1-1	C2	72	104
297	R13ND-021-MM2	1-1	C3	104	+
298	R13ND-021-MM2	1-2	Ap	0	16
299	R13ND-021-MM2	1-2	Bw	16	29
300	R13ND-021-MM2	1-2	Bk	29	43
301	R13ND-021-MM2	1-2	C1	86	112
302	R13ND-021-MM2	1-2	C2	112	+
303	R13ND-021-MM2	1-3	Ap	0	15
304	R13ND-021-MM2	1-3	Bw1	15	33
305	R13ND-021-MM2	1-3	Bw2	33	48
306	R13ND-021-MM2	1-3	Bw3	48	64
307	R13ND-021-MM2	1-3	BCk	64	90
308	R13ND-021-MM2	1-3	C1	90	116
309	R13ND-021-MM2	1-3	C2	116	+
310	R13ND-021-MM2	1-4	Ap	0	17
311	R13ND-021-MM2	1-4	Bt	17	34
312	R13ND-021-MM2	1-4	Bk	34	56
313	R13ND-021-MM2	1-4	BCk	56	76
314	R13ND-021-MM2	1-4	2C1	76	83
315	R13ND-021-MM2	1-4	2C2	83	100
316	R13ND-021-MM2	1-4	2C3	100	+
317	R13ND-021-MM2	1-5	Ap	0	19
318	R13ND-021-MM2	1-5	Bw	19	35
319	R13ND-021-MM2	1-5	BK	35	58
320	R13ND-021-MM2	1-5	BCk	58	74
321	R13ND-021-MM2	1-5	2C1	74	94
322	R13ND-021-MM2	1-5	2C2	94	106
323	R13ND-021-MM2	1-5	2C3	106	+
324	R13ND-021-MM2	2-1	Ap	0	15
325	R13ND-021-MM2	2-1	Bt	15	32
326	R13ND-021-MM2	2-1	Bk1	32	55
327	R13ND-021-MM2	2-1	Bk2	55	71
328	R13ND-021-MM2	2-1	BCk	71	82
329	R13ND-021-MM2	2-1	C1	82	104

330	R13ND-021-MM2	2-1	C2	104	+
331	R13ND-021-MM2	2-2	Ap	0	15
332	R13ND-021-MM2	2-2	Bt	15	36
333	R13ND-021-MM2	2-2	Bk1	36	55
334	R13ND-021-MM2	2-2	Bk2	55	72
335	R13ND-021-MM2	2-2	C1	72	96
336	R13ND-021-MM2	2-2	C2	96	+
337	R13ND-021-MM2	2-3	Ap	0	17
338	R13ND-021-MM2	2-3	Bw	17	32
339	R13ND-021-MM2	2-3	Bk1	32	48
340	R13ND-021-MM2	2-3	Bk2	48	69
341	R13ND-021-MM2	2-3	BCk	69	92
342	R13ND-021-MM2	2-3	C1	92	115
343	R13ND-021-MM2	2-3	C2	115	+
344	R13ND-021-MM2	2-4	Ap	0	14
345	R13ND-021-MM2	2-4	Bw	14	33
346	R13ND-021-MM2	2-4	Bk1	33	56
347	R13ND-021-MM2	2-4	Bk2	56	70
348	R13ND-021-MM2	2-4	C1	70	82
349	R13ND-021-MM2	2-4	C2	82	103
350	R13ND-021-MM2	2-4	C3	103	+
351	R13ND-021-MM2	2-5	Ap	0	16
352	R13ND-021-MM2	2-5	Bw1	16	34
353	R13ND-021-MM2	2-5	Bw2	34	50
354	R13ND-021-MM2	2-5	Bk	50	69
355	R13ND-021-MM2	2-5	BCk	69	82
356	R13ND-021-MM2	2-5	C1	82	98
357	R13ND-021-MM2	2-5	C2	98	116
358	R13ND-021-MM2	2-5	C3	116	+
359	R13ND-021-MM2	3-1	Ap	0	15
360	R13ND-021-MM2	3-1	Bt	15	31
361	R13ND-021-MM2	3-1	Btk1	31	46
362	R13ND-021-MM2	3-1	Btk2	46	63
363	R13ND-021-MM2	3-1	BCk	63	77
364	R13ND-021-MM2	3-1	C	77	108
365	R13ND-021-MM2	3-1	C2	108	+
366	R13ND-021-MM2	3-2	Ap	0	13
367	R13ND-021-MM2	3-2	Bt1	13	26
368	R13ND-021-MM2	3-2	Bt2	26	39
369	R13ND-021-MM2	3-2	Bk1	39	64
370	R13ND-021-MM2	3-2	Bk2	64	80
371	R13ND-021-MM2	3-2	C1	80	98

372	R13ND-021-MM2	3-2	C2	98	+
373	R13ND-021-MM2	3-3	Ap	0	13
374	R13ND-021-MM2	3-3	Bw	13	30
375	R13ND-021-MM2	3-3	Bk1	30	43
376	R13ND-021-MM2	3-3	Bk2	43	61
377	R13ND-021-MM2	3-3	BC	61	79
378	R13ND-021-MM2	3-3	C1	79	99
379	R13ND-021-MM2	3-3	C2	99	+
380	R13ND-021-MM2	3-4	A	0	15
381	R13ND-021-MM2	3-4	AE	15	23
382	R13ND-021-MM2	3-4	BE	23	48
383	R13ND-021-MM2	3-4	Bt	48	69
384	R13ND-021-MM2	3-4	BCg	69	84
385	R13ND-021-MM2	3-4	Cg1	84	108
386	R13ND-021-MM2	3-4	Cg2	108	+
387	R13ND-021-MM2	3-5	A1	0	13
388	R13ND-021-MM2	3-5	A2	13	28
389	R13ND-021-MM2	3-5	AE	28	37
390	R13ND-021-MM2	3-5	E	37	59
391	R13ND-021-MM2	3-5	Bt1	59	84
392	R13ND-021-MM2	3-5	Bt2	84	102
393	R13ND-021-MM2	3-5	C	102	+
394	R13ND-021-MM2	4-1	Ap	0	12
395	R13ND-021-MM2	4-1	Bw	12	42
396	R13ND-021-MM2	4-1	Bk	42	63
397	R13ND-021-MM2	4-1	2BCk	63	76
398	R13ND-021-MM2	4-1	2C1	76	91
399	R13ND-021-MM2	4-1	2C2	91	107
400	R13ND-021-MM2	4-1	3C	107	+
401	R13ND-021-MM2	4-2	Ap	0	16
402	R13ND-021-MM2	4-2	Bw1	16	36
403	R13ND-021-MM2	4-2	Bw2	36	65
404	R13ND-021-MM2	4-2	BC	65	79
405	R13ND-021-MM2	4-2	2C1	79	95
406	R13ND-021-MM2	4-2	2C2	95	108
407	R13ND-021-MM2	4-2	3C	108	+
408	R13ND-021-MM2	4-3	Ap	0	13
409	R13ND-021-MM2	4-3	Bw1	13	31
410	R13ND-021-MM2	4-3	Bw2	31	54
411	R13ND-021-MM2	4-3	2BC	54	66
412	R13ND-021-MM2	4-3	2C1	66	86
413	R13ND-021-MM2	4-3	2C2	86	95

414	R13ND-021-MM2	4-3	3C1	95	111
415	R13ND-021-MM2	4-3	3C2	111	+
416	R13ND-021-MM2	4-4	Ap	0	15
417	R13ND-021-MM2	4-4	Bw1	15	34
418	R13ND-021-MM2	4-4	Bw2	34	57
419	R13ND-021-MM2	4-4	BC	57	80
420	R13ND-021-MM2	4-4	C1	80	98
421	R13ND-021-MM2	4-4	C2	98	108
422	R13ND-021-MM2	4-4	C3	108	118
423	R13ND-021-MM2	4-4	C4	118	+
424	R13ND-021-MM2	4-5	Ap	0	17
425	R13ND-021-MM2	4-5	Bw1	17	40
426	R13ND-021-MM2	4-5	Bw2	40	64
427	R13ND-021-MM2	4-5	BC	64	76
428	R13ND-021-MM2	4-5	C1	76	94
429	R13ND-021-MM2	4-5	C2	94	112
430	R13ND-021-MM2	4-5	C3	112	+
431	R13ND-021-MM3	Center-1	A	0	11
432	R13ND-021-MM3	Center-1	Bw	11	21
433	R13ND-021-MM3	Center-1	E	21	28
434	R13ND-021-MM3	Center-1	Bt	28	45
435	R13ND-021-MM3	Center-1	2Bt	45	59
436	R13ND-021-MM3	Center-1	2Bk	59	85
437	R13ND-021-MM3	Center-1	2C	85	104
438	R13ND-021-MM3	Center-1	3C	104	+
439	R13ND-021-MM3	1-1	A	0	15
440	R13ND-021-MM3	1-1	Bt1	15	32
441	R13ND-021-MM3	1-1	Bt2	32	52
442	R13ND-021-MM3	1-1	Bk	52	76
443	R13ND-021-MM3	1-1	BCk	76	87
444	R13ND-021-MM3	1-1	C	87	104
445	R13ND-021-MM3	1-1	Cy	104	+
446	R13ND-021-MM3	1-2	A1	0	10
447	R13ND-021-MM3	1-2	A2	10	22
448	R13ND-021-MM3	1-2	Bw	22	43
449	R13ND-021-MM3	1-2	Bk1	43	58
450	R13ND-021-MM3	1-2	Bk2	58	82
451	R13ND-021-MM3	1-2	C	82	104
452	R13ND-021-MM3	1-2	Cy	104	+
453	R13ND-021-MM3	1-3	A1	0	10
454	R13ND-021-MM3	1-3	A2	10	22
455	R13ND-021-MM3	1-3	Bw	22	42

456	R13ND-021-MM3	1-3	Bk	42	59
457	R13ND-021-MM3	1-3	BCk	59	82
458	R13ND-021-MM3	1-3	C	82	108
459	R13ND-021-MM3	1-3	Cy	108	+
460	R13ND-021-MM3	1-4	A	0	15
461	R13ND-021-MM3	1-4	Bt	15	39
462	R13ND-021-MM3	1-4	Bk1	39	54
463	R13ND-021-MM3	1-4	Bk2	54	72
464	R13ND-021-MM3	1-4	BCk	72	85
465	R13ND-021-MM3	1-4	C1	85	106
466	R13ND-021-MM3	1-4	C2	106	+
467	R13ND-021-MM3	1-5	A	0	13
468	R13ND-021-MM3	1-5	Bw	13	32
469	R13ND-021-MM3	1-5	Bt	32	56
470	R13ND-021-MM3	1-5	Bk	56	74
471	R13ND-021-MM3	1-5	BCk	74	87
472	R13ND-021-MM3	1-5	C1	87	109
473	R13ND-021-MM3	1-5	C2	109	+
474	R13ND-021-MM3	2-1	A	0	15
475	R13ND-021-MM3	2-1	Bt1	15	27
476	R13ND-021-MM3	2-1	Bt2	27	47
477	R13ND-021-MM3	2-1	Bk	47	75
478	R13ND-021-MM3	2-1	BCk	75	89
479	R13ND-021-MM3	2-1	C	89	+
480	R13ND-021-MM3	2-2	A	0	14
481	R13ND-021-MM3	2-2	Bw	14	29
482	R13ND-021-MM3	2-2	Bt	29	51
483	R13ND-021-MM3	2-2	Bk1	51	65
484	R13ND-021-MM3	2-2	Bk2	65	85
485	R13ND-021-MM3	2-2	BC	85	103
486	R13ND-021-MM3	2-2	C	103	+
487	R13ND-021-MM3	2-3	A	0	16
488	R13ND-021-MM3	2-3	Bw1	16	32
489	R13ND-021-MM3	2-3	Bw2	32	56
490	R13ND-021-MM3	2-3	Bk1	56	79
491	R13ND-021-MM3	2-3	Bk2	79	92
492	R13ND-021-MM3	2-3	BCk	92	104
493	R13ND-021-MM3	2-3	C	104	+
494	R13ND-021-MM3	2-4	A	0	15
495	R13ND-021-MM3	2-4	Bw	15	33
496	R13ND-021-MM3	2-4	Bt	33	50
497	R13ND-021-MM3	2-4	Bk1	50	64

498	R13ND-021-MM3	2-4	Bk2	64	83
499	R13ND-021-MM3	2-4	BCk	83	100
500	R13ND-021-MM3	2-4	C	100	+
501	R13ND-021-MM3	2-5	A	0	14
502	R13ND-021-MM3	2-5	Bw	14	26
503	R13ND-021-MM3	2-5	Bt	26	43
504	R13ND-021-MM3	2-5	Bk1	43	60
505	R13ND-021-MM3	2-5	Bk2	60	85
506	R13ND-021-MM3	2-5	BC	85	104
507	R13ND-021-MM3	2-5	C	104	+
508	R13ND-021-MM3	3-1	A	0	16
509	R13ND-021-MM3	3-1	Bw	16	33
510	R13ND-021-MM3	3-1	Bt	33	54
511	R13ND-021-MM3	3-1	2BCk	54	75
512	R13ND-021-MM3	3-1	3C1	75	101
513	R13ND-021-MM3	3-1	3C2	101	+
514	R13ND-021-MM3	3-2	A	0	14
515	R13ND-021-MM3	3-2	Bw	14	26
516	R13ND-021-MM3	3-2	Bt	26	46
517	R13ND-021-MM3	3-2	Bk	46	69
518	R13ND-021-MM3	3-2	BCk	69	87
519	R13ND-021-MM3	3-2	C1	87	104
520	R13ND-021-MM3	3-2	C2	104	+
521	R13ND-021-MM3	3-3	A	0	18
522	R13ND-021-MM3	3-3	Bt	18	39
523	R13ND-021-MM3	3-3	Bky	39	59
524	R13ND-021-MM3	3-3	Bk	59	73
525	R13ND-021-MM3	3-3	BCk	73	84
526	R13ND-021-MM3	3-3	C1	84	105
527	R13ND-021-MM3	3-3	C2	105	+
528	R13ND-021-MM3	3-4	A	0	18
529	R13ND-021-MM3	3-4	BE	18	30
530	R13ND-021-MM3	3-4	Bt1	30	45
531	R13ND-021-MM3	3-4	Bt2	45	61
532	R13ND-021-MM3	3-4	2BK	61	75
533	R13ND-021-MM3	3-4	3BCk	75	96
534	R13ND-021-MM3	3-4	C	96	+
535	R13ND-021-MM3	3-5	AE	0	19
536	R13ND-021-MM3	3-5	E	19	30
537	R13ND-021-MM3	3-5	Bt1	30	58
538	R13ND-021-MM3	3-5	Bt2	58	67
539	R13ND-021-MM3	3-5	Bk	67	95

540	R13ND-021-MM3	3-5	BC	95	109
541	R13ND-021-MM3	3-5	C	109	+
542	R13ND-021-MM3	4-1	A	0	13
543	R13ND-021-MM3	4-1	Bw1	13	25
544	R13ND-021-MM3	4-1	Bw2	25	40
545	R13ND-021-MM3	4-1	Bk	40	69
546	R13ND-021-MM3	4-1	BCk	69	88
547	R13ND-021-MM3	4-1	C1	88	107
548	R13ND-021-MM3	4-1	C2	107	+
549	R13ND-021-MM3	4-2	A	0	13
550	R13ND-021-MM3	4-2	Bt	13	32
551	R13ND-021-MM3	4-2	Bk1	32	44
552	R13ND-021-MM3	4-2	Bk2	44	65
553	R13ND-021-MM3	4-2	BCk	65	84
554	R13ND-021-MM3	4-2	C1	84	110
555	R13ND-021-MM3	4-2	C2	110	+
556	R13ND-021-MM3	4-3	A	0	16
557	R13ND-021-MM3	4-3	Bt1	16	35
558	R13ND-021-MM3	4-3	Bt2	35	49
559	R13ND-021-MM3	4-3	Bk1	49	67
560	R13ND-021-MM3	4-3	Bk2	67	84
561	R13ND-021-MM3	4-3	C1	84	105
562	R13ND-021-MM3	4-3	C2	105	+
563	R13ND-021-MM3	4-4	A	0	12
564	R13ND-021-MM3	4-4	Bt	12	33
565	R13ND-021-MM3	4-4	Bk1	33	51
566	R13ND-021-MM3	4-4	Bk2	51	72
567	R13ND-021-MM3	4-4	BCk	72	83
568	R13ND-021-MM3	4-4	C1	83	99
569	R13ND-021-MM3	4-4	C2	99	+
570	R13ND-021-MM3	4-5	A	0	12
571	R13ND-021-MM3	4-5	Bw	12	24
572	R13ND-021-MM3	4-5	Bt	24	42
573	R13ND-021-MM3	4-5	Bk	42	64
574	R13ND-021-MM3	4-5	BCk	64	76
575	R13ND-021-MM3	4-5	C1	76	95
576	R13ND-021-MM3	4-5	C2	95	112
577	R13ND-021-MM3	4-5	C3	112	+
578	R13ND-091-MM1	Center-1	Ap1	0	4
579	R13ND-091-MM1	Center-1	Ap2	4	14
580	R13ND-091-MM1	Center-1	Bw	14	27
581	R13ND-091-MM1	Center-1	Bk1	27	46

582	R13ND-091-MM1	Center-1	Bk2	46	71
583	R13ND-091-MM1	Center-1	BC	71	87
584	R13ND-091-MM1	Center-1	C	87	+
585	R13ND-091-MM1	1-1	Ap	0	11
586	R13ND-091-MM1	1-1	Bt	11	21
587	R13ND-091-MM1	1-1	Bk1	21	44
588	R13ND-091-MM1	1-1	Bk2	44	70
589	R13ND-091-MM1	1-1	BCk	70	87
590	R13ND-091-MM1	1-1	C	87	+
591	R13ND-091-MM1	1-2	Ap	0	14
592	R13ND-091-MM1	1-2	Bt	14	36
593	R13ND-091-MM1	1-2	Bk	36	62
594	R13ND-091-MM1	1-2	C1	62	77
595	R13ND-091-MM1	1-2	C2	77	+
596	R13ND-091-MM1	1-3	Ap	0	11
597	R13ND-091-MM1	1-3	Bw	11	29
598	R13ND-091-MM1	1-3	Btk1	29	42
599	R13ND-091-MM1	1-3	Btk2	42	64
600	R13ND-091-MM1	1-3	C1	64	97
601	R13ND-091-MM1	1-3	C2	97	+
602	R13ND-091-MM1	1-4	Ap	0	13
603	R13ND-091-MM1	1-4	Bw	13	27
604	R13ND-091-MM1	1-4	Btk	27	40
605	R13ND-091-MM1	1-4	Bk	40	61
606	R13ND-091-MM1	1-4	BCk	61	81
607	R13ND-091-MM1	1-4	C1	81	101
608	R13ND-091-MM1	1-4	C2	101	+
609	R13ND-091-MM1	1-5	Ap1	0	14
610	R13ND-091-MM1	1-5	Ap2	14	26
611	R13ND-091-MM1	1-5	Bt	26	48
612	R13ND-091-MM1	1-5	Bk	48	83
613	R13ND-091-MM1	1-5	C1	83	102
614	R13ND-091-MM1	1-5	C2	102	+
615	R13ND-091-MM1	2-1	Ap	0	12
616	R13ND-091-MM1	2-1	Bw	12	27
617	R13ND-091-MM1	2-1	Btk1	27	49
618	R13ND-091-MM1	2-1	Btk2	49	69
619	R13ND-091-MM1	2-1	C1	69	94
620	R13ND-091-MM1	2-1	C2	94	+
621	R13ND-091-MM1	2-2	Ap	0	13
622	R13ND-091-MM1	2-2	A	13	26
623	R13ND-091-MM1	2-2	Bw1	26	44

624	R13ND-091-MM1	2-2	Bw2	44	61
625	R13ND-091-MM1	2-2	Bk	61	82
626	R13ND-091-MM1	2-2	C1	82	113
627	R13ND-091-MM1	2-2	C2	113	+
628	R13ND-091-MM1	2-3	Ap	0	14
629	R13ND-091-MM1	2-3	A	14	30
630	R13ND-091-MM1	2-3	BE	30	50
631	R13ND-091-MM1	2-3	EB	50	64
632	R13ND-091-MM1	2-3	Bth	64	76
633	R13ND-091-MM1	2-3	Bt	76	97
634	R13ND-091-MM1	2-3	BCy	97	+
635	R13ND-091-MM1	2-4	Ap	0	9
636	R13ND-091-MM1	2-4	A	9	22
637	R13ND-091-MM1	2-4	Bw	22	36
638	R13ND-091-MM1	2-4	EB	36	47
639	R13ND-091-MM1	2-4	E	47	59
640	R13ND-091-MM1	2-4	Bth	59	74
641	R13ND-091-MM1	2-4	Bt	74	100
642	R13ND-091-MM1	2-4	BC	100	+
643	R13ND-091-MM1	2-5	Ap	0	9
644	R13ND-091-MM1	2-5	A	9	26
645	R13ND-091-MM1	2-5	Bk1	26	44
646	R13ND-091-MM1	2-5	Bk2	44	67
647	R13ND-091-MM1	2-5	C1	67	97
648	R13ND-091-MM1	2-5	C2	97	+
649	R13ND-091-MM1	3-1	Ap	0	14
650	R13ND-091-MM1	3-1	Bk1	14	32
651	R13ND-091-MM1	3-1	Bk2	32	57
652	R13ND-091-MM1	3-1	BCk	57	81
653	R13ND-091-MM1	3-1	C	86	+
654	R13ND-091-MM1	3-2	Ap	0	12
655	R13ND-091-MM1	3-2	Bt1	12	33
656	R13ND-091-MM1	3-2	Bt2	33	43
657	R13ND-091-MM1	3-2	Bk1	43	65
658	R13ND-091-MM1	3-2	Bk2	65	82
659	R13ND-091-MM1	3-2	BCk	82	104
660	R13ND-091-MM1	3-2	C	104	+
661	R13ND-091-MM1	3-3	Ap	0	23
662	R13ND-091-MM1	3-3	Bw	23	40
663	R13ND-091-MM1	3-3	Bk1	40	65
664	R13ND-091-MM1	3-3	Bk2	65	80
665	R13ND-091-MM1	3-3	BCk	80	108

666	R13ND-091-MM1	3-3	C	108	+
667	R13ND-091-MM1	3-4	Ap	0	20
668	R13ND-091-MM1	3-4	AB	20	30
669	R13ND-091-MM1	3-4	Bw	30	44
670	R13ND-091-MM1	3-4	Bk1	44	63
671	R13ND-091-MM1	3-4	Bk2	63	87
672	R13ND-091-MM1	3-4	C	87	+
673	R13ND-091-MM1	3-5	Ap1	0	13
674	R13ND-091-MM1	3-5	Ap2	13	29
675	R13ND-091-MM1	3-5	Bw	29	42
676	R13ND-091-MM1	3-5	Bt1	42	60
677	R13ND-091-MM1	3-5	Bt2	60	85
678	R13ND-091-MM1	3-5	BCk	85	106
679	R13ND-091-MM1	3-5	C	106	+
680	R13ND-091-MM1	4-1	Ap	0	16
681	R13ND-091-MM1	4-1	Bw	16	35
682	R13ND-091-MM1	4-1	Bk1	35	56
683	R13ND-091-MM1	4-1	Bk2	56	79
684	R13ND-091-MM1	4-1	BC	79	94
685	R13ND-091-MM1	4-1	C	94	+
686	R13ND-099-MM1	Center-2	A	0	16
687	R13ND-099-MM1	Center-2	Bt	16	35
688	R13ND-099-MM1	Center-2	Btk	35	53
689	R13ND-099-MM1	Center-2	Bk	53	70
690	R13ND-099-MM1	Center-2	BCk	70	85
691	R13ND-099-MM1	Center-2	C	85	+
692	R13ND-099-MM1	1-1	A	0	15
693	R13ND-099-MM1	1-1	Bw	15	31
694	R13ND-099-MM1	1-1	Bk	31	49
695	R13ND-099-MM1	1-1	BCk	49	65
696	R13ND-099-MM1	1-1	C	65	96
697	R13ND-099-MM1	1-1	2C	96	+
698	R13ND-099-MM1	1-2	A	0	19
699	R13ND-099-MM1	1-2	Bw	19	34
700	R13ND-099-MM1	1-2	Bk	34	59
701	R13ND-099-MM1	1-2	BCk	59	78
702	R13ND-099-MM1	1-2	C1	78	94
703	R13ND-099-MM1	1-2	C2	94	+
704	R13ND-099-MM1	1-4	A	0	23
705	R13ND-099-MM1	1-4	Bw	23	41
706	R13ND-099-MM1	1-4	Bt	41	57
707	R13ND-099-MM1	1-4	Bk	57	72

708	R13ND-099-MM1	1-4	BCk	72	92
709	R13ND-099-MM1	1-4	C	92	+
710	R13ND-099-MM1	1-5	A1	0	20
711	R13ND-099-MM1	1-5	A2	20	37
712	R13ND-099-MM1	1-5	Bt	37	66
713	R13ND-099-MM1	1-5	Bk	66	82
714	R13ND-099-MM1	1-5	BCk	82	97
715	R13ND-099-MM1	1-5	C	97	+
716	R13ND-099-MM1	2-1	A	0	19
717	R13ND-099-MM1	2-1	Bw	19	32
718	R13ND-099-MM1	2-1	Bk1	32	48
719	R13ND-099-MM1	2-1	Bk2	48	70
720	R13ND-099-MM1	2-1	C1	70	98
721	R13ND-099-MM1	2-1	C2	98	+
722	R13ND-099-MM1	2-2	A	0	16
723	R13ND-099-MM1	2-2	Bk1	16	33
724	R13ND-099-MM1	2-2	Bk2	33	52
725	R13ND-099-MM1	2-2	Bk3	52	70
726	R13ND-099-MM1	2-2	BCk	70	84
727	R13ND-099-MM1	2-2	C1	84	102
728	R13ND-099-MM1	2-2	C2	102	+
729	R13ND-099-MM1	2-3	A	0	14
730	R13ND-099-MM1	2-3	Bk1	14	26
731	R13ND-099-MM1	2-3	Bk2	26	40
732	R13ND-099-MM1	2-3	Bk3	40	59
733	R13ND-099-MM1	2-3	C	59	70
734	R13ND-099-MM1	2-3	2C	70	99
735	R13ND-099-MM1	2-3	3C1	99	115
736	R13ND-099-MM1	2-3	3C2	115	+
737	R13ND-099-MM1	2-4	A	0	17
738	R13ND-099-MM1	2-4	Bt1	17	33
739	R13ND-099-MM1	2-4	Bt2	33	46
740	R13ND-099-MM1	2-4	Bk1	46	63
741	R13ND-099-MM1	2-4	Bk2	63	89
742	R13ND-099-MM1	2-4	C	89	+
743	R13ND-099-MM1	2-5	A	0	17
744	R13ND-099-MM1	2-5	Bw	17	28
745	R13ND-099-MM1	2-5	Bt	28	42
746	R13ND-099-MM1	2-5	Bk	42	61
747	R13ND-099-MM1	2-5	BCk	61	75
748	R13ND-099-MM1	2-5	C1	75	103
749	R13ND-099-MM1	2-5	C2	103	+

750	R13ND-099-MM1	3-1	A	0	20
751	R13ND-099-MM1	3-1	Bw	20	42
752	R13ND-099-MM1	3-1	Bt	42	65
753	R13ND-099-MM1	3-1	Bk	65	77
754	R13ND-099-MM1	3-1	BCk	77	94
755	R13ND-099-MM1	3-1	C1	94	110
756	R13ND-099-MM1	3-1	C2	110	+
757	R13ND-099-MM1	3-2	A1	0	19
758	R13ND-099-MM1	3-2	A2	19	32
759	R13ND-099-MM1	3-2	Bw	32	46
760	R13ND-099-MM1	3-2	Bt	46	65
761	R13ND-099-MM1	3-2	Bk	65	77
762	R13ND-099-MM1	3-2	C1	77	100
763	R13ND-099-MM1	3-2	C2	100	+
764	R13ND-099-MM1	3-3	A	0	22
765	R13ND-099-MM1	3-3	Ak	22	40
766	R13ND-099-MM1	3-3	Bt	40	57
767	R13ND-099-MM1	3-3	Bk	57	79
768	R13ND-099-MM1	3-3	Kroto	79	94
769	R13ND-099-MM1	3-3	C	94	+
770	R13ND-099-MM1	3-4	A	0	19
771	R13ND-099-MM1	3-4	BE	19	31
772	R13ND-099-MM1	3-4	Bt1	31	42
773	R13ND-099-MM1	3-4	Bt2	42	66
774	R13ND-099-MM1	3-4	Bk	66	84
775	R13ND-099-MM1	3-4	C1	84	104
776	R13ND-099-MM1	3-4	C2	104	+
777	R13ND-099-MM1	3-5	A	0	21
778	R13ND-099-MM1	3-5	Bw	21	47
779	R13ND-099-MM1	3-5	Bk1	47	65
780	R13ND-099-MM1	3-5	Bk2	65	82
781	R13ND-099-MM1	3-5	2C	82	94
782	R13ND-099-MM1	3-5	3C	94	+
783	R13ND-099-MM1	4-1	A	0	19
784	R13ND-099-MM1	4-1	Bw1	19	34
785	R13ND-099-MM1	4-1	Bw2	34	51
786	R13ND-099-MM1	4-1	Bk	51	79
787	R13ND-099-MM1	4-1	C	79	+
788	R13ND-099-MM1	4-2	A	0	20
789	R13ND-099-MM1	4-2	Bt1	20	44
790	R13ND-099-MM1	4-2	Bt2	44	59
791	R13ND-099-MM1	4-2	Bk	59	72

792	R13ND-099-MM1	4-2	BCk	72	85
793	R13ND-099-MM1	4-2	C	85	+
794	R13ND-099-MM1	4-3	A	0	19
795	R13ND-099-MM1	4-3	Bt	19	45
796	R13ND-099-MM1	4-3	Btk	45	61
797	R13ND-099-MM1	4-3	Bk	61	77
798	R13ND-099-MM1	4-3	C1	77	102
799	R13ND-099-MM1	4-3	C2	102	+
800	R13ND-099-MM1	4-4	A1	0	24
801	R13ND-099-MM1	4-4	A2	24	50
802	R13ND-099-MM1	4-4	Bt	50	85
803	R13ND-099-MM1	4-4	Btk	85	98
804	R13ND-099-MM1	4-4	2C	98	+
805	R13ND-099-MM1	4-4	Kroto	14	20
806	R13ND-099-MM1	4-5	A1	0	20
807	R13ND-099-MM1	4-5	A2	20	35
808	R13ND-099-MM1	4-5	Bw	35	51
809	R13ND-099-MM1	4-5	Bt	51	66
810	R13ND-099-MM1	4-5	Bk	66	92
811	R13ND-099-MM1	4-5	BCk	92	107
812	R13ND-099-MM1	4-5	C	107	+
813	R13ND-099-MM2	Center-2	Ap	0	15
814	R13ND-099-MM2	Center-2	Bk1	15	49
815	R13ND-099-MM2	Center-2	Bk2	49	63
816	R13ND-099-MM2	Center-2	BCk	63	82
817	R13ND-099-MM2	Center-2	C	82	+
818	R13ND-099-MM2	1-1	Ap	0	18
819	R13ND-099-MM2	1-1	Bk1	18	33
820	R13ND-099-MM2	1-1	Bk2	43	73
821	R13ND-099-MM2	1-1	C	88	+
822	R13ND-099-MM2	1-2	Apk	0	13
823	R13ND-099-MM2	1-2	Bw	13	27
824	R13ND-099-MM2	1-2	Bk1	27	42
825	R13ND-099-MM2	1-2	Bk2	42	60
826	R13ND-099-MM2	1-2	BCk	60	77
827	R13ND-099-MM2	1-2	C	77	+
828	R13ND-099-MM2	1-3	Apk	0	12
829	R13ND-099-MM2	1-3	Bw	12	27
830	R13ND-099-MM2	1-3	Bk	27	52
831	R13ND-099-MM2	1-3	2C	82	+
832	R13ND-099-MM2	1-4	Apk	0	14
833	R13ND-099-MM2	1-4	Bk1	14	29

834	R13ND-099-MM2	1-4	Bk2	29	49
835	R13ND-099-MM2	1-4	Bk3	49	72
836	R13ND-099-MM2	1-4	C	72	111
837	R13ND-099-MM2	1-4	2C	111	+
838	R13ND-099-MM2	1-5	Apk	0	16
839	R13ND-099-MM2	1-5	Bk1	16	41
840	R13ND-099-MM2	1-5	Bk2	41	63
841	R13ND-099-MM2	1-5	Bk3	63	85
842	R13ND-099-MM2	1-5	BCk	85	+
843	R13ND-099-MM2	2-1	Ap1	0	8
844	R13ND-099-MM2	2-1	Ap2	8	20
845	R13ND-099-MM2	2-1	Bw	20	38
846	R13ND-099-MM2	2-1	Bk	38	53
847	R13ND-099-MM2	2-1	2Bk	53	72
848	R13ND-099-MM2	2-1	2C	72	88
849	R13ND-099-MM2	2-1	3C1	88	106
850	R13ND-099-MM2	2-1	3C2	106	+
851	R13ND-099-MM2	2-2	Ap	0	14
852	R13ND-099-MM2	2-2	Bt	14	31
853	R13ND-099-MM2	2-2	Bk1	31	54
854	R13ND-099-MM2	2-2	Bk2	54	71
855	R13ND-099-MM2	2-2	C1	71	103
856	R13ND-099-MM2	2-2	C2	103	+
857	R13ND-099-MM2	2-3	Ap	0	14
858	R13ND-099-MM2	2-3	Bw	14	24
859	R13ND-099-MM2	2-3	Bk1	24	48
860	R13ND-099-MM2	2-3	Bk2	48	69
861	R13ND-099-MM2	2-3	BC	69	80
862	R13ND-099-MM2	2-3	C	80	+
863	R13ND-099-MM2	2-4	Ap1	0	5
864	R13ND-099-MM2	2-4	Ap2	5	13
865	R13ND-099-MM2	2-4	Bw	13	22
866	R13ND-099-MM2	2-4	Bk1	22	41
867	R13ND-099-MM2	2-4	Bk2	41	69
868	R13ND-099-MM2	2-4	C1	69	102
869	R13ND-099-MM2	2-4	C2	102	+
870	R13ND-099-MM2	2-5	Ap	0	15
871	R13ND-099-MM2	2-5	Bw	15	28
872	R13ND-099-MM2	2-5	Bk	28	53
873	R13ND-099-MM2	2-5	BCk	53	73
874	R13ND-099-MM2	2-5	C1	73	103
875	R13ND-099-MM2	2-5	C2	103	+

876	R13ND-099-MM2	3-1	Ap	0	11
877	R13ND-099-MM2	3-1	Bk1	11	26
878	R13ND-099-MM2	3-1	Bk2	26	44
879	R13ND-099-MM2	3-1	Btk	44	71
880	R13ND-099-MM2	3-1	Btky	71	94
881	R13ND-099-MM2	3-1	C	94	+
882	R13ND-099-MM2	3-2	Ap	0	10
883	R13ND-099-MM2	3-2	Bw	10	28
884	R13ND-099-MM2	3-2	Bk	28	48
885	R13ND-099-MM2	3-2	BCk	48	74
886	R13ND-099-MM2	3-2	C1	74	93
887	R13ND-099-MM2	3-2	C2	93	+
888	R13ND-099-MM2	3-3	Ap	0	17
889	R13ND-099-MM2	3-3	Bw	17	29
890	R13ND-099-MM2	3-3	Bk	29	54
891	R13ND-099-MM2	3-3	BCk	54	68
892	R13ND-099-MM2	3-3	C	68	+
893	R13ND-099-MM2	3-4	Ap	0	14
894	R13ND-099-MM2	3-4	Bw	14	33
895	R13ND-099-MM2	3-4	Bk	33	53
896	R13ND-099-MM2	3-4	BCk	53	69
897	R13ND-099-MM2	3-4	C1	69	100
898	R13ND-099-MM2	3-4	C2	100	+
899	R13ND-099-MM2	3-5	Ap	0	26
900	R13ND-099-MM2	3-5	Ak	26	49
901	R13ND-099-MM2	3-5	Bk	49	80
902	R13ND-099-MM2	3-5	C1	80	103
903	R13ND-099-MM2	3-5	C2	103	+
904	R13ND-099-MM2	4-1	Ap	0	14
905	R13ND-099-MM2	4-1	Apk	14	23
906	R13ND-099-MM2	4-1	Bk1	23	44
907	R13ND-099-MM2	4-1	Bk2	44	64
908	R13ND-099-MM2	4-1	BC	64	77
909	R13ND-099-MM2	4-1	C1	77	97
910	R13ND-099-MM2	4-1	C2	97	+
911	R13ND-099-MM2	4-2	Ap	0	17
912	R13ND-099-MM2	4-2	Bk	17	37
913	R13ND-099-MM2	4-2	BC	37	63
914	R13ND-099-MM2	4-2	C1	63	99
915	R13ND-099-MM2	4-2	C2	99	+
916	R13ND-099-MM2	4-3	Ap	0	16
917	R13ND-099-MM2	4-3	Bk1	16	40

918	R13ND-099-MM2	4-3	Bk2	40	59
919	R13ND-099-MM2	4-3	BCk	59	74
920	R13ND-099-MM2	4-3	C1	74	98
921	R13ND-099-MM2	4-3	C2	98	+
922	R13ND-099-MM2	4-4	Ap	0	10
923	R13ND-099-MM2	4-4	Bw	10	31
924	R13ND-099-MM2	4-4	Bk1	31	53
925	R13ND-099-MM2	4-4	Bk2	53	71
926	R13ND-099-MM2	4-4	BC	71	84
927	R13ND-099-MM2	4-4	C	84	+
928	R13ND-099-MM2	4-5	Ap	0	10
929	R13ND-099-MM2	4-5	Bk1	10	30
930	R13ND-099-MM2	4-5	Bk2	30	56
931	R13ND-099-MM2	4-5	BC	56	69
932	R13ND-099-MM2	4-5	C1	69	91
933	R13ND-099-MM2	4-5	C2	91	+

APPENDIX Q. PARTICLE FRACTIONATION FROM PIPETTE PARTICLE SIZE ANALYSIS FOR HISTORIC AND CURRENT PEDONS

ID	Coarse Fragments	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Sand	Coarse Silt	Fine Silt	Silt	Clay
	%										
1	0.70	1.90	5.30	5.20	13.00	12.00	38.10		21.80	42.70	19.90
2	1.30	3.40	6.00	6.70	17.40	12.10	46.90		14.70	30.00	24.40
3	1.60	2.20	5.40	6.10	16.40	13.10	44.80		15.90	31.30	25.50
4	1.90	2.00	5.70	6.30	16.80	13.20	45.90		15.90	31.90	24.10
5	2.20	1.70	4.40	5.30	15.60	12.40	41.60		20.80	35.40	25.20
6	4.30	2.50	5.30	5.40	15.40	12.20	45.10		21.70	35.90	23.30
7	3.10	2.30	4.90	5.50	15.60	12.10	43.50		22.30	37.30	22.30
8	3.30	1.90	5.10	6.10	16.90	12.60	45.90		21.10	36.40	21.00
9	2.80	3.30	6.00	5.80	14.40	11.00	43.30		24.90	41.30	18.20
10	1.40	2.50	4.60	5.20	12.20	9.80	34.30		18.90	38.20	27.50
11	2.90	3.80	5.70	6.80	16.30	10.20	42.80		16.30	30.50	26.70
12	3.50	3.20	5.50	5.70	12.80	8.80	36.00		21.70	36.50	27.50
13	3.70	4.30	6.00	5.60	11.90	8.30	36.10		21.90	35.50	28.40
14	2.00	1.70	3.90	4.00	9.00	7.30	25.90		28.10	43.20	30.90
15	3.70	3.40	6.20	6.00	13.60	10.10	39.30		21.30	36.80	23.90
16	3.80	3.70	5.40	5.60	12.30	9.30	36.30		22.00	37.50	26.20
17	0.10	4.80	6.20	6.00	13.80	9.60	40.40		20.60	35.40	24.20
18	0.10	1.60	7.50	10.40	19.20	8.30	47.00		13.10	22.70	30.30
19	0.10	1.70	5.00	5.40	14.00	12.30	38.40		22.00	36.60	25.00
20	2.00	4.80	5.90	4.60	9.80	8.50	33.60		24.40	38.70	27.70
21	4.00	5.70	7.80	5.30	10.80	8.90	38.50		23.80	38.70	22.80
22	3.00	3.70	7.10	6.20	12.70	9.90	39.60		24.00	39.20	21.20
23	8.00	4.80	7.30	6.10	12.50	9.30	40.00		23.30	39.20	20.80
24	0.00	5.30	8.90	7.10	14.70	10.00	46.00		18.40	33.70	20.30
25	0.00	2.90	5.80	5.80	13.60	8.90	37.00		19.20	32.50	30.50
26	0.10	3.40	6.20	5.90	13.40	8.80	37.70		21.50	35.50	26.80

27	0.10	4.30	5.70	4.90	10.80	7.80	33.50		22.10	35.40	31.10
28	4.00	4.20	7.60	5.80	12.80	9.00	39.40		20.50	35.60	25.00
29	5.00	4.50	8.10	7.30	15.60	12.00	47.50		19.80	35.90	16.60
30	7.00	5.70	7.30	6.30	13.40	9.70	42.40		23.50	37.20	20.40
31	4.32	2.11	3.64	7.86	21.67	14.56	49.57	13.51	19.76	31.75	18.68
32	3.65	1.36	3.11	6.10	19.12	13.19	42.64	18.07	21.45	39.05	18.31
33	4.10	2.56	3.70	7.50	21.12	14.32	49.20	15.33	21.90	37.23	13.57
34	4.54	2.33	3.97	7.44	21.32	14.67	49.53	18.11	19.65	36.91	13.56
35	0.19	0.65	1.91	4.77	10.61	10.98	29.50	24.73	21.43	46.80	23.70
36	0.57	1.96	2.55	4.51	10.61	13.43	33.44	29.35	19.19	46.78	19.78
37	0.09	0.44	1.25	2.91	7.06	11.61	23.27	30.50	19.55	50.05	26.69
38	1.41	0.87	1.61	4.14	10.66	15.32	32.59	24.75	17.94	42.69	24.72
39	1.43	2.83	3.55	6.11	13.34	13.74	39.49	17.73	19.51	35.89	24.62
40	3.67	3.22	4.19	7.70	16.34	12.68	44.14	14.94	20.32	35.26	20.61
41	1.82	2.07	3.92	7.80	13.63	10.30	37.71	16.15	17.32	33.47	28.82
42	2.12	2.66	4.21	8.79	15.12	10.44	41.22	14.52	16.98	31.50	27.28
43	4.76	4.45	4.94	8.40	13.35	9.46	40.60	13.79	22.42	36.21	23.18
44	4.25	3.75	5.12	8.17	13.18	9.36	39.58	14.48	21.83	36.31	24.12
45	2.83	2.69	4.36	7.10	11.56	8.25	33.96	11.47	22.82	34.28	31.76
46	1.26	2.53	4.31	9.28	15.34	9.47	40.93	11.38	21.14	32.52	26.55
47	1.75	5.67	5.67	10.30	15.18	8.26	45.07	12.62	16.99	29.61	25.32
48	2.57	2.17	5.66	12.63	15.18	7.53	43.17	8.51	16.26	24.77	32.06
49	5.51	6.95	7.49	11.28	13.02	8.61	47.35	11.20	20.59	31.79	20.86
50	4.80	3.36	5.52	8.10	11.72	9.22	37.92	16.56	19.01	35.57	26.51
51	6.29	4.87	5.64	8.69	13.24	9.94	42.38	13.39	24.03	37.42	20.20
52	1.31	3.80	5.21	8.18	13.39	11.75	42.32	17.71	18.65	36.36	21.32
53	1.63	1.60	3.04	5.38	9.63	13.02	32.67	27.43	21.20	48.63	18.70
54	0.62	0.69	1.36	2.80	6.89	11.00	22.80	32.33	20.43	51.71	25.49
55	0.85	1.08	1.35	2.37	5.32	11.22	21.35	31.81	30.13	61.95	16.71

APPENDIX R. SOIL ORGANIC CARBON SOIL ORGANIC MATTER AND WATER CHARACTERISTIC INFORMATION FOR HISTORIC AND CURRENT PEDONS

ID	Organic Carbon Walkley Black	Organic Carbon LOI	Soil Organic Matter	1/10 Water Bar	1/3 Water Bar	15 Bar Water	Water Content Saturation Extract
	% by weight						
1	5.22		9.02				61.3
2	2.42		4.18				48.2
3	1.55		2.68				45.7
4	1.33		2.30				36.4
5	0.70		1.21				40.2
6	0.49		0.85				41.8
7	0.33		0.57				41.3
8	0.18		0.31				42
9	0.16		0.28				38.5
10	3.50		6.05	42.9	28.2	14.7	56.5
11	1.40		2.42	26.9	20.8	11.2	45.9
12	0.60		1.04	25.6	19.3	8.9	42.1
13	0.20		0.35	24.6	20	9.1	43.6
14	0.20		0.35	28.5	24	11.2	47.3
15	0.10		0.17	25.7	19.5	8.8	40.2
16	0.10		0.17	26.2	20.7	9.6	44.1
17	3.96		6.84	37.6	26.4	13	56
18	0.94		1.62	26.3	30.6	11.8	46.8
19	0.68		1.18	31.2	23.4	14.4	52.9
20	0.36		0.62	33	23.4	12.3	47.3
21	0.19		0.33	33.1	23.8	12.4	47.4
22	0.11		0.19	31.6	24.5	12.9	47.2
23	0.11		0.19	30.9	24.1	12.6	45
24	3.18		5.50	37	23.3	12.5	49.8
25	0.92		1.59	32.3	24.7	15.2	53.77
26	0.71		1.23	29.8	23.7	14	52.2
27	0.47		0.81	32.3	24	12.8	47.8
28	0.25		0.43	28.6	22.2	11.3	45.1
29	0.12		0.21	24.1	18.2	9.1	38.7
30	0.12		0.21	30.2	30	13.1	46.4
31	1.28	1.32	2.29		21.1	9.4	42.7
32	0.40	0.67	1.16		24.5	8.8	45.2

33	0.16	0.47	0.81		22.5	7.9	40.6
34	0.15	0.45	0.78		22.0	7.9	40.9
35	3.72	3.84	6.63		32.1	14.2	60.1
36	1.08	1.33	2.30		21.0	7.7	37.9
37	0.93	1.37	2.36		26.2	12.0	52.8
38	0.42	0.79	1.37		21.8	9.1	45.3
39	0.23	0.58	1.01		20.7	9.4	43.6
40	0.30	0.58	1.00		23.5	9.5	45.4
41	2.71	2.58	4.46	34.1	25.3	12.4	48.5
42	0.94	1.23	2.12	29.4	21.0	9.6	46.1
43	0.65	0.91	1.57	25.1	18.3	8.0	41.5
44	0.46	0.75	1.30	25.1	18.0	7.6	39.6
45	0.38	0.69	1.19	25.9	19.9	8.7	46.3
46	3.26	3.13	5.40	40.2	29.7	16.5	53.2
47	1.16	1.42	2.45	29.6	20.6	10.7	39.2
48	0.60	1.07	1.84	30.4	21.6	11.8	49.0
49	0.49	0.86	1.49	33.0	22.2	13.3	49.9
50	0.38	0.75	1.29	35.9	27.1	11.6	44.7
51	0.21	0.62	1.07	34.6	26.2	12.0	44.3
52	2.07	2.03	3.52	37.0	25.0	11.4	42.8
53	0.78	1.02	1.77	35.6	24.1	9.8	47.6
54	0.53	0.78	1.34	39.8	30.0	10.4	47.1
55	0.31	0.59	1.03	37.6	26.8	9.1	45.0

APPENDIX S. TEXTURE, SOM, CCE, EC 1:1, ECE, PH 1:1, AND TOTAL CARBON, NITROGEN AND SULFUR FOR TRANSECT PEDONS

ID	Texture	% OM (LOI)	CCE % by Weight	EC 1:1 dS/m	Electrical Conductivity Saturated Paste Converted Hogg/Henry dS/m	pH 1:1	Carbon, Total NCS, % wt	Nitrogen, Total NCS, % wt	Sulfur, Total NCS, % wt
56	L	3.05	13.05	2.34	6.27	7.78	2.82	0.11	0.03
57	L	1.02	24.98	2.43	6.54	8.33	3.44	0.03	0.03
58	L	0.85	16.28	2.14	5.67	8.34	2.27	0.01	0.03
59	L	0.75	14.74	1.62	4.10	8.37			
60	L	0.68	16.02	1.43	3.54	8.31			
61	L	0.69	15.45	1.26	3.01	8.30			
62	L	2.87	4.15	0.93	2.04	7.67	2.36	0.16	0.01
63	L	2.87	0.54	1.09	2.52	7.59	1.75	0.13	0.01
64	L	1.49	0.35	1.12	2.60	7.79	0.71	0.07	0.01
65	L	1.25	12.63	1.06	2.42	8.17			
66	L	1.03	19.63	0.87	1.85	8.29			
67	L	3.17	1.75	1.09	2.51	7.82	2.20	0.17	0.02
68	L	3.22	0.27	1.62	4.11	7.66	2.12	0.16	0.03
69	L	2.10	0.12	1.68	4.30	7.68	1.00	0.10	0.03
70	L	1.55	26.88	2.72	7.41	7.75			
71	CL	0.95	16.32	1.22	2.91	8.04			
72	CL	1.10	21.90	1.22	2.91	8.08			
73	L	3.34	0.62	2.68	7.29	7.97	2.26	0.23	0.08
74	L	3.27	0.50	3.34	9.28	7.67	2.24	0.16	0.12
75	L	2.26	0.08	2.67	7.26	7.52	1.09	0.11	0.08
76	CL	1.51	33.31	2.61	7.08	7.82	4.74	0.05	0.50
77	CL	0.96	22.98	1.55	3.90	7.76			
78	L	3.01	0.49	3.67	10.27	7.79	2.08	0.15	0.16
79	L	3.10	0.42	2.66	7.23	7.85	1.93	0.14	0.20
80	L	1.95	0.62	1.30	3.14	7.78	1.06	0.10	0.05
81	L	1.12	29.79	1.52	3.80	8.10			

82	L	1.04	14.04	0.75	1.49	8.12			
83	CL	0.89	21.04	3.74	10.48	8.16			
84	L	3.16	0.60	3.33	9.25	7.76	2.06	0.18	0.25
85	CL	1.46	25.29	2.61	7.08	7.64	3.76	0.06	0.13
86	L	2.54	1.59	1.85	4.81	8.06	1.64	0.12	0.03
87	CL	1.12	27.41	1.61	4.06	8.00			
88	L	0.79	20.86	0.94	2.07	7.97			
89	L	2.88	0.74	3.50	9.76	8.22	1.95	0.17	0.16
90	CL	2.81	0.49	3.43	9.55	7.72	1.82	0.12	0.17
91	CL	2.16	0.02	2.89	7.93	7.31	1.18	0.09	0.13
92	CL	0.87	28.60	0.91	1.97	8.11			
93	CL	0.80	16.10	0.74	1.44	8.13			
94	CL	0.78	17.20	0.81	1.66	8.06			
95	L	2.77	1.79	0.73	1.42	7.85	1.81	0.15	0.02
96	L	1.67	0.37	0.74	1.46	7.84	0.62	0.07	0.01
97	L	1.20	24.16	2.33	6.24	8.01	3.47	0.06	0.07
98	L	0.86	22.14	1.15	2.69	8.33			
99	CL	0.90	19.13	1.01	2.28	8.32			
100	CL	0.74	16.76	0.83	1.74	8.32			
101	L	2.99	0.75	0.58	0.97	7.64	1.84	0.15	0.01
102	L	1.93	0.27	0.32	0.20	7.79	0.78	0.08	0.00
103	L	1.47	0.32	0.77	1.54	7.88	0.53	0.06	0.01
104	L	1.14	27.81	1.51	3.78	8.21			
105	L	0.85	20.82	0.91	1.97	8.23			
106	CL	0.72	16.85	0.77	1.54	8.20			
107	L	2.94	0.82	0.52	0.80	7.68	1.81	0.14	0.01
108	L	1.90	0.29	0.27	0.05	7.84	0.86	0.07	0.00
109	L	1.35	0.17	0.36	0.30	8.10	0.42	0.04	0.00
110	L	1.03	1.42	0.64	1.15	8.01			
111	CL	0.91	20.42	1.16	2.71	8.10			

112	CL	0.78	16.47	1.17	2.74	8.13			
113	L	3.10	3.31	0.60	1.03	7.87	2.22	0.18	0.01
114	L	2.14	7.64	0.43	0.53	7.95	2.07	0.19	0.03
115	L	1.24	21.93	0.38	0.38	8.32	3.01	0.14	0.04
116	L	0.99	19.82	1.14	2.66	8.27			
117	CL	0.77	17.09	1.24	2.97	8.29			
118	CL	0.69	17.30	1.39	3.40	8.18			
119	L	2.43	4.68	0.69	1.30	7.79	1.94	0.25	0.03
120	L	1.39	1.23	0.37	0.33	8.02	0.59	0.15	0.03
121	L	1.13	22.78	1.00	2.24	8.21	3.18	0.11	0.04
122	L	0.93	18.87	1.74	4.47	8.21			
123	CL	0.75	15.38	1.04	2.35	8.19			
124	L	2.26	8.10	0.66	1.21	7.95	2.30	0.18	0.03
125	L	1.18	2.65	0.37	0.35	8.07	0.84	0.14	0.02
126	L	1.05	20.19	0.40	0.42	8.32	2.74	0.12	0.02
127	L	0.88	18.92	0.42	0.51	8.52	2.52	0.11	0.02
128	L	0.64	16.06	0.54	0.84	8.69			
129	CL	0.74	22.04	0.57	0.95	8.54			
130	L	2.32	2.83	0.33	0.21	8.13	1.60	0.20	0.02
131	L	1.37	6.01	0.38	0.38	8.11	1.21	0.18	0.02
132	L	1.07	27.92	0.87	1.83	8.59	3.78	0.13	0.04
133	CL	0.71	17.63	0.65	1.20	8.50			
134	L	2.13	3.65	0.43	0.54	8.07	1.68	0.20	0.02
135	L	1.55	1.70	0.43	0.51	7.94	0.84	0.15	0.02
136	L	1.13	19.08	0.89	1.89	8.26	2.73	0.12	0.04
137	L	0.80	16.91	0.96	2.13	8.46			
138	CL	0.72	16.02	0.63	1.12	8.63			
139	L	2.01	13.06	1.47	3.66	8.19	2.73	0.19	0.05
140	L	0.85	17.09	1.52	3.81	8.36	2.34	0.12	0.05
141	L	0.78	15.02	0.98	2.16	8.50	1.99	0.10	0.03

142	CL	0.75	16.04	0.74	1.45	8.45			
143	L	2.17	8.22	0.55	0.89	8.17	2.20	0.20	0.04
144	L	1.01	16.08	0.65	1.17	8.69	2.24	0.12	0.03
145	L	1.03	14.50	0.62	1.10	8.87	2.08	0.14	0.03
146	L	0.94	16.93	0.45	0.58	8.87			
147	L	0.99	14.53	0.38	0.37	8.73			
148	CL	0.90	14.65	0.32	0.18	8.74			
149	CL	6.09	0.10	0.81	1.68	5.24	4.00	0.47	0.07
150	L	2.13	0.07	0.26	0.01	6.54	1.07	0.14	0.03
151	C	2.13	0.12	0.58	0.56	7.42	0.97	0.20	0.03
152	C	1.16	4.40	1.99	4.32	7.73	1.04	0.62	0.19
153	CL	1.03	17.77	2.31	6.18	7.86			
154	CL	1.05	15.97	1.15	2.69	8.44			
155	CL	0.89	12.05	1.01	2.27	5.26			
156	L	6.63	0.08	0.54	0.85	6.28	4.08	0.42	0.06
157	L	3.01	0.08	0.44	0.56	7.84	1.80	0.25	0.04
158	C	2.42	0.07	0.91	1.46	7.92	1.18	0.23	0.04
159	C	2.06	0.08	3.04	7.11	7.75			
160	C	1.10	0.45	3.41	8.10	7.86			
161	C	0.94	8.86	3.09	7.25	7.99			
162	CL	0.93	12.00	2.19	5.82	8.18			
163	CL	6.16	0.12	0.68	1.27	5.28	3.98	0.43	0.06
164	SIL	2.81	0.05	0.52	0.80	6.28	1.63	0.23	0.04
165	C	3.20	0.10	1.28	2.44	7.01	1.95	0.29	0.06
166	C	1.57	0.14	2.54	5.78	7.57			
167	CL	1.17	0.15	2.70	7.35	7.73			
168	CL	1.00	0.22	2.12	5.61	8.10			
169	CL	6.05	0.12	1.03	2.33	5.52	3.88	0.42	0.07
170	L	2.54	0.07	1.06	2.41	7.16	1.37	0.20	0.04
171	L	1.61	1.03	1.11	2.56	7.75	0.87	0.17	0.03

172	L	1.05	25.44	1.04	2.36	8.31			
173	CL	0.98	21.28	1.05	2.39	8.38			
174	CL	0.94	16.45	1.10	2.55	8.36			
175	CL	0.84	14.26	1.14	2.65	8.22			
176	CL	5.23	0.14	1.13	2.62	5.50	3.56	0.42	0.08
177	CL	2.61	0.15	0.85	1.78	6.77	1.52	0.24	0.04
178	C	2.24	2.29	1.57	3.21	7.44	0.89	0.16	0.03
179	CL	1.08	15.29	2.19	5.82	7.97			
180	CL	0.99	21.36	1.83	4.74	8.08			
181	CL	0.91	17.48	2.15	5.70	8.06			
182	CL	0.89	14.52	2.30	6.15	7.99			
183	L	5.17	0.20	0.79	1.60	5.33	3.23	0.40	0.04
184	L	2.07	0.21	0.44	0.55	6.26	1.21	0.16	0.03
185	CL	1.12	0.08	1.47	3.66	7.70	0.40	0.13	0.03
186	CL	0.95	4.48	3.72	10.42	7.99			
187	CL	0.92	17.87	3.76	10.54	8.07			
188	CL	0.94	17.69	3.02	8.32	8.21			
189	CL	0.86	12.86	2.65	7.20	8.10			
190	L	6.21	0.22	0.70	1.33	5.35	3.82	0.43	0.05
191	L	2.28	0.07	0.16	0.00	6.73	1.26	0.20	0.02
192	CL	1.82	0.32	0.53	0.81	7.52	0.70	0.12	0.02
193	CL	1.00	21.52	2.43	6.54	7.91	2.97	0.10	0.26
194	CL	0.92	14.57	1.79	4.61	8.08			
195	CL	0.83	12.91	0.92	2.00	8.44			
196	L	5.19	0.24	0.85	1.78	6.69	3.56	0.44	0.05
197	CL	2.46	0.44	0.41	0.47	7.72	1.18	0.22	0.03
198	L	1.86	16.08	0.38	0.37	8.14	2.80	0.18	0.03
199	CL	1.16	24.02	0.47	0.65	8.30	3.38	0.12	0.03
200	CL	0.85	14.29	0.60	1.03	8.50			
201	CL	0.81	13.19	0.56	0.92	8.90			

202	CL	0.79	12.36	0.58	0.99	8.97			
203	L	4.82	0.11	0.53	0.84	4.90	3.15	0.39	0.05
204	L	2.09	0.13	0.19	0.00	6.33	1.02	0.18	0.02
205	L	1.75	0.10	0.57	0.94	7.16	0.67	0.16	0.02
206	L	0.87	8.84	3.25	9.01	7.97			
207	CL	0.79	17.58	1.21	2.88	8.65			
208	L	0.88	17.92	1.22	2.90	8.77			
209	CL	0.84	14.05	1.27	3.05	8.83			
210	CL	5.00	0.14	0.60	1.04	5.74	3.07	0.27	0.01
211	CL	2.36	0.24	0.37	0.33	7.63	1.08	0.10	0.00
212	CL	1.58	21.25	0.56	0.91	8.10	3.36	0.08	0.01
213	CL	1.05	19.42	1.65	4.18	8.03			
214	CL	0.90	10.49	3.18	8.80	7.96			
215	CL	0.80	13.42	1.10	2.54	8.37			
216	L	5.52	0.22	0.41	0.48	6.50	3.24	0.31	0.03
217	L	2.88	0.65	0.33	0.22	7.71	1.60	0.14	0.01
218	CL	1.73	29.33	0.31	0.16	8.24	4.42	0.10	0.01
219	CL	1.19	21.82	0.47	0.63	8.39	3.10	0.05	0.01
220	CL	0.96	12.67	2.15	5.70	7.91			
221	CL	0.81	12.87	1.82	4.69	7.87			
222	CL	5.62	0.09	0.63	1.12	5.30	3.49	0.35	0.02
223	C	2.29	0.04	0.25	0.00	6.98	0.99	0.12	0.00
224	CL	1.34	23.73	0.78	1.57	8.10	3.38	0.03	0.03
225	CL	1.10	14.74	2.99	8.23	7.88			
226	CL	0.79	12.53	2.03	5.34	8.05			
227	CL	4.68	0.15	0.58	0.97	5.66	2.89	0.26	0.02
228	CL	2.42	0.20	0.31	0.16	7.31	1.08	0.10	0.00
229	CL	1.52	21.02	0.37	0.35	8.26	3.04	0.05	0.00
230	CL	1.12	18.34	0.68	1.26	8.35			
231	CL	0.91	13.41	2.68	7.29	7.89			

232	CL	0.85	11.72	1.03	2.32	8.22			
233	L	4.25	0.15	0.82	1.71	6.45	2.51	0.24	0.01
234	L	2.75	0.22	0.47	0.63	7.57	1.33	0.12	0.00
235	L	1.48	22.37	0.44	0.54	8.20	3.42	0.07	0.00
236	L	1.21	16.30	0.79	1.59	8.28			
237	CL	0.94	12.39	2.98	8.20	7.90			
238	CL	1.01	11.94	2.61	7.08	7.96			
239	CL	0.87	15.76	2.72	7.41	8.00			
240	CL	4.45	0.30	0.98	2.17	6.66	2.63	0.26	0.01
241	L	1.62	21.36	0.34	0.26	8.22	3.34	0.09	0.00
242	CL	1.20	17.28	0.38	0.36	8.49	2.56	0.05	0.00
243	CL	1.00	16.58	0.60	1.03	8.52			
244	CL	0.81	11.09	2.74	7.47	7.95			
245	CL	0.79	13.09	0.85	1.80	8.34			
246	L	3.91	0.08	0.97	2.16	5.74	2.31	0.24	0.01
247	SCL	1.63	0.48	0.26	0.00	7.69	0.68	0.05	0.00
248	CL	1.24	9.63	0.42	0.49	8.10	1.66	0.04	0.00
249	CL	0.97	19.30	0.52	0.80	8.35			
250	CL	0.94	14.79	0.37	0.36	8.69			
251	CL	0.81	11.73	0.35	0.28	8.82			
252	L	6.09	0.02	0.45	0.57	5.46	3.77	0.32	0.01
253	L	2.19	0.18	0.22	0.00	6.66	1.16	0.09	0.00
254	C	2.56	0.09	0.69	0.87	7.36	1.33	0.15	0.01
255	CL	1.04	6.93	2.95	8.11	7.88	1.04	0.00	1.06
256	CL	0.88	17.18	2.87	7.87	8.03			
257	CL	0.86	9.29	1.31	3.18	8.31			
258	CL	0.83	15.65	1.25	2.98	8.31			
259	L	5.84	0.12	0.73	1.43	6.08	3.74	0.33	0.04
260	CL	2.27	0.18	0.41	0.48	7.13	1.07	0.11	0.00
261	CL	1.66	2.20	0.81	1.66	7.82	1.00	0.09	0.01

262	L	1.13	28.51	1.06	2.43	8.16			
263	CL	0.96	14.38	0.96	2.13	8.42			
264	CL	0.83	13.76	1.29	3.12	8.25			
265	CL	6.13	0.17	0.70	1.35	5.71	3.94	0.38	0.02
266	CL	3.26	0.17	0.95	2.08	6.74	1.79	0.17	0.01
267	CL	2.13	0.16	1.21	2.86	7.47	1.01	0.10	0.02
268	CL	1.49	15.50	1.44	3.57	7.95			
269	CL	1.03	18.36	1.06	2.41	8.23			
270	CL	1.00	12.07	3.15	8.71	8.00			
271	CL	0.88	10.09	3.25	9.01	7.97			
272	L	5.45	0.08	0.63	1.12	5.88	3.54	0.30	0.03
273	CL	2.22	0.12	1.25	2.99	7.22	1.10	0.13	0.01
274	CL	1.78	0.27	1.15	2.69	7.69	0.70	0.08	0.01
275	CL	1.40	23.71	1.07	2.46	8.10			
276	CL	1.08	15.69	0.90	1.94	8.34			
277	CL	1.05	13.66	0.89	1.90	8.33			
278	SCL	0.80	6.93	0.76	1.04	8.30			
279	L	4.90	0.15	0.67	1.25	6.19	3.23	0.30	0.02
280	L	3.02	0.12	0.43	0.53	7.44	1.77	0.17	0.00
281	CL	2.23	2.87	0.52	0.79	8.01	1.20	0.10	0.00
282	CL	1.53	15.65	0.43	0.53	8.29			
283	SCL	1.02	9.73	0.33	0.00	8.51			
284	LS	0.57	9.33	0.26	0.73	8.66			
285	CL	3.20	0.19	0.33	0.21	7.20	1.88	0.17	0.01
286	CL	1.80	11.87	0.36	0.32	8.08	2.15	0.10	0.00
287	CL	1.30	24.09	0.33	0.22	8.61	3.28	0.02	0.00
288	CL	1.26	27.11	0.34	0.24	8.81	3.51	0.04	0.01
289	CL	1.07	19.71	0.38	0.37	8.96			
290	CL	0.96	17.88	0.45	0.58	8.93			
291	CL	0.92	11.89	0.42	0.50	8.81			

292	L	3.53	0.57	0.34	0.25	7.83	2.08	0.19	0.00
293	CL	2.33	4.14	0.32	0.19	7.90	1.54	0.09	0.00
294	L	1.64	17.10	0.30	0.13	8.17	2.82	0.06	0.00
295	CL	1.22	18.60	0.31	0.18	8.43	2.55	0.05	0.00
296	CL	1.13	13.86	0.37	0.35	8.79			
297	CL	0.98	10.56	0.46	0.62	9.00			
298	CL	3.60	1.19	0.36	0.31	7.95	2.25	0.22	0.01
299	CL	2.65	7.25	0.32	0.19	8.06	2.29	0.13	0.00
300	L	2.34	14.36	0.29	0.11	8.18	2.81	0.09	0.00
301	L	1.23	12.32	1.28	3.08	8.24			
302	CL	1.13	10.45	2.37	6.36	8.00			
303	L	3.22	0.19	1.32	3.20	6.76	1.89	0.19	0.00
304	L	1.70	0.22	0.35	0.27	7.36	0.80	0.07	0.02
305	L	1.40	0.17	0.27	0.05	7.81	0.54	0.05	0.00
306	SL	1.18	0.82	0.24	0.00	8.14	0.57	0.06	0.01
307	SL	0.86	7.06	0.25	0.00	8.42			
308	SL	0.59	7.93	0.45	0.59	8.63			
309	SL	0.60	9.59	0.98	2.19	8.51			
310	CL	3.08	0.12	0.35	0.28	7.28	1.70	0.15	0.01
311	CL	1.62	0.49	0.74	1.44	9.15	0.71	0.06	0.00
312	CL	1.09	28.69	0.70	1.33	9.72	3.87	0.02	0.01
313	CL	0.72	14.69	0.67	1.25	9.69			
314	SL	0.55	10.23	0.63	1.13	9.74			
315	SL	0.42	5.08	0.46	0.63	9.68			
316	LS	0.36	5.75	0.23	0.62	9.36			
317	L	2.99	0.15	0.21	0.00	6.11	1.71	0.17	0.00
318	CL	2.20	0.27	0.32	0.19	8.41	1.02	0.12	0.00
319	L	1.32	15.91	1.02	2.29	8.88	2.47	0.04	0.02
320	SCL	1.00	15.09	1.75	3.70	8.57			
321	SCL	0.89	12.43	1.49	2.99	8.42			

322	SCL	0.75	9.99	1.30	2.50	8.49			
323	SCL	0.90	8.77	1.15	2.08	8.49			
324	L	3.43	0.12	1.13	2.63	5.99	2.05	0.19	0.01
325	CL	1.74	0.77	0.51	0.77	7.85	0.73	0.08	0.00
326	L	1.14	18.26	0.43	0.53	9.00	2.48	0.06	0.00
327	L	1.00	16.53	0.56	0.91	9.38			
328	CL	0.87	16.65	0.64	1.17	9.36			
329	CL	0.83	16.92	0.67	1.25	9.34			
330	CL	0.79	11.88	0.64	1.17	9.19			
331	L	3.19	0.17	0.36	0.33	7.11	1.87	0.20	0.00
332	CL	1.95	1.67	0.31	0.17	7.88	1.02	0.07	0.00
333	L	1.32	16.74	0.29	0.09	8.40	2.46	0.05	0.00
334	L	1.11	17.65	0.27	0.03	8.64			
335	CL	0.99	13.66	0.71	1.36	8.43			
336	CL	0.86	8.99	2.04	5.37	7.97			
337	CL	3.27	0.59	0.32	0.19	7.92	2.08	0.21	0.01
338	L	2.62	1.13	0.31	0.15	8.16	1.45	0.15	0.00
339	L	2.11	10.85	0.40	0.42	8.44	2.24	0.11	0.00
340	L	1.39	22.43	1.09	2.51	8.34	3.14	0.05	0.02
341	L	1.36	13.33	2.58	6.99	8.19			
342	SIL	1.07	12.70	2.26	6.03	8.16			
343	SIL	1.15	5.38	3.53	9.85	7.96			
344	L	2.83	0.17	0.24	0.00	7.62	1.70	0.14	0.00
345	L	1.65	0.10	0.20	0.00	7.90	0.67	0.05	0.00
346	L	1.26	8.30	0.24	0.00	8.41	1.48	0.03	0.00
347	L	1.19	15.74	0.28	0.07	8.62			
348	L	1.03	15.29	0.37	0.35	8.71			
349	L	0.98	9.46	0.58	0.96	8.65			
350	L	0.97	7.39	1.34	3.25	8.46			
351	L	3.24	0.12	0.62	1.09	6.81	1.82	0.20	0.00

352	L	1.64	0.02	0.14	0.00	7.81	0.63	0.05	0.00
353	SL	1.27	0.10	0.20	0.00	8.00	0.47	0.03	0.00
354	SL	1.02	8.76	0.19	0.00	8.42			
355	SL	0.81	8.34	0.22	0.00	8.49			
356	SL	0.69	6.08	0.25	0.00	8.70			
357	SL	0.81	6.78	0.50	0.74	8.65			
358	SL	0.77	5.49	1.10	2.54	8.43			
359	L	3.38	0.08	0.14	0.00	6.67	1.84	0.18	0.01
360	CL	2.14	0.47	0.28	0.07	8.07	0.88	0.07	0.00
361	CL	1.55	19.20	0.33	0.24	8.67	2.81	0.05	0.00
362	CL	1.08	19.45	0.35	0.29	8.98	2.56	0.01	0.00
363	CL	0.99	19.85	0.40	0.44	9.14			
364	CL	0.94	13.39	0.51	0.77	9.22			
365	CL	0.93	11.49	0.52	0.80	9.13			
366	L	3.58	0.25	0.26	0.01	6.80	2.02	0.17	0.00
367	CL	1.97	0.12	0.19	0.00	7.42	0.75	0.08	0.00
368	CL	1.56	0.99	0.44	0.55	8.12	0.60	0.05	0.00
369	CL	1.13	19.57	1.12	2.60	8.19	2.74	0.02	0.03
370	CL	0.99	16.40	1.70	4.34	8.19			
371	CL	0.99	10.61	3.19	8.83	7.93			
372	CL	0.87	9.16	2.67	7.26	7.88			
373	L	3.53	0.19	0.32	0.18	7.13	2.11	0.21	0.01
374	CL	1.70	1.20	0.65	1.17	8.28	0.88	0.08	0.00
375	L	1.29	21.65	2.71	7.38	8.45	3.17	0.03	0.06
376	L	1.04	17.66	3.29	9.13	8.52	2.48	0.01	0.06
377	L	0.98	14.08	2.54	6.87	8.45			
378	CL	0.97	12.32	2.43	6.54	8.41			
379	CL	0.92	10.44	2.02	5.31	8.34			
380	L	4.23	0.19	0.26	0.02	6.15	2.46	0.24	0.01
381	L	3.74	0.17	0.19	0.00	6.31	2.26	0.23	0.00

382	CL	1.84	0.17	0.16	0.00	6.55	0.69	0.09	0.00
383	CL	1.67	0.18	0.19	0.00	6.58	0.62	0.08	0.00
384	CL	1.46	0.14	0.19	0.00	7.07			
385	CL	1.23	0.10	0.21	0.00	7.12			
386	CL	1.08	0.14	0.33	0.23	7.80			
387	L	5.78	0.07	0.34	0.25	5.40	3.44	0.36	0.02
388	L	5.20	0.04	0.18	0.00	6.04	3.26	0.30	0.01
389	L	4.56	0.04	0.13	0.00	6.11	2.83	0.28	0.00
390	L	1.39	0.09	0.08	0.00	6.41	0.65	0.05	0.00
391	C	1.63	0.15	0.11	0.00	6.38			
392	C	1.03	0.02	0.14	0.00	6.55			
393	CL	0.83	0.00	0.10	0.00	6.78			
394	L	3.46	0.07	0.23	0.00	6.29	2.15	0.20	0.01
395	L	2.20	0.15	0.27	0.03	7.47	1.06	0.10	0.00
396	L	1.75	12.39	0.31	0.15	8.11	2.35	0.11	0.00
397	SL	0.86	3.73	0.29	0.09	8.24			
398	SCL	1.02	1.60	0.35	0.00	8.07			
399	SL	0.72	5.98	0.23	0.00	8.11			
400	CL	0.98	7.68	0.31	0.17	8.04			
401	L	3.75	0.15	0.39	0.39	6.12	2.24	0.22	0.01
402	L	1.79	0.10	0.20	0.00	7.34	0.87	0.10	0.00
403	L	1.65	0.13	0.25	0.00	7.97	0.86	0.08	0.00
404	L	1.30	0.22	0.25	0.00	7.96			
405	L	1.13	0.20	0.20	0.00	7.89			
406	L	0.79	0.13	0.16	0.00	8.00			
407	CL	0.91	2.15	0.29	0.09	8.06			
408	L	3.40	0.10	0.20	0.00	6.17	1.99	0.20	0.00
409	L	1.71	0.20	0.15	0.00	7.00	0.83	0.08	0.00
410	L	1.83	0.19	0.19	0.00	7.56	0.95	0.08	0.00
411	L	1.74	0.17	0.21	0.00	7.57			

412	SL	1.02	0.17	0.14	0.00	7.45			
413	SL	0.82	0.14	0.08	0.00	7.27			
414	L	1.03	0.10	0.10	0.00	7.14			
415	CL	0.92	0.12	0.16	0.00	7.43			
416	L	3.39	0.07	0.20	0.00	6.11	2.03	0.21	0.01
417	L	1.93	0.17	0.14	0.00	6.96	0.87	0.09	0.00
418	L	1.87	0.18	0.12	0.00	7.22	0.87	0.11	0.02
419	L	1.38	0.12	0.12	0.00	7.01			
420	CL	1.04	0.15	0.15	0.00	7.52			
421	CL	1.35	8.54	0.39	0.39	7.87			
422	CL	0.74	7.65	0.26	0.01	8.11			
423	CL	0.75	7.65	0.28	0.08	8.10			
424	L	3.67	-0.02	0.14	0.00	5.86	2.05	0.19	0.01
425	L	1.90	0.02	0.12	0.00	6.72	0.84	0.08	0.00
426	CL	2.05	0.02	0.09	0.00	6.82	0.99	0.10	0.00
427	CL	1.29	0.04	0.10	0.00	6.89			
428	CL	1.08	0.08	0.10	0.00	6.96			
429	CL	1.07	0.00	0.10	0.00	7.24			
430	CL	1.07	0.59	0.17	0.00	7.75			
431	L	7.60	0.00	0.54	0.86	6.42	4.56	0.43	0.03
432	L	3.12	0.07	0.22	0.00	6.09	1.77	0.15	0.00
433	SL	1.63	0.08	0.29	0.11	6.62	0.77	0.06	0.00
434	C	1.87	0.22	2.53	5.76	7.50	0.70	0.06	0.04
435	SCL	1.01	0.02	5.42	13.44	7.99	0.37	0.10	0.28
436	SL	0.59	0.02	5.69	16.35	8.15			
437	LS	0.47	-0.01	3.93	11.77	8.15			
438	CL	0.65	2.86	4.72	13.43	8.41			
439	L	6.13	-0.05	0.49	0.71	7.05	3.60	0.33	0.04
440	CL	2.83	-0.01	0.28	0.08	7.72	1.28	0.12	0.00
441	C	1.83	0.14	0.80	1.16	7.69	0.69	0.07	0.00

442	CL	1.27	8.74	5.78	16.62	8.45			
443	CL	1.01	11.42	5.69	16.35	8.60			
444	CL	0.90	12.97	5.70	16.38	8.52			
445	CL	0.83	10.06	5.31	15.21	8.41			
446	L	8.77	0.11	0.66	1.23	6.75	5.56	0.52	0.04
447	L	5.27	0.25	0.39	0.41	7.68	3.20	0.29	0.01
448	L	2.65	0.08	0.23	0.00	8.04	1.38	0.12	0.00
449	L	1.89	4.74	0.45	0.58	7.87	1.54	0.07	0.00
450	L	1.35	14.31	2.83	7.75	8.09			
451	CL	1.19	13.15	3.91	11.00	8.28			
452	CL	0.98	6.89	4.88	13.92	8.14			
453	L	8.34	0.02	0.68	1.26	6.69	4.91	0.47	0.03
454	L	4.20	0.29	0.44	0.55	7.02	2.51	0.28	0.01
455	L	2.85	0.15	0.23	0.00	7.33	1.49	0.12	0.00
456	CL	1.63	3.82	3.97	11.18	7.64	1.15	0.09	0.09
457	CL	1.34	18.96	6.80	19.69	8.25			
458	CL	1.03	13.31	4.72	13.43	8.32			
459	CL	0.93	10.54	4.71	13.40	8.23			
460	L	7.00	0.15	0.54	0.86	6.89	4.07	0.36	0.02
461	CL	2.79	0.34	0.33	0.24	7.51	1.37	0.12	0.00
462	L	1.69	16.05	3.44	9.58	7.88	2.74	0.07	0.07
463	L	1.33	20.99	5.77	16.59	8.36			
464	CL	1.20	17.74	5.39	15.45	8.37			
465	CL	1.07	12.62	5.41	15.51	8.23			
466	CL	0.96	13.84	5.00	14.28	8.17			
467	L	9.19	0.21	0.57	0.95	6.97	5.51	0.47	0.02
468	L	3.54	0.19	0.30	0.14	7.30	2.22	0.20	0.00
469	CL	2.16	0.30	0.52	0.80	7.34	0.92	0.11	0.00
470	CL	1.44	16.14	3.98	11.21	8.10			
471	CL	1.31	21.67	5.37	15.39	8.14			

472	CL	1.12	16.21	6.05	17.44	8.29			
473	CL	0.98	8.77	5.89	16.96	8.19			
474	L	5.42	0.08	0.47	0.65	5.93	3.30	0.31	0.02
475	CL	2.62	0.10	0.48	0.67	6.88	1.37	0.12	0.00
476	CL	2.00	0.15	2.07	5.46	7.94	0.83	0.08	0.03
477	CL	1.12	18.84	7.46	21.68	8.57	2.74	0.03	0.24
478	CL	1.01	17.36	7.35	21.35	8.57			
479	CL	0.82	11.70	7.36	21.38	8.52			
480	L	6.27	0.49	0.63	1.14	6.91	3.89	0.38	0.05
481	L	3.13	0.17	0.30	0.13	7.32	1.63	0.18	0.01
482	CL	2.36	0.19	0.39	0.41	7.73	0.99	0.12	0.01
483	CL	1.46	10.45	0.36	0.30	8.35			
484	CL	1.33	16.21	0.47	0.64	8.65			
485	CL	1.07	14.23	1.14	2.66	8.77			
486	CL	0.81	10.52	4.72	13.43	8.26			
487	L	6.48	0.07	0.58	0.96	6.30	3.95	0.38	0.03
488	L	3.58	0.05	0.27	0.03	6.71	2.08	0.23	0.01
489	L	2.04	0.12	0.35	0.27	7.35	0.90	0.10	0.00
490	CL	1.15	1.62	0.29	0.10	8.37			
491	CL	1.19	21.88	1.82	4.70	8.25			
492	CL	1.12	16.02	2.48	6.69	8.32			
493	CL	0.92	11.71	4.21	11.90	8.18			
494	L	7.19	0.08	0.62	1.11	6.15	4.27	0.43	0.02
495	L	3.29	0.00	0.29	0.09	6.75	1.72	0.16	0.00
496	CL	2.04	0.02	0.39	0.40	7.52	0.81	0.08	0.00
497	L	1.53	14.26	1.20	2.85	8.05			
498	CL	1.17	15.71	4.31	12.20	8.36			
499	CL	1.14	14.36	5.06	14.46	8.33			
500	CL	1.00	9.26	5.54	15.90	8.31			
501	L	7.27	0.25	0.64	1.16	7.20	4.51	0.45	0.02

502	L	3.82	0.14	0.36	0.30	7.31	1.91	0.21	0.02
503	CL	2.44	0.17	0.25	0.00	7.32	1.09	0.12	0.00
504	L	1.44	12.38	1.45	3.59	7.97	2.16	0.05	0.00
505	CL	1.26	16.09	3.79	10.63	8.27			
506	CL	1.09	12.66	3.75	10.51	8.30			
507	CL	0.97	10.38	4.64	13.19	8.16			
508	L	8.25	0.14	0.54	0.86	6.56	5.19	0.49	0.02
509	L	3.40	0.05	0.22	0.00	6.91	1.81	0.17	0.00
510	CL	1.92	0.09	0.20	0.00	7.01	0.80	0.08	0.00
511	SL	1.12	9.06	0.24	0.00	8.32			
512	CL	1.30	20.29	0.52	0.79	8.45			
513	CL	1.00	13.12	1.32	3.21	8.49			
514	L	6.62	0.15	0.54	0.85	6.52	3.88	0.39	0.01
515	L	2.59	0.14	0.21	0.00	7.00	1.20	0.14	0.00
516	CL	1.96	0.87	0.39	0.41	7.38	0.82	0.07	0.00
517	L	1.19	15.39	1.16	2.72	8.19	2.25	0.02	0.01
518	CL	1.26	17.34	4.00	11.27	8.25			
519	CL	0.89	15.43	4.12	11.63	8.38			
520	CL	0.82	12.67	4.70	13.37	8.32			
521	L	5.22	0.19	0.52	0.81	6.47	3.08	0.28	0.01
522	CL	1.95	0.15	3.48	9.70	8.28	0.83	0.10	0.05
523	CL	1.01	5.86	6.45	18.64	8.52	1.27	0.08	1.25
524	CL	0.88	17.76	6.20	17.89	8.58			
525	CL	0.82	15.09	5.69	16.35	8.49			
526	CL	0.76	12.82	5.52	15.84	8.42			
527	CL	0.68	11.91	4.08	11.51	8.47			
528	L	7.95	0.10	0.50	0.73	5.99	4.71	0.44	0.05
529	L	1.87	0.09	0.21	0.00	6.42	1.01	0.10	0.00
530	CL	1.82	0.09	0.20	0.00	6.48	0.70	0.09	0.00
531	CL	1.52	0.20	0.31	0.15	6.73	0.43	0.05	0.03

532	SCL	1.06	7.00	0.32	0.00	8.11			
533	CL	1.15	18.54	0.40	0.43	8.23			
534	CL	1.01	16.38	0.33	0.23	8.39			
535	SL	6.00	0.15	0.24	0.00	6.01	3.50	0.34	0.05
536	LS	2.13	0.07	0.12	0.31	6.74	1.11	0.09	0.01
537	CL	2.28	0.30	0.80	1.63	8.35	1.12	0.11	0.01
538	CL	1.33	0.78	3.76	10.54	8.04			
539	CL	0.94	17.99	1.19	2.82	8.84			
540	CL	0.89	18.25	1.20	2.85	8.94			
541	CL	0.89	17.10	1.15	2.68	8.88			
542	L	8.72	0.12	0.87	1.85	6.87	5.24	0.51	0.05
543	L	3.85	0.07	0.59	1.00	7.29	2.12	0.20	0.01
544	L	2.66	0.19	0.39	0.42	7.50	1.15	0.12	0.01
545	CL	1.49	20.43	1.10	2.53	8.27	3.11	0.07	0.02
546	CL	1.00	17.49	3.83	10.76	8.62			
547	CL	0.80	11.82	4.04	11.39	8.70			
548	CL	0.72	10.26	5.74	16.50	8.47			
549	L	6.43	0.02	0.73	1.43	6.50	3.81	0.33	0.02
550	CL	2.88	0.44	0.59	1.01	7.55	1.18	0.13	0.00
551	CL	1.64	14.65	0.39	0.40	8.20	2.40	0.06	0.00
552	CL	1.27	24.82	0.42	0.50	8.76	3.41	0.03	0.01
553	CL	1.07	16.38	2.08	5.49	8.54			
554	CL	0.83	11.22	4.61	13.10	8.56			
555	CL	0.79	10.41	6.27	18.10	8.47			
556	L	4.92	0.15	0.82	1.71	6.22	2.99	0.27	0.01
557	CL	2.23	4.04	2.24	5.97	7.76	1.03	0.10	0.03
558	CL	1.26	3.51	7.08	20.54	8.35	0.99	0.03	0.59
559	CL	1.08	16.94	7.70	22.40	8.75	2.40	0.04	0.42
560	CL	1.16	17.48	8.06	23.49	8.68			
561	CL	0.87	10.74	7.65	22.25	8.58			

562	CL	0.80	8.39	7.41	21.53	8.51			
563	L	6.12	0.02	0.82	1.71	6.55	3.75	0.33	0.05
564	C	2.93	0.07	1.01	1.72	7.21	1.45	0.16	0.02
565	CL	1.59	15.53	5.98	17.23	8.65	2.80	0.06	0.13
566	CL	1.13	24.33	6.20	17.89	8.84			
567	CL	0.91	15.94	6.15	17.74	8.81			
568	CL	0.76	13.41	6.68	19.33	8.72			
569	CL	0.73	10.23	6.98	20.24	8.62			
570	L	7.13	0.27	0.91	1.98	6.91	4.57	0.47	0.05
571	L	4.05	0.14	0.54	0.86	7.48	2.34	0.22	0.02
572	CL	2.76	0.15	0.37	0.34	7.82	1.36	0.16	0.00
573	CL	1.48	25.35	3.58	10.00	8.36	3.68	0.04	0.06
574	CL	1.24	21.99	3.84	10.79	8.62			
575	CL	1.07	15.61	5.07	14.49	8.55			
576	CL	0.90	10.62	5.46	15.66	8.54			
577	CL	0.89	9.72	4.88	13.92	8.57			
578	C	4.41	0.94	0.53	0.45	8.23	2.82	0.23	0.01
579	CL	2.60	0.32	0.46	0.62	8.06	1.13	0.10	0.00
580	CL	1.77	14.44	0.56	0.92	8.28	2.58	0.07	0.01
581	CL	1.19	23.39	0.69	1.31	8.58	3.47	0.03	0.00
582	CL	0.93	26.85	0.93	2.04	8.83	3.51	0.01	0.00
583	CL	0.83	23.75	1.23	2.92	8.76			
584	CL	0.71	20.92	1.27	3.06	8.63			
585	L	4.84	0.79	0.87	1.84	7.53	3.16	0.27	0.01
586	CL	2.38	4.51	0.64	1.17	8.08	1.64	0.14	0.00
587	L	1.20	27.75	0.60	1.03	8.53	3.92	0.04	0.00
588	L	0.89	24.67	0.52	0.80	8.92	3.24	0.00	0.00
589	CL	0.73	20.22	0.91	1.96	8.79			
590	C	0.76	17.66	1.30	2.47	8.63			
591	L	5.43	0.58	0.56	0.92	7.70	3.35	0.27	0.00

592	CL	2.70	0.49	0.51	0.75	7.99	1.21	0.12	0.00
593	L	1.22	29.00	0.40	0.43	8.84	4.01	0.02	0.01
594	CL	0.77	24.45	0.53	0.83	9.01			
595	C	0.49	16.80	0.67	0.81	8.99			
596	L	5.21	1.90	0.46	0.62	7.99	3.38	0.29	0.01
597	CL	2.66	3.96	0.43	0.53	8.19	1.69	0.10	0.00
598	CL	1.69	20.09	0.43	0.52	8.49	3.17	0.07	0.00
599	CL	1.06	27.97	0.40	0.43	8.82	3.83	0.32	0.01
600	CL	0.86	23.29	0.46	0.60	8.97			
601	C	0.85	21.11	0.54	0.46	8.79			
602	L	5.66	1.50	0.82	1.71	7.89	3.78	0.01	0.00
603	CL	3.13	0.52	0.69	1.31	7.92	1.70	0.14	0.00
604	CL	1.72	21.58	0.49	0.70	8.36	3.13	0.03	0.00
605	CL	1.43	22.54	0.43	0.53	8.48	3.34	0.17	0.06
606	CL	1.13	24.12	0.42	0.49	8.62			
607	C	1.26	20.83	0.59	0.59	8.59			
608	C	0.99	20.43	0.47	0.27	8.77			
609	L	5.45	0.36	0.54	0.84	7.70	3.48	0.38	0.06
610	CL	3.01	0.19	0.44	0.57	7.88	1.64	0.20	0.03
611	CL	2.04	0.39	0.51	0.77	8.03	1.00	0.19	0.03
612	CL	1.03	19.36	0.44	0.55	8.59	3.06	0.13	0.02
613	CL	0.84	24.80	0.63	1.14	8.75			
614	C	0.75	22.77	0.52	0.42	8.81			
615	L	4.04	0.43	2.39	6.42	7.72	2.49	0.27	0.10
616	L	2.39	0.37	3.19	8.83	7.81	1.32	0.22	0.20
617	CL	1.36	24.67	2.86	7.84	8.27	3.53	0.15	0.08
618	CL	0.89	24.82	3.98	11.21	8.44	3.24	0.13	0.14
619	CL	0.62	16.58	2.12	5.61	8.48			
620	CL	0.54	19.66	1.67	4.25	8.52			
621	L	4.80	0.36	2.26	6.03	7.33	3.17	0.36	0.10

622	L	4.68	0.20	3.41	9.49	7.66	3.08	0.36	0.17
623	L	2.51	0.19	3.88	10.91	7.74	1.46	0.21	0.17
624	CL	1.54	4.85	3.28	9.10	7.96	1.51	0.16	0.13
625	CL	1.10	26.18	3.19	8.83	8.36			
626	CL	0.80	24.84	1.93	5.05	8.53			
627	CL	0.90	23.96	1.77	4.56	8.43			
628	L	5.09	0.24	3.41	9.49	7.59	3.66	0.40	0.18
629	L	4.77	0.17	5.04	14.40	7.52	3.44	0.37	0.33
630	L	2.40	0.22	5.43	15.57	7.64	1.33	0.16	0.30
631	SL	1.66	0.22	4.85	13.83	7.75			
632	C	2.10	0.25	5.37	13.31	7.72			
633	C	1.43	0.22	5.00	12.33	7.85			
634	C	1.24	7.57	4.63	11.34	7.99			
635	L	5.92	0.62	1.52	3.80	7.98	4.20	0.47	0.10
636	L	6.03	0.52	1.95	5.10	7.88	3.99	0.43	0.11
637	L	6.36	0.17	2.32	6.21	7.38	4.04	0.44	0.14
638	L	2.38	0.12	2.15	5.70	7.18	1.34	0.26	0.07
639	SL	1.48	0.05	1.54	3.86	7.30	0.75	0.21	0.03
640	C	1.92	0.07	1.86	3.97	7.32			
641	C	1.37	0.20	2.10	4.61	7.72			
642	C	1.04	10.04	2.88	6.69	7.88			
643	L	5.60	2.80	1.77	4.56	7.87	3.91	0.45	0.10
644	L	3.23	3.67	1.54	3.87	7.98	2.24	0.30	0.04
645	CL	2.12	19.49	1.38	3.38	7.98	3.53	0.19	0.02
646	CL	1.45	28.21	1.31	3.17	7.98	4.07	0.16	0.01
647	CL	1.00	27.11	1.47	3.66	7.91			
648	CL	0.82	21.85	1.23	2.92	8.02			
649	CL	3.87	2.59	0.72	1.39	8.07	2.54	0.33	0.01
650	L	1.86	26.45	0.76	1.52	8.27	4.09	0.22	0.01
651	L	1.29	33.51	0.81	1.67	8.60	4.59	0.13	0.01

652	CL	0.88	24.82	1.52	3.82	8.56			
653	CL	0.74	19.90	2.06	5.43	8.39			
654	L	4.15	2.42	0.89	1.90	8.04	2.74	0.33	0.02
655	CL	2.57	0.25	0.98	2.19	7.98	1.03	0.20	0.00
656	CL	2.25	11.76	0.91	1.97	8.31	2.58	0.21	0.01
657	CL	1.17	20.78	0.59	0.99	8.88	2.98	0.16	0.00
658	L	0.69	16.19	0.55	0.89	9.03			
659	CL	0.91	21.51	0.83	1.74	8.77			
660	CL	0.86	21.84	1.13	2.63	8.65			
661	L	4.88	0.97	0.98	2.16	7.62	3.14	0.44	0.01
662	L	2.10	0.19	0.55	0.87	8.07	0.97	0.27	0.00
663	L	1.56	13.12	0.43	0.52	8.56	2.19	0.18	0.00
664	L	1.22	26.58	0.49	0.71	8.85			
665	CL	0.95	24.53	0.51	0.77	8.92			
666	CL	0.92	22.55	0.94	2.06	8.42			
667	CL	5.10	1.28	0.72	1.39	7.86	3.26	0.39	0.01
668	CL	3.42	0.08	0.87	1.85	7.75	1.78	0.30	0.00
669	CL	2.42	0.19	0.64	1.15	7.95	1.03	0.21	0.00
670	CL	1.55	24.07	0.44	0.56	8.43	3.54	0.18	0.00
671	CL	1.13	19.72	0.47	0.64	8.59			
672	CL	0.82	22.76	0.43	0.52	8.77			
673	CL	4.24	5.58	0.54	0.85	8.04	3.18	0.35	0.00
674	CL	5.15	0.51	0.66	1.20	7.93	3.21	0.41	0.00
675	L	3.51	0.12	0.60	1.03	7.97	1.92	0.29	0.00
676	CL	2.35	0.17	0.41	0.45	8.12	1.11	0.21	0.00
677	CL	1.69	4.12	0.56	0.92	8.22			
678	CL	1.00	23.94	0.50	0.72	8.60			
679	C	0.94	24.30	0.47	0.29	8.75			
680	L	5.02	1.45	0.69	1.31	7.86	3.20	0.46	0.01
681	L	2.62	0.50	0.80	1.63	8.12	1.33	0.27	0.00

682	L	1.23	8.46	0.98	2.19	8.41	1.51	0.21	0.00
683	SCL	0.90	20.85	0.83	1.25	8.55			
684	SCL	0.88	20.47	1.04	1.80	8.52			
685	CL	0.77	21.27	0.79	1.61	8.79			
686	L	5.31	0.45	0.97	2.14	7.60	3.33	0.46	0.00
687	CL	2.30	0.27	0.49	0.69	7.82	1.00	0.20	0.00
688	CL	1.62	8.34	0.45	0.60	8.17	1.61	0.23	0.00
689	L	1.14	27.64	0.53	0.84	8.33			
690	L	0.93	22.43	1.14	2.66	8.06			
691	CL	0.84	19.11	0.55	0.89	8.37			
692	L	4.97	1.04	0.38	0.38	7.89	3.20	0.39	0.01
693	CL	2.10	2.04	0.30	0.12	8.16	1.22	0.23	0.00
694	CL	1.39	19.85	0.33	0.22	8.51	2.92	0.19	0.00
695	CL	1.12	25.97	0.34	0.26	8.78	3.46	0.19	0.00
696	CL	0.92	18.07	0.36	0.30	8.92			
697	SCL	1.13	14.89	0.37	0.02	8.83			
698	L	5.52	3.28	0.35	0.30	8.04	3.78	0.46	0.01
699	CL	3.64	6.70	0.34	0.24	8.27	3.03	0.37	0.00
700	L	2.06	15.63	0.31	0.15	8.50	2.93	0.26	0.00
701	CL	1.31	24.14	0.28	0.07	8.80			
702	CL	1.10	14.78	0.36	0.30	8.61			
703	SCL	1.59	14.22	0.39	0.08	8.72			
704	CL	6.37	1.64	0.34	0.26	7.95	4.38	0.54	0.01
705	L	3.28	0.19	0.31	0.15	8.11	1.69	0.29	0.00
706	CL	1.94	1.36	0.27	0.04	8.43	0.93	0.21	0.00
707	CL	1.37	29.58	0.28	0.07	9.04			
708	CL	0.97	18.60	0.32	0.18	9.08			
709	CL	0.86	17.08	0.36	0.31	9.03			
710	L	7.54	0.79	0.34	0.26	7.71	4.84	0.61	0.02
711	L	6.78	1.34	0.30	0.13	7.92	4.34	0.49	0.01

712	CL	2.26	0.10	0.15	0.00	8.24	1.02	0.23	0.00
713	CL	1.02	20.12	0.24	0.00	8.71			
714	CL	1.04	23.13	0.40	0.43	8.56			
715	CL	0.87	18.99	0.41	0.47	8.53			
716	CL	4.33	1.02	1.11	2.56	7.39	2.78	0.34	0.02
717	L	2.09	9.61	0.46	0.60	8.03	2.04	0.18	0.00
718	L	1.44	21.01	0.37	0.33	8.35	3.09	0.17	0.00
719	L	1.10	19.89	0.35	0.27	8.57	2.72	0.16	0.00
720	CL	1.00	19.83	0.36	0.31	8.76			
721	CL	0.85	17.11	0.34	0.26	8.71			
722	L	4.11	2.78	0.36	0.32	7.98	3.00	0.37	0.01
723	L	2.18	3.44	0.30	0.14	8.23	1.62	0.22	0.00
724	L	1.76	11.97	0.42	0.48	8.34	2.33	0.22	0.00
725	L	1.42	15.57	0.52	0.79	8.36			
726	CL	1.02	13.46	0.55	0.88	8.44			
727	CL	2.05	12.56	0.43	0.53	8.69			
728	CL	1.05	19.37	0.45	0.59	8.77			
729	CL	4.01	4.59	0.54	0.86	7.82	2.93	0.38	0.00
730	L	1.92	13.93	0.34	0.24	8.17	2.73	0.23	0.03
731	L	1.33	17.99	0.32	0.20	8.30	2.79	0.20	0.01
732	L	1.45	15.64	0.31	0.15	8.47	2.53	0.39	0.00
733	CL	0.92	20.02	0.33	0.21	8.70			
734	SL	0.51	18.16	0.22	0.00	8.88			
735	CL	0.54	18.55	0.23	0.00	8.90			
736	CL	0.77	16.02	0.31	0.18	8.78			
737	L	3.98	1.08	0.37	0.35	7.82	2.64	0.34	0.01
738	CL	2.09	0.14	0.26	0.01	8.12	1.07	0.20	0.00
739	CL	1.74	1.00	0.30	0.14	8.22	0.76	0.19	0.00
740	CL	1.07	25.50	0.37	0.33	8.73	3.38	0.15	0.00
741	L	1.02	25.92	0.32	0.20	9.08			

742	CL	0.87	19.31	0.35	0.29	9.05			
743	L	3.67	1.26	0.31	0.15	8.00	2.34	0.34	0.00
744	L	2.24	0.27	0.21	0.00	8.15	1.09	0.24	0.00
745	CL	1.74	0.14	0.24	0.00	8.13	0.63	0.20	0.00
746	CL	1.48	13.46	0.32	0.20	8.27	2.22	0.16	0.00
747	CL	1.05	21.65	0.36	0.31	8.50			
748	CL	0.92	17.67	0.37	0.33	8.65			
749	CL	0.76	16.09	0.38	0.37	8.75			
750	CL	4.66	0.40	0.42	0.49	7.36	2.99	0.38	0.00
751	L	2.25	0.20	0.24	0.00	7.83	1.09	0.25	0.00
752	CL	1.24	1.13	0.23	0.00	8.13	0.51	0.17	0.00
753	CL	1.26	14.32	0.36	0.30	8.35			
754	CL	1.07	22.71	0.41	0.45	8.51			
755	CL	0.95	17.32	0.42	0.49	8.63			
756	CL	0.87	15.38	0.49	0.70	8.58			
757	CL	5.46	0.17	0.33	0.22	7.06	3.47	0.43	0.01
758	L	4.42	0.19	0.24	0.00	7.31	2.74	0.41	0.00
759	L	2.35	0.19	0.31	0.17	7.65	1.02	0.27	0.00
760	CL	1.63	3.61	0.43	0.52	8.18	0.93	0.22	0.00
761	CL	0.97	25.08	0.30	0.12	8.67			
762	CL	0.80	22.96	0.29	0.09	7.78			
763	CL	0.77	20.48	0.30	0.13	8.71			
764	L	5.54	0.59	0.45	0.58	7.62	3.60	0.43	0.02
765	L	4.14	4.56	0.42	0.49	8.02	3.09	0.37	0.00
766	CL	2.07	1.57	0.41	0.48	8.16	0.97	0.21	0.00
767	CL	1.19	25.29	0.39	0.40	8.37			
768	CL	1.65	15.37	0.37	0.36	8.28			
769	CL	0.89	18.43	0.36	0.32	8.33			
770	L	5.82	0.32	0.47	0.66	7.34	3.87	0.46	0.01
771	L	3.01	0.13	0.26	0.02	7.85	1.62	0.46	0.00

772	CL	2.65	0.20	0.30	0.12	8.04	1.33	0.26	0.00
773	CL	1.78	0.69	0.37	0.35	8.33	0.63	0.24	0.00
774	L	1.13	21.38	0.39	0.42	8.71			
775	CL	0.51	11.89	0.23	0.00	9.02			
776	C	0.96	19.75	0.32	0.00	8.66			
777	CL	5.15	0.17	0.36	0.31	7.47	3.39	0.52	0.00
778	CL	2.10	0.24	0.34	0.26	8.24	1.05	0.27	0.00
779	CL	1.34	19.62	0.38	0.37	8.65	2.84	0.22	0.00
780	CL	1.10	21.25	0.41	0.46	8.58			
781	SCL	0.57	24.38	0.34	0.00	8.75			
782	SCL	0.74	17.11	0.44	0.20	8.35			
783	L	6.15	0.58	0.33	0.21	7.78	3.83	0.51	0.01
784	L	3.03	0.20	0.30	0.14	7.94	1.43	0.28	0.00
785	L	1.88	4.62	0.32	0.18	8.29	1.28	0.21	0.00
786	L	1.34	29.71	0.34	0.26	8.65			
787	CL	1.02	17.77	0.40	0.43	8.80			
788	L	7.88	0.14	0.31	0.16	7.30	5.32	0.61	0.03
789	CL	3.82	0.15	0.24	0.00	7.71	1.82	0.32	0.00
790	CL	1.79	4.49	0.30	0.14	8.28	1.15	0.24	0.00
791	L	1.30	16.98	0.41	0.45	8.61			
792	CL	1.15	22.98	0.64	1.17	8.67			
793	CL	1.12	16.49	0.40	0.43	8.47			
794	L	6.10	1.78	0.40	0.42	7.89	4.09	0.53	0.02
795	CL	2.17	0.17	0.33	0.21	8.02	0.80	0.18	0.00
796	CL	1.35	12.82	0.27	0.05	8.42	2.01	0.18	0.00
797	CL	1.17	33.88	0.31	0.15	8.57			
798	CL	1.01	17.40	0.30	0.13	8.50			
799	CL	0.87	11.14	0.25	0.00	8.61			
800	L	6.02	1.00	0.48	0.69	7.59	4.09	0.55	0.03
801	L	5.39	0.07	0.21	0.00	7.71	3.15	0.40	0.01

802	CL	1.68	0.08	0.20	0.00	8.03			
803	CL	1.10	17.80	0.29	0.09	8.38			
804	SL	0.71	8.08	0.19	0.00	8.56			
805	CL	1.76	0.07	0.25	0.00	7.88			
806	L	6.86	0.20	0.42	0.48	7.39	4.66	0.61	0.02
807	L	6.22	0.10	0.29	0.10	7.76	3.80	0.48	0.01
808	L	4.32	0.08	0.25	0.00	7.74	2.56	0.34	0.00
809	CL	1.47	0.07	0.20	0.00	7.99			
810	SL	0.88	1.89	0.20	0.00	8.33			
811	CL	0.83	22.39	0.24	0.00	8.53			
812	CL	0.92	9.52	0.29	0.11	8.42			
813	L	3.23	1.62	0.44	0.56	7.96	2.05	0.34	0.00
814	L	1.37	34.28	0.35	0.27	8.82	4.60	0.19	0.00
815	L	1.15	27.68	0.36	0.31	8.95	3.77	0.16	0.00
816	CL	1.12	19.47	0.40	0.42	8.86			
817	CL	0.93	19.24	0.46	0.62	8.84			
818	L	3.00	0.80	0.38	0.38	7.89	1.75	0.29	0.00
819	L	1.59	10.08	0.37	0.35	8.37	1.67	0.19	0.00
820	L	1.16	25.08	0.35	0.28	8.83	3.43	0.17	0.00
821	SIL	0.93	19.71	0.41	0.47	8.77			
822	L	2.94	3.01	0.34	0.25	8.17	2.04	0.32	0.00
823	L	2.49	3.44	0.33	0.23	8.11	1.57	0.24	0.00
824	L	1.39	6.37	0.30	0.12	8.40	1.32	0.19	0.00
825	L	1.32	23.65	0.30	0.14	8.55	3.44	0.15	0.02
826	CL	1.15	16.82	0.29	0.10	8.80			
827	CL	0.93	13.71	0.29	0.11	8.78			
828	L	2.60	4.10	0.36	0.31	7.99	2.04	0.25	0.03
829	L	3.37	1.42	0.30	0.14	8.07	1.95	0.26	0.03
830	L	1.66	10.61	0.35	0.30	8.24	1.92	0.12	0.02
831	LS	1.12	11.98	0.29	0.80	8.67			

832	L	2.92	3.85	0.37	0.35	7.96	2.03	0.24	0.03
833	SL	1.83	8.84	0.28	0.06	8.24	1.64	0.19	0.02
834	LS	1.40	10.42	0.25	0.70	8.31	2.09	0.18	0.02
835	SL	0.97	14.42	0.27	0.03	8.53	2.28	0.13	0.01
836	SL	0.95	14.43	0.28	0.06	8.76			
837	SL	0.59	12.84	0.22	0.00	8.79			
838	L	3.06	3.15	0.43	0.51	7.93	2.03	0.24	0.03
839	L	1.82	6.31	0.32	0.19	8.23	1.64	0.22	0.02
840	L	1.33	15.38	0.35	0.27	8.53	2.49	0.12	0.01
841	L	1.22	11.21	0.34	0.27	8.83			
842	SL	1.22	14.84	0.36	0.31	8.87			
843	L	3.34	0.27	0.46	0.61	7.44	2.05	0.28	0.03
844	L	2.74	0.45	0.35	0.29	7.74	1.60	0.24	0.02
845	L	1.44	2.71	0.28	0.08	8.13	0.85	0.15	0.01
846	L	1.17	25.64	0.45	0.58	8.39	3.62	0.11	0.03
847	SL	0.67	15.60	0.35	0.28	8.57			
848	SIL	1.02	25.18	0.59	1.00	8.47			
849	CL	0.88	16.26	0.53	0.82	8.72			
850	CL	0.86	11.80	0.73	1.44	8.55			
851	L	2.68	0.43	0.46	0.61	7.78	1.66	0.24	0.02
852	CL	1.71	2.39	0.43	0.52	8.02	1.03	0.15	0.02
853	CL	1.42	22.16	0.39	0.41	8.52	3.13	0.13	0.03
854	CL	1.27	21.58	0.44	0.54	8.61			
855	CL	0.94	17.69	0.58	0.98	8.51			
856	CL	0.79	15.10	2.34	6.27	7.86			
857	L	3.50	1.03	0.46	0.61	7.88	2.37	0.29	0.04
858	L	2.53	6.44	0.33	0.22	8.21	2.07	0.25	0.03
859	L	1.70	24.91	0.36	0.30	8.43	3.79	0.21	0.02
860	L	1.42	28.09	0.38	0.38	8.83	3.86	0.16	0.03
861	L	1.23	20.92	0.41	0.46	8.88			

862	CL	1.05	18.40	0.42	0.48	8.81			
863	L	3.31	1.28	0.40	0.43	7.84	2.31	0.32	0.03
864	L	3.22	0.93	0.36	0.30	7.93	1.85	0.23	0.02
865	L	2.12	0.37	0.43	0.54	7.94	0.88	0.23	0.02
866	CL	1.47	17.16	0.38	0.39	8.37	2.61	0.14	0.02
867	CL	1.21	20.06	0.38	0.36	8.62	2.93	0.12	0.02
868	CL	1.03	18.33	0.43	0.53	8.70			
869	CL	2.29	14.56	2.47	6.66	7.92			
870	L	3.58	0.29	0.50	0.73	7.66	2.05	0.33	0.02
871	CL	2.04	10.09	0.45	0.58	8.05	2.13	0.17	0.03
872	CL	1.36	25.85	0.39	0.40	8.36	3.64	0.16	0.04
873	CL	1.10	16.32	0.44	0.56	8.55			
874	CL	0.83	15.44	1.73	4.45	7.96			
875	CL	0.77	14.78	2.50	6.75	7.93			
876	L	3.33	0.59	0.48	0.66	7.90	1.95	0.26	0.03
877	L	1.55	17.55	0.39	0.42	8.35	2.93	0.18	0.02
878	L	1.31	25.49	0.38	0.37	8.53	3.68	0.11	0.03
879	CL	1.11	20.72	0.42	0.49	8.74	2.91	0.17	0.03
880	CL	0.79	18.26	0.83	1.73	8.35			
881	CL	0.76	17.37	1.26	3.02	8.09			
882	CL	3.21	0.47	0.47	0.63	7.78	1.91	0.29	0.03
883	L	1.66	9.06	0.35	0.28	8.18	1.90	0.20	0.02
884	L	1.40	22.96	0.39	0.40	8.47	3.59	0.16	0.03
885	CL	1.09	19.94	0.43	0.53	8.77	2.70	0.13	0.02
886	CL	0.87	15.90	0.50	0.73	8.69			
887	CL	0.76	15.58	1.43	3.53	8.11			
888	L	3.40	0.37	0.46	0.61	7.72	2.13	0.33	0.03
889	L	1.84	12.40	0.41	0.45	8.21	2.39	0.16	0.02
890	L	1.54	27.37	0.43	0.52	8.54	3.82	0.16	0.05
891	L	1.22	22.09	0.49	0.69	8.73			

892	CL	0.93	17.17	0.69	1.31	8.57			
893	L	3.91	0.38	0.48	0.67	8.09	2.55	0.34	0.04
894	L	1.76	4.78	0.43	0.52	8.59	1.18	0.14	0.02
895	L	1.25	20.59	0.63	1.11	8.74	2.91	0.15	0.02
896	CL	1.10	21.14	0.80	1.64	8.61			
897	CL	0.94	20.19	0.78	1.57	8.54			
898	CL	0.79	16.66	0.54	0.84	8.39			
899	L	4.42	1.33	0.59	0.99	8.07	3.13	0.38	0.04
900	L	3.34	15.55	0.61	1.08	8.36	3.77	0.28	0.04
901	CL	1.61	22.94	0.56	0.90	8.34	3.52	0.14	0.02
902	CL	0.99	23.81	0.47	0.64	8.24			
903	CL	0.87	22.57	0.43	0.53	8.22			
904	L	3.41	3.92	0.45	0.59	8.01	2.37	0.28	0.03
905	L	2.54	18.77	0.36	0.31	8.33	3.77	0.25	0.03
906	L	1.71	32.24	0.39	0.39	8.69	4.72	0.16	0.04
907	SIL	1.18	25.48	0.43	0.52	8.90	3.48	0.12	0.02
908	CL	0.88	20.52	0.40	0.42	8.99			
909	CL	0.94	16.76	0.47	0.65	8.85			
910	CL	0.78	16.09	0.45	0.58	8.83			
911	CL	3.25	4.46	0.44	0.54	8.06	2.38	0.27	0.03
912	L	1.70	25.84	0.38	0.38	8.48	3.78	0.17	0.03
913	CL	1.11	19.36	0.43	0.52	8.73	2.63	0.12	0.02
914	CL	0.92	11.07	0.43	0.52	8.80			
915	CL	0.86	11.81	0.92	2.00	8.39			
916	L	3.30	2.12	0.43	0.52	8.06	2.16	0.34	0.03
917	L	1.80	32.53	0.41	0.45	8.65	4.75	0.18	0.05
918	L	1.53	27.01	0.43	0.54	8.90	3.86	0.17	0.04
919	CL	1.22	20.05	0.45	0.57	8.92			
920	CL	0.99	17.58	0.46	0.61	8.75			
921	CL	0.87	16.33	2.14	5.67	7.93			

922	CL	3.36	1.83	0.39	0.40	8.01	2.20	0.30	0.04
923	L	3.31	1.12	0.30	0.15	8.05	1.99	0.27	0.03
924	L	1.38	26.68	0.37	0.33	8.53	3.77	0.14	0.03
925	L	1.60	17.21	0.42	0.50	8.64			
926	L	1.25	16.14	0.87	1.85	8.51			
927	CL	0.89	17.41	1.29	3.10	8.27			
928	L	3.34	1.24	0.42	0.51	7.82	2.15	0.31	0.03
929	L	1.65	13.09	0.34	0.26	8.24	2.42	0.22	0.02
930	L	1.40	24.56	0.38	0.37	8.53	3.44	0.18	0.03
931	CL	1.11	19.90	0.46	0.61	8.71			
932	CL	0.86	16.54	0.75	1.48	8.60			
933	CL	0.76	16.14	2.29	6.12	8.05			

APPENDIX T. EXTRACTABLE CALCIUM, MAGNESIUM, POTASSIUM, SODIUM, CEC 7, AND CORRECTED GYPSUM %

ID	Calcium, NH4OAc Extractable, 2M KCl displacement, cmol(+)/kg	Magnesium, NH4OAc Extractable, 2M KCl displacement, cmol(+)/kg	Potassium, NH4OAc Extractable, 2M KCl displacement, cmol(+)/kg	Sodium, NH4OAc Extractable, 2M KCl displacement, cmol(+)/kg	CEC, NH4OAc, pH 7.0, 2M KCl displacement, cmol(+)/kg	Corrected Gypsum, <2mm, % wt
56	50.3	14.1	0.3	0.7	12.0	
57	50.3	18.1	0.1	1.7	9.5	
58	42.5	19.9	0.1	1.6	9.7	
59						
60						
61						
62	47.0	7.2	0.4	0.0	15.3	
63	24.6	5.7	0.2	0.1	18.2	
64	13.1	7.9	0.2	0.3	13.5	
65						
66						
67	29.0	7.4	0.4	0.0	17.0	
68	20.1	11.3	0.2	0.4	20.7	
69	14.6	14.8	0.3	0.7	20.3	
70						
71						
72						
73	22.9	12.4	0.3	0.6	19.6	
74	21.8	16.2	0.2	1.1	21.3	
75	19.7	16.8	0.3	1.1	21.8	
76	76.9	13.9	0.1	0.5	10.8	
77						
78	25.0	21.3	0.4	1.0	19.5	
79	31.1	16.8	0.3	1.0	21.1	
80	18.7	15.3	0.3	0.8	19.8	

81					
82					
83					
84	31.2	19.7	0.2	1.0	21.4
85	59.6	14.3	0.1	0.6	13.1
86	19.2	15.1	0.2	0.6	20.1
87					
88					
89	27.9	19.4	0.4	0.6	19.6
90	26.3	14.5	0.2	0.7	19.1
91	22.8	12.7	0.2	0.4	22.1
92					
93					
94					
95	28.2	6.4	0.3	0.0	15.7
96	14.9	5.9	0.2	0.0	15.3
97	54.0	11.9	0.1	0.6	9.6
98					
99					
100					
101	21.0	4.9	0.3	0.0	17.2
102	13.2	5.1	0.2	0.0	14.9
103	11.7	9.1	0.2	0.1	15.0
104					
105					
106					
107	20.3	4.4	0.3	0.0	16.8
108	14.9	5.5	0.2	0.0	17.0
109	11.7	8.8	0.2	0.0	15.6
110					

111					
112					
113	42.2	6.3	0.5	0.0	16.6
114	52.0	7.1	0.2	0.0	14.2
115	51.1	10.7	0.1	0.1	12.1
116					
117					
118					
119	48.5	6.5	0.3	0.0	14.0
120	18.4	7.0	0.2	0.0	13.1
121	51.2	14.0	0.1	0.2	11.6
122					
123					
124	48.8	8.8	0.4	0.0	14.4
125	25.5	7.5	0.3	0.0	13.1
126	49.7	8.7	0.2	0.2	11.6
127	47.2	11.0	0.2	0.4	10.6
128					
129					
130	31.8	6.6	0.4	0.0	16.0
131	42.8	8.6	0.2	0.0	12.6
132	49.3	15.3	0.1	0.8	9.3
133					
134	46.8	8.5	0.4	0.0	15.4
135	20.4	8.0	0.3	0.0	15.4
136	48.1	11.7	0.1	0.4	10.5
137					
138					
139	48.6	15.2	0.4	0.7	13.0
140	42.2	20.7	0.2	1.1	10.5

141	39.3	15.1	0.3	0.8	9.7	
142						
143	47.0	8.8	0.5	0.3	13.2	
144	45.7	11.6	0.2	1.1	9.9	
145	45.9	17.1	0.2	1.3	11.3	
146						
147						
148						
149	15.7	4.7	2.1	0.0	24.4	
150	7.4	6.5	0.5	0.0	14.0	
151	10.0	12.8	0.5	0.0	20.4	
152	45.8	9.2	0.2	0.1	14.1	0.0
153						
154						
155						
156	15.2	5.4	1.0	0.2	25.7	
157	8.7	7.0	0.2	1.1	16.0	
158	11.1	19.8	0.4	3.5	28.0	
159						
160						
161						
162						
163	15.7	5.1	1.4	0.0	25.0	
164	9.7	7.0	0.9	0.7	17.6	
165	14.8	17.4	0.6	3.2	31.0	
166						
167						
168						
169	17.2	5.0	1.9	0.0	23.9	
170	14.4	6.1	1.3	0.3	18.4	

171	19.2	6.6	0.7	0.7	13.7	
172						
173						
174						
175						
176	16.0	4.7	2.0	0.0	22.1	
177	13.0	6.7	1.2	0.0	18.1	
178	22.3	15.9	1.3	0.3	24.5	
179						
180						
181						
182						
183	12.1	4.5	2.0	0.0	20.6	
184	7.4	6.9	0.9	0.2	14.8	
185	5.8	9.6	0.6	1.4	14.4	
186						
187						
188						
189						
190	15.7	5.0	1.4	0.0	23.7	
191	8.4	6.3	0.4	0.0	14.2	
192	10.0	11.8	0.3	0.0	17.2	
193	71.0	10.7	0.1	0.2	11.2	0.9
194						
195						
196	18.2	4.5	2.7	0.0	21.7	
197	16.0	5.4	0.5	0.0	17.3	
198	51.7	7.3	0.3	0.0	12.4	
199	52.7	10.3	0.3	0.0	10.7	
200						

201					
202					
203	11.7	3.4	1.2	0.0	19.3
204	7.4	5.6	0.5	0.0	13.1
205	7.8	9.1	0.3	0.0	14.9
206					
207					
208					
209					
210	15.3	4.0	0.9	0.0	19.7
211	15.0	5.1	0.2	0.0	16.5
212	54.9	7.6	0.3	0.0	11.3
213					
214					
215					
216	17.5	4.3	1.2	0.0	21.6
217	24.0	5.0	0.4	0.0	17.7
218	54.9	5.8	0.2	0.0	11.1
219	49.7	11.3	0.3	0.0	10.6
220					
221					
222	14.8	4.1	1.4	0.0	22.3
223	12.7	7.9	0.5	0.0	19.1
224	52.5	10.8	0.3	0.0	12.0
225					
226					
227	14.8	4.2	1.7	0.0	21.3
228	14.3	5.9	0.7	0.0	18.3
229	53.7	8.4	0.3	0.0	12.1
230					

231						
232						
233	17.6	4.8	1.3	0.0	21.1	
234	17.9	5.1	0.6	0.0	18.7	
235	55.4	8.2	0.3	0.0	11.4	
236						
237						
238						
239						
240	17.1	4.4	1.6	0.0	19.2	
241	55.1	6.4	0.3	0.0	11.3	
242	50.7	12.7	0.5	0.0	11.4	
243						
244						
245						
246	14.9	4.0	1.3	0.0	18.4	
247	11.2	5.1	0.3	0.0	12.4	
248	47.1	9.4	0.3	0.0	13.1	
249						
250						
251						
252	14.9	5.1	1.1	0.0	24.6	
253	7.7	5.6	0.4	0.0	12.8	
254	9.9	17.2	0.5	1.0	27.4	
255	117.1	11.8	0.3	0.6	14.6	5.7
256						
257						
258						
259	18.8	5.3	1.5	0.0	25.1	
260	11.4	7.4	0.9	0.0	17.8	

261	20.4	11.0	0.6	0.0	15.5
262					
263					
264					
265	17.8	4.7	1.8	0.0	24.7
266	15.7	6.4	0.6	0.0	20.4
267	15.0	7.6	0.4	0.0	18.2
268					
269					
270					
271					
272	17.0	4.8	1.4	0.0	23.0
273	15.1	7.0	0.5	0.0	18.7
274	11.8	7.2	0.3	0.0	14.6
275					
276					
277					
278					
279	18.9	4.8	0.7	0.0	22.6
280	17.4	4.8	0.4	0.0	18.9
281	52.8	7.1	0.4	0.0	18.0
282					
283					
284					
285	11.8	5.8	1.5	0.0	17.1
286	49.9	17.1	0.7	0.0	16.7
287	47.2	22.1	0.4	0.0	10.9
288	43.0	27.9	0.5	0.1	10.4
289					
290					

291					
292	20.1	5.4	1.9	0.0	18.5
293	46.1	8.2	1.0	0.0	16.6
294	55.0	8.9	0.6	0.0	13.5
295	51.2	15.4	0.6	0.0	12.0
296					
297					
298	31.5	4.6	2.0	0.0	19.6
299	59.3	6.0	0.7	0.0	16.9
300	58.3	6.5	0.3	0.0	13.5
301					
302					
303	13.7	4.5	1.4	0.0	16.3
304	11.5	4.3	0.4	0.0	14.0
305	10.4	4.4	0.2	0.0	12.3
306	16.3	5.3	0.2	0.0	10.7
307					
308					
309					
310	9.7	4.5	1.0	0.7	14.8
311	11.7	11.9	0.2	4.8	16.8
312	48.6	16.1	0.2	5.0	10.5
313					
314					
315					
316					
317	8.5	4.2	0.8	0.0	14.3
318	10.7	10.6	0.2	0.9	17.8
319	52.1	14.8	0.1	2.6	11.0
320					

321					
322					
323					
324	10.1	5.6	1.7	0.0	16.4
325	11.6	12.9	0.6	0.2	15.8
326	48.1	21.8	0.4	1.4	10.3
327					
328					
329					
330					
331	13.4	5.1	1.4	0.0	18.0
332	21.3	9.0	0.4	0.0	16.7
333	52.9	11.4	0.3	0.0	12.3
334					
335					
336					
337	20.8	4.3	1.3	0.0	19.0
338	33.2	6.4	0.4	0.0	19.0
339	56.5	10.0	0.2	0.1	14.8
340	55.5	13.5	0.2	1.5	11.5
341					
342					
343					
344	13.8	4.0	1.0	0.0	15.6
345	11.7	3.2	0.3	0.0	11.7
346	50.6	8.2	0.2	0.0	10.8
347					
348					
349					
350					

351	13.9	4.4	1.4	0.0	16.6
352	11.2	4.1	0.3	0.0	13.4
353	11.3	4.3	0.2	0.0	11.4
354					
355					
356					
357					
358					
359	9.9	5.2	1.3	0.0	16.2
360	12.7	10.2	0.4	0.0	16.7
361	54.4	19.2	0.3	0.1	12.0
362	51.1	23.7	0.5	0.4	11.2
363					
364					
365					
366	10.5	5.1	1.2	0.0	16.9
367	11.4	9.2	0.5	0.3	19.5
368	16.4	11.5	0.3	0.7	18.1
369	53.0	12.1	0.2	1.3	12.4
370					
371					
372					
373	10.6	7.2	1.4	0.0	16.5
374	19.1	16.2	0.4	0.7	16.3
375	47.8	25.3	0.2	3.0	10.0
376	45.1	22.9	0.1	3.3	8.9
377					
378					
379					
380	12.2	5.3	1.1	0.0	18.4

381	13.2	5.3	0.6	0.0	18.8
382	10.4	5.6	0.5	0.0	15.9
383	14.2	6.8	0.7	0.0	20.8
384					
385					
386					
387	12.2	4.3	1.8	0.0	22.2
388	14.2	5.1	1.7	0.0	22.7
389	11.2	4.5	1.5	0.0	19.1
390	4.6	1.9	0.7	0.0	7.1
391					
392					
393					
394	10.6	3.7	1.7	0.0	15.6
395	13.9	5.2	0.7	0.0	16.7
396	56.5	8.6	0.5	0.0	15.3
397					
398					
399					
400					
401	11.0	3.7	2.0	0.0	16.6
402	10.6	4.4	0.7	0.0	13.8
403	13.4	6.1	0.6	0.0	16.8
404					
405					
406					
407					
408	10.7	3.8	1.8	0.0	16.6
409	10.2	4.0	0.8	0.0	14.2
410	14.3	6.1	0.7	0.0	18.8

411					
412					
413					
414					
415					
416	11.0	4.1	1.4	0.0	17.3
417	11.8	5.3	0.6	0.0	15.8
418	13.3	5.9	0.6	0.0	17.8
419					
420					
421					
422					
423					
424	10.6	3.6	1.4	0.0	17.4
425	10.8	4.8	0.7	0.0	15.5
426	14.1	6.6	0.8	0.0	20.4
427					
428					
429					
430					
431	15.1	6.4	2.1	0.0	23.9
432	5.8	4.5	1.7	0.0	15.0
433	3.2	5.2	0.9	0.4	10.8
434	3.9	15.2	1.0	4.6	19.8
435	11.8	17.6	0.5	6.7	15.9
436					
437					
438					
439	16.5	5.5	3.7	0.0	23.9
440	12.7	9.5	1.9	0.0	22.2

441	10.1	11.9	1.0	1.0	20.4
442					
443					
444					
445					
446	23.1	6.4	2.1	0.0	27.0
447	20.0	6.2	1.6	0.0	23.7
448	15.5	6.0	1.3	0.0	18.9
449	51.1	10.4	0.9	0.0	16.6
450					
451					
452					
453	20.7	7.1	2.4	0.0	27.7
454	15.2	6.5	1.3	0.0	21.3
455	13.0	8.6	1.0	0.0	20.5
456	20.8	21.0	0.6	3.9	17.5
457					
458					
459					
460	19.5	6.0	1.6	0.0	24.9
461	14.6	7.3	1.1	0.0	19.6
462	54.6	14.6	0.8	2.6	14.6
463					
464					
465					
466					
467	26.2	7.5	2.6	0.0	31.5
468	14.2	7.4	1.1	0.0	19.7
469	10.9	11.3	0.7	1.0	21.0
470					

471					
472					
473					
474	12.2	4.5	2.3	0.1	20.7
475	7.8	7.4	1.5	2.1	18.1
476	7.3	12.8	0.9	6.3	20.5
477	55.0	21.1	0.4	14.1	14.8
478					
479					
480	19.0	6.4	2.2	0.0	23.0
481	14.7	6.2	1.1	0.0	19.6
482	17.1	8.4	0.9	0.0	20.8
483					
484					
485					
486					
487	16.8	5.8	1.4	0.0	23.1
488	14.1	4.9	0.8	0.0	18.6
489	12.7	5.3	0.6	0.0	16.1
490					
491					
492					
493					
494	17.8	6.0	1.5	0.0	25.1
495	12.5	5.4	1.1	0.0	17.8
496	11.3	8.1	1.0	0.0	17.9
497					
498					
499					
500					

501	24.3	6.8	1.3	0.0	26.4	
502	16.0	8.6	1.0	0.0	24.0	
503	13.0	8.3	0.9	0.0	20.1	
504	51.7	12.0	0.7	0.7	14.8	
505						
506						
507						
508	19.4	6.2	2.0	0.0	26.6	
509	12.4	5.4	1.3	0.0	18.0	
510	11.8	5.7	0.9	0.0	16.7	
511						
512						
513						
514	16.6	5.8	1.2	0.0	22.4	
515	10.0	6.7	0.9	0.0	16.5	
516	14.5	11.6	0.9	0.0	20.7	
517	56.1	11.8	0.5	1.2	14.7	
518						
519						
520						
521	13.9	5.3	1.3	0.2	19.9	
522	4.8	16.3	0.5	12.2	24.3	
523	135.8	22.4	0.2	12.4	16.9	4.7
524						
525						
526						
527						
528	18.3	4.9	1.4	0.0	26.8	
529	8.7	3.1	0.4	0.0	11.3	
530	12.6	5.9	0.4	0.0	17.4	

531	13.7	6.5	0.2	0.0	17.8
532					
533					
534					
535	13.2	4.3	0.7	0.1	21.0
536	4.9	3.4	0.3	0.9	9.5
537	10.1	13.3	0.2	5.1	21.0
538					
539					
540					
541					
542	21.1	6.4	2.8	0.0	27.2
543	15.6	7.0	2.4	0.0	20.7
544	14.7	7.6	2.0	0.0	20.6
545	54.5	11.8	1.1	1.7	14.3
546					
547					
548					
549	19.1	5.4	2.9	0.0	25.5
550	18.7	8.0	1.6	0.0	22.5
551	113.0	12.9	1.1	0.0	15.6
552	124.2	21.3	0.8	0.8	13.1
553					
554					
555					
556	14.7	5.0	1.8	0.2	19.2
557	5.5	15.5	0.7	6.8	22.5
558	44.1	28.3	0.5	13.2	18.5
559	64.9	27.2	0.4	14.9	15.6
560					

561					
562					
563	15.2	6.2	2.6	0.4	22.6
564	10.5	10.9	1.1	3.5	22.1
565	109.3	21.7	0.4	12.0	16.7
566					
567					
568					
569					
570	21.6	7.3	3.0	0.0	27.1
571	16.2	7.3	2.2	0.0	21.9
572	14.1	8.0	1.3	0.0	20.8
573	54.3	17.5	0.5	4.4	13.8
574					
575					
576					
577					
578	27.8	7.8	0.7	0.0	23.9
579	16.9	7.2	0.3	0.0	19.4
580	68.4	15.0	0.1	0.0	13.6
581	112.4	160.6	0.1	0.1	10.8
582	109.8	30.9	0.1	1.2	10.8
583					
584					
585	30.5	8.3	0.9	0.0	26.0
586	37.2	11.9	0.3	0.0	16.5
587	51.6	9.8	0.1	0.1	8.5
588	46.0	17.5	0.2	0.7	8.5
589					
590					

591	28.3	8.4	0.7	0.0	27.4
592	19.4	10.0	0.3	0.0	21.1
593	51.5	14.3	0.2	0.2	11.1
594					
595					
596	32.9	9.3	0.5	0.0	26.2
597	24.9	12.7	0.2	0.0	19.6
598	101.5	18.1	0.2	0.0	15.1
599	114.9	24.7	0.1	0.0	11.6
600					
601					
602	32.2	9.4	0.6	0.1	26.9
603	18.5	11.6	0.4	0.1	22.0
604	49.6	11.9	0.3	0.0	13.8
605	49.4	12.6	0.2	0.0	11.5
606					
607					
608					
609	27.2	8.7	0.6	0.1	29.1
610	18.0	7.4	0.3	0.0	20.7
611	16.6	8.7	0.3	0.0	19.0
612	51.2	10.4	0.2	0.0	7.7
613					
614					
615	24.1	10.5	0.4	1.0	23.3
616	27.2	13.8	0.3	1.3	16.8
617	114.5	20.1	0.2	2.2	9.7
618	116.2	33.7	0.2	2.9	9.4
619					
620					

621	27.7	10.0	0.7	0.9	24.4
622	25.1	17.7	0.3	2.9	28.8
623	14.2	17.6	0.3	3.3	20.9
624	17.0	19.7	0.2	3.0	15.0
625					
626					
627					
628	29.5	16.3	0.5	4.4	31.1
629	32.1	25.9	0.3	8.3	34.4
630	23.5	23.4	0.3	6.7	24.3
631					
632					
633					
634					
635	40.6	10.6	0.8	0.9	33.1
636	39.9	11.1	0.4	1.4	25.7
637	36.3	12.4	0.3	1.3	34.3
638	17.3	6.1	0.1	0.6	14.4
639	12.1	4.8	0.2	0.8	11.7
640					
641					
642					
643	58.8	13.2	0.6	0.4	31.5
644	54.8	11.5	0.3	0.4	26.4
645	59.6	9.6	0.2	0.1	16.1
646	55.2	8.5	0.2	0.1	13.3
647					
648					
649	39.1	8.7	0.5	0.0	21.8
650	54.7	8.9	0.2	0.1	12.8

651	53.8	17.0	0.2	0.7	11.4
652					
653					
654	36.1	8.0	0.6	0.1	22.5
655	20.5	9.3	0.3	0.1	22.1
656	63.0	20.3	0.3	0.4	17.3
657	102.8	21.2	0.2	0.9	11.9
658					
659					
660					
661	31.1	7.4	0.4	0.0	25.4
662	15.9	7.3	0.3	0.0	17.0
663	63.6	21.9	0.2	0.3	15.6
664					
665					
666					
667	34.1	7.8	0.5	0.0	26.5
668	19.6	7.4	0.3	0.0	22.6
669	18.8	8.9	0.3	0.0	21.5
670	114.3	13.0	0.2	0.0	11.3
671					
672					
673	41.3	8.5	0.6	0.0	22.7
674	32.6	7.3	0.3	0.0	29.2
675	20.8	7.0	0.2	0.0	21.2
676	14.9	7.7	0.3	0.0	17.6
677					
678					
679					
680	34.8	9.4	0.6	0.0	25.3

681	21.1	12.3	0.3	0.0	20.6
682	71.5	17.0	0.1	0.0	10.6
683					
684					
685					
686	26.0	6.9	1.7	0.0	27.0
687	27.8	7.2	1.9	0.0	28.7
688	16.5	8.2	0.4	0.0	19.2
689					
690					
691					
692	30.4	5.9	1.3	0.0	25.2
693	25.7	9.1	0.5	0.0	20.7
694	56.1	11.3	0.3	0.0	15.2
695	52.9	16.6	0.3	0.3	14.2
696					
697					
698	54.7	6.5	1.6	0.0	27.5
699	82.3	10.2	0.7	0.0	22.1
700	120.0	12.1	0.5	0.0	16.2
701					
702					
703					
704	38.2	6.5	1.2	0.0	28.0
705	23.3	6.7	0.4	0.0	24.2
706	19.4	12.3	0.3	0.0	19.7
707					
708					
709					
710	34.3	7.0	1.5	0.0	31.5

711	32.8	7.1	0.4	0.0	29.4
712	16.0	7.7	0.3	0.0	19.3
713					
714					
715					
716	24.9	6.9	1.1	0.0	22.1
717	42.6	10.7	0.5	0.0	18.5
718	56.8	10.8	0.3	0.1	15.1
719	53.6	15.8	0.3	0.3	14.8
720					
721					
722	44.4	5.1	1.4	0.0	20.8
723	54.8	5.6	0.5	0.0	14.9
724	56.4	9.9	0.5	0.0	14.7
725					
726					
727					
728					
729	56.7	4.8	1.1	0.0	19.7
730	58.6	5.6	0.7	0.0	15.2
731	55.6	8.7	0.3	0.0	14.6
732	55.1	12.5	0.4	0.0	13.9
733					
734					
735					
736					
737	25.8	5.1	1.0	0.0	21.3
738	18.1	5.7	0.4	0.0	18.2
739	17.8	10.9	0.3	0.0	19.2
740	50.8	16.1	0.2	0.6	13.5

741					
742					
743	27.0	4.7	0.6	0.0	20.2
744	14.8	4.1	0.3	0.0	15.7
745	15.7	6.1	0.4	0.0	16.8
746	51.5	11.6	0.3	0.2	15.9
747					
748					
749					
750	21.8	5.9	1.1	0.0	24.0
751	14.7	5.9	0.4	0.0	18.3
752	14.1	9.2	0.2	0.0	12.8
753					
754					
755					
756					
757	22.2	5.7	0.9	0.0	25.0
758	21.8	6.6	0.3	0.0	24.2
759	15.2	10.1	0.6	0.0	22.8
760	29.5	18.2	0.4	0.0	24.2
761					
762					
763					
764	31.1	6.7	1.0	0.0	27.5
765	59.3	9.0	0.4	0.1	23.8
766	40.1	11.5	0.4	0.0	21.6
767					
768					
769					
770	25.7	8.7	1.1	0.0	28.4

771	16.0	8.9	0.4	0.0	20.2
772	14.0	13.8	0.4	0.0	23.1
773	13.6	19.7	0.4	0.0	22.4
774					
775					
776					
777	22.8	9.9	1.0	0.0	27.7
778	13.4	15.4	0.5	0.0	21.5
779	53.1	18.9	0.4	0.1	14.0
780					
781					
782					
783	29.0	6.8	1.3	0.0	27.9
784	18.4	7.8	0.5	0.0	22.8
785	28.6	13.8	0.4	0.3	19.9
786					
787					
788	32.7	7.7	1.9	0.0	37.0
789	19.9	8.6	0.7	0.0	26.2
790	27.2	18.3	0.6	0.0	18.3
791					
792					
793					
794	34.6	7.2	1.6	0.0	28.5
795	15.6	8.9	0.6	0.0	19.9
796	75.7	14.6	0.2	0.0	12.5
797					
798					
799					
800	26.6	6.9	1.9	0.0	25.4

801	19.8	7.7	0.6	0.0	25.3
802					
803					
804					
805					
806	27.4	7.0	1.9	0.0	29.9
807	25.8	6.2	1.1	0.0	27.7
808	18.9	6.2	0.5	0.0	21.6
809					
810					
811					
812					
813	32.8	5.3	0.8	0.0	19.9
814	52.0	14.8	0.3	0.2	10.4
815	46.0	18.6	0.3	0.5	11.0
816					
817					
818	23.3	5.0	0.8	0.0	18.0
819	54.6	14.1	0.6	0.1	14.3
820	45.9	18.2	0.4	0.2	10.4
821					
822	40.0	4.0	0.9	0.0	17.2
823	50.2	6.0	0.5	0.0	16.3
824	54.5	8.8	0.6	0.0	13.3
825	54.8	10.9	0.5	0.0	9.4
826					
827					
828	48.5	3.7	0.8	0.0	15.9
829	28.9	4.3	0.5	0.0	18.4
830	55.8	7.3	0.5	0.0	13.6

831					
832	42.9	3.0	1.0	0.0	15.5
833	54.5	4.5	0.6	0.0	14.0
834	51.2	7.3	0.5	0.0	11.8
835	50.2	10.4	0.7	0.0	10.8
836					
837					
838	43.3	3.5	1.1	0.0	18.0
839	55.7	4.9	0.6	0.0	13.6
840	53.2	13.6	0.5	0.0	10.8
841					
842					
843	16.8	5.7	0.9	0.0	19.2
844	17.1	5.7	0.5	0.0	18.6
845	17.7	7.9	0.4	0.0	15.1
846	56.9	9.6	0.3	0.0	11.5
847					
848					
849					
850					
851	17.5	6.1	0.6	0.0	18.7
852	19.5	9.1	0.5	0.0	14.3
853	53.8	13.3	0.4	0.1	17.0
854					
855					
856					
857	24.6	5.0	1.1	0.0	19.7
858	54.6	6.3	0.6	0.0	17.5
859	56.4	9.1	0.4	0.0	14.1
860	50.0	19.6	0.4	0.1	12.0

861					
862					
863	24.3	4.6	1.1	0.0	19.3
864	21.5	5.2	0.9	0.0	20.5
865	17.9	6.9	0.7	0.0	20.9
866	55.1	10.4	0.4	0.0	15.8
867	52.2	16.7	0.4	0.1	13.6
868					
869					
870	18.5	5.8	1.2	0.0	21.0
871	53.5	9.7	0.7	0.0	19.5
872	54.8	10.0	0.4	0.0	12.6
873					
874					
875					
876	18.4	6.4	0.8	0.0	20.3
877	59.7	9.6	0.5	0.0	15.6
878	58.3	12.2	0.4	0.0	13.6
879	54.3	19.6	0.4	0.0	13.1
880					
881					
882	19.3	8.3	0.7	0.0	21.6
883	46.1	12.6	0.5	0.0	17.0
884	61.3	13.9	0.3	0.0	13.8
885	54.0	23.1	0.4	0.0	14.3
886					
887					
888	19.7	7.8	0.6	0.0	23.0
889	58.8	12.6	0.4	0.0	18.3
890	60.0	14.6	0.2	0.0	13.9

891					
892					
893	24.3	8.9	0.5	0.0	24.3
894	53.8	19.9	0.4	0.0	15.0
895	52.1	24.4	0.3	0.0	12.9
896					
897					
898					
899	41.4	12.4	0.5	0.0	28.0
900	61.0	20.6	0.4	0.0	22.0
901	61.7	13.6	0.4	0.0	14.9
902					
903					
904	56.8	6.8	0.8	0.0	19.6
905	63.0	10.4	0.4	0.0	15.6
906	59.4	19.0	0.4	0.0	12.2
907	54.0	22.3	0.4	0.3	12.7
908					
909					
910					
911	56.2	7.4	0.7	0.0	19.9
912	60.4	13.5	0.4	0.0	13.8
913	54.4	19.4	0.4	0.2	13.9
914					
915					
916	35.2	6.5	0.8	0.0	20.3
917	63.8	16.2	0.4	0.0	14.4
918	55.8	22.5	0.4	0.0	13.7
919					
920					

921					
922	32.6	5.6	0.8	0.0	20.4
923	27.6	8.8	0.6	0.0	24.0
924	62.5	13.5	0.4	0.0	13.5
925					
926					
927					
928	28.2	6.9	1.0	0.0	20.4
929	57.2	10.1	0.6	0.0	16.5
930	60.1	14.2	0.4	0.0	13.9
931					
932					
933					

APPENDIX U. SAS OUTPUT FOR MATCHED PAIRS T-TEST ON BARNES SURFACE HORIZON WALKLEY-BLACK SOIL ORGANIC CARBON %

Matched Pairs t Test

Barnes Surface Horizon Walkley Black SOC %

The TTEST Procedure

Difference: New - Old

N	Mean	Std Dev	Std Err	Minimum	Maximum
3	-0.8667	0.2155	0.1244	-1.1100	-0.7000

Mean	95% CL Mean		Std Dev	95% CL Std Dev	
-0.8667	-1.4020	-0.3314	0.2155	0.1122	1.3543

DF	t Value	Pr > |t|
2	-6.97	0.0200

APPENDIX V. SITE CORRELATION TABLE

Site Name in Thesis	Site Name for 2013-2014 Laboratory Work	Site Names in Historic Characterization Data
Cass County	R12ND-017-MM1	B2C†
Dickey County 1	R13ND-021-MM1	S58ND-11-1
Dickey County 2	R13ND-021-MM2	S60-ND-11-5
Dickey County 3	R13ND-021-MM3	S60-ND-11-7
Steele County	R13ND-091-MM1	S53ND-46-1; B3A†
Walsh County 1	R13ND-099-MM1	S59ND-50-1; B5A†
Walsh County 2	R13ND-099-MM2	S59ND-50-2; B5B†

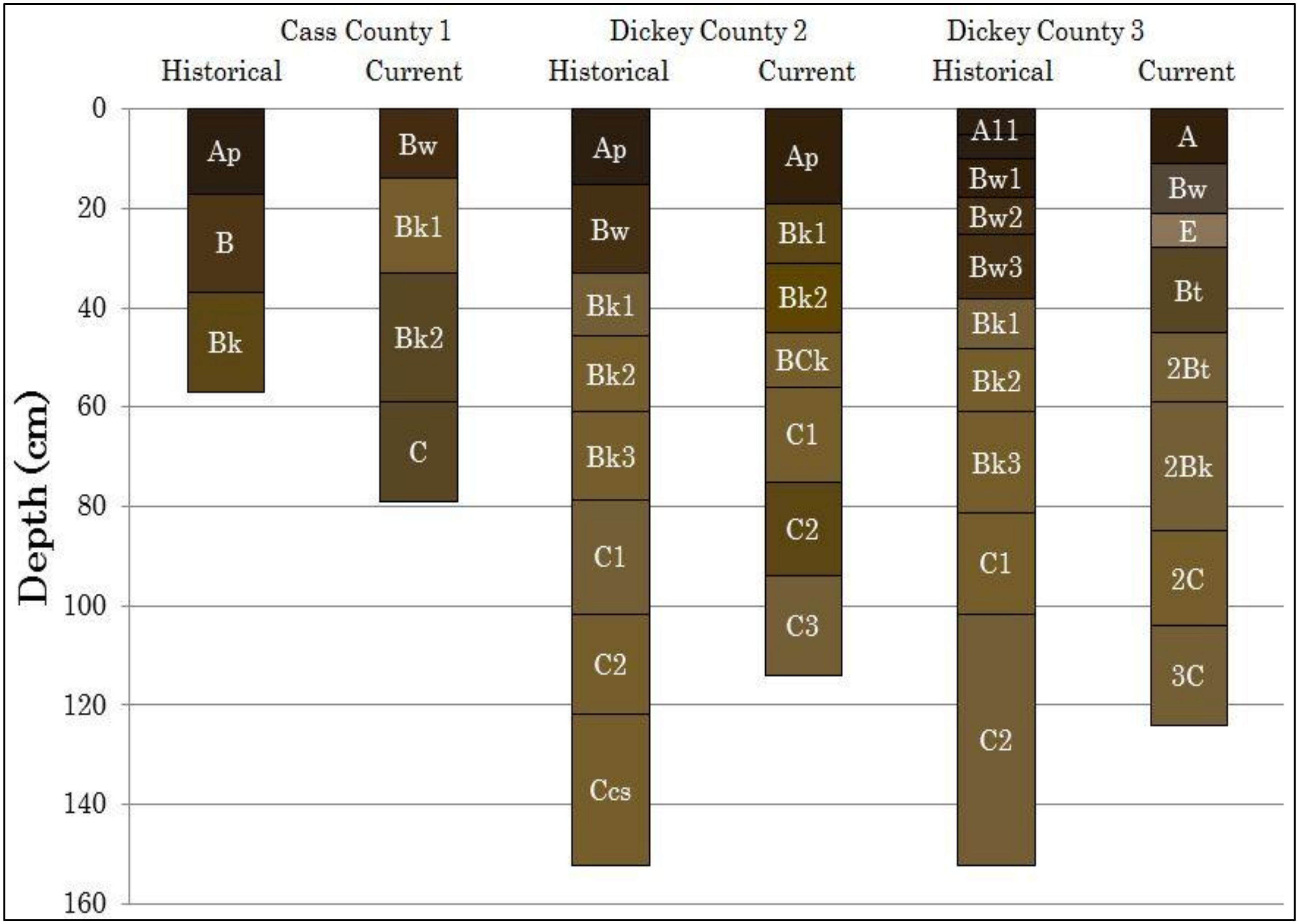
†Pedons located in Redmond thesis (Redmond, 1959).

APPENDIX W. CROPPING HISTORIES FOR ALL STUDY SITES FROM 1997-2013

Year	Sites						
	Cass County	Dickey County 1	Dickey County 2	Dickey County 3	Steele County	Walsh County 1	Walsh County 2
2013	Wheat†	Soybeans	CRP	Pasture	Corn	CRP	Soybeans
2012	Soybeans	Corn	CRP	Pasture	Corn	CRP	Wheat
2011	Wheat	Soybeans	CRP	Pasture	Fallow/wet	CRP	Soybeans
2010	Soybeans	Corn	Corn	Pasture	Soybeans	CRP	Wheat
2009	Wheat	Soybeans	Soybeans	Pasture	Soybeans	CRP	Canola
2008	Soybeans	Corn	Corn	Pasture	Soybeans	CRP	Wheat
2007	Wheat	Soybeans	Soybeans	Pasture	Corn	CRP	Sunflowers
2006	Soybeans	Wheat	Soybeans	Pasture	Corn	CRP	Wheat
2005	Wheat	Soybeans	Fallow	Pasture	Wheat	CRP	Grass/Pasture
2004	Soybeans	Corn	Corn	Pasture	Soybeans	CRP	Wheat
2003	Soybeans	Soybeans	Soybeans	Pasture	Corn	CRP	Unknown
2002	Wheat	Soybeans	Corn	Pasture	Soybeans	CRP	Wheat
2001	Soybeans	Fallow	Soybeans	Pasture	Wheat	CRP	Wheat
2000	Wheat	Wheat	Unknown	Pasture	Soybeans	CRP	Wheat
1999	Unknown	Grass/Pasture	Unknown	Pasture	Fallow	CRP	Unknown
1998	Sunflowers	Unknown	Wheat	Pasture	Sunflowers	CRP	Wheat
1997	Wheat	Grass/Sunflowers	Sunflowers	Pasture	Wheat	CRP	Wheat

†Data from the National Agricultural Statistics Service (NASS)

APPENDIX X. PEDON REPRESENTATIONS FOR THE THREE SAMPLE SITES NOT UTILIZED IN THE MAIN CHARACTERIZATION ANALYSIS



Colors were converted from Munsell notation to RGB for these visualizations.