DISTRIBUTION AND PARTITIONING OF LEAD RELATED TO SOIL CHARACTERISTICS IN A FORMER GUN RANGE

BY

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Distribution and Partitioning of Lead Related to Soil Characteristics in a Former Gun Range

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ABSTRACT

Lead shot is commonly used in shooting ranges throughout the world. When introduced into the environment, several factors such as wind and precipitation will aid in the breakdown of the lead (Pb) compound, as well as the transportation of the Pb throughout the soil in which it lands. Weathering and other environmental factors will cause the Pb to oxidize, potentially turning it into hydroxide, sulfate, carbonate, or a phosphate species.

The amount of precipitation that falls annually in a Pb shot contaminated range contributes to lead distribution within the soil profile. Acid precipitation and acidic soils can solubilize the Pb making it more mobile. Conversely, organic matter, clays, and other mineral components can inhibit the mobility of soluble Pb because of sorption onto soil particles. Therefore, it is important to identify the type of soil, the permeability, porosity, pH, and organic matter content which will influence how much the Pb will migrate through the soil. It will also give insight to the future leaching potential.

When Pb is subject to dissolution and erosion, it can leach into soil and groundwater, possibly causing health problems for humans and animals. Because of the potential impacts, this research examines the spatial distribution of Pb from munitions used at the Grand Valley Hunting Ranch in Orwell, Ohio, a property now owned and under ecological restoration plans by the Western Reserve Land Conservancy. A preliminary assessment of elevated Pb concentration in soils was determined using an X-ray Fluorescence Spectrometer (XRF). Four sample locations were established and were cored to further and more accurately analyze Pb concentrations in the soil. The four locations were located within the fall zone of the Pb shot. A fifth location outside of the fall zone was cored and designated as the reference. Each core was 60-90 cm in total length and divided into 2-5 cm segments and halved, resulting in 148 total samples. This depth provided a good illustration of how the Pb leached through the soil.

Total Pb, plant available Pb and water soluble Pb and other metals were analyzed using Inductively Coupled Plasma – Atomic Emissions Spectroscopy (ICP-AES). Soil physical properties such as soil texture and organic matter was also determined. Results of Pearson correlation analysis and backward stepwise regression indicated that lead movement is determined by organic matter content, soil conductivity, pH and bulk density. This information will assist the Western Reserve Land Conservancy (WRLC) with developing mitigation techniques.

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CHAPTER 1.0 INTRODUCTION

Lead (Pb) is a toxic heavy metal that is a naturally occurring element in the environment. Lead concentrations throughout the environment have increased due to human activities. Lead has been used for centuries in products ranging from paints to gasolines and ammunitions. There have been well-documented cases of wetland and aquatic lead contamination from these sources (Rooney, Mclaren, & Cresswell, 1999). Because of Pb's toxicity, it can cause adverse effects to these environments (Scheetz & Rimstidt, 2008). Lead can be transmitted or transported by erosion even to remote locations. Therefore, humans, flora, and fauna can come in contact with Pb.

Children tend to have a higher contact rate with Pb than do adults, mainly because children come in contact with soil as they play in it, and ingest it from hand-to-mouth and toys-to-mouth transfer. This can lead to exposure and potential health problems. Health effects can range from permanently delayed physical and mental development, neurological disorders, kidney and liver damage, and death (United States Environmental Protection Agency [USEPA], 2013).

Adults can have similar acute or chronic problems when they come in contact with the contaminant. These effects can include high blood pressure, kidney damage, and reproductive problems. In addition, pregnant woman that come in contact with Pb can miscarriage or begin labor prematurely (USEPA, 2013).

In order to avoid these health risks, the United States Environmental Protection Agency (USEPA) has enacted procedures to control the presence of Pb in the environment. Title IV of the Toxic Substances Control Act (TSCA), Clean Water Act, and the Clean Air Act help regulate Pb levels to reduce exposure and protect human health (USEPA, 2014).

CHAPTER 2.0 LITERATURE REVIEW

Natural Pb concentrations in soil typically range from 50-400 ppm; however, there have been cases where Pb concentrations have reached 11,000 ppm due to additional introduction from other sources, such as shooting ranges, mining activity, and waste deposition (USEPA, 2013). It is estimated that the United States is home to 9,000 non-military outdoor shooting ranges (Scheetz & Rimstidt, 2009). In addition, it is estimated that three billion kilograms of munitions have been shot there in the 20th century. This Pb was used for hunting and recreational use, and is increasing in rate by 60 million kg per year (Cao, Ma, Chen, Hardison, & Harris, 2003).

When Pb pellets come in contact with soil, several reactions can occur including oxidation, carbonation, and hydration. When these processes occur in an outdoor environment, a weathering rate of 1% can occur. Furthermore, it is estimated that 5% of metallic Pb can be transformed to lead carbonate and lead sulfate within a 20-30 year period (Cao et al, 2003). Ninety-Seven percent of a Pb shot consists of metallic Pb. The remaining 3% is a distribution of 2% antimony, 0.5% arsenic and 0.5% nickel, depending on the manufacturer (Scheetz & Rimstidt, 2009).

The Minnesota Pollution Control Agency has estimated that the average annual rate of Pb shot dispensed is 1,184,203 kg per gun range (Kimmel & Tranel, 2005). It is also reported that a single Pb shot per 12,000 liters of water can result in contamination that surpasses the World Health Organization standard for drinking water of 10 μg/L (Kimmel & Tranel, 2005). There are very stringent standards for Pb levels in drinking water across the world. The European Union and World Health Organization drinking water standards for Pb are 10 μg/L, and the EPA's drinking water action level for Pb is

15 μg/L with the maximum contaminant level goal of 0 μg/L (Scientific Committee on Health and Environmental Risks [SCHER], 2011). The EPA also states that Pb levels above the action level for drinking water, and above 400 ppm in soils used for play areas for children, can be harmful. Other residential soils that are in non-play areas should be less than 1200 ppm (Agency for Toxic Substance & Disease Registry [ATSDR], 2007).

Ecological systems can also be adversely impacted by elevated levels of Pb in soil. Lead is not considered to be an essential nutrient for plant growth and development or essential for birds and mammals. Lead in soils can cause reduced growth, inhibition of enzymes needed for photosynthesis, interference with respiration, and reduced water absorption and transpiration in plants (USEPA 2005). In animals, Pb can cause encephalopathy and gastrointestinal malfunction, as well as a variety of other conditions (anxiety, vocalization, maniacal behavior, etc.) depending on the species. In the United States, ecological soil screening levels (Eco-SSL) for plants has been established at 120 ppm, 1,700 ppm for soil invertebrates, 11 ppm for birds and 56 ppm for mammals (USEPA, 2005). Therefore, it is important for shooting ranges to identify high concentration of Pb in soil in order to organize mitigation techniques and avoid contamination and potential adverse health effects to the ecological community.

When Pb pellets, such as those from shot guns, are introduced into the environment, several factors including wind and precipitation will aid in the breakdown of the Pb compound, as well as the transportation of the Pb throughout the soil (Duggan & Dhawan, 2007). The decomposition from environmental factors will be higher within the top 10 cm of the soil surface. This is mostly due to the spent pellets residing there; typically, 78-84% of pellets are located in the top 10 cm of soil, while 52-55% are located in the top five centimeters (Thomas, Mensik, & Feldheim, 2001). Weathering will cause the Pb to oxidize, potentially turning into hydroxide, sulfate, carbonate, or a phosphate species soil (Duggan & Dhawan, 2007).

The amount of precipitation that falls annually in a Pb shot contaminated range contributes to Pb distribution within the soil profile (Selonen et al., 2012). Acid precipitation and acidic soils can solubilize the Pb making it more mobile. Conversely, organic matter, clays, and other mineral components can inhibit the mobility of soluble Pb because of sorption onto soil particles (Duggan & Dhawan, 2007). Therefore, it is important to identify the type of soil, the permeability, porosity, pH, and organic matter content that will influence the amount of Pb that will migrate through the soil. It will also give insight to the future leaching potential (Duggan & Dhawan, 2007).

Various studies have shown that once Pb enters the environment, adverse effects on the flora and fauna can occur. The amount of Pb in the soil of a pine forest affected parts of the biota differently depending upon the organism and when the concentration of Pb was applied (Selonen et al., 2012). Pine needles that were three-years-old or younger were gathered from seven 25-year-old Scots Pines that were near each study site. In addition, *V. myrtillus* leaf samples and *A. muscaria sporocarps* were also collected. The pine needles were collected from trees that were in the area of heaviest lead concentration from the two contaminated Pb sites, one site being newly contaminated and the other displaying older contamination. Pine needles that were collected from the control site were collected at random. The results showed that Pb concentrations from the contaminated sites were higher than the control site for all species studied. Furthermore, the pine needles and *V. myrtillus* leaf samples from the newly contaminated site showed higher Pb concentration than did those from the older contaminated site. Conversely, *A. muscaria sporocarps* displayed Pb concentrations that were twice as high at the older site than those at the newer site (Selonen et al., 2012).

Enchytraeid worms, *Oribatida*, and *Mesostigmata*, displayed similar characteristics as the pine needles. The Pb concentration in the two contaminated sites which housed *A. muscaria* sporocarps, *Enchytraeid* worms, *Oribatida*, and *Mesostigmata* were higher than the control. Additionally, *Oribatida*, and *Mesostigmata* displayed a concentration of Pb that was twice as high in the older contaminated site than the newer site. The study concluded that all of the flora and fauna in the Pb contaminated zones contained the toxic metal (Selonen et al., 2012).

A separate study examined Pb ingestion rates by waterfowl in feeding marshes that were subject to Pb pellet distribution. It examined shot densities in each feeding marsh, and noted that the ingestion rate was higher in marshes with slower rates of sedimentation. The study also noted that because shot concentration is higher toward the soil surface, the waterfowl had a higher likelihood of accidentally consuming it instead of grit, which they use to aid in digestion (Pain, 1991).

A similar study's findings agreed with this result; doves also ingest grit to aid in digestion, and can accidentally ingest Pb shot in areas with high pellet availability. The report identified effects of Pb shot ingestion in both the primary consumer's physical wellbeing, as well as reproductive effects that could occur in the primary consumer and its offspring (Buerger, Mirarchi, & Lisani, 1986).

Mourning doves were trapped near Auburn University, Alabama and caged for the study. In addition to their controlled diets, they were fed a water intake that was contaminated with 0.001 μg/g of Pb. The 75 doves were then randomly assigned and force fed a specific number of Pb shot (1, 2, 4, and 8). In addition, 25 additional doves received a browntop millet seed and designated the control group. Dead birds where autopsied, and their liver, kidney, and radius and ulnar bones were examined. It was concluded that the birds that received the Pb shot had a greater mortality rate than did the control birds, and those that consumed more Pb had higher mortality rates than did those that consumed less (Buerger et al., 1986).

A reproductive analysis was conducted on female doves with a diet consisting of a wet Pb concentration of 0.22μg/g. After mating, the female doves were randomly selected to determine which 25 of the 50 birds would receive Pb dosing. Those chosen were then force fed a number eight Pb shot; the others were fed one browntop millet seed. When eggs were produced, physical measurements were taken. There were no physical difference between control group eggs and Pb contaminated eggs. The eggs were then incubated to determine egg fertility. Fertile eggs were examined and returned to the incubator until hatched. The hatched doves were evaluated, and unhatched eggs were examined to determine age (Buerger et al., 1986).

In both studies, the Pb in the doves' systems was exceptionally high in the tissues, especially the liver and kidneys. In the reproductive study, birds that ingested the Pb pellets had decreased egg hatchability (number of eggs hatched per number of fertile eggs). However, the Pb did not affect the fertility of the parent dove, nor did it affect the productivity of those eggs that did mature. The study concluded by noting that female mourning doves ingest Pb, they will most likely experience higher mortality rates, as well as a decrease in reproductive ability (Buerger et al., 1986).

It is clear from the above studies that Pb can have extremely detrimental effects when pellets are available to interact with flora and fauna in an exposed region. In order to view the density and relationship between spent pellets and soil, another study was conducted to determine if a correlation existed between the depths of soil and the number of spent pellets located in the soil (Mudge, 1984).. The different soil types were characterized by grazed flood meadow on alluvial silt, freshwater marsh (silt on sand), and peaty flood meadow. Most of the Pb pellets were found within the top five centimeters of the soil's surface. The depths of the pellets were compared to the amount of vegetation that existed on the surface; the higher the percentage of vegetation, the more shots were available in the five centimeters of soil. The difference in pellet saturation between vegetated soil and to non-vegetated area was 3.9% (Mudge, 1984).

Additionally, the rate of sedimentation between years and habitats stayed consistent throughout and did not show and influence on pellet concentration. Other factors such as type of habitat and number of years of operation did not seem to have an influence on the vertical movement of the Pb shot (Flint, 1998).

As Pb's presence in soil can be extremely toxic to flora and fauna, it is important to understand how it occurs in the soil, as well as how it can travel through and permeate it. Lead's presence in soil has been identified in two states: metallic and oxidized. The first state, metallic, occurs from Pb pellets that rest on or have entered the top soil and not yet weathered. The second state, oxidized, is from Pb that has weathered over time from precipitation and wind. Oxidized Pb is more likely to leach into the surrounding areas (Duggan & Dhawan, 2007). Precipitation with low pH that falls on soils causes Pb to travel more easily through acidic soils due to increased solubility (Kimmel & Tranel, 2005). In neutral to basic soils, Pb levels have been found at the highest concentrations in the top 5.0 cm of the surface then decreased with depth (Duggan & Dhawan, 2007).

Earthen impact berms are a backstop or bullet trap designed to sop direct fired rounds. These areas have been shown to have three to six times higher levels of Pb concentrated in the soil than do soils in other parts of the range. The Pb is not contained in these berms, and can move due to soil re-suspension, and therefore flow into adjacent areas further increasing the Pb levels in fields surrounding the berms (Basunia & Landsberger, 2001). The length of time Pb shot is in the soil will affect the type of Pb and increase the concentrations of Pb compounds (Selonen et al., 2012).

Extractable Pb in the soil is mostly contained in the A-Horizon. Weathering, such as wind and rain, which cause the Pb to erode, has the most effect near the soil's surface. Furthermore, the vegetation and root system that binds the soil together in the A-horizon will create a barrier that will inhibit Pb from leaching into the other horizons (Scheetz & Rimstidt, 2009). When the soil has been tilled, it weakens the binding properties in the A-horizon, therefore improving water infiltration, aeration, and less stable vegetation cover. These changes enhance the Pb leaching potential into the deeper horizons (Scheetz & Rimstidt, 2009).

Excessive Pb levels in soil from Pb shot can cause adverse effects within the immediate area, and can leach into other areas or water causing more widespread effects. Therefore identifying soil properties that contribute to Pb movement is the first step in characterizing how Pb shot will affect flora and fauna. The historic shooting ranges at Grand Valley Hunting Ranch were analyzed for Pb concentrations and soil properties. The goal of this research was to gather and analyze data to enhance the understanding of

Pb's form and movement in the soil so that the Western Reserve Land Conservancy can implement mitigation techniques to reduce available Pb contamination at the site. The study will determine the form of Pb, depth of contamination, and Pb movement through the soil profile.

CHAPTER 3.0 HYPOTHESIS & OBJECTIVES

3.1 HYPOTHESIS

It is hypothesized that the Grand Valley Hunting Ranch, which had active munitions in use for 17 years without Pb shot restrictions, has elevated concentration of Pb in the soil in the fall zone.

It is further hypothesized that the distribution of Pb in the soil will be influenced by soil properties such as organic matter and texture as well as chemical properties such as pH. Organic matter and fine textured soils will reduce the transport of Pb to lower horizons, whereas low pH will increase the movement of Pb to lower horizons.

3.2 OBJECTIVES

To determine the amount of Pb that has migrated through the soil at the Grand Valley Hunting Ranch, there are three objectives that were examined.

1. Identify locations of the core samples based on the highest Pb concentration or hot spots at the shooting range area of the Grand Valley Hunting Ranch.
2. Identify various fractions of Pb concentration through vertical layers of the cores that are associated with each fraction of Pb in the soil column:

    a). Total Pb fraction
    b). Plant available Pb fraction
    c). Water Soluble Pb fraction

3. Using statistical methods, model the soil properties with Pb concentrations to determine the properties that have the greatest effect on Pb movement in the core.

CHAPTER 4.0 MATERIALS AND METHODS

4.1 SITE AND SOIL DESCRIPTION

Core soil samples were selected from different locations throughout the range based on the location of historic shooting stands and preliminary soils analysis for Pb. Five sample sites were selected; four of which were located within the fall zone, and one was located outside of the fall zone and designated as the natural state of pre-gun range soil or reference site (Figure 1).

In order to locate where the soil cores would be collected, a total of 21 different soil samples were collected for Pb concentration from different areas of the ranch that were within the Pb fall zone. The samples were gathered through the use of a trowel; the first two centimeters of soil were gathered and placed in an air-tight polyurethane bag and numbered. A Geographic Position System (GPS) was then used to locate the coordinates of the sample sites, which was then used to reference the sites' locations on the aerial map though a Geographic Information System (GIS) ArcGIS 10.1 (ESRI, 2012). A trend was then

Figure 1 Map of the Grand Valley Hunting Ranch with yellow circles indicating shooting points and yellow outline indicating potential fall zone locations. Red box indicates area of focus.

established between the location of the samples to the shooting stands and ranges on the map. Each sample was dried at 105ºC for 96 hours in a Fisher Oven (Isotemp 500 Series) and then pestle and mortared to fit through a 212 micrometer sieve. Drying and sieving the samples accomplished two objectives: examining the soil for Pb pellets and creating a medium fine enough to be analyzed in an S2 Ranger, mid-resolution X-ray fluorescence spectrometer (XRF).

The samples were then placed into the XRF to determine Pb concentrations. The corresponding information and geographic coordinates were entered into ArcGIS to map where the Pb "hot spots" were identified. From the 21 different soil samples, the four samples that exhibited the highest Pb concentration were selected for coring (Table 1).

Table 1 XRF Lead Analysis of soil samples from the Grand Valley Hunting Ranch

Site Number	1	2	3	4	5	6	7	8	9	10	11
Pb Conc. (%)	0.11	0.302	0.072	0.105	0.209	0.65	0.341	0.012	0.065	0.693	2.062
Ranking of site to Pb conc.	11	7	15	12	9	4	6	18	16	3	1
# of Pb Pellets	1	1	0	0	4	16	7	0	0	4	8
Site Number	12	13	14	15	16	17	18	19	20	21	
Pb Conc. (%)	0.414	0.851	0.192	0.006	0.01	0.048	0.216	0.085	0.079	0.003	
Ranking of site to Pb conc.	5	2	10	20	19	17	8	13	14	21	
# of Pb Pellets	3	3	0	0	0	0	0	3	0	0	

Samples 11, 13, 10, and 6 had the highest Pb concentration of the samples, respectively; however, soil samples 11 and 13 were too close in proximity to provide a representative sample. Therefore, site 19 was selected instead of 13 to capture soil characteristics in the west area of the ranch. The last core that was gathered was the reference core (RC), which was located outside of the fall zone of the shooting ranch. Site locations can be seen in Figure 2.

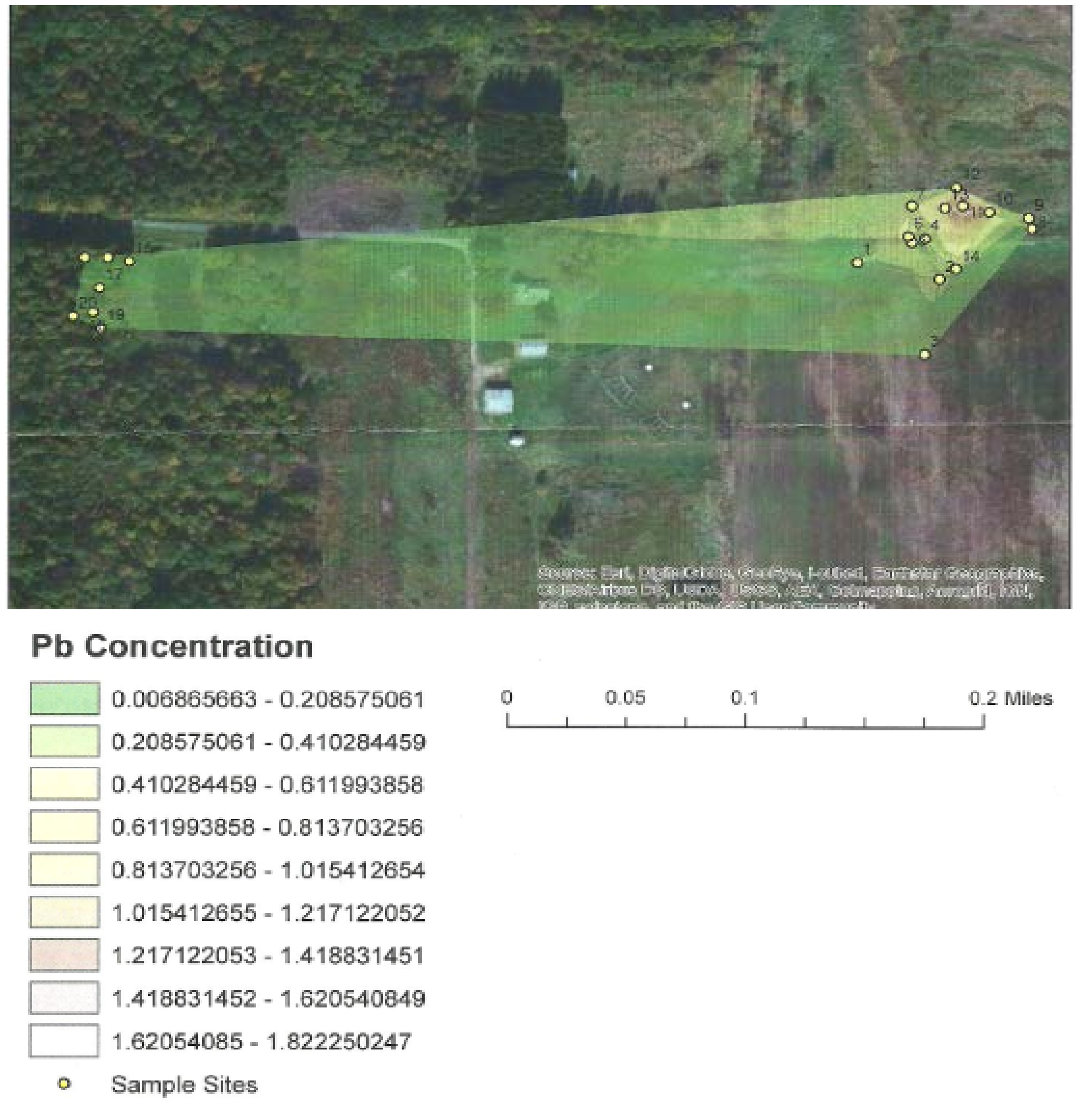


Figure 2: Map of Samples taken at Grand Valley Hunting Ranch

Once the sites 6, 10, 11, and 19 were established as the location for coring, they were dried and then sifted through a 212 mm sieve. Sites 6, 10, and 11 had a range of 4-16 spent pellets found in the sites, with site 6 having the most (16) (Table 1). The three sites, 6, 10, and 11 were located in the north area of the ranch, with site 6 having a drop zone between sites 10 and 11. Site 19 was located at western part of the ranch; within the sites, three spent pellets were found. Site 19 was not in close proximity to the other sites, and displayed the lowest Pb concentration and Pb pellets (Figure 3)

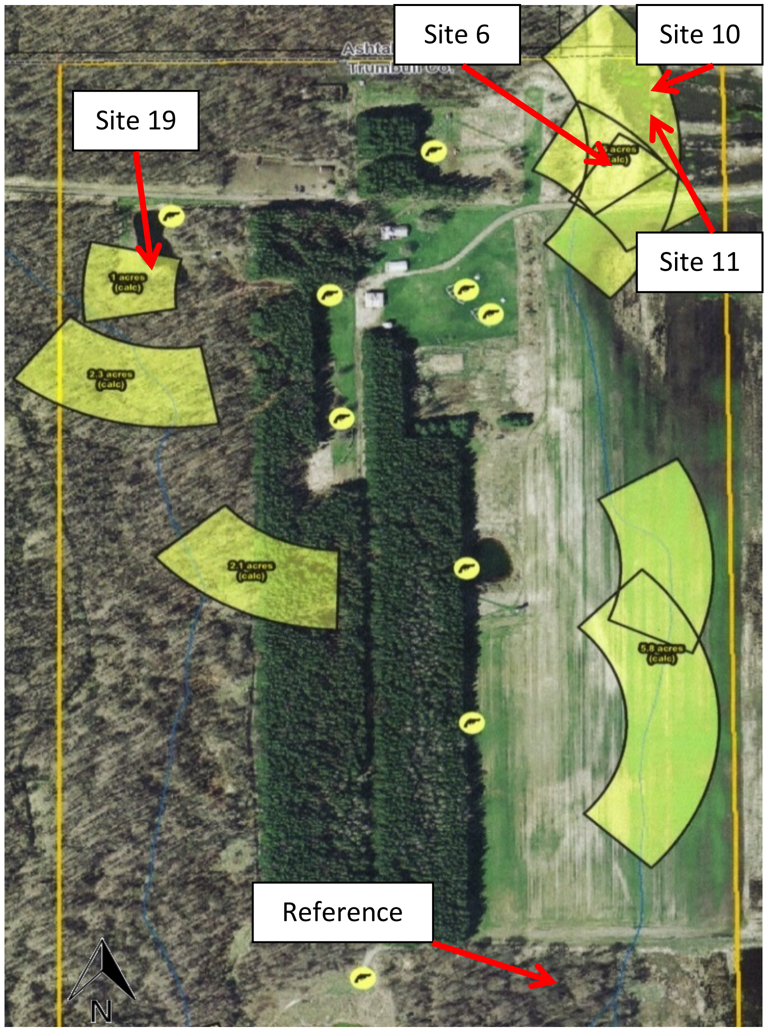


Figure 3 Map of the Grand Valley Hunting Ranch with approximate sites of core locations identified.

4.2 SOIL DESCRIPTIONS

Figure 4 displays each site's soil type of the Grand Valley Hunting Ranch. Sample sites 6, 10, and 11 have the same soil type, Carlisle muck, ponded (Ch). This soil is very poorly drained and slopes 0-2%. The mean water precipitation is 28-42 inches per year, which makes this area prone to ponding. The water table is 0-12 inches below the surface and the mean air temperature is 28-42°F. The formation of the land is represented by bogs on till plains, lake plains, swales on terraces, and the typical soil profile consist of 65 inches of muck (United States Department of Agriculture [USDA], 2013).

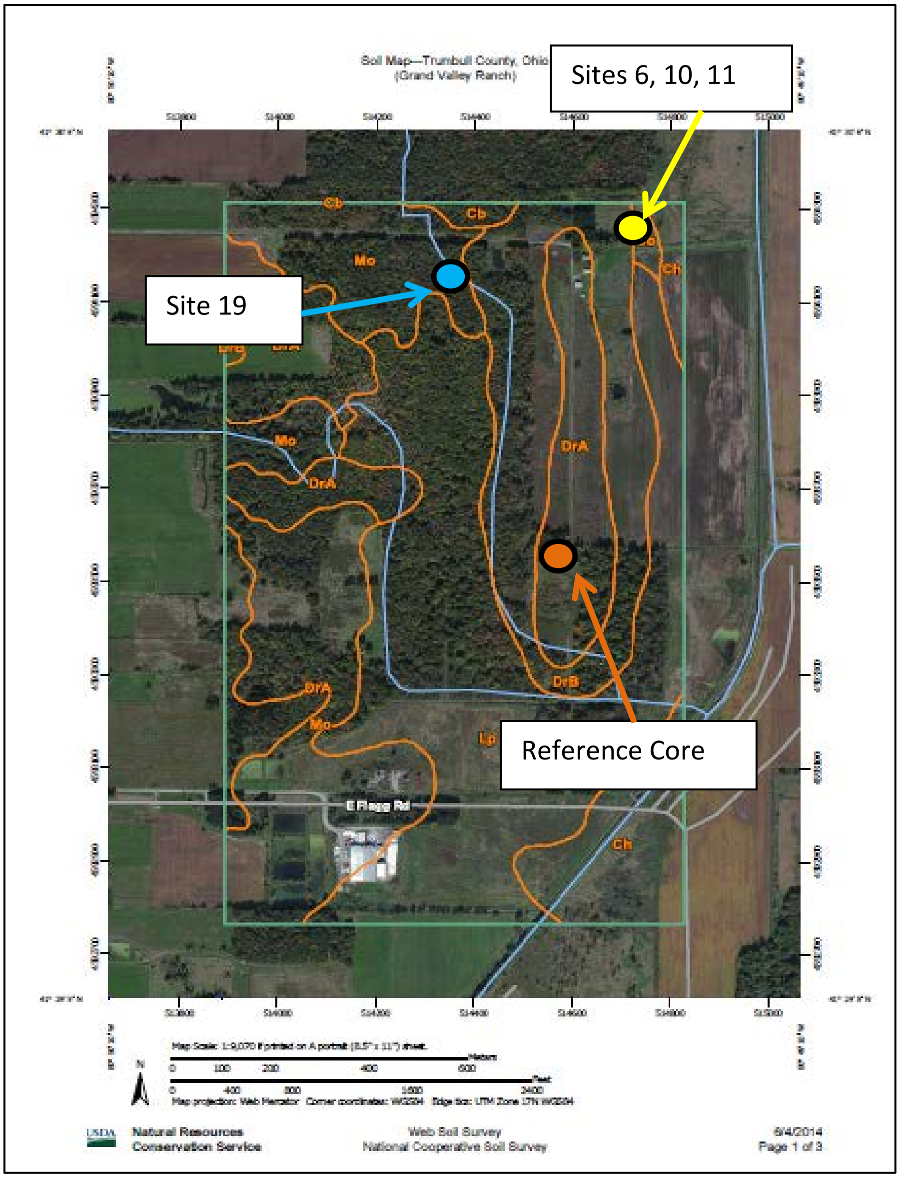


Figure 4 Soil Map of Grand Valley Ranch (Trumbull County, OH)

Sample site 19's soil type is Darien silt loam (DrB). This soil type experiences a mean precipitation of 32-42 inches per year and has a mean air temperature of 48-54°F. The water table ranges from 6-18 inches below the surface, and the natural drainage class is somewhat poorly drained. It does not experience flooding and ponding as do the other sites. The slope of the land is 2-6% and the landform is knolls on till plains. The typical profile of this soil is 13 inches of silt loam, followed by 13-47 inches of clay loam, then 47-70 inches of silty clay loam (USDA, 2013).

The Reference Core's (RC) soil type is Darien silt loam (DrA) which is much like Core 19's soil type. The soil that exhibited here had two major differences than Core 19: the slope and the landform. The slope of the RC is 0-2% and the landform of the soil is flats on till plains. The soil is somewhat poorly drained and features the same soil profile as Core 19. Additionally, the amount of precipitation, air temperature, and water table levels are the same as soil DrB (USDA, 2013). Figure 5 shows the overall layout of the sites.

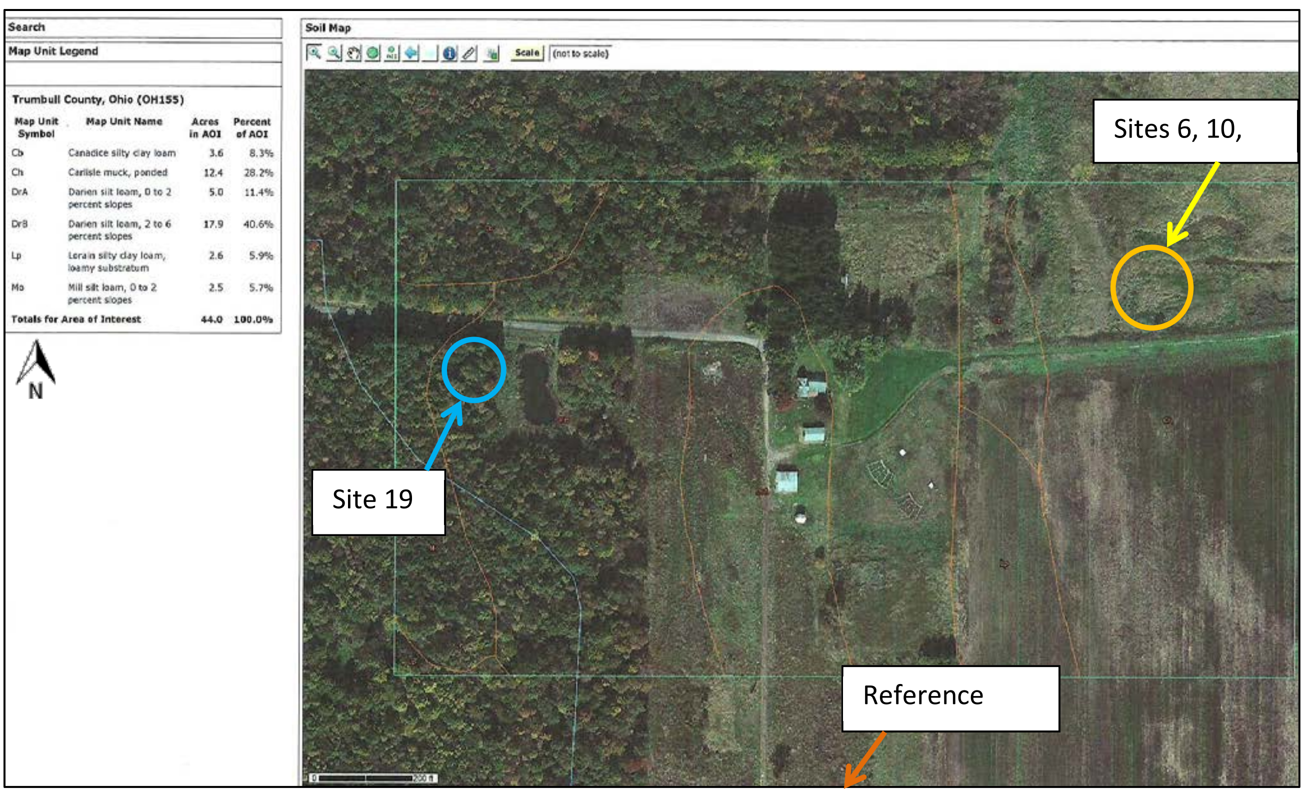


Figure 5 Map of Grand Valley Hunting Ranch (websoilsurvey.nrcs.usda.gov)

4.3 Core Sampling Methodology

An aluminum irrigation pipe 10 cm in diameter and ranging from 90-120 cm in length was used to acquire the soil cores. The pipe was hand driven into soil with a four pound sledge hammer to the depth of the water table, which ranged from 60-90 cm. This method is similar to a common technique where a soil recovery probe is hammered into the ground (Scheetz & Rimstidt, 2008). The core was sealed to maintain pressure and pulled from the ground, aided by a car scissor jack. Five cores were taken from the five locations identified for the study.

After the samples were collected, the cores were cut in half lengthwise with a table saw with as little soil contact as possible. Once both sides of the pipe were cut, a non-serrated knife was used to slice through the core, which pried open the pipe revealing the two relatively equal core segments (Figure 6). The two halves of the cores were examined based on their appearance and composition. Examining the halves allowed for analysis of the different soil horizons.

Figure 6 A split core using a table saw

The horizons in the cores were Horizons O, A, E and B. The O horizon, or organic horizon, contains high amounts of organic material that include partially decomposed and undecomposed organic material that is on the soil's surface. The A horizon, or commonly called the top soil, resides below the O horizon, consists of high concentrations of organic matter that has humified. This is followed by the E horizon, or zone of losses, and contains a concentration of sand and silt particles (less clay) and is usually lighter in color than the A or B horizons. The B horizon, located below E, displays an alluvial concentration of silicate clay, humus, and other metal species that has migrated down from the previous horizons (USDA, 2016). For the purposes of this thesis, the A horizon was specifically noted based on the organic matter content and other soil properties. Because the O horizon was displaced during coring, any remaining undecomposed material was grouped with the A horizon. The remaining horizons were categorized as the B horizon, and typically included the sand, silt, and clay particles found in the E and B horizons. In addition, these samples were collected in a saturated environment and displayed characteristics of hydric soils such as the mottled look (areas of red and grey iron oxides) of the lower horizons.

Cores were sectioned into five centimeters segments for analysis. If immediate sections were not prepared, the core were wrapped in cellophane, numbered, and placed in a refrigerator to inhibit bacterial growth. Later, they were divided and prepared for analysis (Figure 7).

Figure 7 Layers of cores subdivided and prepared for analysis.

4.4 Bulk Density Methodology

Bulk density (BD) of soil is displayed through the ratio of the mass of dry soil to the bulk volume of the soil (Blake & Hartge, 1986). Soil texture and the densities of sand, silt, clay, and organic matter affect the structural support, water, solute movement, and aeration of the soil. In general, BD increases with depth because of the lack of organic matter (OM) present in the lower soil layers due to the lack of pore space (USDA, 2008). In order to calculate the bulk density of the soil samples, they were dried in an aluminum dish for three days at a constant temperature of 105°C. Once the samples were completely dried, they were left to cool. After cooling, the samples were placed in one quart size bags where they were weighed (Figure 6). The weights of the bags were torn in order to get an accurate reading of the weight per sample. Once the weights of the soils were established, several calculations were conducted to find the bulk density of each sample. The equation to find the bulk density is shown as (Blake & Hartge, 1986):

$$\frac{Weight\ of\ Sample\ (g)}{Volume = [(\pi)r^2 * height\ per\ soil\ sample(cm)]} = Bulk\ Density$$

$$(\pi)r^2 = 41.854$$

$$Volume = \ 209.269$$

4.5 Particle Size Analysis

Soil texture, or particle size, determines the amount of sand, silt and clay present. The clay content is the most active in retarding cation movement in a soil profile. Therefore, soils that are higher in clay content may have slower cation (free Pb) movement compared to soils with less clay content. Soil texture can also affect the amount and type of nutrients and metals found at various layers in the soil profile.

To determine the particle size, the cores were divided into groups based on the different soil layers identified in each of the cores. The layers were visually identified when the cores were split in half. Once the different layers were grouped according to their appearance and texture, their relevant horizons were identified.

The soil layers were weighed to 45-50 g, with each soil group having the same ratio per layer. Once the weight of each soil layer was established, 10-20 mL of hydrogen peroxide (H_2O_2) was slowly added to each layer to remove organics. Once the samples were no longer reacting, the soil samples were placed in a drying oven (Fisher) for two hours; when the time elapsed, another 10 mL of H_2O_2 was added to remove any existing organic matter. After the exothermic reaction of soil and H_2O_2 ceased, the soil was placed in the oven to dry. As soon as the soil was dry, it was removed from the oven to cool to room temperature. A mixture of 250 mL of deionized (DI) water and 100 mL of hexametaphosphate (HMP) was added so that the solution could soak overnight. The next morning, the soil solution was added into an electric mixer for five minutes and placed into a one liter plastic container on an orbital shaker where is was shaken for five hours. The soil solution was transferred into a 1000mL graduate cylinder and filled to volume with DI water for hydrometer analysis (Gee & Bauder, 1986).

The soil solution in the graduated cylinder was covered and shaken end-over-end for one minute. After shaking, a soil hydrometer (Bouyoucos Scale ASTM 152) was placed in the cylinder and the hydrometer reading was recorded at 30-, 40-, and 60-seconds, and 3 minutes. After the completing the first soil hydrometer readings, the one liter graduated cylinder was again shaken end-over-end for one minute. Once a minute passed, the soil hydrometer was placed in the cylinder where readings were taken at 30-

and 40- seconds, and at one-, three-, 10-, 30-, 60-, 90-, 120-, 480-, and 1440 minutes (Gee & Bauder, 1986). After the density of each was determined, the United States Department of Agriculture (USDA) Natural Resources Conservation Service Texture Triangle was used to determine particle size (United States Department of Agriculture [USDA], 1998).

The Texture Triangle determines the particle size analysis (PSA) based on the percentages of clay, silt, and sand present in the soil. Based on this, soils are categorized into texture classes ranging from sandy soil materials (course soils with high sand content) to loamy soil materials (moderately course to moderately fine textured, made up of sand, silt, and clay), and clayey soils (finely textured, comprised mostly of clay with sand and silt mixed in) (USDA, 1993).

Particle Size Analysis (PSA) determines the different soil sizes by identifying viscosity (Gee & Bauder, 1986). The PSA of a soil can influence Pb leaching potential through the soil. The PSA can also determine the type of mitigation techniques that can be effectively implemented (Dermatas & Chrysocoou, 2007).

4.6 Soil Characterization Analysis Methodology

The weight of each layer was recorded, and then the core sample was heated to a temperature of 105°C for 24 hours. After 24 hours had elapsed, the segments were re-weighed to determine the sample moisture content at the time of sampling. To determine the organic matter found in the cores, the samples were placed in a muffle furnace at 450°C for 16 hours. After 16 hours elapsed, the combustible organic matter burned off. The difference in weight pre- and post- furnace represented the combustible organic material found in the dry sample (Nelson and Sommers, 1996). Equation 2.0 shows how loss of ignition (LOI) was calculated.

$$LOI_{500} = \frac{(Wt. of\ dry\ soil - Wt. of\ furnace\ soil)}{Wt. of\ dry\ soil} * 100$$

4.7 pH AND CONDUCTIVITY METHODOLOGY

The pH and conductivity were determined to provide information about the soil environment with respect to the amount of ion activity. The lower the pH, the greater amount of hydrogen ions and the greater potential for Pb weathering and leaching. The greater conductivity indicates higher amounts of inorganic ions. Although conductivity does not indicate what ions are available, the presence of free ions may affect the toxicity of lead and the amount of leaching to lower soil layers.

The alkalinity of a soil is characterized by the pH in water. High alkalinity in the soil will cause Pb to weather faster, therefore increasing Pb's leaching potential. The procedure for determining the pH includes a ratio of 1:1, 10 grams of soil to 10 mL of water (Thomas, 1996). However, in sections that experienced a high absorption factor (high organic material), a higher ratio was used. After all the soil sections were weighed (Fisher Scientific Accu 4102) in a glass beaker, 10 mL of water was added (Thermo Scientific 10.0 mL Finn Pipette); the samples were then stirred with a glass rod, and set aside for 15 minutes then pH was recorded using an Oakton pH 11 series meter.

To analyze pH and conductivity, a soil to water ratio of 1:1 is commonly used. However, this ratio can be increased when instances of high organic matter occur. When this happens, the soil absorbs more water skewing the analysis. The water ratio is typically increased to account for the filtrate needed for the test.

The conductivity of the soil was measured using the soil-to-water method (Rhoades, 1996). The salinity of the soil was calculated to determine the soil's water soluble salts. Calculating the salinity of the soil enhanced understanding Pb's leaching through the soil, as certain factors can disrupt the salinity; these include: climate, soil texture, plant species, and salt distribution and composition. The Soil-to-Water method used a ratio of 1:5, 10 grams of soil to 50 mL of water. The samples were weighed in a beaker, water was added, then placed on an orbital shaker for 30 minutes at a 145 rpm. After 30 minutes, the soil-to-water solution was placed in a Whatman 40 Filter Paper (125 mm); where the filtrate's conductivity was measured (Hach Sension5 meter) (Figure 8).

Figure 8 Staging samples to measure Conductivity and pH

4.8 ORGANIC MATTER ANALYSIS

The method used to determine organic matter content was Loss of Ignition method (Nelson & Sommers, 1996). Crucibles were placed in an oven for 24 hours at a constant temperature of 105°C. This removed any excess water that may have been on the crucibles. The crucibles were then cooled to room temperature through the use of a desiccator. The samples were weighed (Accu-124 Fisher Scientific), then placed in a Barnstead Thermolyne 1400 Furnace for 16 hours at 450°C. After 16 hours elapsed, the samples were placed in a desiccator to achieve room temperature, and reweighed. To ensure that the samples were not compromised, gloves and tongs were used during transfer of material. The loss of weight represented the combustible organic content found in the dry samples.

4.9 Lead Fraction Analysis

Three fractions of Pb were evaluated; Total Pb, Plant Available (Mehlich III) Pb, and Water Soluble Pb. Total Pb is the entire amount of Pb in the soil able to be removed using an acid digestion. This is the largest fraction of metal in the soil. This value is very important, as it is the aggregate of Pb present and is the method used by many governmental regulations to set limits of land use. The second Pb fraction examined was the plant-available Pb, or Mehlich III Pb. This is the amount of Pb in soil that is bioaccessible by flora in the region. The last fraction assessed was water-soluble Pb. This is the Pb that is able to be dissolved in water, and is important in determining how the Pb might leach downward through the soil layers or laterally to other regions.

4.10 Total Metal Methodology

The total metal analyses procedure used was the Acid Digestion EPA method 3050B (USEPA, 1996). The soil samples were weighed to the nearest 0.500-1.000 gram. After the samples were weighed, 5 mL of a 1:1 concentration of HNO_3 and DI water was

Figure 9 Samples of Pre and Post Hot Block usage from Total Metal Analysis

added to the samples. The samples were placed in a hot block, with a reflux cap added to the top of the samples, for 15 minutes at 95°C then cooled, and five mL of concentrated HNO_3 was added. The samples were again placed in the hot block, (Figure 9) with their reflux cap on, for two hours at 95°C then cooled. Two mL of DI water was added to the samples along with one mL of H_2O_2. After ten minutes, an exothermic reaction occurred and the samples were placed in the hot blocks with reflux caps on for two hours at 95°C, and then cooled. Five mL of concentrated HCl was added, and the samples were again heated for 15 minutes at 95°C. Samples were then left to cool, and diluted to 50 mL with DI water. Samples were run on Inductively Coupled Plasma - Atomic Emissions Spectroscopy (ICP-AES) for metal concentrations.

4.11 Mehlich III Analysis Method

The plant available determination of lead was ascertained through the use of Mehlich III extraction (Reed and Martens, 1996). Macronutrient and micronutrient levels were evaluated in soils by this method. Two grams of soil and 20 mL of Mehlich III extractant were mixed, and shook for five minutes on a Cole and Parmer Orbital Shaker at 180 cycles/min. After five minutes elapsed, the Mehlich III and soil solution were filtered through Whatman 40 filter paper. The filtrate from the soil solution was then collected in a 15 mL conical tube and analyzed by the ICP-AES.

4.12 Water Soluble Analysis Method

Water soluble Pb levels were determined using a water-to-soil ratio of 10:1. The solution was then placed on an orbital shaker for three hours at a rate of 145 rpm, then filtered through Whatman #1 filter paper (Figure 10). The accumulated filtrate was analyzed for water soluble metals using the ICP- AES.

Figure 10 Water Soluble Analysis Filtrate

4.13 Statistical Analysis

The data was amassed, sorted, and evaluated using SPSS statistical program (IBM, 2011) for Pearson Correlation and backward stepwise regression. Pearson Correlation measures the linear relationship between two variables where a +1 relationship indicates a total positive correlation, and a -1 relationship indicates a total negative correlation; a value of 0 indicates there is no correlation between the variables.

Backward stepwise regression is a process where the statistical software determines a model of the relationship between a group of independent parameters with a measured dependent variable. The model starts with all independent values to determine the dependent variable in question. The program removes the independent variable that has the lowest significance in a step-wise fashion to improve the model. Once the model is at the highest significance, the program ceases to produce a model that represents the assigned variables.

CHAPTER 5.0 RESULTS AND DISCUSSIONS

Soil samples of the Grand Valley Hunting Ranch were taken using a coring method, and soil descriptions, bulk densities and particle sizes were recorded. The soil characteristics were analyzed, including pH, conductivity, and organic matter. The Pb fractions were analyzed, including Total, Plant Available, and Water Soluble Pb concentrations. Relationships were then established using a Pearson correlation and backwards stepwise regression to see if there were any statistically significant correlations between soil characteristics and Pb concentrations in the cores.

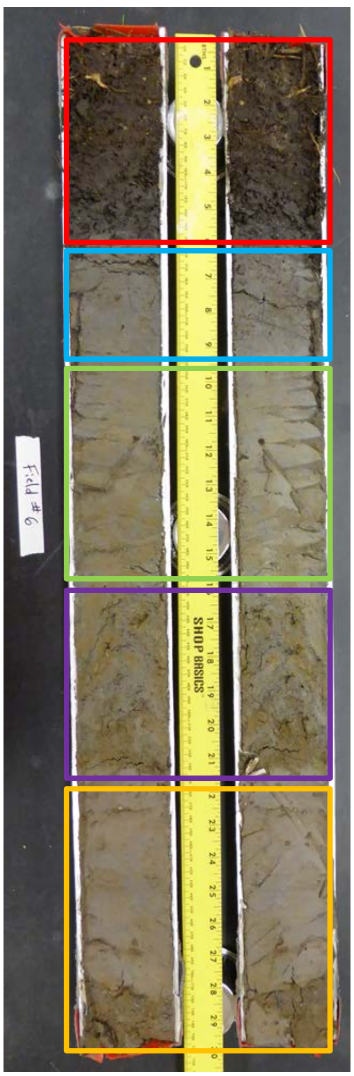
5.1 Soil Core Descriptions and Particle Size Descriptions

Core #6 was 75 cm in length (divided into five centimeters segments), and had a compaction rate of 12.7 cm (Table 2). The top 15 cm of the core was classified as the A-Horizon, due to the rich organic matter and plant growth in the humus (red box in Table 2). Here, seeds, sticks, fibrous roots, and weeds were spread throughout. The black soil had a spongy feel that lacked high compaction. In the next section, 15-25 cm, the soil transformed from organic-rich to clay-rich and became more compacted than the previous section. From 25-40 cm, the soil continued to have a clay-like consistency with a lighter-brown color becoming predominant. The colors of orange, green, and black were also visible, and the compaction changed to a moist/slimy texture. In the next section of the core, 40-55 cm, orange, brown, and green colors were prevalent.

The consistency changed to a lightly compacted soil with a sandy texture; here, pebbles were easily visible. In the last section of the core, 55-75 cm, the soil transformed to clayish texture with orange, brown, and green colors. The sandy texture with looser compaction reappeared in the last three centimeters of the core. From 15-75 cm, the soil was categorized as the B-Horizon because of the combination of inorganic soil and sand.

The first 15 cm of Core #6 were silty loam (red box in Table 2). The soil changed to clay loam, from 15-25 cm (blue box in Table 2). From 25-40 cm, the soil was loam (green box) followed by a sandy loam from 40-55 cm (purple box), and lastly was classified as clay from 55- 75 cm, (orange box in Table 2).

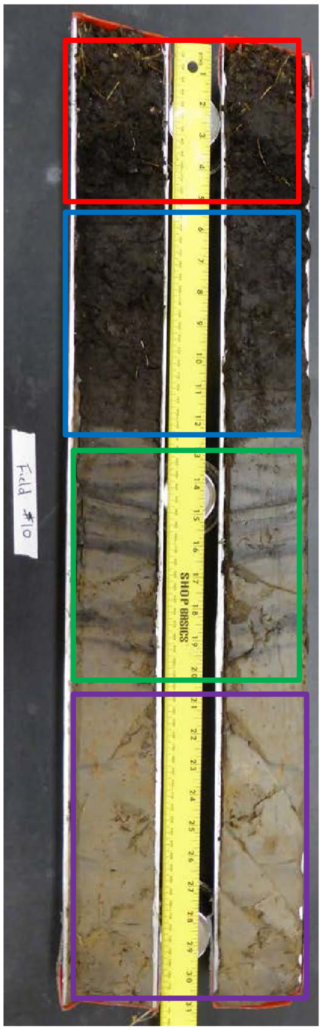
Table 2 Core #6's soil analysis in relation to its soil horizons



Core #6	Depth (cm)	pH	CD (µS/cm)	% Clay	% Silt
1A	5	5.05	800	12	57
1B	5	4.89	800	12	57
2A	10	4.91	617	12	57
2B	10	4.97	566	12	57
3A	15	4.81	502	12	57
3B	15	4.9	502	12	57
4A	20	4.63	277	30	40
4B	20	4.65	252	30	40
5A	25	4.78	76.6	30	40
5B	25	4.81	74.7	30	40
6A	30	4.79	68.7	26	38.5
6B	30	4.65	63	26	38.5
7A	35	4.91	74.2	26	38.5
7B	35	4.88	67.8	26	38.5
8A	40	4.82	61.7	26	38.5
8B	40	5.01	59.2	26	38.5
9A	45	5.3	49	11.5	23
9B	45	5.4	51.2	11.5	23
10A	50	5.67	43.6	11.5	23
10B	50	5.62	43.1	11.5	23
11A	55	5.6	50.2	11.5	23
11B	55	5.85	50.2	11.5	23
12A	60	7.26	123.4	48	33.5
12B	60	6.84	126.8	48	33.5
13A	65	6.99	180.2	48	33.5
13B	65	7.01	176.1	48	33.5
14A	70	6.98	159.8	48	33.5
14B	70	7	153.9	48	33.5
15A	75	6.98	155.2	48	33.5
15B	75	6.96	164.2	48	33.5

Core #10 was 78 cm in length and was divided into 17 different sections with each section consisting of two samples (A and B) ranging from 3-5 cm in length. This can be seen in Table 3. The compaction rate of the core was 10.2 cm, and the core's segments ranged from 3-5 cm in length. Black, organic-rich soil was prevalent in the top 13 cm of the core. It was classified as sandy clay loam (red box in Table 3). In the next section, 13-31.5 cm, the soil gradually turned from a spongy, moist consistency to clay as it traveled downward toward the next section. Here, the roots and dark brown organic-rich soil continued. The blue box in Table 3 shows this section; it was classified as sandy loam/loam. The top 31.5 cm of the core was considered the A-Horizon due to its organic richness, spongy consistency, and lack of compaction. Fibrous roots, weeds, sticks, and seeds were readily visible in the top 13 cm of the core. In the remaining length of the core, 31.5-78 cm, the soil displayed a clay texture that was predominantly gray with light-brown hues. Also, in this section, red rust-like specs were present which indicated possible oxidation. It is notable that from 32-50 cm, the soil displayed layers of black every two cm. The black soil was one cm in length and had the same consistently as the gray soil. The 31.5-50 cm range was also classified as clay loam, which is represented as the green box in Table 3. The last section of the score, from 50-78 cm, was classified as silty clay loam, and is shown in the purple box of the figure. The remaining length of the core, 31.5-78 cm, was considered the B-Horizon because the soil lacked an organic rich substance, and because the bottom of the core was a combination of clay and sand.

Table 3 Core #10's soil analysis in relation to its soil horizons

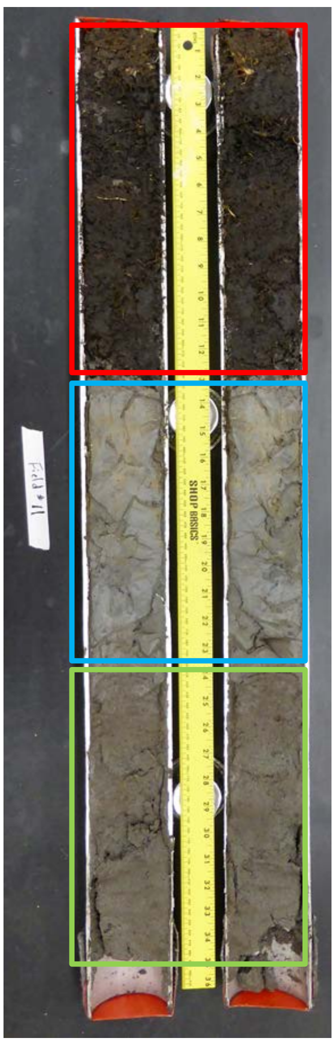


Core #10	Depth (cm)	pH	CD (µS/cm)	% Clay	% Silt
1A	5	4.45	1541	20	21
1B	5	4.49	1493	20	21
2A	8	4.28	1670	20	21
2B	8	4.23	1468	20	21
3A	13	4.04	1592	20	21
3B	13	4.08	1547	20	21
4A	18	3.88	1834	15	24.5
4B	18	3.91	1758	15	24.5
5A	23	4.02	1409	15	24.5
5B	23	3.99	1446	15	24.5
6A	28	4.13	883	15	24.5
6B	28	4.1	868	15	24.5
7A	31.5	4.61	363	33	44.5
7B	31.5	4.3	405	33	44.5
8A	36.5	3.98	178.8	33	44.5
8B	36.5	4.01	176.8	33	44.5
9A	41.5	3.87	244	33	44.5
9B	41.5	3.81	253	33	44.5
10A	46.5	3.95	127.4	33	44.5
10B	46.5	3.82	126.8	33	44.5
11A	50	4.06	126	33.5	53
11B	50	4.07	125.5	33.5	53
12A	55	3.69	108.4	33.5	53
12B	5	3.62	112.2	33.5	53
13A	60	3.98	101.6	38	59
13B	60	4.06	101.4	38	59
14A	65	4.17	114.8	38	59
14B	65	4.24	116	38	59
15A	70	4.47	81	38	59
15B	70	4.53	82.7	38	59
16A	75	4.7	114.2	38	59
16B	75	4.59	110.7	38	59
17A	78	4.56	196.2	38	59
17B	78	4.56	201	38	59

Core #11 was 88 cm in length and had a compaction rate of 20.3 cm. This core was divided into 2-5 cm segments. The analysis of the segments with its corresponding soil horizon is listed in Table 4. The top five centimeters of the core was brown in color and appeared to be organic-rich. Fibrous roots and weeds intertwined throughout this section. From 5-33 cm, the soil darkened and displayed a slimy texture. It should be noted that although the top 33 cm can be divided into the aforementioned two sections, both were classified as sandy loam, and considered the A-Horizon (red box in Table 4). This was from the high amount of organic matter that was evident.

The remaining length of the core was considered the B-Horizon because the core had a consistency of sand and clay, and lacked organic matter. The compaction increased with depth, and root and weed fragments were notable. From 33-61 cm, the soil was gray in color with widespread hues of orange. It was classified as loam (blue box). The remaining length of the core, 61-88 cm, consisted of soil that was sandy in texture and gray in color. Here, the soil was loosely compacted and was wet and slimy in texture. It was classified as loamy sand (green box of Table 4.)

Table 4 Core #11's soil analysis in relation to its soil horizons

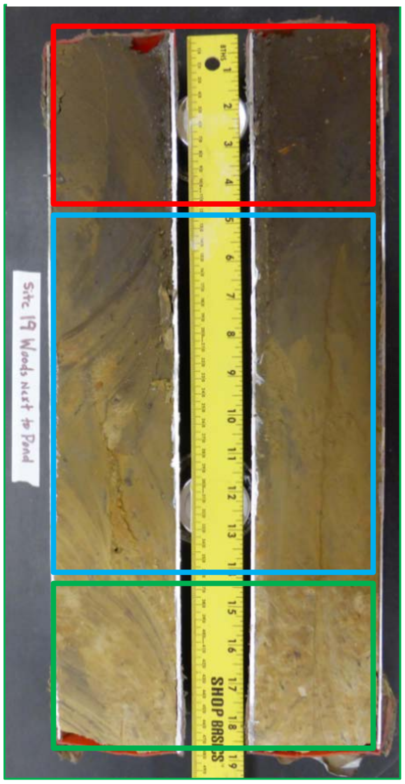


Core #11	Depth (cm)	pH	CD (µS/cm)	% Clay	% Silt
1A	5	5.06	719	12	24.5
1B	5	5.07	685	12	24.5
2A	10	4.9	436	12	24.5
2B	10	4.91	482	12	24.5
3A	15	4.87	505	12	24.5
3B	15	4.89	490	12	24.5
4A	20	4.64	775	12	24.5
4B	20	4.64	720	12	24.5
5A	25	4.63	610	12	24.5
5B	25	4.56	589	12	24.5
6A	30	4.7	593	12	24.5
6B	30	4.62	569	12	24.5
7A	33	4.54	678	12	24.5
7B	33	4.56	611	12	24.5
8A	38	4.24	300	19.5	46
8B	38	4.15	340	19.5	46
9A	43	4.25	161.9	19.5	46
9B	43	4.27	174.9	19.5	46
10A	48	4.38	189.8	19.5	46
10B	48	4.29	202	19.5	46
11A	53	4.38	224	19.5	46
11B	53	4.38	220	19.5	46
12A	58	5.25	144.3	19	41
12B	58	5.31	146.3	19	41
13A	61	5.75	150.2	19	41
13B	61	5.53	148.5	19	41
14A	66	4.68	358	4	12
14B	66	4.61	367	4	12
15A	71	4.56	203	4	12
15B	71	4.62	184.7	4	12
16A	76	4.44	263	4	12
16B	76	4.46	264	4	12
17A	81	3.31	316	4	12
17B	81	3.23	335	4	12
18A	86	3.3	290	4	12
18B	86	3.23	290	4	12
19A	88	3.92	229	4	12
19B	88	3.81	236	4	12

Core #19 was 48 cm in length and had a compaction rate of 4.4 cm. The soil core was sectioned into 3-5 cm segments for chemical and physical analysis, as well as for visual appearance analysis (Table 5). Overall, the core contained highly dense soil throughout the entire length. In the top 15 cm, the humus and clay pigeon fragments from past trap shooting were easily identified. The soil appeared dark brown and organic-rich with a few black specs scattered throughout; this part of the core would be considered the A-Horizon, as the A-Horizon displays the most concentrated amount of organic matter in the core. The remaining length of the core comprises the B-Horizon, a nonorganic rich soil that is mostly made up of clay and silt. The B-Horizon starts in the next section of the core at 15 cm and continues to 48 cm. From centimeters 10-20, the soil changed from the dark brown soil to lighter grey-brown with the continuation of black specs. The soil layer from 20-30 cm began to exhibit light brown-yellow hues. Section 30-35 cm is yellowish brown in color and had orange spots throughout. The last layer of soil, 35-48 cm, appeared extremely compressed with a rocky-cement appearance with hues of black, white, gray, and yellow. Also, there were pieces of hard rock (parent material) and soil located here.

Particle Size Analysis on Core #19 from 0-15 cm concluded that the soil was loam (red box in Table 5). The next soil section from 15-35 cm, was classified as loam/silt loam (blue box in Table 5). The remainder was a clay loam, from 35-48 cm (green box in Table 5).

Table 5 Core #19's soil analysis in relation to its soil horizons



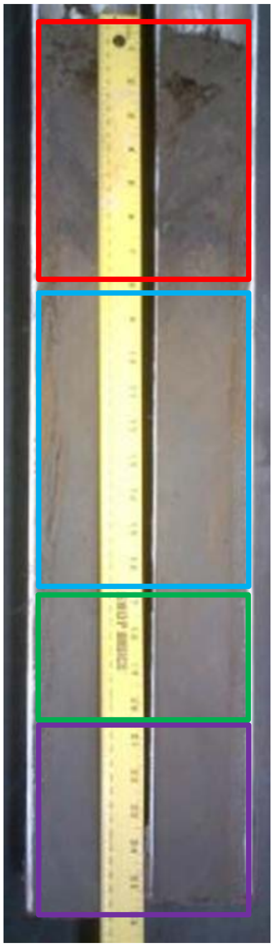
Core #19	Depth (cm)	pH	CD (µS/cm)	% Clay	% Silt
1A	5	5.03	97.0	14	44.5
1B	5	5.01	81.3	14	44.5
2A	10	4.96	105.2	14	44.5
2B	10	4.77	93.5	14	44.5
3A	15	4.75	96.4	14	44.5
3B	15	4.60	74.2	14	44.5
4A	20	4.67	46.5	17	50
4B	20	4.63	49.3	17	50
5A	25	4.47	48.8	17	50
5B	25	4.52	45.0	17	50
6A	30	4.10	48.4	17	50
6B	30	4.11	40.9	17	50
7A	35	3.46	61.0	17	50
7B	35	3.47	57.8	17	50
8A	40	3.65	65	30.5	42
8B	40	3.63	58.6	30.5	42
9A	45	4.59	56.5	30.5	42
9B	45	4.55	61.1	30.5	42
10A	48	4.99	50	30.5	42
10B	48	4.91	40.7	30.5	42

The reference core (RC) displayed a similar appearance and had the same characteristics as Core #19. The length of the RC was 66 cm and it had a compaction rate of 11.43 cm. The core was divided into 5-6 cm segments where chemical and physical analyses were conducted (Table 6).

In the top five centimeters of the reference core, dark brown organic-rich soil was present with hues of gray and black throughout. The consistency of the top five centimeters was lightly compacted and exhibited roots in the upper three cm. In the next section, 5-15 cm, the soil turned from a dark brown to a gray with prevalent hues of black and brown. From the top of the core to a depth of 15 cm, the A-Horizon was evident; this was due to the organic rich soil that was exhibited here. From this section downward, the compaction consistency continued to become more compressed. From 15-25 cm, gray soil continued to dominate the color scheme of the core with the continuation of black hues scattered throughout. However, the gray color became darker as the section ended. In the next section of the core, 25-40 cm, the dark gray color that developed in the last section turned into a brown with hues of gray that were evenly distributed; this could be either the AB-Horizon or E-Horizon. Also, when this section was cut in half for continued analysis, blue, green, and orange hues were scattered within the sample. The last section of the core, from 40-66 cm, displayed soil that was dark brown in color with hues of black that appeared highly compacted. The last five centimeters of this section displayed reddish roots when it was divided into two halves. The bottom length of the core, 40-66 cm, could be a B-Horizon. This was because of the increase in compaction combined with inorganic soil.

Particle size analysis determined that the first 0-30 cm of #RC were classified as clay loam (red box in Table 6). The blue box represents clay/clay loam, which stretches from 30-40 cm (blue box in Table 6). From 40-55 cm, the soil was silty clay loam (green box in Table 6), and the final 11 cm of the core, from 55-66 cm (purple box in Table 6), was clay loam/silty loam.

Table 6 RC's soil analysis in relation to its soil horizons



Core RC	Depth (cm)	pH	CD (µS/cm)	% Clay	% Silt
1A	5	5.54	936	34.5	42.5
1B	5	5.5	941	34.5	42.5
2A	10	5.77	696	34.5	42.5
2B	10	5.81	705	34.5	42.5
3A	15	5.94	860	34.5	42.5
3B	15	5.9	953	34.5	42.5
4A	20	6.26	547	32.5	43
4B	20	6.28	586	32.5	43
5A	25	7.05	480	32.5	43
5B	25	7.12	485	32.5	43
6A	30	7.21	476	32.5	43
6B	30	7.24	475	32.5	43
7A	35	7.16	542	44.5	35.5
7B	35	7.08	533	44.5	35.5
8A	40	7.01	607	44.5	35.5
8B	40	7.14	656	44.5	35.5
9A	45	7.12	597	36	47
9B	45	7.11	598	36	47
10A	50	7.26	529	38	43
10B	50	7.11	538	38	43
11A	55	7.17	547	38	43
11B	55	7.17	537	38	43
12A	60	7.28	510	40.5	46
12B	60	7.26	506	40.5	46
13A	66	7.21	492	40.5	46
13B	66	7.33	534	40.5	46

5.2 Bulk Density Results

Cores #10 and 11 experienced average bulk densities that were similar to one another. The similar densities can be related to the soil type that was established using the United States Department of Agriculture's Web Soil Survey (USDA, 2013). Core #10 had an overall average BD of 0.923 g/cm^3, and Core #11 had a BD 1.025 g/cm^3. These values corresponded to the USDA's (2013) report of their soil type of Carlisle muck. The soil type found in the top 31.5 cm of Core #10 and the top 33 cm of Core #11 displayed the most significant change in BD due to the high organic matter in the top of their soil sections. However, the BD increased with depth with some sections of the two cores having a higher BD than the rest. This was from the increase in the soils compaction through the remaining length of the cores. This increase resulted from the clay and sandy soil that was present through the bottom of the core.

Core #6 displayed the same soil type and characteristics as Cores 10 and 11; however, the overall average BD of the core was 1.412 g/cm^3. The higher BD shows that this core contained more compacted and slightly less organic soil than did cores #10 and #11. In Core #6, the greatest change in BD occurred at 20 cm, where the BD changed from 0.386 g/cm^3 to 1.414 g/cm^3. This means that the highest amount of organic material was located in the top 20 cm of the core. This is related to the USDA's (2013) report on its parent soil material being herbaceous organic. Throughout the remaining length of the core, the soil's compaction increased due to a change from organic rich soil to clay and sandy soil.

Core's # 19 and RC displayed similar soil characteristics and bulk density. With the two cores having the same soil type, Darien Silt Loam, the BD was almost similar. The BD of the two cores increased as the cores increased in depth; this was due to the high soil compaction exhibited in each. At the outermost section of the two cores, 0-5 cm, the BD was at its lowest. The BD in the top five centimeters of Core #19 was 0.913 g/cm^3, while it was 0.741 g/cm^3 for RC, and increased with depth in both; this means that more organic matter was present in the top of the core than the remaining length of each core. The overall BD average of Core #19 was 1.397 g/cm^3 and the RC had an entire average of 1.541 g/cm^3. Core #19 displayed a similar trend throughout, but the BD was lower and less constant than the RC core.

5.3 Particle Size Analysis

In Core #6, there were several locations that showed an increase and decrease in particle size, and there was no particle size trend to depth of the core. The results of PSA can be located in the section above, titled "Soil Core Descriptions and Particle Size Descriptions."

Core #10 was the next core to be analyzed for PSA. Through Core #10, a trend among clay and silt percentage was apparent. The deeper the soil, the more the particle size of silt and clay increased (Figure 5.0).

Core #11's PSA is similar to Core #6, where the particle sizes of the core increased and decreased at different depths of the core(Figure 6.0); the increase and decrease can be seen throughout the core with both percentages of silt and clay displaying their heaviest particles in the middle of the core.

Core #19 displayed increases and decreases in particle size at different locations through the core. In the top of the core, the percentage of clay is highest, whereas silt has the highest percent in the middle of the core (Figure 2.0).

The RC displays similar results to the other cores, as the particle size of the cores varied with the height of the core. There was no trend in relation to depth and particle size (Figure 3.0).

5.4 pH and Conductivity Results

Core #6 was divided into 15 different sections that encompassed a pH range of 4.63-7.01. In the top 15 cm of the core, a different ratio was used for each of the three sections; this was due to the high absorption factor of soil to water. The topmost part of the core, 0-5 cm, used a soil to water ratio of 1:5. In the 5-10 cm layer, the ratio of 1:4 was used, and in the 10-15 cm layer, a ratio of 1:3. For the remaining layers of the core, a 1:1 ratio was used.

The top 15 cm of the core displayed a pH that decreased as the sections moved downward. This was from the organic-rich soil that was located in this part of the core. This factor indicates an increase in Pb's leaching potential from the top layer to the remaining sections. However, below 15 cm, the soil changed from an organic-rich soil to clay. The remaining length of the core, 15-75 cm, exhibited a constant increase in pH from 4.80-6.97. Through these sections, there were increases in pH higher than the average of 6.97, peaking at 7.26. These slightly higher than average increases occurred at 55-75 cm, where the compacted soil displayed a sandy texture. However, the high individual segments' readings in each half were irrelevant due to the pH of the other half of the core. The higher pH shown in the bottom sections of the core indicates Pb's decrease in leaching potential. This is from the clay-type soil and the high compaction rate of the soil in the bottom sections.

To calculate conductivity, a soil to water ratio of 1:5 was used. At the topmost section of the core, the average of the two half sections was 800 µS/cm. From this section, the CD continued to decrease to a depth of 30 cm where the CD was 65.9 µS/cm. It continued to remain in this range through the 50cm segment. In this layer of the core, the texture was sandy, compressed, and light bluish-gray with hues of orange and brown. For the remaining length of the core, the CD increased to 159.7 µS/cm. It was apparent that there was a gradual decrease in CD as depth increased. This corresponds to the different soil textures through the length of the core. The top of the core exhibited a soil that was dark and rich in organic matter, which explains the high CD; however, the remaining length of the core was a compacted clay soil that showed little evidence of organic material. The two distinctive soil types would be the reason why the CD changed from an 800 µS/cm to a 159.7 µS/cm through the core (Table 7).

Table 7 pH and Conductivity results for Core #6

Core #6	Depth (cm)	pH	pH average (*std. dev.)*	CD (µS/cm)	CD Avg. (Std. Dev.) (µS/cm)
1A	5	5.05	4.97	800	800.0
1B	5	4.89	*0.11*	800	*0.00*
2A	10	4.91	4.94	617	591.5
2B	10	4.97	*0.04*	566	*36.06*
3A	15	4.81	4.86	502	502.0
3B	15	4.9	*0.06*	502	*0.00*
4A	20	4.63	4.64	277	264.5
4B	20	4.65	*0.01*	252	*17.68*
5A	25	4.78	4.80	76.6	75.7
5B	25	4.81	*0.02*	74.7	*1.34*
6A	30	4.79	4.72	68.7	65.9
6B	30	4.65	*0.10*	63	*4.03*
7A	35	4.91	4.90	74.2	71.0
7B	35	4.88	*0.02*	67.8	*4.53*
8A	40	4.82	4.92	61.7	60.5
8B	40	5.01	*0.13*	59.2	*1.77*
9A	45	5.3	5.35	49	50.1
9B	45	5.4	*0.07*	51.2	*1.56*
10A	50	5.67	5.65	43.6	43.4
10B	50	5.62	*0.04*	43.1	*0.35*
11A	55	5.6	5.73	50.2	50.2
11B	55	5.85	*0.18*	50.2	*0.00*
12A	60	7.26	7.05	123.4	125.1
12B	60	6.84	*0.30*	126.8	*2.40*
13A	65	6.99	7.00	180.2	178.2
13B	65	7.01	*0.01*	176.1	*2.90*
14A	70	6.98	6.99	159.8	156.9
14B	70	7	*0.01*	153.9	*4.17*
15A	75	6.98	6.97	155.2	159.7
15B	75	6.96	*0.01*	164.2	*6.36*

In Core #10, the topmost part of the core (0-31.5 cm) displayed an average pH of 4.16 from the two replications. In this top layer, a soil:water ratio of 1:2 was used due to the high absorption factor of soil from high organic matter content. Throughout the length of the core, the pH increased and decreased at various locations ranging in value from 3.62-4.7. There was no correlation between core depth and pH.

However, there was a correlation of conductivity (CD) to depth. The ratio that was used to determine the CD of soil to water ratio was 1:5, soil:water ratio. The topmost part of the core expressed an average CD of 1517 μS/cm while the bottom averaged 198.6 μS/cm. This means that more inorganic ions are present at the top of the core compared to the bottom, and that the potential of Pb traveling through the soil is higher at the top of the core than the bottom The CD spike from 1569.5 μS/cm to 1796 μS/cm at 13-18 cm shows more inorganic ions are present there than the rest of the core. This soil layer exhibited a dark brown organic-rich texture with roots present in the top and bottom (Table 8).

Table 8 pH and Conductivity results for Core #10

Core #10	Depth (cm)	pH	pH Avg. *(Std. Dev.)*	CD (µS/cm)	CD Avg. (Std. Dev.) (µS/cm)
1A	5	4.45	4.47	1541	1517
1B	5	4.49	*0.03*	1493	*33.94*
2A	8	4.28	4.255	1670	1569
2B	8	4.23	*0.04*	1468	*142.84*
3A	13	4.04	4.06	1592	1569.5
3B	13	4.08	*0.03*	1547	*31.82*
4A	18	3.88	3.895	1834	1796
4B	18	3.91	*0.02*	1758	*53.74*
5A	23	4.02	4.005	1409	1427.5
5B	23	3.99	*0.02*	1446	*26.16*
6A	28	4.13	4.115	883	875.5
6B	28	4.1	*0.02*	868	*10.61*
7A	31.5	4.61	4.455	363	384
7B	31.5	4.3	*0.22*	405	*29.7*
8A	36.5	3.98	3.995	178.8	177.8
8B	36.5	4.01	*0.02*	176.8	*1.41*
9A	41.5	3.87	3.84	244	248.5
9B	41.5	3.81	*0.04*	253	*6.36*
10A	46.5	3.95	3.885	127.4	127.1
10B	46.5	3.82	*0.09*	126.8	*0.42*
11A	50	4.06	4.065	126	125.75
11B	50	4.07	*0.01*	125.5	*0.35*
12A	55	3.69	3.655	108.4	110.3
12B	5	3.62	*0.05*	112.2	*2.69*
13A	60	3.98	4.02	101.6	101.5
13B	60	4.06	*0.06*	101.4	*0.14*
14A	65	4.17	4.205	114.8	115.4
14B	65	4.24	*0.05*	116	*0.85*
15A	70	4.47	4.5	81	81.85
15B	70	4.53	*0.04*	82.7	*1.2*
16A	75	4.7	4.645	114.2	112.45
16B	75	4.59	*0.08*	110.7	*2.47*
17A	78	4.56	4.56	196.2	198.6
17B	78	4.56	*0*	201	*3.39*

Core #11 was divided into 19 sections, each ranging from 2-5 cm in length. Again, the sections were divided into two samples each for analysis. The pH at the topmost section of the core was 5.65 on average; at the bottom of the core the pH was 3.87. Through the length of the core, the pH varied. From 0-33 cm the pH gradually decreased from 5.07 to 4.55 which corresponded with the non-compacted, organic-rich soil that was visible. From 33-61 cm, pH rose from 4.55 to 5.65; this was most likely due to the clay soil located there. The clay soil, which was heavily compacted, displayed little potential for Pb leaching into the next layer. The slight increase in pH was caused by the clay type soil exhibited in this layer. The pH at the next section of soil started at 4.65 at 62 cm and decreased to 3.87 at the end of the core. The decrease in pH indicated Pb's potential increase in leaching through this layer of the core because of the sandy soil exhibited.

The CD of Core #11's topmost layer was 702 μS/cm, where the CD at the end of the core was 232.5 μS/cm. Throughout the length of Core #11, there were increases and decreases in CD; the highest CD was established at the topmost part of the core, and the lowest was located at 53-58 cm where the CD was 146.3 μS/cm. The ratio of soil to water that was used to conduct the CD testing was 1:5, this ratio was used throughout the length of the core. Table 9 shows detailed pH and CD readings by segment.

Table 9 pH and Conductivity results for Core #11

Core #11	Depth (cm)	pH	pH Average *(std. dev.)*	CD (µS/cm)	CD Avg. (Std. Dev.) (µS/cm)
1A	5	5.06	5.07	719	702.00
1B	5	5.07	*0.01*	685	*24.04*
2A	10	4.9	4.91	436	459.00
2B	10	4.91	*0.01*	482	*32.53*
3A	15	4.87	4.88	505	497.50
3B	15	4.89	*0.01*	490	*10.61*
4A	20	4.64	4.64	775	747.50
4B	20	4.64	*0.00*	720	*38.89*
5A	25	4.63	4.60	610	599.50
5B	25	4.56	*0.05*	589	*14.85*
6A	30	4.7	4.66	593	581.00
6B	30	4.62	*0.06*	569	*16.97*
7A	33	4.54	4.55	678	644.50
7B	33	4.56	*0.01*	611	*47.38*
8A	38	4.24	4.20	300	320.00
8B	38	4.15	*0.06*	340	*28.28*
9A	43	4.25	4.26	161.9	168.40
9B	43	4.27	*0.01*	174.9	*9.19*
10A	48	4.38	4.34	189.8	195.90
10B	48	4.29	*0.06*	202	*8.63*
11A	53	4.38	4.38	224	222.00
11B	53	4.38	*0.00*	220	*2.83*
12A	58	5.25	5.28	144.3	145.30
12B	58	5.31	*0.04*	146.3	*1.41*
13A	61	5.75	5.64	150.2	149.35
13B	61	5.53	*0.16*	148.5	*1.20*
14A	66	4.68	4.65	358	362.50
14B	66	4.61	*0.05*	367	*6.36*
15A	71	4.56	4.59	203	193.85
15B	71	4.62	*0.04*	184.7	*12.94*
16A	76	4.44	4.45	263	263.50
16B	76	4.46	*0.01*	264	*0.71*
17A	81	3.31	3.27	316	325.50
17B	81	3.23	*0.06*	335	*13.44*
18A	86	3.3	3.27	290	290.00
18B	86	3.23	*0.05*	290	*0.00*
19A	88	3.92	3.87	229	232.50
19B	88	3.81	*0.08*	236	*4.95*

Core #19 was divided into 10 different sections and had a pH range of 3.46-5.03. Throughout the entire length of the core, a ratio of 1:1 was used to determine the pH. The average pH gradually decreased from 5.02 to 4.95 from 0-40 cm which was likely due to the soil being highly compacted; however, at 40-48 cm, the pH began to increase and continued to do so throughout the remaining length of the core. This was again likely due to soil compaction levels. The Pb leaching potential for the entire core was low because of the high compaction rate and high bulk density; however, with the pH decreasing to 3.64 at 40 cm and rising back to 4.95 at the end of the core (48 cm), leaching Pb will have the most difficulty passing though the top-most and bottom-most part of the core where pH and bulk density are higher (Table 10).

Table 10 pH and Conductivity results for Core #19

Core #19	Depth (cm)	pH	pH Average *(std. dev.)*	CD (µS/cm)	CD Avg. (Std. Dev.) (µS/cm)
1A	5	5.03	5.02	97.0	89.15
1B	5	5.01	*0.01*	81.3	*11.10*
2A	10	4.96	4.87	105.2	99.35
2B	10	4.77	*0.13*	93.5	*8.27*
3A	15	4.75	4.68	96.4	85.30
3B	15	4.60	*0.11*	74.2	*15.70*
4A	20	4.67	4.65	46.5	47.90
4B	20	4.63	*0.03*	49.3	*1.98*
5A	25	4.47	4.50	48.8	46.90
5B	25	4.52	*0.04*	45.0	*2.69*
6A	30	4.10	4.11	48.4	44.65
6B	30	4.11	*0.01*	40.9	*5.30*
7A	35	3.46	3.47	61.0	59.40
7B	35	3.47	*0.01*	57.8	*2.26*
8A	40	3.65	3.64	65	61.80
8B	40	3.63	*0.01*	58.6	*4.53*
9A	45	4.59	4.57	56.5	58.80
9B	45	4.55	*0.03*	61.1	*3.25*
10A	48	4.99	4.95	50	45.35
10B	48	4.91	*0.06*	40.7	*6.58*

A soil to water ratio of 1:5 was used to assess conductivity in Core #19. At the top-most section of the core, CD was 89.15 μS/cm. From here, it increased and decreased, finally declining as depth increased with the overall CD lower than any of the other cores (Table 10).

The RC was divided into 13 different sections and exhibited similar characteristics to Core #19 in texture, compaction, and soil type; however, the RC displayed a continual increase in pH throughout the entire length of the core. At the top of the core, the average pH was 5.52, and gradually increased to 7.27. This increase, along with the high compaction of the clay soil, will inhibit Pb's leachability through the soil. However, the increase in pH was not significantly higher than that of the other cores when comparing the sections. From 30 cm through the remaining length of the core, the pH stabilized to around 7.17. Due to the high pH, Pb will not be readily soluble and have a difficult time leaching through the soil.

On the contrary, the CD of this core was not similar to that of Core #19. The CD range for RC was 936-492 μS/cm, and increased at various spots throughout the core. At 15 cm, there was a significant difference in conductivity values as shown by the standard deviation. This is an unusual change, as there is no change in particle size in this area (Table 11). Potentially, there could be an accumulation of calcareous deposits which would correspond to the higher pH and CD.

Table 11 pH and Conductivity results for Core RC

Core RC	Depth (cm)	pH	pH Average (std. dev.)	CD (µS/cm)	CD Avg. (Std. Dev.) (µS/cm)
1A	5	5.54	5.52	936	938.5
1B	5	5.5	*0.03*	941	*3.54*
2A	10	5.77	5.79	696	700.5
2B	10	5.81	*0.03*	705	*6.36*
3A	15	5.94	5.92	860	906.5
3B	15	5.9	*0.03*	953	*65.76*
4A	20	6.26	6.27	547	566.5
4B	20	6.28	*0.01*	586	*27.58*
5A	25	7.05	7.085	480	482.5
5B	25	7.12	*0.05*	485	*3.54*
6A	30	7.21	7.225	476	475.5
6B	30	7.24	*0.02*	475	*0.71*
7A	35	7.16	7.12	542	537.5
7B	35	7.08	*0.06*	533	*6.36*
8A	40	7.01	7.075	607	631.5
8B	40	7.14	*0.09*	656	*34.65*
9A	45	7.12	7.115	597	597.5
9B	45	7.11	*0.01*	598	*0.71*
10A	50	7.26	7.185	529	533.5
10B	50	7.11	*0.11*	538	*6.36*
11A	55	7.17	7.17	547	542
11B	55	7.17	*0.00*	537	*7.07*
12A	60	7.28	7.27	510	508
12B	60	7.26	*0.01*	506	*2.83*
13A	66	7.21	7.27	492	513
13B	66	7.33	*0.08*	534	*29.70*

Throughout all the cores, the pH varied throughout the length. It should be noted that the top of each core registered a pH above 4. This means that Pb will be competing with other metals for adsorption sites on the humic matter (Steinnes, 2013). Copper (Cu), zinc (Zn) and other heavy metals will compete for the adsorption sites on the soil. Lead has a stronger adsorption factor to the clay fractions compared to the other heavy metals (Steinnes, 2013). This means that the Pb will likely adsorb to the clay particles in higher amounts than the other metals.

The results of the five cores in relation to Pb vary from core to core. Lead becomes less soluble when the pH in the soil increases. This is often due to the complexation with organic matter, sorption on oxide and silicate clay minerals, or precipitation as carbonate, sulfate, or phosphate. However, in alkaline soils, the solubility may increase due to the formation of soluble Pb-organic and Pb-hydroxy complexes (Steinnes, 2013).

There are different variables that can break Pb's bond to the soil, which will accelerate Pb's leaching potential; these include: different nutrients found in the soil, acid rain, agricultural activities, and/or other conditions. These conditions will cause the adsorbed Pb ions from the soil to break apart and leach downward to other layers. Soils that consist of a low pH will have a higher probability of leaching due to the increased solubility. Cores #6 and RC displayed a pH above four in all sections. Core #11 exhibited the same, except in the last 76-88 cm. Here, Pb can be adsorbed on the humic layer and the clay sections; however, Pb would have a difficult time leaching thorough the soil due to the high pH. It would especially be difficult for the Pb to penetrate bottoms of cores #6 and RC, where the pH reached a 7. In Core #11, the pH decreased to less than four in the last few sections of the core; this means if Pb would reach the bottom of the core, it would leach more easily.

Cores #10 and #19 displayed similarities in pH characteristics. As noted earlier, all cores displayed a pH of greater than four at the topmost section of each of the cores. This means that the humic matter in the topmost section will adsorb Pb. However, with the pH increasing and decreasing at different lengths in the two cores, the probability of increased leaching occurs. Since the pH of the two cores had an average of four throughout the entire length, Pb will only be able to adsorb on the permanent charges of clay-size particles. Though there is an absence of humic matter in the lower sections of soil, Pb is still adsorbed on the clay minerals and iron oxides (Steinnes, 2013). Lead's adsorption factor on the clay size particles will break apart the bonds more easily between Pb and soil when the pH decreases. Different environmental conditions such as acid rain will decrease the pH causing Pb to pass through the soil easier than if the pH was higher.

5.5 Organic Matter Results

The organic matter in Core #6 ranged from 52.09-0.435%, with the highest content registering in the top 10 cm. Here, the OM had a combined average percentage of 45.33%, which was from the organic-rich soil, as well as sticks, seeds, and fibrous roots present throughout the section. The OM content was roughly halved from 10-15 cm, decreasing to 23.55%. This was due to soil consistency changing from organic-prevalent material to clay-rich material. Roots and seeds were still visible, which contributed to the moderate OM percentage; however, they were not as predominant. The OM content sharply decreased in the next five centimeters section (15-20 cm) to 8.29%, as there was little organic material present in this region. Organic material was present from 20-25 cm, however, as the OM percentage rose to an average of 14.14%. The organic material here was not visible from the surface of the core. From 25 cm through the remainder of the core, the OM percentage varied between roughly 0.5% and 2%, due to the soil texture and compaction levels present. At 45-55 cm, an average OM content of 0.503% was measured. This was due to the sandy, loosely compacted consistency. However, from 55-75 cm, the OM rose to 1.83%, because the soil became clay rich and more highly compacted.

Core #10 had an OM range from 79.39-2.77%, with the highest concentration present in the topmost area of the core. The combined average of the two half sections within the top 18 cm was 77.09% due to the highly organic-rich soil that is displayed; fibrous roots, seeds, sticks, and weeds were present throughout. Although organic debris was still present in the next section, it was not as condensed, and therefore the OM decreased to an average of 66.43% from 18-23 cm. The minor decrease was also due to the transition of organic-rich soil to a slightly more compacted soil, which was present though 31.5 cm. The OM continued to decrease through this length, reaching 44.74% at 28 cm and then rapidly falling to 18.36% at 31.5 cm. The OM then steadily fell to a combined percentage of 3.83% at 78 cm. These values are accurate when compared to the physical appearance of Core #10. As organic debris decrease and clay content and soil compaction increase, the OM percentage decreases.

Core # 11 also exhibited a variation in OM content, ranging from 60.18-0.5478%. As with the previous cores, the highest OM was visible in the topmost section of the core. The average OM reading in the top section (5 cm) was 56.74%, from the highly organic-rich soil present. From 5-33 cm, organic matter debris was identified by fibrous roots and weeds that intertwined throughout. This contributed to average 47.14% OM content present in this section. From here, the OM percentage sharply decreased to 3.05%, from 33-38 cm. This was from compacted clay soil that was present. A gradual decreased continued from 38-58 cm, with the OM content averaging 1.68%; however, from 58-66 cm, the OM increased slightly to 3.81%. This was likely due to the slightly less compacted soil, and the start of sandy soil consistency. As the soil texture changed to a loosely compacted sandy/slimy texture through 76 cm, the OM bottomed out at an average of 0.749%.

In Core #19 the organic matter (OM) varied from 0.961-8.75%. The topmost part of the core had the highest percentage of organic matter, with an average of 8.24% at 10 cm; this indicates that in this region, more than 8% of the soil consisted of some type of organic matter. From here, the OM steadily decreased through 25-30 cm, where the OM decreased to the lowest combined percentage of 1.08%. From this section, the remaining core stabilized with minimal difference in OM percentage; the average from the bottom of the cores was 1.89%. After briefly decreasing again, the OM values stabilized between 30-48 cm, at a constant OM of 1.98%. The high OM results at the top of the core are likely due to the close proximity with organic matter at the surface.

The reference core (RC) was similar in appearance and compaction to Core #19. It displayed an organic matter range from 12.83-2.11%. The largest percentage of OM was exhibited in the top five centimeters of the core where the combined average of the two half cores sections was 12.78%; this was due to the dark organic-rich soil present in this region. From five centimeters, the OM percentage gradually decreased 7.57-4.82% until 20 cm, where the OM content began to stabilize. It remained stable through the end of the core, with an average OM percentage of 2.31. This was most likely due to the soil type changing from organic-rich to clay.

In examining the results of the five cores, Core #10 had the highest OM content. With this and the depressed pH and low bulk density, Pb has a higher leachability in this core than the others. The downward movement of lead through soil corresponds to the movement of organic matter in soil (Steinnes, 2013). As the organic material moves, so does the Pb. The evidence of weeds, sticks, and other organic debris with loose compaction makes Pb easily transportable. Since Core #10 had the highest average percentage of OM at 74.96%, the probability of leaching is highest. This, coupled with its low pH within the top 23 cm, improves the likelihood of Pb leaching through core #10.

The next core to exhibit the highest probability of leaching was Core #11. This core had the second highest OM percentage of the group, measuring an average of 43.14% through the top 33 cm of the core. Much like the previous core, the average pH through 33 cm was considered low at 4.76 and the bulk density was relatively low (1.03 g/cm^3); these factors increase the likelihood of Pb's ability to leach through the soil layers.

5.6 LEAD BREAKDOWN ANALYSIS

To aid in analyzing how Pb exists throughout the soil cores, several extractions were used to determine the different forms of Pb in the soil segments. In the following sections, the extractions include Water Soluble fraction, Plant Available (Mehlich III extraction), and Total Metals (hot acid digestion). During analysis, those metals held very lightly by the soil will be most able to move throughout the soil profile (water extractable). Conversely, those that are held tightly to the soil particle will be retained and will not leach, therefore having reduced biological activity (Total Metals). Each solution was analyzed for metal content using an ICP-AES. Based on Scheetz's and Rimstidt's (2009) study, lead, as well as arsenic, cadmium, beryllium, antimony, and nickel which have been shown as trace elements in Pb shot, were analyzed.

5.7 Total Metal Results

During the analysis of the cores at the Grand Valley Hunting Ranch, the soil was examined for Pb levels above 400 ppm. According to the USEPA, Pb levels are not to exceed 400 ppm for soil suitable for children play areas. The results were also noted for Pb levels above 1200 ppm, as this is the convention for lead soil not used in non- play areas (ATSDR, 2007). As the Western Reserve Land Conservancy is repurposing the land for purposes not likely including children play areas, the 1200 ppm guideline was most useful during analysis.

The first core analyzed for total metal was Core #6. Through the entire length, the highest concentration of Pb was located within the top 20 cm of the core. Here, the average total Pb concentration was 10438 ppm, with the highest concentration of 24410 ppm at 5-10 cm. The levels were well above the USEPA's restriction of Pb in the soil of 400 ppm for play and 1200 ppm for non-play use (ATSDR, 2007).

The next core analyzed was Core #10. Similar to Core #6, Core #10 displayed a high concentration of Pb in the topmost section of the core. At 0-18 cm the average concentration was 3581 ppm, with the highest concentration of 7410 ppm located at 5-8 cm. The average concentration of Pb was well above the USEPA's restriction for Pb in soil, both for play and non-play use.

In Core #11, the top 25 cm displayed the highest concentration of Pb. The average Pb concentration here was 3491 ppm, with the highest concentration of 8074 ppm at 5-10 cm. The average concentration of Pb within the top layer is well above the USEPA's restriction for Pb for both play and non-play use. It should be noted that the Pb concentration varied greatly throughout the top 25 cm. At 5-10 cm, the average concentration of Pb was 8074 ppm and in the next section, 10-15 cm, the concentration of Pb decreased to 637.6 ppm.

Core #19 displayed a similar trend to Core #11 based on the ratio of concentration to depth. In the topmost section, 0-15 cm, the average concentration of Pb was 931.3 ppm, with the highest concentration, 1444 ppm, at 5-10 cm. Core #19 and Core #11 displayed similar characteristics in core depth and Pb concentration. At 0-5 cm, the concentration of Pb was 766.0 ppm and increased in concentration at 5-10 cm to 1444 ppm, and decreased to 584.0 ppm at 10-15 cm. The entire area, though, is still above the USEPA's restriction for Pb levels for play areas.

The RC displayed the lowest Pb concentration of all of the cores examined. In the top five centimeters of the core, the average Pb concentration was 40.68 ppm. From there, the concentrations decreased to 22 ppm or lower, all well within both the play- and non- play area guidelines according to the USEPA.

5.8 Mehlich III Results

During the analysis, arsenic, beryllium, nickel, lead, and antimony were all assessed because they are the materials that comprise a single Pb shot. However, for the purpose of this report, lead (Pb) was the only metal identified.

Results for Core #6 showed that Mehlich III Pb levels were the highest among the top 15 cm of the core, with an average of 1206 ppm. This value registers above the USEPA's standard for Pb levels for both play areas and non-play areas in residential zones. The highest concentration of Pb was at 10-15 cm, where the average of the two samples equaled 2213 ppm. Through the remaining length of the core, Pb levels increased and decreased at certain depths.

The second core examined under the Mehlich III analysis was core #10. The results displayed high concentrations at depths between 0-8 cm. The average concentration here was 552 ppm, with the highest amount of Pb, 673 ppm, found in the top five centimeters of the core. These top layers are where most of the biological activity takes place (plants, insects, microorganisms); therefore, there is a significant potential for interaction between organisms and Pb.

Core #11 displayed an average of 717.89 ppm through the top 20 cm of the core. The highest concentration was 1198 ppm, found at 10-15 cm. Core #11 displayed different concentration characteristics than Cores #6 and #10. In #6 and #10, the highest Pb concentration was found at the top of the core. Core #11, however, registered 529.2 ppm in the top five centimeters, and then increased to the peak reading (1198 ppm) as depth increased to 15 cm. It was notable that the Mehlich III Pb value decreased at 15-20 cm to 264.4 ppm, but sharply increased to 930.4 ppm at 20 cm.

Core #19 showed similar results to Core #11 for Mehlich III levels. Lead levels from 0-15 cm yielded 353.4 ppm. Levels then increased with depth, as the Mehlich III Pb reached 504 ppm at 10-15 cm.

The reference core displayed negligible Mehlich Pb levels within the top 20 cm of the core, at 4.83 ppm.

5.9 Water Soluble Results

In Core # 6, Water Soluble Pb was highest concentrated in the top 20 cm of the core. Here, the average Water Soluble Pb concentration was 10.08 ppm, peaking at 23.58 ppm from 5-10 cm. Similarly, Core #10's highest concentration of Water Soluble Pb was located in the top 13 cm of the core. Here, it averaged 6.18 ppm. The highest amount was located at 0-5 cm displaying an average of 10.05 ppm. Core #11's Water Soluble levels were almost identical to Core #10; in Core #10, concentrations equaled 7.01 ppm at the 0-20 cm section, and peaked at 11.18 ppm at 5-10 cm. In Core #19, the amount of Water Soluble Pb was located within the top 20 cm of the core. The average concentration of Water Soluble Pb was 2.79 ppm, with the greatest amount, 4.54 ppm, at 5-10 cm. The RC had average Pb levels less than 1.0 ppm with several below detection limits.

The Water Soluble Pb found in these cores will be examined in the following sections to determine if they have relationships with any of the soil properties measured. They will be analyzed using the Pearson correlation and Backwards Stepwise Regression method.

5.10 PEARSON CORRELATION

Simple correlation (Pearson Correlation, or PC) was completed between Pb and soil properties to identify trends. Using backwards stepwise regression, data on soil properties and metals were modeled to determine the most important soil properties in decreasing Pb movement and solubility. This information will be used in future projects to propose treatment measure in areas of Grand Valley Hunting Ranch with unacceptable Pb content (1200 ppm for non-play areas, 400 for play areas) (ATSDR, 2007). IBM's (International Business Machines) SPSS statistics software was used to understand the relationship between the different Pb fractions (Total, Mehlich III, and Water Soluble) in the cores and pH, conductivity (CD), organic matter (OM), and bulk density (BD) (IBM, 2011).

Core # 6

Total Pb, Water Soluble, and Mehlich III all displayed some linear correlation (IBM, 2011). As shown in Table 12, the first correlation results were with Mehlich III Pb; OM and CD displayed a linear tendency. OM resulted with a positive PC of 0.813, and $p \leq 0.05$. The CD analysis displayed the same significance, but a lower PC of 0.763. Total Pb for Core #6 displayed a similar tendency to Mehlich III, with both OM and CD displaying a significant ($p \leq 0.05$) positive correlation. The PC value of PM was 0.849 and CD displayed a value of 0.798. For Water Soluble Pb, a significant ($p \leq 0.05$) positive correlation existed with OM and CD. Organic matter displayed a slightly higher PC of 0.677 to CD's 0.635.

Table 12 Pearson Correlation with Significance Value Core #6

Correlations

		Bulk_D_6	OM_6	pH_6	Cond_6	Clay_6	Silt_6	Pb_Meh_6	Pb_Total_6	Pb_Water_6
Bulk_D_6	Pearson Correlation	1	-.892**	.416*	-.933**	.488**	-.881**	-.792**	-.806**	-.698**
	Sig. (2-tailed)		.000	.022	.000	.006	.000	.000	.000	.000
	N	30	30	30	30	30	30	30	30	30
OM_6	Pearson Correlation	-.892**	1	-.387*	.922**	-.435*	.831**	.813**	.849**	.677**
	Sig. (2-tailed)	.000		.034	.000	.016	.000	.000	.000	.000
	N	30	30	30	30	30	30	30	30	30
pH_6	Pearson Correlation	.416*	-.387*	1	-.244	.728**	-.440*	-.309	-.288	-.281
	Sig. (2-tailed)	.022	.034		.194	.000	.015	.097	.123	.133
	N	30	30	30	30	30	30	30	30	30
Cond_6	Pearson Correlation	-.933**	.922**	-.244	1	-.323	.854**	.763**	.798**	.635**
	Sig. (2-tailed)	.000	.000	.194		.082	.000	.000	.000	.000
	N	30	30	30	30	30	30	30	30	30
Clay_6	Pearson Correlation	.488**	-.435*	.728**	-.323	1	-.217	-.408*	-.417*	-.413*
	Sig. (2-tailed)	.006	.016	.000	.082		.250	.025	.022	.023
	N	30	30	30	30	30	30	30	30	30
Silt_6	Pearson Correlation	-.881**	.831**	-.440*	.854**	-.217	1	.709**	.712**	.608**
	Sig. (2-tailed)	.000	.000	.015	.000	.250		.000	.000	.000
	N	30	30	30	30	30	30	30	30	30
Pb_Meh_6	Pearson Correlation	-.792**	.813**	-.309	.763**	-.408*	.709**	1	.950**	.944**
	Sig. (2-tailed)	.000	.000	.097	.000	.025	.000		.000	.000
	N	30	30	30	30	30	30	30	30	30
Pb_Total_6	Pearson Correlation	-.806**	.849**	-.288	.798**	-.417*	.712**	.950**	1	.816**
	Sig. (2-tailed)	.000	.000	.123	.000	.022	.000	.000		.000
	N	30	30	30	30	30	30	30	30	30
Pb_Water_6	Pearson Correlation	-.698**	.677**	-.281	.635**	-.413*	.608**	.944**	.816**	1
	Sig. (2-tailed)	.000	.000	.133	.000	.023	.000	.000	.000	
	N	30	30	30	30	30	30	30	30	30

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Core #10

Core #10 was analyzed for strong correlations among soil properties. The data found that Total Pb was strongly and significantly correlated at the $p \leq 0.05$ level to OM, with a PC of 0.646. Similarly, Total Pb was correlated at the $p \leq 0.05$ to CD, with a PC value of 0.618. These variables were all positively correlated. Testing found, however, that Total Pb also had a strong negative correlation with silt; values were PC = -0.580. BD was also significantly, negatively correlated, with a PC = -0.511 and $p \leq 0.05$. Lastly, clay content was negatively correlated, with a PC value equaling -0.445 at the $p \leq 0.05$ level. Both Water Soluble Pb and Mehlich III Pb displayed similar results to Total Pb; OM, and CD were both positively correlated and statistically significant, while a negative correlation existed between BD, clay, and silt. These values can be found in Table 13.

Table 13 Pearson Correlation with Significance Value Core #10

Correlations

		Bulk_D_10	OM_10	pH_10	Cond_10	Clay_10	Silt_10	Pb_Mehlich_10	Pb_Total_10	Pb_Water_10
Bulk_D_10	Pearson Correlation	1	-.878**	-.224	-.868**	.827**	.858**	-.474**	-.511**	-.509**
	Sig. (2-tailed)		.000	.203	.000	.000	.000	.005	.002	.002
	N	34	34	34	34	34	34	34	34	34
OM_10	Pearson Correlation	-.878**	1	-.028	.994**	-.920**	-.940**	.574**	.646**	.614**
	Sig. (2-tailed)	.000		.873	.000	.000	.000	.000	.000	.000
	N	34	34	34	34	34	34	34	34	34
pH_10	Pearson Correlation	-.224	-.028	1	-.053	.221	.181	.288	.204	.277
	Sig. (2-tailed)	.203	.873		.766	.208	.305	.099	.247	.113
	N	34	34	34	34	34	34	34	34	34
Cond_10	Pearson Correlation	-.868**	.994**	-.053	1	-.918**	-.926**	.535**	.618**	.578**
	Sig. (2-tailed)	.000	.000	.766		.000	.000	.001	.000	.000
	N	34	34	34	34	34	34	34	34	34
Clay_10	Pearson Correlation	.827**	-.920**	.221	-.918**	1	.958**	-.382*	-.445**	-.419*
	Sig. (2-tailed)	.000	.000	.208	.000		.000	.026	.008	.014
	N	34	34	34	34	34	34	34	34	34
Silt_10	Pearson Correlation	.858**	-.940**	.181	-.926**	.958**	1	-.518**	-.580**	-.552**
	Sig. (2-tailed)	.000	.000	.305	.000	.000		.002	.000	.001
	N	34	34	34	34	34	34	34	34	34
Pb_Mehlich_10	Pearson Correlation	-.474**	.574**	.288	.535**	-.382*	-.518**	1	.877**	.990**
	Sig. (2-tailed)	.005	.000	.099	.001	.026	.002		.000	.000
	N	34	34	34	34	34	34	34	34	34
Pb_Total_10	Pearson Correlation	-.511**	.646**	.204	.618**	-.445**	-.580**	.877**	1	.897**
	Sig. (2-tailed)	.002	.000	.247	.000	.008	.000	.000		.000
	N	34	34	34	34	34	34	34	34	34
Pb_Water_10	Pearson Correlation	-.509**	.614**	.277	.578**	-.419*	-.552**	.990**	.897**	1
	Sig. (2-tailed)	.002	.000	.113	.000	.014	.001	.000	.000	
	N	34	34	34	34	34	34	34	34	34

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Core # 11

Total Pb was most positively correlated at $p \leq 0.05$ level to organic matter, with a PC = 0.510. Conductivity was most correlated, with a PC coefficient = 0.482, also at the $p \leq 0.05$ level of significance. Conversely, BD had a significant negative correlation ($p \leq 0.05$), with a PC = -0.579. Water Soluble Pb and Mehlich III Pb echoed these results, as OM and CD were positively and significantly correlated, while BD was significantly negatively correlated at the $p \leq 0.05$ level. Values can be seen in Table 14.

Table 14 Pearson Correlation with Significance Value Core #11

Correlations

		Bulk_D_11	OM_11	pH_11	Cond_11	Clay_11	Silt_11	Pb_Mehl_11	Pb_Total_11	Pb_Water_11
Bulk_D_11	Pearson Correlation	1	-.967**	-.342*	-.929**	-.015	.145	-.643**	-.579**	-.605**
	Sig. (2-tailed)		.000	.035	.000	.929	.383	.000	.000	.000
	N	38	38	38	38	38	38	38	38	38
OM_11	Pearson Correlation	-.967**	1	.362*	.936**	.034	-.125	.602**	.510**	.573**
	Sig. (2-tailed)	.000		.026	.000	.838	.455	.000	.001	.000
	N	38	38	38	38	38	38	38	38	38
pH_11	Pearson Correlation	-.342*	.362*	1	.144	.458**	.353*	.283	.270	.265
	Sig. (2-tailed)	.035	.026		.389	.004	.030	.085	.102	.108
	N	38	38	38	38	38	38	38	38	38
Cond_11	Pearson Correlation	-.929**	.936**	.144	1	-.133	-.269	.562**	.482**	.547**
	Sig. (2-tailed)	.000	.000	.389		.427	.103	.000	.002	.000
	N	38	38	38	38	38	38	38	38	38
Clay_11	Pearson Correlation	-.015	.034	.458**	-.133	1	.984**	.022	.017	.042
	Sig. (2-tailed)	.929	.838	.004	.427		.000	.895	.919	.804
	N	38	38	38	38	38	38	38	38	38
Silt_11	Pearson Correlation	.145	-.125	.353*	-.269	.984**	1	-.081	-.075	-.054
	Sig. (2-tailed)	.383	.455	.030	.103	.000		.629	.656	.750
	N	38	38	38	38	38	38	38	38	38
Pb_Mehl_11	Pearson Correlation	-.643**	.602**	.283	.562**	.022	-.081	1	.979**	.991**
	Sig. (2-tailed)	.000	.000	.085	.000	.895	.629		.000	.000
	N	38	38	38	38	38	38	38	38	38
Pb_Total_11	Pearson Correlation	-.579**	.510**	.270	.482**	.017	-.075	.979**	1	.968**
	Sig. (2-tailed)	.000	.001	.102	.002	.919	.656	.000		.000
	N	38	38	38	38	38	38	38	38	38
Pb_Water_11	Pearson Correlation	-.605**	.573**	.265	.547**	.042	-.054	.991**	.968**	1
	Sig. (2-tailed)	.000	.000	.108	.000	.804	.750	.000	.000	
	N	38	38	38	38	38	38	38	38	38

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Core #19

Total Pb's strongest positive relationship in Core #19 was to OM, with a PC coefficient of 0.937, significant at $p \leq 0.05$. This was closely followed by a PC = 0.877 correlation to CD ($p \leq 0.05$). Total Pb was negatively correlated to BD. The PC coefficient equaled -0.833 ($p \leq 0.05$). It was also negatively correlated to clay, with PC = -0.545, ($p \leq 0.05$).

Mehlich III Pb and Water Soluble Pb produced very similar results as Total Pb for OM, CD, BD, and clay; both OM and CD were positively and significantly correlated (p

≤ 0.05), while BD and clay were negatively correlated ($p \leq 0.05$). It should be noted that only Total Pb and Mehlich III Pb were positively correlated with pH (Table 15).

Table 15 Pearson Correlation with Significance Value Core #19

Correlations

		Bulk_D_19	OM_19	pH_19	Cond_19	Clay_19	Silt_19	Pb_Meh_19	Pb_Total_19	Pb_Water_19
Bulk_D_19	Pearson Correlation	1	-.924**	-.658**	-.765**	.538*	.238	-.854**	-.833**	-.592**
	Sig. (2-tailed)		.000	.002	.000	.014	.313	.000	.000	.006
	N	20	20	20	20	20	20	20	20	20
OM_19	Pearson Correlation	-.924**	1	.589**	.869**	-.567**	-.226	.948**	.937**	.740**
	Sig. (2-tailed)	.000		.006	.000	.009	.337	.000	.000	.000
	N	20	20	20	20	20	20	20	20	20
pH_19	Pearson Correlation	-.658**	.589**	1	.338	-.172	-.306	.484*	.490*	.231
	Sig. (2-tailed)	.002	.006		.144	.468	.189	.031	.028	.327
	N	20	20	20	20	20	20	20	20	20
Cond_19	Pearson Correlation	-.765**	.869**	.338	1	-.426	-.361	.885**	.877**	.683**
	Sig. (2-tailed)	.000	.000	.144		.061	.117	.000	.000	.001
	N	20	20	20	20	20	20	20	20	20
Clay_19	Pearson Correlation	.538*	-.567**	-.172	-.426	1	-.625**	-.583**	-.545*	-.633**
	Sig. (2-tailed)	.014	.009	.468	.061		.003	.007	.013	.003
	N	20	20	20	20	20	20	20	20	20
Silt_19	Pearson Correlation	.238	-.226	-.306	-.361	-.625**	1	-.201	-.211	.123
	Sig. (2-tailed)	.313	.337	.189	.117	.003		.395	.372	.606
	N	20	20	20	20	20	20	20	20	20
Pb_Meh_19	Pearson Correlation	-.854**	.948**	.484*	.885**	-.583**	-.201	1	.991**	.782**
	Sig. (2-tailed)	.000	.000	.031	.000	.007	.395		.000	.000
	N	20	20	20	20	20	20	20	20	20
Pb_Total_19	Pearson Correlation	-.833**	.937**	.490*	.877**	-.545*	-.211	.991**	1	.786**
	Sig. (2-tailed)	.000	.000	.028	.000	.013	.372	.000		.000
	N	20	20	20	20	20	20	20	20	20
Pb_Water_19	Pearson Correlation	-.592**	.740**	.231	.683**	-.633**	.123	.782**	.786**	1
	Sig. (2-tailed)	.006	.000	.327	.001	.003	.606	.000	.000	
	N	20	20	20	20	20	20	20	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

These results show that Pb levels, including Total, Water Soluble, and Mehlich III Pb, are positively and statistically significantly correlated to OM and CD. This means that as OM and CD increase, Pb levels will likely increase as well. Conversely, most of the core results showed that Pb is negatively correlated with BD, and in some cases, silt or clay. This means that as BD and silt or clay levels increase, Pb is likely to decrease.

5.11 Backwards Stepwise Regression

For each core, a backwards stepwise regression was run to determine if a relationship existed between the dependent variables (Total Pb, Mehlich III Pb, and Water Soluble Pb) and the independent variables (pH, conductivity, organic matter, bulk density, silt, and clay). This was done using IBM's SPSS statistical software (IBM, 2011). During this analysis, the R Square and significance (probability) were examined to determine if a relationship existed.

Total Pb was the first dependent variable examined in Core #6 (Table 16). During this analysis, it was found that OM had the most significant correlation, with an R Square value of 0.722, and $p \leq 0.05$. Mehlich III Pb echoed these results, as it was also most strongly correlated to OM. Here, the R Square value equaled 0.661, with a $p \leq 0.05$.

Table 16 Backwards Stepwise Regression for Core #6
Total (top), Mehlich (left), Water Soluble (right)

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.869[a]	.755	.691	3739.93258
2	.868[b]	.754	.702	3670.62395
3	.866[c]	.749	.709	3627.21281
4	.858[d]	.736	.706	3649.66213
5	.851[e]	.724	.704	3660.27856
6	.849[f]	.722	.712	3612.36132

a. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6, Cond_6, Bulk_D_6
b. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6, Cond_6
c. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6
d. Predictors: (Constant), Clay_6, pH_6, OM_6
e. Predictors: (Constant), Clay_6, OM_6
f. Predictors: (Constant), OM_6
g. Dependent Variable: Pb_Total_6

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.838[a]	.703	.625	363.77949
2	.835[b]	.698	.635	358.94062
3	.835[c]	.697	.648	352.50434
4	.830[d]	.689	.653	350.21659
5	.826[e]	.683	.659	346.89619
6	.813[f]	.661	.649	352.04017

a. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6, Cond_6, Bulk_D_6
b. Predictors: (Constant), Clay_6, pH_6, OM_6, Cond_6, Bulk_D_6
c. Predictors: (Constant), pH_6, OM_6, Cond_6, Bulk_D_6
d. Predictors: (Constant), OM_6, Cond_6, Bulk_D_6
e. Predictors: (Constant), OM_6, Bulk_D_6
f. Predictors: (Constant), OM_6
g. Dependent Variable: Pb_Meh_6

Model Summary[e]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.748[a]	.559	.444	5.03300
2	.745[b]	.555	.463	4.94817
3	.732[c]	.535	.461	4.95717
4	.728[d]	.530	.476	4.88722

a. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6, Cond_6, Bulk_D_6
b. Predictors: (Constant), Silt_6, Clay_6, pH_6, OM_6, Cond_6
c. Predictors: (Constant), Silt_6, Clay_6, pH_6, Cond_6
d. Predictors: (Constant), Silt_6, Clay_6, pH_6
e. Dependent Variable: Pb_Water_6

Conversely, Water Soluble Pb showed a correlation to pH, clay, and silt. The R square value was 0.530 for those remaining independent variables; of these, silt showed the most significant relationship, with a $p \leq 0.05$, followed by clay and pH, with $p \leq 0.05$ and 0.048, respectively.

The regression for Core #10 showed that silt, pH, BD, clay, and OM were all correlated to Total Pb. This relationship had an R Square value of 0.654, where all were significant according to their probability. Silt was most significant, with a $p \leq 0.05$. Water Soluble Pb also showed a correlation with silt, pH, BD, clay and OM. They were all significantly related, with significance values less than 0.050. Mehlich III Pb's results echoed this, with silt, pH, BD, clay and OM also being significantly related ($p \leq 0.021$), with silt and slay having the most significant relationship with $p \leq 0.002$ (Table 17). The final model included %silt, %clay, %OM, BD, and pH to predict all three fractions of Pb in the soil.

Table 17 Backwards Stepwise Regression for Core #10
Total (top), Mehlich (left), Water Soluble (right)

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.841[a]	.707	.642	1219.66359
2	.841[b]	.707	.654	1198.33118

a. Predictors: (Constant), Silt_10, pH_10, Cond_10, Bulk_D_10, Clay_10, OM_10

b. Predictors: (Constant), Silt_10, pH_10, Bulk_D_10, Clay_10, OM_10

c. Dependent Variable: Pb_Total_10

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.821[a]	.674	.602	115.77991
2	.818[b]	.670	.611	114.51640

a. Predictors: (Constant), Silt_10, pH_10, Cond_10, Bulk_D_10, Clay_10, OM_10

b. Predictors: (Constant), Silt_10, pH_10, Bulk_D_10, Clay_10, OM_10

c. Dependent Variable: Pb_Mehlich_10

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.834[a]	.695	.627	1.69302
2	.832[b]	.693	.638	1.66795

a. Predictors: (Constant), Silt_10, pH_10, Cond_10, Bulk_D_10, Clay_10, OM_10

b. Predictors: (Constant), Silt_10, pH_10, Bulk_D_10, Clay_10, OM_10

c. Dependent Variable: Pb_Water_10

Core #11 was examined under the backward stepwise regression. The only correlation for Total Pb was with BD, with an R Square value = 0.335. The Sig. value was 0.000. Water Soluble Pb and Mehlich III Pb were also correlated with BD only, with R Square = 0.366 (Water Soluble) and 0.414 (Mehlich III Pb). Sig. values were both 0.000. This information can be seen in Table 18. The final model included only bulk density as a predictor for all three fractions of Pb in the soil.

Table 18 Backwards Stepwise Regression for Core #11
Total (top), Mehlich (left), Water Soluble (right)

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.627[a]	.393	.276	1835.63008
2	.625[b]	.390	.295	1811.07509
3	.622[c]	.386	.312	1788.98762
4	.621[d]	.386	.331	1763.65086
5	.612[e]	.375	.339	1753.01426
6	.579[f]	.335	.317	1782.48184

a. Predictors: (Constant), Silt_11, OM_11, pH_11, Cond_11, Bulk_D_11, Clay_11

b. Predictors: (Constant), Silt_11, OM_11, pH_11, Bulk_D_11, Clay_11

c. Predictors: (Constant), OM_11, pH_11, Bulk_D_11, Clay_11

d. Predictors: (Constant), OM_11, pH_11, Bulk_D_11

e. Predictors: (Constant), OM_11, Bulk_D_11

f. Predictors: (Constant), Bulk_D_11

g. Dependent Variable: Pb_Total_11

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.657[a]	.432	.322	280.60168
2	.656[b]	.431	.342	276.37725
3	.652[c]	.426	.356	273.44198
4	.651[d]	.424	.373	269.85732
5	.650[e]	.423	.390	266.15132
6	.643[f]	.414	.397	264.50715

a. Predictors: (Constant), Silt_11, OM_11, pH_11, Cond_11, Bulk_D_11, Clay_11

b. Predictors: (Constant), Silt_11, pH_11, Cond_11, Bulk_D_11, Clay_11

c. Predictors: (Constant), Silt_11, Cond_11, Bulk_D_11, Clay_11

d. Predictors: (Constant), Cond_11, Bulk_D_11, Clay_11

e. Predictors: (Constant), Cond_11, Bulk_D_11

f. Predictors: (Constant), Bulk_D_11

g. Dependent Variable: Pb_Mehl_11

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.616[a]	.379	.259	2.86018
2	.616[b]	.379	.282	2.81516
3	.614[c]	.377	.301	2.77657
4	.608[d]	.370	.315	2.75000
5	.608[e]	.370	.334	2.71061
6	.605[f]	.366	.349	2.68067

a. Predictors: (Constant), Silt_11, OM_11, pH_11, Cond_11, Bulk_D_11, Clay_11

b. Predictors: (Constant), Silt_11, OM_11, pH_11, Bulk_D_11, Clay_11

c. Predictors: (Constant), Silt_11, pH_11, Bulk_D_11, Clay_11

d. Predictors: (Constant), Silt_11, pH_11, Bulk_D_11

e. Predictors: (Constant), pH_11, Bulk_D_11

f. Predictors: (Constant), Bulk_D_11

g. Dependent Variable: Pb_Water_11

Core #19 was the last to be examined. As seen in Table 19, it had a relationship with OM, with R Square = 0.878, $p \leq 0.05$. Water Soluble, however, was significantly correlated with both OM and silt. The R square value for this model was 0.636 for OM and silt as a predictor for Water Soluble Pb at $p \leq 0.05$. Both Total Pb and Mehlich III Pb resulted with only %OM as a significant parameter with an R Square value = 0.898 at $p \leq$ 0.05.

Table 19 Backwards Stepwise Regression for Core #19
Total (top), Mehlich (left), Water Soluble (right)

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.948[a]	.899	.853	178.61200
2	.948[b]	.899	.864	172.11951
3	.948[c]	.899	.873	166.38518
4	.948[d]	.898	.879	162.31653
5	.945[e]	.894	.881	160.49246
6	.937[f]	.878	.871	167.23142

a. Predictors: (Constant), Silt_19, OM_19, pH_19, Cond_19, Bulk_D_19, Clay_19

b. Predictors: (Constant), OM_19, pH_19, Cond_19, Bulk_D_19, Clay_19

c. Predictors: (Constant), OM_19, Cond_19, Bulk_D_19, Clay_19

d. Predictors: (Constant), OM_19, Cond_19, Bulk_D_19

e. Predictors: (Constant), OM_19, Cond_19

f. Predictors: (Constant), OM_19

g. Dependent Variable: Pb_Total_19

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.963[a]	.927	.893	55.69720
2	.962[b]	.926	.900	53.81873
3	.961[c]	.924	.904	52.63055
4	.956[d]	.913	.897	54.52495
5	.949[e]	.901	.889	56.54151
6	.948[f]	.898	.892	55.78490

a. Predictors: (Constant), Silt_19, OM_19, pH_19, Cond_19, Bulk_D_19, Clay_19

b. Predictors: (Constant), Silt_19, OM_19, Cond_19, Bulk_D_19, Clay_19

c. Predictors: (Constant), Silt_19, OM_19, Bulk_D_19, Clay_19

d. Predictors: (Constant), Silt_19, OM_19, Clay_19

e. Predictors: (Constant), OM_19, Clay_19

f. Predictors: (Constant), OM_19

g. Dependent Variable: Pb_Meh_19

Model Summary[f]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.847[a]	.717	.587	1.04604
2	.846[b]	.715	.613	1.01176
3	.841[c]	.707	.628	.99193
4	.821[d]	.674	.613	1.01175
5	.798[e]	.636	.593	1.03744

a. Predictors: (Constant), Silt_19, OM_19, pH_19, Cond_19, Bulk_D_19, Clay_19

b. Predictors: (Constant), Silt_19, OM_19, Cond_19, Bulk_D_19, Clay_19

c. Predictors: (Constant), Silt_19, OM_19, Cond_19, Clay_19

d. Predictors: (Constant), Silt_19, OM_19, Cond_19

e. Predictors: (Constant), Silt_19, OM_19

f. Dependent Variable: Pb_Water_19

CHAPTER 6.0 DISCUSSION

In the cores that were analyzed, the highest percentage of organic matter (OM) and Total Pb was located within the A-horizon. The Pb shot was deposited on the surface which is probably the largest factor in its location; however, this Pb has not significantly moved from the A Horizon in over 20 years since its deposition. This finding echoes Scheetz study, which explains that extractable Pb is mostly contained within the A Horizon. Environmental factors will cause the Pb to erode, causing the highest amount of Pb to be identified where there is the highest amount of OM which is consistent with these results (Sheetz, 2009).

Precipitation and high acid content can accelerate Pb's leachability, and with the Grand Valley soil averaging a pH of 4.72 at the contaminated sites, and an average precipitation of 28-42" per year, it is expected that the Pb would leach.

The organic matter, clays, and other mineral components that are present in the A Horizon can inhibit the mobility of soluble Pb, in particular, vertical movement, because of sorption onto soil particles (Duggan & Dhawan, 2007). This, coupled with the binding ability of vegetation and roots in this layer, will hinder Pb's ability to leach past the A Horizon and into the lower soil horizons; this barrier is why there is a sharp decrease in Total Pb levels below the A Horizon in the Grand Valley Hunting Ranch soil samples (Sheetz, 2009). Potentially, the Pb could be moving laterally, staying within the A Horizon.

All of these factors support the hypothesis that the distribution of Pb in the soil will be influenced by soil properties. Organic matter and high clay percentages reduced

Pb movement into lower horizons, whereas pH increased the likelihood of Pb leaching through the soil.

The Grand Valley Hunting Ranch was active for 17 years, much like the shooting ranch in Hälvälä, Finland, which was active for 22 years. There were two layers that were identified within the top eight centimeters of the cores: the fermentation layer, in which the top 5-8 cm of the core consisted of decomposed material, and the humus layer, where the top one cm was comprised of fine organic and well decomposed matter (Selonen et al., 2012). The Grand Valley had similar findings to Hälvälä, with the top five centimeters of each core consisting of rich organic material, and the topmost layer containing decomposed, fine organic material. Further, both sites displayed similar OM percentages; Hälvälä averaged an OM percentage of 59%, and cores #6, 10, and 11 from the Grand Valley Hunting Ranch averaged 60.37%. Core #19 from Grand Valley displayed a much lower OM content, at 8.09%. This is likely due to its differing soil type (cores 6, 10, and 11 are Carlisle Muck, whereas Core #19 is Darien Silt Loam).

The Hälvälä Ranch samples had a Total Pb analysis reading of 12,239 ppm within the top eight centimeters of the cores. Similarly, Cores 6, 10, and 11 from Grand Valley had an average Total Pb 10,049 ppm within the top 10 cm. The Total Pb averages for both ranches were above the recommended legislation for its own country.

Conversely, the Water Soluble Pb levels for Hälvälä and Grand Valley were significantly different. The Hälvälä Ranch had a water-extractable Pb content of 0.40 ppm, whereas the Grand Valley Hunting Ranch had a content of 10.66 ppm. The difference between the two ranches is most likely due to the difference in the amount and type of precipitation in the areas. The average amount of precipitation for the Grand

Valley Hunting Ranch is 28-42 inches (71.1-106.7 cm) annually (USDA, 2013). The annual precipitation average for the area around the Hälvälä ranch is 25.71 inches (65.3 cm), with low to medium risk for acid rain (Finnish, 2012). The higher amount of precipitation and low pH at Grand Valley most likely contributed to a higher amount of Water Soluble Pb for the Grand Valley Hunting Ranch. Also, the soil pH for both sites were very similar, as Grand Valley averaged a pH of 4.77 for cores 6, 10, and 11, and the old contaminated (OC) site in Hälvälä had an average pH of 4.8 (Selonen et al., 2012). Therefore, this factor was considered a constant variable between the two studies.

The Grand Valley Hunting Ranch displayed similar results in cores 6, 10, and 11 for Total Pb, Water Soluble Pb, and Plant Available Pb (Mehlich III). These three parameters were compared to several soil characteristics, including pH, conductivity (CD), organic matter (OM), silt, and clay. Cores 6, 10, and 11 had similar correlations to OM and CD, shown by using a Pearson's Correlation. Cores 6, 10, and 11 displayed a Total Pb average at 7,460 ppm within the top 15 cm of the cores, with Core #6 having the highest average of 13,728 ppm. These three cores also had an average Water Soluble Pb content of 8.32 ppm, again with core #6 displaying the highest amount, with an average of 12.7 ppm within the top 15 cm of the core. Finally, the average Plant Available (Mehlich III) Pb for the three cores was 753.8 ppm, with Core #6 having the highest average of 1206 ppm.

With Core #6 exhibiting the highest amount of Pb through the three fractions tested, and comparing these fractions to the different soil parameters, Core #6 has the highest percentage of Pb leaching through the soil into the other horizons. Referring to Figure 1.0, the Map of the Grand Valley Hunting Ranch, it can be seen that the Core #6 had the higher probability of Pb shot concentration due to the cross-over of the different shooting platforms used at the ranch. Core #6 was between the drop zones of three of the shooting stands, as shown in Figure 1.0. In Table 1.0 it is shown that Core #6 had the highest amount of actual Pb shot pellets within the top five centimeters of the core. Cores #10 and 11 displayed the second highest average of the three parameters tested. The results show that they had the next highest likelihood of Pb being able to leach into the different soil horizons. Cores #10 and 11 are close in proximity to Core #6, which could contribute to the second highest ranges of shot concentration and lead concentrations in each of their representative drop zones.

Core #19 showed similar results to cores #6, 10, and 11, although Pb levels were lesser across all three parameters. This could be due to Core #19 having a different soil type, Darien Silt Loam. In relating all of the cores, #19 displayed a similar relationship of CD and OM; however, the percentage of OM within the top five centimeters of the core was 8.09% whereas the average of cores #6, 10, and 11 was 60.37%. Similarly, Core #19 had a CD of 89.15; whereas cores #6, 10, and 11 had an average CD of 1,006.

Because of the lower amounts of OM and CD in Core #19's soil, the amounts of Total Pb, Water Soluble, and Plant available Pb in the soil would be lower. Core #19 had an average of 931.3 ppm of Total Pb within the top 15 cm of the core, while the average of the other cores was 7,460 ppm. Water Soluble Pb for Core #19 was an average of 3.01 ppm with the top 15 cm of the core, whereas the other three cores had an average of 8.32 ppm. Lastly, Plant Available Pb (Mehlich III) for Core #19 was an average of 353.4 ppm within the top 15 cm of the core, whereas cores #6, 10, and 11 had an average of 753.79 ppm.

These results show that of the four active sample sites, Core #19 is the least likely to have Pb leach through the soil. In examining Figure 1, Core #19 is ~400 meters from cores #6, 10, and 11, and is a different soil type. The fall zone of Core #19 consists of only one shooting platform where cores #6, 10, and 11 all have three in close proximity. These are likely reasons as to why the Pb levels are lower for Core #19.

As Total, Mehlich III, and Water Soluble Pb levels were all significantly higher than those found in the reference core, the first hypothesis, that munitions use has increased Pb concentrations in the soil, has been supported.

6.1 Future Research

The flora and fauna of the Grand Valley Hunting Ranch can be examined as a potential factor of Pb movement. There have been many previous studies on the examination of Pb's impact on the flora and fauna; however, this research did not examine this effect in Grand Valley. Many of the effects previously noted in research are very specific to the contamination site; therefore, this type of evaluation would be useful for future mitigation of the soil.

Another area of future study is the examination of the number of Pb shot in each of the areas where the cores were extracted. Instead of examining the top few centimeters of each core for Pb shot, future analysis could examine both a larger surface area and the entire core depth to get the full perspective of how many Pb pellets have been deposited and how far they have traveled vertically. This information could help in the establishment of future concerns and the best method of remediation.

CHAPTER 7.0 CONCLUSION

Four Pb contaminated cores were taken from the Grand Valley Hunting Ranch in Orwell, Ohio, and were compared to a reference core to examine the amounts of Pb present, as well as leaching potential. The first supposition of the hypothesis, that Pb levels area elevated in the falls zones, was supported as all cores in the fall zones had significantly higher Pb concentrations than did the reference core. In addition, the amount of Pb in the top soil of the core was related to the number of intersecting fall zones. The Pb levels of the four contaminated cores were compared to each core's location within the shooting ranch; Core #6 had the highest amount of Pb shot present, likely based on its proximity to the shooting platforms. It also had the highest amount of Total, Plant Available (Mehlich III), and Water Soluble Pb, making it the most probable for Pb mobility. The other cores showed decreased Pb content as proximity to the shooting platforms decreased, as well as decreased Pb content with less organic-rich soil.

Each of the contaminated cores displayed a correlation between organic matter (OM), bulk density (BD), and/or conductivity (CD) with Pb concentrations. This correlation displayed a significant role in the amount and location of Pb found in the soil. The correlation was examined in relation to the different samples' soil types. Conductivity was positively correlated to Pb levels, and pH facilitated Pb movement through the soil layers. This shows that these soil characteristics are correlated to Pb.

Finally, the cores showed that there were interactions between soil properties that influenced where the Pb was found in the soil profile for each fraction of Pb, as determined by the regression model. These models indicate that there could be multiple soil properties that influence how Pb behaves in the soil.

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Appendix A: Total, Mehlich, and Water Pb Values and Variables Analysis

Plant Available metals extracted with Mehlich Data for Core #6

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
WestRes M3 #6 1A	1	5	0.323	0.139	0.000	902.9	7.218	446.4	44.64	5.05	800	12	57
WestRes M3 #6 1B	2	5	38.9	0.151	0.000	892.5	14.91	520.9	52.09	4.89	800	12	57
WestRes M3 #6 2A	1	10	39.7	0.181	0.000	1832.0	16.87	430.3	43.03	4.91	617	12	57
WestRes M3 #6 2B	2	10	48.8	0.187	0.000	2594.0	37.8	415.7	41.57	4.97	566	12	57
WestRes M3 #6 3A	1	15	36.7	0.276	0.000	418.5	6.515	271.2	27.12	4.81	502	12	57
WestRes M3 #6 3B	2	15	35	0.274	0.000	597.5	7.302	199.9	19.99	4.9	502	12	57
WestRes M 6 4A	1	20	29.7	0.355	0.000	249.3	2.006	107.7	10.77	4.63	277	30	40
WestRes M 6 4B	2	20	29.4	0.362	0.000	251.4	2.094	58.15	5.81	4.65	252	30	40
WestRes M3 6 5A	1	25	9.2	0.308	0.000	31.73	0.351	260.7	26.07	4.78	76.6	30	40
WestRes M3 6 5B	2	25	9.2	0.307	0.000	31.31	0.361	22.1	2.21	4.81	74.7	30	40
WestRes M 6 6A	1	30	*5.4*	0.306	0.000	13.11	0.147	9.12	0.91	4.79	68.7	26	38.5
WestRes M 6 6B	2	30	*5.3*	0.286	0.000	12.59	0.128	15.48	1.55	4.65	63	26	38.5
WestRes M 6 7A	1	35	*6*	0.329	0.000	10.05	*0.072*	15.60	1.56	4.91	74.2	26	38.5
WestRes M 6 7B	2	35	*6.1*	0.325	0.000	10.11	*0.067*	14.51	1.45	4.88	67.8	26	38.5
WestRes M 6 8A	1	40	*6*	0.226	0.000	5.968	*0.042*	13.17	1.32	4.82	61.7	26	38.5
WestRes M 6 8B	2	40	*6*	0.227	0.000	6.129	*0.041*	10.31	1.03	5.01	59.2	26	38.5
WestRes M 6 9A	1	45	*5.5*	0.167	0.000	5.042	*0.058*	12.93	1.29	5.3	49	11.5	23
WestRes M 6 9B	2	45	*5.4*	0.146	0.000	4.725	*0.048*	7.38	0.74	5.4	51.2	11.5	23
WestRes M 6 10A	1	50	*5.6*	0.118	0.000	4.900	*0.069*	4.35	0.44	5.67	43.6	11.5	23
WestRes M 6 10B	2	50	*5.7*	0.113	0.000	4.323	*0.041*	5.32	0.53	5.62	43.1	11.5	23
WestRes M 6 11A	1	55	*3.6*	0.083	0.000	16.13	0.125	5.55	0.55	5.6	50.2	11.5	23
WestRes M 6 11B	2	55	*3.2*	0.081	0.000	16.31	0.129	4.88	0.49	5.85	50.2	11.5	23
WestRes M 6 12A	1	60	*5*	0.219	0.000	2.614	*0.046*	16.29	1.63	7.26	123.4	48	33.5
WestRes M 6 12B	2	60	*5*	0.225	0.000	2.597	*0.045*	16.65	1.67	6.84	126.8	48	33.5
WestRes M 6 13A	1	65	*6.1*	0.240	0.000	3.869	*0.047*	17.88	1.79	6.99	180.2	48	33.5
WestRes M 6 13B	2	65	*6.4*	0.240	0.000	4.071	*0.046*	16.98	1.70	7.01	176.1	48	33.5
WestRes M 6 14A	1	70	*5.6*	0.112	0.000	4.218	*0.063*	34.61	3.46	6.98	159.8	48	33.5
WestRes M 6 14B	2	70	*5.4*	0.097	0.000	3.961	*0.043*	12.39	1.24	7	153.9	48	33.5
WestRes M 6 15A	1	75	*6.3*	0.152	0.000	19.51	0.12	15.16	1.52	6.98	155.2	48	33.5
WestRes M 6 15B	2	75	*6.1*	0.148	0.000	19.32	0.119	16.56	1.66	6.96	164.2	48	33.5

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich Data for Core #6 (cont)

Italics = Below Detectable Limit

Mehlich Core #6		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley 6 1	Avg.	19.6115	0.1450	0.0000	897.7000	11.0640
	StDev	*27.28*	*0.01*	*0.00*	*7.35*	*5.44*
Grand Valley6 2	Avg.	44.2500	0.1840	0.0000	2213.0000	27.3350
	StDev	*6.43*	*0.00*	*0.00*	*538.82*	*14.80*
Grand Valley6 3	Avg.	35.8500	0.2750	0.0000	508.0000	6.9085
	StDev	*1.20*	*0.00*	*0.00*	*126.57*	*0.56*
Grand Valley6 4	Avg.	29.5500	0.3585	0.0000	250.3500	2.0500
	StDev	*0.21*	*0.00*	*0.00*	*1.48*	*0.06*
Grand Valley6 5	Avg.	9.2000	0.3075	0.0000	31.5200	0.3560
	StDev	*0.00*	*0.00*	*0.00*	*0.30*	*0.01*
Grand Valley6 6	Avg.	5.3500	0.2960	0.0000	12.8500	0.1375
	StDev	*0.07*	*0.01*	*0.00*	*0.37*	*0.01*
Grand Valley6 7	Avg.	6.0500	0.3270	0.0000	10.0800	0.0695
	StDev	*0.07*	*0.00*	*0.00*	*0.04*	*0.00*
Grand Valley6 8	Avg.	6.0000	0.2265	0.0000	6.0485	0.0415
	StDev	*0.00*	*0.00*	*0.00*	*0.11*	*0.00*
Grand Valley6 9	Avg.	5.4500	0.1565	0.0000	4.8835	0.0530
	StDev	*0.07*	*0.01*	*0.00*	*0.22*	*0.01*
Grand Valley6 10	Avg.	5.6500	0.1155	0.0000	4.6115	0.0550
	StDev	*0.07*	*0.00*	*0.00*	*0.41*	*0.02*
Grand Valley6 11	Avg.	3.4000	0.0820	0.0000	16.2200	0.1270
	StDev	*0.28*	*0.00*	*0.00*	*0.13*	*0.00*
Grand Valley6 12	Avg.	5.0000	0.2220	0.0000	2.6055	0.0455
	StDev	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*
Grand Valley6 13	Avg.	6.2500	0.2400	0.0000	3.9700	0.0465
	StDev	*0.21*	*0.00*	*0.00*	*0.14*	*0.00*
Grand Valley6 14	Avg.	5.5000	0.1045	0.0000	4.0895	0.0530
	StDev	*0.14*	*0.01*	*0.00*	*0.18*	*0.01*
Grand Valley6 15	Avg.	6.2000	0.1500	0.0000	19.4150	0.1195

Total Metals using the EPA Method 3051B for Core #6

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
Grand Valy T#6 1A	1	5	117.8	1.35	43.36	12110	87.49	446.4	44.64%	0.19	5.05	800	12	57
Grand Vally T#6 1B	2	5	99.82	1.45	49.19	12030	57.13	520.9	52.09%	0.19	4.89	800	12	57
Grand Valy T#6 2A	1	10	239.2	1.3	47.58	27560	178.4	430.3	43.03%	0.31	4.91	617	12	57
Grand Valy T#6 2B	2	10	271	1.47	65.84	21260	384.5	415.7	41.57%	0.31	4.97	566	12	57
Grand Valy T#6 3A	1	15	64.01	1.57	51.22	4543	29.88	415.7	27.12%	0.39	4.81	502	12	57
Grand Valy T#6 3B	2	15	68.47	1.64	53.32	4863	38.52	271.2	19.99%	0.39	4.9	502	12	57
Grand Valy T#6 4A	1	20	25.39	1.58	49.86	605.9	6.89	199.9	10.77%	1.41	4.63	277	30	40
Grand Valy T#6 4B	2	20	23.37	1.48	47.25	531.3	6.53	107.7	5.81%	1.41	4.65	252	30	40
Grand Valy T#6 5A	1	25	9.46	1.33	41.41	80.46	2.06	58.15	26.07%	1.73	4.78	76.6	30	40
Grand Valy T#6 5B	2	25	8.78	1.22	40.9	59.15	1.52	260.7	2.21%	1.73	4.81	74.7	30	40
Grand Valy T#6 6A	1	30	5.43	1.11	39.86	27.38	1.09	22.13	0.91%	1.63	4.79	68.7	26	38.5
Grand Valy T#6 6B	2	30	5.76	1.18	42.05	27.38	1.19	9.12	1.55%	1.63	4.65	63	26	38.5
Grand Valy T#6 7A	1	35	4.05	1.19	41.24	21.16	1.14	15.48	1.56%	1.64	4.91	74.2	26	38.5
Grand Valy T#6 7B	2	35	3.87	1.2	42.34	21.3	0.94	15.60	1.45%	1.64	4.88	67.8	26	38.5
Grand Valy T#6 8A	1	40	3.6	1.22	44.47	19.12	1.05	14.51	1.32%	1.56	4.82	61.7	26	38.5
Grand Valy T#6 8B	2	40	10.1	2.87	38.49	19.33	2.94	13.17	1.03%	1.56	5.01	59.2	26	38.5
Grand Valy T#6 9A	1	45	3.14	*0.78*	34.8	13.35	*0.68*	10.31	1.29%	1.98	5.3	49	11.5	23
Grand Valy T#6 9B	2	45	3.28	*0.83*	35.07	14.36	*0.79*	12.93	0.74%	1.98	5.4	51.2	11.5	23
Grand Valy T#6 10A	1	50	4.21	1.5	33.38	28.08	1.1	7.38	0.44%	1.94	5.67	43.6	11.5	23
Grand Valy T#6 10B	2	50	3.11	*0.83*	33.79	12.22	*0.86*	4.35	0.53%	1.94	5.62	43.1	11.5	23
Grand Valy T#6 11A	1	55	3.93	*0.83*	24.19	32.39	1.02	5.32	0.55%	1.42	5.6	50.2	11.5	23
Grand Valy T#6 11B	2	55	3.36	*0.61*	23.17	31.37	*0.9*	5.55	0.49%	1.42	5.85	50.2	11.5	23
Grand Valy T#6 12A	1	60	4.59	1.38	51.58	15.96	1.69	4.88	1.63%	1.90	7.26	123.4	48	33.5
Grand Valy T#6 12B	2	60	5.72	1.44	79.05	20.72	1.73	16.29	1.67%	1.90	6.84	126.8	48	33.5
Grand Valy T#6 13A	1	65	3.77	1.48	58.6	16.41	1.59	16.65	1.79%	1.77	6.99	180.2	48	33.5
Grand Valy T#6 13B	2	65	4.79	1.68	60.62	16.4	2.03	17.88	1.70%	1.77	7.01	176.1	48	33.5
Total Metals #6 14A	1	70	3.71	1.78	54.7	14.59	*0.97*	16.98	3.46%	1.69	6.98	159.8	48	33.5
Total Metals #6 14B	2	70	4.04	1.79	55.68	14.96	*0.9*	34.61	1.24%	1.69	7	153.9	48	33.5
Grand Valy T#6 15A	1	75	4.56	1.44	54.2	46.12	1.52	12.39	1.52%	1.64	6.98	155.2	48	33.5
Grand Valy T#6 15B	2	75	5.42	1.89	61.78	50.94	1.7	15.16	1.66%	1.64	6.96	164.2	48	33.5
Grand Valy T#6 15C	3	75	4.43	1.34	53.76	22.81	1.22	16.56	1.59%	1.64	6.97	159.7	48	33.5

Italics = Below Detectable Limit

Total Metals using the EPA Method 3051B for Core #6

Metal Core #6			As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley 6 1		Avg.	108.8100	1.4000	46.2750	12070.0000	72.3100
		StDev	*12.71*	*0.07*	*4.12*	*56.57*	*21.47*
Grand Valley6 2		Avg.	255.1000	1.3850	56.7100	24410.0000	281.4500
		StDev	*22.49*	*0.12*	*12.91*	*4454.77*	*145.73*
Grand Valley6 3		Avg.	66.2400	1.6050	52.2700	4703.0000	34.2000
		StDev	*3.15*	*0.05*	*1.48*	*226.27*	*6.11*
Grand Valley6 4		Avg.	24.3800	1.5300	48.5550	568.6000	6.7100
		StDev	*1.43*	*0.07*	*1.85*	*52.75*	*0.25*
Grand Valley6 5		Avg.	9.1200	1.2750	41.1550	69.8050	1.7900
		StDev	*0.48*	*0.08*	*0.36*	*15.07*	*0.38*
Grand Valley6 6		Avg.	5.5950	1.1450	40.9550	27.3800	1.1400
		StDev	*0.23*	*0.05*	*1.55*	*0.00*	*0.07*
Grand Valley6 7		Avg.	3.9600	1.1950	41.7900	21.2300	1.0400
		StDev	*0.13*	*0.01*	*0.78*	*0.10*	*0.14*
Grand Valley6 8		Avg.	6.8500	2.0450	41.4800	19.2250	1.9950
		StDev	*4.60*	*1.17*	*4.23*	*0.15*	*1.34*
Grand Valley6 9		Avg.	3.2100	0.8050	34.9350	13.8550	0.7350
		StDev	*0.10*	*0.04*	*0.19*	*0.71*	*0.08*
Grand Valley6 10		Avg.	3.6600	1.1650	33.5850	20.1500	0.9800
		StDev	*0.78*	*0.47*	*0.29*	*11.21*	*0.17*
Grand Valley6 11		Avg.	3.6450	0.7200	23.6800	31.8800	0.9600
		StDev	*0.40*	*0.16*	*0.72*	*0.72*	*0.08*
Grand Valley6 12		Avg.	5.1550	1.4100	65.3150	18.3400	1.7100
		StDev	*0.80*	*0.04*	*19.42*	*3.37*	*0.03*
Grand Valley6 13		Avg.	4.2800	1.5800	59.6100	16.4050	1.8100
		StDev	*0.72*	*0.14*	*1.43*	*0.01*	*0.31*
Grand Valley6 14		Avg.	3.8750	1.7850	55.1900	14.7750	0.9350
		StDev	*0.23*	*0.01*	*0.69*	*0.26*	*0.05*
Grand Valley6 15		Avg.	4.9900	1.6650	57.9900	48.5300	1.6100
		StDev	*0.61*	*0.32*	*5.36*	*3.41*	*0.13*

Italics = Below Detectable Limit

Water Soluble metals for Core #6

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	%clay	%silt
WestR50 Wt6 1A	1	5	0.3	*0.003*	0.135	6.953	0.892	446.4	44.64%	5.05	800	12	57
WestR50 Wt6 1B	2	5	0.271	0	0.141	6.673	0.868	520.9	52.09%	4.89	800	12	57
WestR50 Wt6 2A	1	10	0.316	*0.029*	0.131	13.77	1.955	430.3	43.03%	4.91	617	12	57
WestRes Wt6 2B	2	10	-1.57	0.204	0	33.38	5.538	415.7	41.57%	4.97	566	12	57
WestR50 Wt6 3A	1	15	0.19	0	0	2.067	1.191	271.2	27.12%	4.81	502	12	57
WestRes Wt6 3B	2	15	0.578	0	0.896	13.36	2.02	199.9	19.99%	4.9	502	12	57
WestRW 6 4A	1	20	0.353	*0.001*	0.565	2.025	1.264	107.7	10.77%	4.63	277	30	40
WestRW 6 4B	2	20	0.379	*0.004*	0.643	2.399	1.101	58.15	5.81%	4.65	252	30	40
WestRW 6 5A	1	25	0.14	*0.003*	0.75	0.395	*0.082*	260.7	26.07%	4.78	76.6	30	40
WestRW 6 5B	2	25	0.089	0	0.407	0.214	0.151	22.126	2.21%	4.81	74.7	30	40
WestRW 6 6A	1	30	0.121	*0.029*	2.028	0.649	*0.019*	9.125	0.91%	4.79	68.7	26	38.5
WestRW 6 6B	2	30	0.072	0	0.684	0.179	*0.021*	15.48	1.55%	4.65	63	26	38.5
WestRW 6 7A	1	35	*0.048*	0	0.777	0.187	*0.015*	15.60	1.56%	4.91	74.2	26	38.5
WestRW 6 7B	2	35	*0.053*	*0.001*	0.915	0.186	*0.011*	14.51	1.45%	4.88	67.8	26	38.5
WestRW 6 8A	1	40	*0.059*	*0.001*	1.067	0.182	*0.01*	13.17	1.32%	4.82	61.7	26	38.5
WestRW 6 8B	2	40	*0.053*	*0.009*	1.213	0.22	*0.013*	10.31	1.03%	5.01	59.2	26	38.5
WestRW 6 9A	1	45	*0.069*	*0.06*	3.896	0.94	*0.02*	12.93	1.29%	5.3	49	11.5	23
WestRW 6 9B	2	45	*0.065*	*0.097*	5.66	1.363	*0.028*	7.382	0.74%	5.4	51.2	11.5	23
WestRW 6 10A	1	50	*0.017*	*0.067*	7.733	1.743	*0.045*	4.354	0.44%	5.67	43.6	11.5	23
WestRW 6 10B	2	50	*0.038*	*0.048*	6.733	1.446	*0.043*	5.325	0.53%	5.62	43.1	11.5	23
WestRW 6 11A	1	55	0	*0.018*	2.948	1.205	*0.014*	5.549	0.55%	5.6	50.2	11.5	23
WestRW 6 11B	2	55	*0.012*	*0.013*	2.32	0.895	*0.016*	4.878	0.49%	5.85	50.2	11.5	23
WestRW 6 12A	1	60	0	0	0.166	*0.013*	*0.008*	16.29	1.63%	7.26	123.4	48	33.5
WestRW 6 12B	2	60	0	*0.011*	2.692	0.238	*0.018*	16.65	1.67%	6.84	126.8	48	33.5
WestRW 6 13A	1	65	0	0	0.238	*0.025*	0	17.88	1.79%	6.99	180.2	48	33.5
WestRW 6 13B	2	65	*0.009*	*0.001*	0.602	*0.034*	0	16.98	1.70%	7.01	176.1	48	33.5
WestRW 6 14A	1	70	0	*0.015*	3.271	0.333	*0.003*	34.61	3.46%	6.98	159.8	48	33.5
WestRW 6 14B	2	70	0	*0.005*	1.281	0.142	*0.01*	12.39	1.24%	7	153.9	48	33.5
WestRW 6 15A	1	75	0	*0.005*	1.766	0.257	*0.011*	15.16	1.52%	6.98	155.2	48	33.5
WestRW 6 15B	2	75	*0.002*	0	0.141	*0.017*	0	16.56	1.66%	6.96	164.2	48	33.5

Italics = Below Detectable Limit

Water Soluble metals for Core #6

Italics = Below Detectable Limit

Water Core #6		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#6 1	Avg.	0.2855	0.0015	0.1380	6.8130	0.8800
	StDev	*0.02*	*0.00*	*0.00*	*0.20*	*0.02*
Grand Valley#6 2	Avg.	-0.6270	0.1165	0.0655	23.5750	3.7465
	StDev	*1.33*	*0.12*	*0.09*	*13.87*	*2.53*
Grand Valley#6 3	Avg.	0.3840	0.0000	0.4480	7.7135	1.6055
	StDev	*0.27*	*0.00*	*0.63*	*7.99*	*0.59*
Grand Valley#6 4	Avg.	0.3660	0.0025	0.6040	2.2120	1.1825
	StDev	*0.02*	*0.00*	*0.06*	*0.26*	*0.12*
Grand Valley#6 5	Avg.	0.1145	0.0015	0.5785	0.3045	0.1165
	StDev	*0.04*	*0.00*	*0.24*	*0.13*	*0.05*
Grand Valley#6 6	Avg.	0.0965	0.0145	1.3560	0.4140	0.0200
	StDev	*0.03*	*0.02*	*0.95*	*0.33*	*0.00*
Grand Valley#6 7	Avg.	0.0505	0.0005	0.8460	0.1865	0.0130
	StDev	*0.00*	*0.00*	*0.10*	*0.00*	*0.00*
Grand Valley#6 8	Avg.	0.0560	0.0050	1.1400	0.2010	0.0115
	StDev	*0.00*	*0.01*	*0.10*	*0.03*	*0.00*
Grand Valley#6 9	Avg.	0.0670	0.0785	4.7780	1.1515	0.0240
	StDev	*0.00*	*0.03*	*1.25*	*0.30*	*0.01*
Grand Valley#6 10	Avg.	0.0275	0.0575	7.2330	1.5945	0.0440
	StDev	*0.01*	*0.01*	*0.71*	*0.21*	*0.00*
Grand Valley#6 11	Avg.	0.0060	0.0155	2.6340	1.0500	0.0150
	StDev	*0.01*	*0.00*	*0.44*	*0.22*	*0.00*
Grand Valley#6 12	Avg.	0.0000	0.0055	1.4290	0.1255	0.0130
	StDev	*0.00*	*0.01*	*1.79*	*0.16*	*0.01*
Grand Valley#6 13	Avg.	0.0045	0.0005	0.4200	0.0295	0.0000
	StDev	*0.01*	*0.00*	*0.26*	*0.01*	*0.00*
Grand Valley#6 14	Avg.	0.0000	0.0100	2.2760	0.2375	0.0065
	StDev	*0.00*	*0.01*	*1.41*	*0.14*	*0.00*
Grand Valley#6 15	Avg.	0.0010	0.0025	0.9535	0.1370	0.0055
	StDev	*0.00*	*0.00*	*1.15*	*0.17*	*0.01*

Plant Available metals extracted with Mehlich III Core #10

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
WestRes Meh10 1A	1	5	0.319	0.166	0	689.4	5.329	764.2	0.764	76.415	0.159	4.45	1541	20	21
WestRes Meh10 1B	2	5	0.258	0.13	0	656.4	4.955	756.0	0.756	75.598	0.159	4.49	1493	20	21
WestRes Meh10 2A	1	8	0.208	0.146	0	406.9	5.391	772.0	0.772	77.204	0.306	4.28	1670	20	21
WestRes Meh10 2B	2	8	0.228	0.152	0	455.0	6.718	774.0	0.774	77.404	0.306	4.23	1468	20	21
WestRes Meh10 3A	1	13	0.108	0.126	0	67.37	1.859	793.9	0.794	79.394	0.247	4.04	1592	20	21
WestRes Meh10 3B	2	13	0.108	0.124	0	73.50	1.865	777.1	0.777	77.709	0.247	4.08	1547	20	21
WestRes Meh10 4A	1	18	0.11	0.125	0	6.546	0.626	762.8	0.763	76.278	0.292	3.88	1834	15	24.5
WestRes Meh10 4B	2	18	*0.085*	*0.096*	0	6.474	0.811	767.3	0.767	76.726	0.292	3.91	1758	15	24.5
WestR50 Meh10 5A	1	23	*0.086*	*0.05*	0	1.200	0.203	669.0	0.669	66.902	0.285	4.02	1409	15	24.5
WestRes Meh10 5B	2	23	0.094	*0.082*	0	0.957	0.232	659.5	0.659	65.945	0.285	3.99	1446	15	24.5
WestRes Meh10 6A	1	28	0.154	0.181	0	0.679	0.181	452.3	0.452	45.235	0.374	4.13	883	15	24.5
WestRes Meh10 6B	2	28	0.155	0.177	*0.003*	0.715	0.193	442.6	0.443	44.260	0.374	4.1	868	15	24.5
WestRes Meh10 7A	1	31.5	0.217	0.29	*0.002*	0.326	*0.099*	180.1	0.180	18.006	0.588	4.61	363	33	44.5
WestRes Meh10 7B	2	31.5	0.22	0.288	*0.007*	0.367	0.117	187.2	0.187	18.720	0.588	4.3	405	33	44.5
WestRes Meh10 8A	1	36.5	0.262	0.311	0.016	0.908	*0.06*	72.8	0.073	7.276	1.200	3.98	178.8	33	44.5
WestRes Meh10 8B	2	36.5	0.262	0.298	0	0.965	*0.064*	76.4	0.076	7.640	1.200	4.01	176.8	33	44.5
WestRes Meh10 9A	1	41.5	0.28	0.447	1.1	0.756	*0.046*	71.8	0.072	7.185	1.083	3.87	244	33	44.5
WestRes Meh10 9B	2	41.5	0.283	0.447	1.048	0.972	*0.054*	73.9	0.074	7.390	1.083	3.81	253	33	44.5
WestRes Meh10 10A	1	46.5	0.351	0.333	0.3	5.364	*0.024*	46.0	0.046	4.600	1.415	3.95	127.4	33	44.5
WestRes Meh10 10B	2	46.5	0.349	0.311	0.082	5.397	*0.031*	47.5	0.048	4.754	1.415	3.82	126.8	33	44.5
WestRes Meh10 11A	1	50	0.519	0.44	3.582	5.801	*0.027*	44.8	0.045	4.478	1.120	4.06	126	33.5	53
WestRes Meh10 11B	2	50	0.528	0.382	2.628	5.795	*0.018*	43.9	0.044	4.389	1.120	4.07	125.5	33.5	53
WestMeh 10 12A	1	55	0.14	0.283	0	5.443	*0.026*	32.8	0.033	3.276	2.152	3.69	108.4	33.5	53
WestMeh 10 12B	2	5	0.144	0.285	0	5.708	*0.016*	33.6	0.034	3.360	2.152	3.62	112.2	33.5	53
WestMeh 10 13A	1	60	0.182	0.288	0	4.447	*0.02*	34.2	0.034	3.416	1.419	3.98	101.6	38	59
WestMeh 10 13B	2	60	0.18	0.299	0	4.573	*0.01*	34.3	0.034	3.431	1.419	4.06	101.4	38	59
WestMeh 10 14A	1	65	0.219	0.306	0	4.476	*0.011*	41.3	0.041	4.131	1.405	4.17	114.8	38	59
WestMeh 10 14B	2	65	0.232	0.311	0	4.683	*0.019*	39.8	0.040	3.983	1.405	4.24	116	38	59
WestMeh 10 15A	1	70	0.212	0.309	0	5.709	*0.015*	24.9	0.025	2.487	1.277	4.47	81	38	59
WestMeh 10 15B	2	70	0.217	0.309	*0.069*	5.844	*0.028*	27.7	0.028	2.773	1.277	4.53	82.7	38	59
WestMeh 10 16A	1	75	0.229	0.332	1.648	6.501	*0.013*	37.2	0.037	3.720	1.198	4.7	114.2	38	59
WestMeh 10 16B	2	75	0.227	0.309	1.476	6.284	*0.026*	36.4	0.036	3.642	1.198	4.59	110.7	38	59
WestMeh 10 17A	1	78	0.263	0.328	2.556	6.241	*0.029*	44.6	0.045	4.457	1.175	4.56	196.2	38	59
WestMeh 10 17B	2	78	0.26	0.313	2.428	6.063	*0.032*	43.5	0.043	4.347	1.175	4.56	201	38	59

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich III for the Core #10 (cont)

Mehlich Core #10		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#10 1	Avg.	0.2885	0.148	0	672.9	5.142
	StDev	*0.04*	*0.03*	*0.00*	*23.33*	*0.26*
Grand Valley#10 2	Avg.	0.218	0.149	0	430.95	6.0545
	StDev	*0.01*	*0.00*	*0.00*	*34.01*	*0.94*
Grand Valley#10 3	Avg.	0.108	0.125	0	70.435	1.862
	StDev	*0.00*	*0.00*	*0.00*	*4.33*	*0.00*
Grand Valley#10 4	Avg.	0.0975	0.1105	0	6.51	0.7185
	StDev	*0.02*	*0.02*	*0.00*	*0.05*	*0.13*
Grand Valley#10 5	Avg.	0.09	0.066	0	1.0785	0.2175
	StDev	*0.01*	*0.02*	*0.00*	*0.17*	*0.02*
Grand Valley#10 6	Avg.	0.1545	0.179	0.0015	0.697	0.187
	StDev	*0.00*	*0.00*	*0.00*	*0.03*	*0.01*
Grand Valley#10 7	Avg.	0.2185	0.289	0.0045	0.3465	0.108
	StDev	*0.00*	*0.00*	*0.00*	*0.03*	*0.01*
Grand Valley#10 8	Avg.	0.262	0.3045	0.008	0.9365	0.062
	StDev	*0.00*	*0.01*	*0.01*	*0.04*	*0.00*
Grand Valley#10 9	Avg.	0.2815	0.447	1.074	0.864	0.05
	StDev	*0.00*	*0.00*	*0.04*	*0.15*	*0.01*
Grand Valley#10 10	Avg.	0.35	0.322	0.191	5.3805	0.0275
	StDev	*0.00*	*0.02*	*0.15*	*0.02*	*0.00*
Grand Valley#10 11	Avg.	0.5235	0.411	3.105	5.798	0.0225
	StDev	*0.01*	*0.04*	*0.67*	*0.00*	*0.01*
Grand Valley#10 12	Avg.	0.142	0.284	0	5.5755	0.021
	StDev	*0.00*	*0.00*	*0.00*	*0.19*	*0.01*
Grand Valley#10 13	Avg.	0.181	0.2935	0	4.51	0.015
	StDev	*0.00*	*0.01*	*0.00*	*0.09*	*0.01*
Grand Valley#10 14	Avg.	0.2255	0.3085	0	4.5795	0.015
	StDev	*0.01*	*0.00*	*0.00*	*0.15*	*0.01*
Grand Valley#10 15	Avg.	0.2145	0.309	0.0345	5.7765	0.0215
	StDev	*0.00*	*0.00*	*0.05*	*0.10*	*0.01*
Grand Valley#10 16	Avg.	0.228	0.3205	1.562	6.3925	0.0195
	StDev	*0.00*	*0.02*	*0.12*	*0.15*	*0.01*
Grand Valley#10 17	Avg.	0.2615	0.3205	2.492	6.152	0.0305
	StDev	*0.00*	*0.01*	*0.09*	*0.13*	*0.00*

Italics = Below Detectable Limit

Total metals using EPA Method 3051B for Core #10

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	%clay	%silt
Grand Valley T#10 1A	1	5	62.53	*0.94*	40.02	4764	44.93	764.2	76.42%	0.16	4.45	1541	20	21
Grand Valley T#10 1B	2	5	62.04	*0.86*	37.87	4751	56.32	756.0	75.60%	0.16	4.49	1493	20	21
Grand Valy T#10 2A	1	8	117.1	*0.88*	42.14	8483	203	772.0	77.20%	0.31	4.28	1670	20	21
Grand Valy T#10 2B	2	8	92.91	*0.74*	38.26	6336	143.9	774.0	77.40%	0.31	4.23	1468	20	21
Grand Valy T#10 3A	1	13	44.46	*0.45*	37.71	1347	55.25	793.9	79.39%	0.25	4.04	1592	20	21
Grand Valley T#10 3B	2	13	50.07	*0.51*	39.88	1665	57.24	777.1	77.71%	0.25	4.08	1547	20	21
Grand Valy T#10 4A	1	18	72.44	*0.73*	41.54	681.1	14.47	762.8	76.28%	0.29	3.88	1834	15	24.5
Grand Valley T#10 5A	2	18	70.85	*0.6*	38.91	619.1	13.99	767.3	76.73%	0.29	3.91	1758	15	24.5
Grand Valy T#10 5B	1	23	101.8	*0.55*	43.13	162.8	5.64	669.0	66.90%	0.29	4.02	1409	15	24.5
Grand Valley T#10 6A	2	23	105.6	*0.58*	41.14	162.2	5.95	659.5	65.95%	0.29	3.99	1446	15	24.5
Grand Valy T#10 6B	1	28	107.4	*0.83*	52.93	80.67	2.8	452.3	45.23%	0.37	4.13	883	15	24.5
Total Metals #10 7A	2	28	107.9	*0.81*	49.53	81.1	2.84	442.6	44.26%	0.37	4.1	868	15	24.5
Total Metal #10 7B	1	31.5	54.07	1.58	60.71	53.03	*0.8*	180.1	18.01%	0.59	4.61	363	33	44.5
Total Metal #10 8A	2	31.5	46.81	1.38	56.72	63.2	*0.97*	187.2	18.72%	0.59	4.3	405	33	44.5
Total Metal #10 8B	1	36.5	16.78	1.86	58.33	20.67	*0.85*	72.8	7.276%	1.20	3.98	178.8	33	44.5
Grand Valy T#10 9A	2	36.5	16.72	1.87	57.38	21.14	*0.74*	76.4	7.640%	1.20	4.01	176.8	33	44.5
Grand Valy T#10 9B	1	41.5	10.4	1.4	47.19	17.18	1.03	71.8	7.185%	1.08	3.87	244	33	44.5
Grand Valy T#10 10A	2	41.5	10.9	1.5	49.12	17.49	*0.89*	73.9	7.390%	1.08	3.81	253	33	44.5
Grand Valy T#10 10B	1	46.5	8.17	*0.96*	43.37	16.42	*0.86*	46.0	4.600%	1.42	3.95	127.4	33	44.5
Grand Valy T#10 11A	2	46.5	9.15	1.14	48.22	18.6	*0.9*	47.5	4.754%	1.42	3.82	126.8	33	44.5
Grand Valy T#10 11B	1	50	7.32	1.25	57.83	20.52	*0.95*	44.8	4.478%	1.12	4.06	126	33.5	53
Grand Valy T#10 12A	2	50	6.12	1.1	52.13	17.54	*0.92*	43.9	4.389%	1.12	4.07	125.5	33.5	53
Grand Valy T#10 12B	1	55	4.97	*0.98*	42.76	19.98	1.1	32.8	3.276%	2.15	3.69	108.4	33.5	53
Total Metal #10 13A	2	5	4.14	*0.86*	39.22	17.4	*0.93*	33.6	3.360%	2.15	3.62	112.2	33.5	53
Total Metal #10 13B	1	60	3.34	1.6	53.92	18.08	1.13	34.2	3.416%	1.42	3.98	101.6	38	59
Total Metal #10 14A	2	60	2.55	1.41	50.73	15.93	*0.76*	34.3	3.431%	1.42	4.06	101.4	38	59
Total Metal #10 14B	1	65	2.55	1.95	62.01	19.58	*0.98*	41.3	4.131%	1.41	4.17	114.8	38	59
Grand Valy T#10 15 A	2	65	2.95	1.88	60.42	20.86	1.05	39.8	3.983%	1.41	4.24	116	38	59
Grand Valy T#10 15B	1	70	3.79	1.22	54.04	24.27	1.14	24.9	2.487%	1.28	4.47	81	38	59
Grand Valy T#10 16A	2	70	3.47	1.13	47.95	22.12	*0.87*	27.7	2.773%	1.28	4.53	82.7	38	59
Grand Valy T#10 16B	1	75	4.52	1.12	49.5	21.79	*0.93*	37.2	3.720%	1.20	4.7	114.2	38	59
Total Metal #10 17A	2	75	4.09	*0.96*	45.48	22.34	*0.96*	36.4	3.642%	1.20	4.59	110.7	38	59
Total Metal #10 17B	1	78	4.54	1.41	53.68	17.6	*0.81*	44.6	4.457%	1.18	4.56	196.2	38	59
WestRW 10 17B	2	78	4.2	1.45	55.05	20.37	*0.86*	43.5	4.347%	1.18	4.56	201	38	59

Italics = Below Detectable Limit

Total metals using EPA Method 3051B for Core #10

Metal Core #10		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#10 1	Avg.	62.285	0.9	38.945	4757.5	50.625
	StDev	*0.35*	*0.06*	*1.52*	*9.19*	*8.05*
Grand Valley#10 2	Avg.	105.005	0.81	40.2	7409.5	173.45
	StDev	*17.10*	*0.10*	*2.74*	*1518.16*	*41.79*
Grand Valley#10 3	Avg.	47.265	0.48	38.795	1506	56.245
	StDev	*3.97*	*0.04*	*1.53*	*224.86*	*1.41*
Grand Valley#10 4	Avg.	71.645	0.665	40.225	650.1	14.23
	StDev	*1.12*	*0.09*	*1.86*	*43.84*	*0.34*
Grand Valley#10 5	Avg.	103.7	0.565	42.135	162.5	5.795
	StDev	*2.69*	*0.02*	*1.41*	*0.42*	*0.22*
Grand Valley#10 6	Avg.	107.65	0.82	51.23	80.885	2.82
	StDev	*0.35*	*0.01*	*2.40*	*0.30*	*0.03*
Grand Valley#10 7	Avg.	50.44	1.48	58.715	58.115	0.885
	StDev	*5.13*	*0.14*	*2.82*	*7.19*	*0.12*
Grand Valley#10 8	Avg.	16.75	1.865	57.855	20.905	0.795
	StDev	*0.04*	*0.01*	*0.67*	*0.33*	*0.08*
Grand Valley#10 9	Avg.	10.65	1.45	48.155	17.335	0.96
	StDev	*0.35*	*0.07*	*1.36*	*0.22*	*0.10*
Grand Valley#10 10	Avg.	8.66	1.05	45.795	17.51	0.88
	StDev	*0.69*	*0.13*	*3.43*	*1.54*	*0.03*
Grand Valley#10 11	Avg.	6.72	1.175	54.98	19.03	0.935
	StDev	*0.85*	*0.11*	*4.03*	*2.11*	*0.02*
Grand Valley #10 12	Avg.	4.555	0.92	40.99	18.69	1.015
	StDev	*0.59*	*0.08*	*2.50*	*1.82*	*0.12*
Grand Valley#10 13	Avg.	2.945	1.505	52.325	17.005	0.945
	StDev	*0.56*	*0.13*	*2.26*	*1.52*	*0.26*
Grand Valley#10 14	Avg.	2.75	1.915	61.215	20.22	1.015
	StDev	*0.28*	*0.05*	*1.12*	*0.91*	*0.05*
Grand Valley#10 15	Avg.	3.63	1.175	50.995	23.195	1.005
	StDev	*0.23*	*0.06*	*4.31*	*1.52*	*0.19*
Grand Valley#10 16	Avg.	4.305	1.04	47.49	22.065	0.945
	StDev	*0.30*	*0.11*	*2.84*	*0.39*	*0.02*
Grand Valley#10 17	Avg.	4.37	1.43	54.365	18.985	0.835
	StDev	*0.24*	*0.03*	*0.97*	*1.96*	*0.04*

Italics = Below Detectable Limit

Water Soluble metals for Core #10

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	%clay	%silt
WestRes Wt10 1A	1	5	1.0360	0	0.350	9.0870	3.6320	764.2	76.42	0.16	4.45	1541	20	21
WestRes Wt10 1B	2	5	1.0700	0	0.371	11.0100	3.6940	756.0	75.60	0.16	4.49	1493	20	21
WestRes Wt10 2A	1	8	1.3540	0	0.341	7.0430	4.2260	772.0	77.20	0.31	4.28	1670	20	21
WestRes Wt10 2B	2	8	1.2970	0	0.356	6.9030	3.9910	774.0	77.40	0.31	4.23	1468	20	21
WestRes Wt10 3A	1	13	0.2370	0	0.268	1.4110	1.5210	793.9	79.39	0.25	4.04	1592	20	21
WestRes Wt10 3B	2	13	0.2480	0	0.275	1.6400	1.5130	777.1	77.71	0.25	4.08	1547	20	21
WestRes Wt10 4A	1	18	0.2940	*0.0010*	0.474	0.7930	0.7700	762.8	76.28	0.29	3.88	1834	15	24.5
WestRes Wt10 4B	2	18	0.3090	0	0.446	0.9240	0.7220	767.3	76.73	0.29	3.91	1758	15	24.5
WestR50 Wt10 5A	1	23	0.0850	0	0.083	0.0820	*0.0790*	669.0	66.90	0.29	4.02	1409	15	24.5
WestRes Wt10 5B	2	23	0.3440	0	0.315	0.2710	0.2140	659.5	65.95	0.29	3.99	1446	15	24.5
WestRes Wt10 6A	1	28	0.8990	*0.0030*	0.674	0.2620	0.1940	452.3	45.23	0.37	4.13	883	15	24.5
WestRes Wt10 6B	2	28	0.9070	*0.0070*	0.679	0.1170	0.1920	442.6	44.26	0.37	4.1	868	15	24.5
WestRes Wt10 7A	1	31.5	0.2840	*0.0040*	0.374	*0.0580*	*0.0540*	180.1	18.01	0.59	4.61	363	33	44.5
WestRes Wt10 7B	2	31.5	0.3140	*0.0020*	0.428	0.0920	*0.0790*	187.2	18.72	0.59	4.3	405	33	44.5
WestRes Wt10 8A	1	36.5	0.1180	*0.0020*	0.317	0.1820	*0.0130*	72.76	7.28	1.20	3.98	178.8	33	44.5
WestRes Wt10 8B	2	36.5	0.1100	*0.0010*	0.299	0.1330	*0.0140*	76.40	7.64	1.20	4.01	176.8	33	44.5
WestRes Wt10 9A	1	41.5	0.1570	*0.0070*	0.559	0.1060	*0.0040*	71.85	7.18	1.08	3.87	244	33	44.5
WestRes Wt10 9B	2	41.5	0.1090	*0.0040*	0.412	*0.0410*	*0.0170*	73.90	7.39	1.08	3.81	253	33	44.5
WestRes Wt10 10A	1	46.5	0.0700	*0.0020*	0.458	0.0750	*0.0000*	46.00	4.60	1.42	3.95	127.4	33	44.5
WestRes Wt10 10B	2	46.5	0.1970	*0.0210*	1.997	0.4230	*0.0090*	47.54	4.75	1.42	3.82	126.8	33	44.5
WestRes Wt10 11A	1	50	*0.0320*	*0.0010*	0.431	0.0820	*0.0000*	44.78	4.48	1.12	4.06	126	33.5	53
WestRes Wt10 11B	2	50	0.1570	*0.0280*	2.406	0.5360	*0.0040*	43.89	4.39	1.12	4.07	125.5	33.5	53
WestRW 10 12A	1	55	*0.0410*	0	0.208	*0.0160*	*0.0100*	32.76	3.28	2.15	3.69	108.4	33.5	53
WestRW 10 12B	2	5	*0.0130*	0	0.201	*0.0070*	*0.0000*	33.60	3.36	2.15	3.62	112.2	33.5	53
WestRW 10 13A	1	60	0.0070	0	0.213	*0.0000*	*0.0160*	34.16	3.42	1.42	3.98	101.6	38	59
WestRW 10 13B	2	60	*0.0520*	*0.0080*	1.246	0.2720	*0.0170*	34.31	3.43	1.42	4.06	101.4	38	59
WestRW 10 14A	1	65	*0.0140*	0	0.384	*0.0540*	*0.0010*	41.31	4.13	1.41	4.17	114.8	38	59
WestRW 10 14B	2	65	*0.0380*	*0.0050*	1.080	0.2840	*0.0130*	39.83	3.98	1.41	4.24	116	38	59
WestRW 10 15A	1	70	*0.0300*	*0.0270*	2.120	0.5300	*0.0140*	24.87	2.49	1.28	4.47	81	38	59
WestRW 10 15B	2	70	0.0720	*0.0210*	2.025	0.4660	*0.0280*	27.73	2.77	1.28	4.53	82.7	38	59
WestRW 10 16A	1	75	*0.0330*	0	0.478	*0.0480*	*0.0140*	37.20	3.72	1.20	4.7	114.2	38	59
WestRW 10 16B	2	75	0.0700	*0.0070*	1.316	0.2350	*0.0120*	36.42	3.64	1.20	4.59	110.7	38	59
WestRW 10 17A	1	78	*0.0550*	0	0.468	*0.0450*	*0.0130*	44.57	4.46	1.18	4.56	196.2	38	59
WestRW 10 17B	2	78	*0.0400*	0	0.503	*0.0380*	*0.0240*	43.47	4.35	1.18	4.56	201	38	59

Italics = Below Detectable Limit

Water Soluble metals for Core #10

Water Core #10		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#10 1	Avg.	1.0530	0.0000	0.3605	10.0485	3.6630
	StDev	*0.02*	*0.00*	*0.01*	*1.36*	*0.04*
Grand Valley#10 2	Avg.	1.3255	0.0000	0.3485	6.9730	4.1085
	StDev	*0.04*	*0.00*	*0.01*	*0.10*	*0.17*
Grand Valley#10 3	Avg.	0.2425	0.0000	0.2715	1.5255	1.5170
	StDev	*0.01*	*0.00*	*0.00*	*0.16*	*0.01*
Grand Valley#10 4	Avg.	0.3015	0.0005	0.4600	0.8585	0.7460
	StDev	*0.01*	*0.00*	*0.02*	*0.09*	*0.03*
Grand Valley#10 5	Avg.	0.2145	0.0000	0.1990	0.1765	0.1465
	StDev	*0.18*	*0.00*	*0.16*	*0.13*	*0.10*
Grand Valley#10 6	Avg.	0.9030	0.0050	0.6765	0.1895	0.1930
	StDev	*0.01*	*0.00*	*0.00*	*0.10*	*0.00*
Grand Valley#10 7	Avg.	0.2990	0.0030	0.4010	0.0750	0.0665
	StDev	*0.02*	*0.00*	*0.04*	*0.02*	*0.02*
Grand Valley#10 8	Avg.	0.1140	0.0015	0.3080	0.1575	0.0135
	StDev	*0.01*	*0.00*	*0.01*	*0.03*	*0.00*
Grand Valley#10 9	Avg.	0.1330	0.0055	0.4855	0.0735	0.0105
	StDev	*0.03*	*0.00*	*0.10*	*0.05*	*0.01*
Grand Valley#10 10	Avg.	0.1335	0.0115	1.2275	0.2490	0.0045
	StDev	*0.09*	*0.01*	*1.09*	*0.25*	*0.01*
Grand Valley#10 11	Avg.	0.0945	0.0145	1.4185	0.3090	0.0020
	StDev	*0.09*	*0.02*	*1.40*	*0.32*	*0.00*
Grand Valley #10 12	Avg.	0.0270	0.0000	0.2045	0.0115	0.0050
	StDev	*0.02*	*0.00*	*0.00*	*0.01*	*0.01*
Grand Valley#10 13	Avg.	0.0295	0.0040	0.7295	0.1360	0.0165
	StDev	*0.03*	*0.01*	*0.73*	*0.19*	*0.00*
Grand Valley#10 14	Avg.	0.0260	0.0025	0.7320	0.1690	0.0070
	StDev	*0.02*	*0.00*	*0.49*	*0.16*	*0.01*
Grand Valley#10 15	Avg.	0.0510	0.0240	2.0725	0.4980	0.0210
	StDev	*0.03*	*0.00*	*0.07*	*0.05*	*0.01*
Grand Valley#10 16	Avg.	0.0515	0.0035	0.8970	0.1415	0.0130
	StDev	*0.03*	*0.00*	*0.59*	*0.13*	*0.00*
Grand Valley#10 17	Avg.	0.0475	0.0000	0.4855	0.0415	0.0185
	StDev	*0.01*	*0.00*	*0.02*	*0.00*	*0.01*

Plant available metals extracted with Mehlich III for Core #11

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
Grand Valley#11 1A	1	5	0.426	0.248	0	542.8	2.459	601.8	60.17566	5.06	719	12	24.5
Grand Valley#11 1B	2	5	0.395	0.188	0	515.7	1.833	533.0	53.29593	5.07	685	12	24.5
Grand Valley#11 2A	1	10	0.573	0.342	0	1226	12.73	263.1	26.30867	4.9	436	12	24.5
Grand Valley#11 2B	2	10	0.594	0.341	0	1169	11.66	437.8	43.77543	4.91	482	12	24.5
Grand Valley#11 3A	1	15	0.912	0.302	0	264.7	2.908	463.2	46.31808	4.87	505	12	24.5
Grand Valley#11 3B	2	15	0.933	0.29	0	264.1	2.81	470.8	47.07628	4.89	490	12	24.5
Grand Valley#11 4A	1	20	0.494	0.27	0	912	6.673	538.4	53.8351	4.64	775	12	24.5
Grand Valley#11 4B	2	20	0.511	0.275	0	948.8	6.937	547.5	54.7519	4.64	720	12	24.5
Grand Valley#11 5A	1	25	0.486	0.207	0	152.4	2.427	475.9	47.58567	4.63	610	12	24.5
Grand Valley#11 5B	2	25	0.499	0.212	0	172.3	2.467	489.2	48.91851	4.56	589	12	24.5
Grand Valley#11 6A	1	30	0.239	0.267	0	37.8	1.229	445.7	44.57063	4.7	593	12	24.5
Grand Valley#11 6B	2	30	0.245	0.26	0	37.03	1.149	457.1	45.71056	4.62	569	12	24.5
Grand Valley#11 7A	1	33	0.246	0.385	0	13.61	1.094	428.5	42.85451	4.54	678	12	24.5
Grand Valley#11 7B	2	33	0.249	0.395	0	13.8	1.105	447.4	44.73716	4.56	611	12	24.5
Grand Valley#11 8A	1	38	0.286	0.282	0	9.293	0.174	32.2	3.221192	4.24	300	19.5	46
Grand Valley#11 8B	2	38	0.288	0.28	0	9.356	0.17	28.8	2.879058	4.15	340	19.5	46
Grand Valley#11 9A	1	43	0.291	0.206	0	6.894	*0.033*	16.6	1.657405	4.25	161.9	19.5	46
Grand Valley#11 9B	2	43	0.283	0.194	0	6.379	*0.031*	16.1	1.610905	4.27	174.9	19.5	46
Grand Valley#11 10A	1	48	0.258	0.228	0	6.618	*0.042*	17.0	1.704838	4.38	189.8	19.5	46
Grand Valley#11 10B	2	48	0.258	0.222	0	6.669	*0.016*	17.0	1.701997	4.29	202	19.5	46
Grand Valley#11 11A	1	53	0.215	0.209	0	5.201	*0.038*	17.6	1.763298	4.38	224	19.5	46
Grand Valley#11 11B	2	53	0.208	0.197	0	5.122	0.12	12.6	1.258762	4.38	220	19.5	46
Grand Valley#11 12A	1	58	0.249	0.179	0	3.904	*0.054*	19.2	1.920323	5.25	144.3	19	41
Grand Valley#11 12B	2	58	0.249	0.173	0	3.957	*0.041*	18.1	1.806844	5.31	146.3	19	41
Grand Valley#11 13A	1	61	0.241	0.184	0	3.535	*0.036*	29.1	2.914872	5.75	150.2	19	41
Grand Valley#11 13B	2	61	0.257	0.187	0	3.904	*0.048*	38.5	3.851852	5.53	148.5	19	41
Grand Valley#11 14A	1	66	0.176	0.11	0	2.92	0.122	39.4	3.935905	4.68	358	4	12
Grand Valley#11 14B	2	66	0.197	0.111	0	2.893	*0.028*	45.4	4.539306	4.61	367	4	12
Grand Valley#11 15A	1	71	0.067	*0.045*	0	1.466	*0.024*	22.8	2.281798	4.56	203	4	12
Grand Valley#11 15B	2	71	0.065	*0.041*	0	1.479	*0.019*	14.8	1.484535	4.62	184.7	4	12
Grand Valley#11 16A	1	76	0.131	*0.044*	0	1.388	*0.02*	20.9	2.085397	4.44	263	4	12
Grand Valley#11 16B	2	76	0.137	*0.044*	0	1.36	*0.007*	16.8	1.682053	4.46	264	4	12
Grand Valley#11 17A	1	81	*0.048*	*0.024*	0	1.057	0.023	7.1	0.705699	3.31	316	4	12
Grand Valley#11 17B	2	81	*0.048*	*0.024*	0	0.983	0.01	6.6	0.661344	3.23	335	4	12
Grand Valley#11 18A	1	86	*0.016*	*0.016*	0	0.609	0.167	5.5	0.547452	3.3	290	4	12
Grand Valley#11 18B	2	86	*0.016*	*0.012*	0	0.545	0	6.8	0.674971	3.23	290	4	12
Grand Valley#11 19A	1	88	*0.014*	*0.018*	0	1.004	*0.001*	9.3	0.927854	3.92	229	4	12
Grand Valley#11 19B	2	88	*0.016*	*0.016*	0	0.876	*0.011*	9.8	0.97537	3.81	236	4	12

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich III for Core #11

Mehlich Core #11		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#11 1	Avg.	0.4105	0.218	0	529.25	2.146
	StDev	*0.02*	*0.04*	*0.00*	*19.16*	*0.44*
Grand Valley#11 2	Avg.	0.5835	0.3415	0	1197.5	12.195
	StDev	*0.01*	*0.00*	*0.00*	*40.31*	*0.76*
Grand Valley#11 3	Avg.	0.9225	0.296	0	264.4	2.859
	StDev	*0.01*	*0.01*	*0.00*	*0.42*	*0.07*
Grand Valley#11 4	Avg.	0.5025	0.2725	0	930.4	6.805
	StDev	*0.01*	*0.00*	*0.00*	*26.02*	*0.19*
Grand Valley#11 5	Avg.	0.4925	0.2095	0	162.35	2.447
	StDev	*0.01*	*0.00*	*0.00*	*14.07*	*0.03*
Grand Valley#11 6	Avg.	0.242	0.2635	0	37.415	1.189
	StDev	*0.00*	*0.00*	*0.00*	*0.54*	*0.06*
Grand Valley#11 7	Avg.	0.2475	0.39	0	13.705	1.0995
	StDev	*0.00*	*0.01*	*0.00*	*0.13*	*0.01*
Grand Valley#11 8	Avg.	0.287	0.281	0	9.3245	0.172
	StDev	*0.00*	*0.00*	*0.00*	*0.04*	*0.00*
Grand Valley#11 9	Avg.	0.287	0.2	0	6.6365	0.032
	StDev	*0.01*	*0.01*	*0.00*	*0.36*	*0.00*
Grand Valley#11 10	Avg.	0.258	0.225	0	6.6435	0.029
	StDev	*0.00*	*0.00*	*0.00*	*0.04*	*0.02*
Grand Valley#11 11	Avg.	0.2115	0.203	0	5.1615	0.079
	StDev	*0.00*	*0.01*	*0.00*	*0.06*	*0.06*
Grand Valley #11 12	Avg.	0.249	0.176	0	3.9305	0.0475
	StDev	*0.00*	*0.00*	*0.00*	*0.04*	*0.01*
Grand Valley#11 13	Avg.	0.249	0.1855	0	3.7195	0.042
	StDev	*0.01*	*0.00*	*0.00*	*0.26*	*0.01*
Grand Valley#11 14	Avg.	0.1865	0.1105	0	2.9065	0.075
	StDev	*0.01*	*0.00*	*0.00*	*0.02*	*0.07*
Grand Valley#11 15	Avg.	0.066	0.043	0	1.4725	0.0215
	StDev	*0.00*	*0.00*	*0.00*	*0.01*	*0.00*
Grand Valley#11 16	Avg.	0.134	0.044	0	1.374	0.0135
	StDev	*0.00*	*0.00*	*0.00*	*0.02*	*0.01*
Grand Valley#11 17	Avg.	0.048	0.024	0	1.02	0.0165
	StDev	*0.00*	*0.00*	*0.00*	*0.05*	*0.01*
Grand Valley#11 18	Avg.	0.016	0.014	0	0.577	0.0835
	StDev	*0.00*	*0.00*	*0.00*	*0.05*	*0.12*
Grand Valley#11 19	Avg.	0.015	0.017	0	0.94	0.006
	StDev	*0.00*	*0.00*	*0.00*	*0.09*	*0.01*

Italics = Below Detectable Limit

Total Metals using EPA Method 3051B for Core #11

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
Grand Valley T #11 1A	1	5	36.37	2.25	32.66	3486	20.83	601.8	60.18	0.14	5.06	719	12	24.5
Grand Valley T #11 1B	2	5	32.11	1.99	31.46	3657	21.06	533.0	53.3	0.14	5.07	685	12	24.5
Grand Valley T #11 2A	1	10	109.4	2.77	40.57	9173	61.16	263.1	26.3	0.27	4.9	436	12	24.5
Grand Valley T #11 2B	2	10	72.96	2.38	33.02	6975	41.73	437.8	43.8	0.27	4.91	482	12	24.5
Grand Valley T #11 3A	1	15	53.79	2.16	54.67	611.1	10.15	463.2	46.3	0.42	4.87	505	12	24.5
Grand Valley T #11 3B	2	15	47.63	2.23	56.14	664	9.81	470.8	47.1	0.42	4.89	490	12	24.5
Grand Valley T #11 4A	1	20	42.24	1.37	34.52	4711	43.65	538.4	53.8	0.25	4.64	775	12	24.5
Grand Valley T #11 4B	2	20	35.35	1.36	36.01	4815	42.3	547.5	54.8	0.25	4.64	720	12	24.5
Grand Valley T #11 5A	1	25	28.59	1.21	39.21	395.5	18.89	475.9	47.6	0.28	4.63	610	12	24.5
Grand Valley T #11 5B	2	25	31.47	1.24	41.53	417.6	19.26	489.2	48.9	0.28	4.56	589	12	24.5
Grand Valley T #11 6A	1	30	27.43	0.95	35.54	49.53	6.93	445.7	44.6	0.30	4.7	593	12	24.5
Grand Valley T #11 6B	2	30	30.56	1.07	38.13	53.61	7.72	457.1	45.7	0.30	4.62	569	12	24.5
Grand Valley T #11 7A	1	33	27.15	1.65	43.77	21.36	5.81	428.5	42.9	0.29	4.54	678	12	24.5
Grand Valley T #11 7B	2	33	29.56	1.86	46.74	23.34	6.34	447.4	44.7	0.29	4.56	611	12	24.5
Grand Valley T #11 8A	1	38	11.1	1.13	31.42	20.34	*0.84*	32.2	3.2	1.30	4.24	300	19.5	46
Grand Valley T #11 8B	2	38	9.31	1.04	31.85	18.92	*0.52*	28.8	2.9	1.30	4.15	340	19.5	46
Grand Valley T #11 9A	1	43	3.78	1.2	31.81	16.35	*0.33*	16.6	1.7	1.50	4.25	161.9	19.5	46
Grand Valley T #11 9B	2	43	3.91	1.18	32.55	16.24	*0.45*	16.1	1.6	1.50	4.27	174.9	19.5	46
Grand Valley T #11 10A	1	48	2.73	1.16	31.44	14.08	*0.44*	17.0	1.7	1.47	4.38	189.8	19.5	46
Grand Valley T #11 10B	2	48	2.84	1.13	31.45	14.98	*0.2*	17.0	1.7	1.47	4.29	202	19.5	46
Grand Valley T #11 11A	1	53	2.61	*0.93*	25.73	12.16	*0.3*	17.6	1.8	1.68	4.38	224	19.5	46
Grand Valley T #11 11B	2	53	2.45	*0.96*	26.17	12.91	*0.15*	12.6	1.3	1.68	4.38	220	19.5	46
Grand Valley T #11 12A	1	58	3.19	*0.9*	27.28	12.07	*0.16*	19.2	1.9	1.50	5.25	144.3	19	41
Grand Valley T #11 12B	2	58	8.3	*0.81*	24.87	9.89	1.35	18.1	1.8	1.50	5.31	146.3	19	41
Grand Valley T #11 13A	1	61	5.02	*0.88*	27.42	11.65	*0.2*	38.5	2.9	1.36	5.53	148.5	19	41
Grand Valley T #11 13B	2	61	5.95	*0.99*	32.4	13.2	*0.36*	33.8	3.9	1.36	5.66	149.4	19	41
Grand Valley T #11 14A	1	66	5.81	*0.32*	17.01	5.95	0	39.4	3.9	1.23	4.68	358	4	12
Grand Valley T #11 14B	2	66	6.33	*0.39*	18.4	6.95	0	45.4	4.5	1.23	4.61	367	4	12
Grand Valley T #11 15A	1	71	2.62	*0.01*	9.69	2.89	0	22.8	2.3	1.63	4.56	203	4	12
Grand Valley T #11 15B	2	71	2.17	0	10.65	2.85	0	14.8	1.5	1.63	4.62	184.7	4	12
Grand Valley T #11 16A	1	76	5.96	0	11.43	3.95	0	20.9	2.1	1.46	4.44	263	4	12
Grand Valley T #11 16B	2	76	1.05	0	3.33	0.92	0	16.8	1.7	1.46	4.46	264	4	12
Grand Valley T #11 17A	1	81	3.38	0	8.22	2.41	0	7.1	0.7	1.51	3.31	316	4	12
Grand Valley T #11 17B	2	81	4.26	0	8.09	2.52	0	6.6	0.7	1.51	3.23	335	4	12
Grand Valley T #11 18A	1	86	2.79	0	5.95	2.13	0	5.5	0.5	1.27	3.3	290	4	12
Grand Valley T #11 18B	2	86	3.91	0	8.73	3.25	0	6.8	0.7	1.27	3.23	290	4	12
Grand Valley T #11 19A	1	88	4.48	0	7.07	3.23	0	9.3	0.9	1.62	3.92	229	4	12
Grand Valley T #11 19B	2	88	5.18	0	8.18	3.27	0	9.8	1.0	1.62	3.81	236	4	12

Italics = Below Detectable Limit

Total Metals using EPA Method 3051B for Core #11 (cont)

Metal Core #11		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#11 1	Avg.	34.24	2.12	32.06	3571.5	20.945
	StDev	*70.76*	*2.38*	*36.02*	*6415.00*	*41.11*
Grand Valley#11 2	Avg.	91.18	2.575	36.795	8074	51.445
	StDev	*63.38*	*2.27*	*43.85*	*3793.05*	*25.94*
Grand Valley#11 3	Avg.	50.71	2.195	55.405	637.55	9.98
	StDev	*44.94*	*1.80*	*45.33*	*2687.50*	*26.73*
Grand Valley#11 4	Avg.	38.795	1.365	35.265	4763	42.975
	StDev	*31.97*	*1.29*	*37.61*	*2605.25*	*30.60*
Grand Valley#11 5	Avg.	30.03	1.225	40.37	406.55	19.075
	StDev	*29.45*	*1.10*	*38.54*	*233.57*	*13.10*
Grand Valley#11 6	Avg.	28.995	1.01	36.835	51.57	7.325
	StDev	*28.86*	*1.36*	*40.95*	*37.49*	*6.77*
Grand Valley#11 7	Avg.	28.355	1.755	45.255	22.35	6.075
	StDev	*20.33*	*1.50*	*39.08*	*21.84*	*3.59*
Grand Valley#11 8	Avg.	10.205	1.085	31.635	19.63	0.68
	StDev	*6.55*	*1.12*	*31.83*	*17.64*	*0.43*
Grand Valley#11 9	Avg.	3.845	1.19	32.18	16.295	0.39
	StDev	*3.32*	*1.17*	*32.00*	*15.16*	*0.45*
Grand Valley#11 10	Avg.	2.785	1.145	31.445	14.53	0.32
	StDev	*2.73*	*1.03*	*28.59*	*13.57*	*0.25*
Grand Valley#11 11	Avg.	2.53	0.945	25.95	12.535	0.225
	StDev	*2.82*	*0.93*	*26.73*	*12.49*	*0.16*
Grand Valley #11 12	Avg.	5.745	0.855	26.075	10.98	0.755
	StDev	*6.66*	*0.85*	*26.15*	*10.77*	*0.78*
Grand Valley#11 13	Avg.	5.485	0.935	29.91	12.425	0.28
	StDev	*5.88*	*0.66*	*24.71*	*9.58*	*0.10*
Grand Valley#11 14	Avg.	6.07	0.355	17.705	6.45	-0.12
	StDev	*4.48*	*0.20*	*14.05*	*4.92*	*-0.09*
Grand Valley#11 15	Avg.	2.395	-0.01	10.17	2.87	-0.12
	StDev	*4.07*	*0.03*	*11.04*	*3.40*	*-0.14*
Grand Valley#1116	Avg.	3.505	-0.065	7.38	2.435	-0.22
	StDev	*2.22*	*-0.14*	*5.78*	*1.67*	*-0.30*
Grand Valley#1117	Avg.	3.82	-0.055	8.155	2.465	-0.2
	StDev	*3.53*	*-0.06*	*7.02*	*2.33*	*-0.16*
Grand Valley#11 18	Avg.	3.35	-0.06	7.34	2.69	-0.215
	StDev	*4.20*	*-0.06*	*7.90*	*3.24*	*-0.21*
Grand Valley#11 19	Avg.	4.83	-0.07	7.625	3.25	-0.195
	StDev	*5.18*	*-0.07*	*8.18*	*3.27*	*-0.20*

Italics = Below Detectable Limit

Water Soluble metals for Core #11

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
Grand Valley#11 1A	1	5	0.459	*0.017*	2.244	5.572	1.039	601.8	60.17566	5.06	719	12	24.5
Grand Valley#11 1B	2	5	0.467	*0.006*	1.336	5.212	1.046	533.0	53.29593	5.07	685	12	24.5
Grand Valley#11 2A	1	10	2.068	*0.007*	0.971	10.7	7.046	263.1	26.30867	4.9	436	12	24.5
Grand Valley#11 2B	2	10	2.538	0	0.674	11.65	8.592	437.8	43.77543	4.91	482	12	24.5
Grand Valley#11 3A	1	15	0.469	*0.004*	0.676	1.706	1.924	463.2	46.31808	4.87	505	12	24.5
Grand Valley#11 3B	2	15	0.468	0	0.701	1.647	1.907	470.8	47.07628	4.89	490	12	24.5
Grand Valley#11 4A	1	20	1.454	0	0.668	10.11	4.65	538.4	53.8351	4.64	775	12	24.5
Grand Valley#11 4B	2	20	1.071	2.531	0.676	9.48	3.625	547.5	54.7519	4.64	720	12	24.5
Grand Valley#11 5A	1	25	0.557	0	0.58	0.882	1.623	475.9	47.58567	4.63	610	12	24.5
Grand Valley#11 5B	2	25	0.589	*0.044*	0.677	0.993	1.945	489.2	48.91851	4.56	589	12	24.5
Grand Valley#11 6A	1	30	0.536	*0.016*	0.47	0.159	0.878	445.7	44.57063	4.7	593	12	24.5
Grand Valley#11 6B	2	30	0.51	*0.035*	0.546	0.204	0.877	457.1	45.71056	4.62	569	12	24.5
Grand Valley#11 7A	1	33	0.624	0	0.448	*0.069*	0.786	428.5	42.85451	4.54	678	12	24.5
Grand Valley#11 7B	2	33	0.593	*0.009*	0.531	0.08	0.752	447.4	44.73716	4.56	611	12	24.5
Grand Valley#11 8A	1	38	0.495	*0.04*	2.751	0.62	*0.027*	32.2	3.221192	4.24	300	19.5	46
Grand Valley#11 8B	2	38	0.345	*0.005*	0.71	0.103	*0.082*	28.8	2.879058	4.15	340	19.5	46
Grand Valley#11 9A	1	43	0.096	*0.013*	1.037	0.193	*0.012*	16.6	1.657405	4.25	161.9	19.5	46
Grand Valley#11 9B	2	43	0.159	*0.03*	2.467	0.515	*0.028*	16.1	1.610905	4.27	174.9	19.5	46
Grand Valley#11 10A	1	48	0.123	*0.014*	1.569	0.261	*0.012*	17.0	1.704838	4.38	189.8	19.5	46
Grand Valley#11 10B	2	48	0.182	*0.061*	3.673	0.773	*0.023*	17.0	1.701997	4.29	202	19.5	46
Grand Valley#11 11A	1	53	0.194	*0.022*	0.19	*0.066*	*0.046*	17.6	1.763298	4.38	224	19.5	46
Grand Valley#11 11B	2	53	0.049	*0.002*	0.24	*0.023*	*0.013*	12.6	1.258762	4.38	220	19.5	46
Grand Valley#11 12A	1	58	0.142	*0.005*	0.347	0.105	*0.014*	19.2	1.920323	5.25	144.3	19	41
Grand Valley#11 12B	2	58	*0.014*	0	0.095	*0.023*	*0.012*	18.1	1.806844	5.31	146.3	19	41
Grand Valley#11 13A	1	61	0.098	*0.001*	0.09	*0.012*	*0.025*	29.1	2.914872	5.75	150.2	19	41
Grand Valley#11 13B	2	61	0.353	*0.018*	1.578	0.359	*0.023*	38.5	3.851852	5.53	148.5	19	41
Grand Valley#11 14A	1	66	0.129	*0.001*	0.126	*0.022*	*0.013*	39.4	3.935905	4.68	358	4	12
Grand Valley#11 14B	2	66	0.085	*0.001*	0.132	*0.022*	*0.006*	45.4	4.539306	4.61	367	4	12
Grand Valley#11 15A	1	71	0.252	0	0.554	*0.059*	*0.024*	22.8	2.281798	4.56	203	4	12
Grand Valley#11 15B	2	71	*0.044*	0	0.124	*0.005*	*0.005*	14.8	1.484535	4.62	184.7	4	12
Grand Valley#11 16A	1	76	0.083	0	0.151	*0.001*	*0.008*	20.9	2.085397	4.44	263	4	12
Grand Valley#11 16B	2	76	*0.059*	0	0.12	*0.014*	0	16.8	1.682053	4.46	264	4	12
Grand Valley#11 17A	1	81	0.267	*0.006*	1.004	*0.062*	*0.023*	7.1	0.705699	3.31	316	4	12
Grand Valley#11 17B	2	81	0.262	*0.005*	1.297	*0.221*	*0.026*	6.6	0.661344	3.23	335	4	12
Grand Valley#11 18A	1	86	0.097	0	0.144	*0.031*	*0.023*	5.5	0.547452	3.3	290	4	12
Grand Valley#11 18B	2	86	*0.061*	*0.003*	0.14	*0.024*	*0.018*	6.7	0.674971	3.23	290	4	12
Grand Valley#11 19A	1	88	0.096	0	0.146	*0.034*	*0.01*	9.3	0.927854	3.92	229	4	12
Grand Valley#11 19B	2	88	0.088	*0.002*	0.154	*0.017*	*0.016*	9.8	0.97537	3.81	236	4	12

Italics = Below Detectable Limit

Water Soluble metals for Core #11

Water Core #11		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#11 1	Avg.	0.463	0.0115	1.79	5.392	1.0425
	StDev	*0.01*	*0.01*	*0.64*	*0.25*	*0.00*
Grand Valley#11 2	Avg.	2.303	0.0035	0.8225	11.175	7.819
	StDev	*0.33*	*0.00*	*0.21*	*0.67*	*1.09*
Grand Valley#11 3	Avg.	0.4685	0.002	0.6885	1.6765	1.9155
	StDev	*0.00*	*0.00*	*0.02*	*0.04*	*0.01*
Grand Valley#11 4	Avg.	1.2625	1.2655	0.672	9.795	4.1375
	StDev	*0.27*	*1.79*	*0.01*	*0.45*	*0.72*
Grand Valley#11 5	Avg.	0.573	0.022	0.6285	0.9375	1.784
	StDev	*0.02*	*0.03*	*0.07*	*0.08*	*0.23*
Grand Valley#11 6	Avg.	0.523	0.0255	0.508	0.1815	0.8775
	StDev	*0.02*	*0.01*	*0.05*	*0.03*	*0.00*
Grand Valley#11 7	Avg.	0.6085	0.0045	0.4895	0.0745	0.769
	StDev	*0.02*	*0.01*	*0.06*	*0.01*	*0.02*
Grand Valley#11 8	Avg.	0.42	0.0225	1.7305	0.3615	0.0545
	StDev	*0.11*	*0.02*	*1.44*	*0.37*	*0.04*
Grand Valley#11 9	Avg.	0.1275	0.0215	1.752	0.354	0.02
	StDev	*0.04*	*0.01*	*1.01*	*0.23*	*0.01*
Grand Valley#11 10	Avg.	0.1525	0.0375	2.621	0.517	0.0175
	StDev	*0.04*	*0.03*	*1.49*	*0.36*	*0.01*
Grand Valley#11 11	Avg.	0.1215	0.012	0.215	0.0445	0.0295
	StDev	*0.10*	*0.01*	*0.04*	*0.03*	*0.02*
Grand Valley #11 12	Avg.	0.078	0.0025	0.221	0.064	0.013
	StDev	*0.09*	*0.00*	*0.18*	*0.06*	*0.00*
Grand Valley#11 13	Avg.	0.2255	0.0095	0.834	0.1855	0.024
	StDev	*0.18*	*0.01*	*1.05*	*0.25*	*0.00*
Grand Valley#11 14	Avg.	0.107	0.001	0.129	0.022	0.0095
	StDev	*0.03*	*0.00*	*0.00*	*0.00*	*0.00*
Grand Valley#11 15	Avg.	0.148	0	0.339	0.032	0.0145
	StDev	*0.15*	*0.00*	*0.30*	*0.04*	*0.01*
Grand Valley#11 16	Avg.	0.071	0	0.1355	0.0075	0.004
	StDev	*0.02*	*0.00*	*0.02*	*0.01*	*0.01*
Grand Valley#11 17	Avg.	0.2645	0.0055	1.1505	0.1415	0.0245
	StDev	*0.00*	*0.00*	*0.21*	*0.11*	*0.00*
Grand Valley#11 18	Avg.	0.079	0.0015	0.142	0.0275	0.0205
	StDev	*0.03*	*0.00*	*0.00*	*0.00*	*0.00*
Grand Valley#11 19	Avg.	0.092	0.001	0.15	0.0255	0.013
	StDev	*0.01*	*0.00*	*0.01*	*0.01*	*0.00*

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich III for Core #19

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
WestRes M19 1A	1	5	0.094	*0.075*	0	299.7	1.251	80.46	8.045586	0.91	5.03	97	14	44.5
WestRes M19 1B	2	5	0.095	*0.073*	0	295.5	1.247	81.39	8.139	0.91	5.01	81.3	14	44.5
WestRes M19 2A	1	10	0.091	*0.078*	0	502.9	3.38	80.25	8.024874	1.05	4.96	105.2	14	44.5
WestRes M3 19 2B	2	10	0.091	*0.078*	0	505	3.358	87.46	8.745568	1.05	4.77	93.5	14	44.5
WestRes M3 19 3A	1	15	*0.055*	*0.066*	0	223.8	1.082	53.89	5.3888	1.18	4.75	96.4	14	44.5
WestRes M19 3B	2	15	17.29	0	0	293.2	70.66	52.97	5.296797	1.18	4.6	74.2	14	44.5
WestRes M19 4A	1	20	*0.025*	*0.057*	0	54.96	0.263	32.12	3.211867	1.50	4.67	46.5	16.5	50
WestRes M19 4B	2	20	*0.026*	*0.053*	0	56.67	0.239	34.06	3.406106	1.50	4.63	49.3	16.5	50
WestRes M3 19 5A	1	25	*0.009*	*0.057*	0	10.97	*0.088*	17.85	1.785132	1.45	4.47	48.8	17	50
WestRes M3 19 5B	2	25	*0.011*	*0.051*	0	10.64	*0.076*	29.85	2.985219	1.45	4.52	45	17	50
WestRes M3 19 6A	1	30	*0.005*	*0.05*	0	4.24	*0.044*	12.03	1.203209	1.59	4.1	48.4	17	50
WestRes M3 19 6B	2	30	*0.006*	*0.049*	0	3.958	*0.033*	12.80	1.27986	1.59	4.11	40.9	17	50
WestRes M3 19 7A	1	35	*0.011*	*0.083*	0	39.15	0.138	18.50	1.849536	1.64	3.46	61	17	50
WestRes M3 19 7B	2	35	*0.009*	*0.087*	0	41.69	0.167	17.01	1.701405	1.64	3.47	57.8	17	50
WestRes M3 19 8A	1	40	*0.02*	0.25	0	6.047	*0.016*	20.87	2.087444	1.56	3.65	65	30.5	42
WestRes M3 19 8B	2	40	*0.021*	0.247	0	6.738	*0.027*	19.10	1.909575	1.56	3.63	58.6	30.5	42
WestRes M3 19 9A	1	45	*0.046*	0.495	0	4.928	*0.024*	20.31	2.030659	1.71	4.59	56.5	30.5	42
WestRes M3 19 9B	2	45	*0.044*	0.465	0	4.9	*0.001*	20.96	2.096221	1.71	4.55	61.1	30.5	42
WestRes M3 19 10A	1	48	*0.055*	0.345	0	4.223	*0.008*	18.89113	1.885447	1.39	4.99	50	30.5	42
WestRes M3 19 10B	2	48	*0.06*	0.371	0	4.619	*0.012*	18.92779	1.892779	1.39	4.91	40.7	30.5	42

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich III for Core #19

Mehlich Core #19		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#19 1	Avg.	0.0945	0.0740	0.0000	297.6000	1.2490
	StDev	*0.00*	*0.00*	*0.00*	*2.97*	*0.00*
Grand Valley#19 2	Avg.	0.0910	0.0780	0.0000	503.9500	3.3690
	StDev	*0.00*	*0.00*	*0.00*	*1.48*	*0.02*
Grand Valley#19 3	Avg.	8.6725	0.0330	0.0000	258.5000	35.8710
	StDev	*12.19*	*0.05*	*0.00*	*49.07*	*49.20*
Grand Valley#19 4	Avg.	0.0255	0.0550	0.0000	55.8150	0.2510
	StDev	*0.00*	*0.00*	*0.00*	*1.21*	*0.02*
Grand Valley#19 5	Avg.	0.0100	0.0540	0.0000	10.8050	0.0820
	StDev	*0.00*	*0.00*	*0.00*	*0.23*	*0.01*
Grand Valley#19 6	Avg.	0.0055	0.0495	0.0000	4.0990	0.0385
	StDev	*0.00*	*0.00*	*0.00*	*0.20*	*0.01*
Grand Valley#19 7	Avg.	0.0100	0.0850	0.0000	40.4200	0.1525
	StDev	*0.00*	*0.00*	*0.00*	*1.80*	*0.02*
Grand Valley#19 8	Avg.	0.0205	0.2485	0.0000	6.3925	0.0215
	StDev	*0.00*	*0.00*	*0.00*	*0.49*	*0.01*
Grand Valley#19 9	Avg.	0.0450	0.4800	0.0000	4.9140	0.0125
	StDev	*0.00*	*0.02*	*0.00*	*0.02*	*0.02*
Grand Valley#19 10	Avg.	0.0575	0.3580	0.0000	4.4210	0.0100
	StDev	*0.00*	*0.02*	*0.00*	*0.28*	*0.00*

Italics = Below Detectable Limit

Total metals using EPA Method 3051B for Core #19

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
WestRes M19 1A	1	5	8.75	*0.2*	12.11	756.1	3.88	80.46	8.045586	0.91	5.03	97	14	44.5
WestRes M19 1B	2	5	9.27	*0.29*	13.12	775.8	39.8	81.39	8.139	0.91	5.01	81.3	14	44.5
WestRes M19 2A	1	10	15.17	*0.21*	15.29	1410	81.3	80.25	8.024874	1.05	4.96	105.2	14	44.5
WestRes M3 19 2B	2	10	17.18	*0.19*	11.15	1478	75.4	87.46	8.745568	1.05	4.77	93.5	14	44.5
WestRes M3 19 3A	1	15	12.05	*0.24*	12.46	611.7	32.1	53.89	5.3888	1.18	4.75	96.4	14	44.5
WestRes M19 3B	2	15	11.14	*0.21*	12.14	556.2	30.3	52.97	5.296797	1.18	4.6	74.2	14	44.5
WestRes M19 4A	1	20	8.19	*0.16*	12.27	132.6	*7.4*	32.12	3.211867	1.50	4.67	46.5	16.5	50
WestRes M19 4B	2	20	8.4	*0.22*	13.03	135.5	*4.9*	34.06	3.406106	1.50	4.63	49.3	16.5	50
WestRes M3 19 5A	1	25	6.28	*0.21*	14.79	31.05	*3.2*	17.85	1.785132	1.45	4.47	48.8	17	50
WestRes M3 19 5B	2	25	6.19	*0.21*	14.75	26.09	*3.3*	29.85	2.985219	1.45	4.52	45	17	50
WestRes M3 19 6A	1	30	6.3	*0.31*	18.31	16.48	*4.4*	12.03	1.203209	1.59	4.1	48.4	17	50
WestRes M3 19 6B	2	30	6.2	*0.25*	17.37	15.99	*3.6*	12.80	1.27986	1.59	4.11	40.9	17	50
WestRes M3 19 7A	1	35	11.81	*0.5*	20.48	86.25	*9.8*	18.50	1.849536	1.64	3.46	61	17	50
WestRes M3 19 7B	2	35	12.94	*0.5*	21.57	75.99	*6.6*	17.01	1.701405	1.64	3.47	57.8	17	50
WestRes M3 19 8A	1	40	9.24	0	13.89	9.54	*1.1*	20.87	2.087444	1.56	3.65	65	30.5	42
WestRes M3 19 8B	2	40	16.78	1.26	24.66	18.76	*6.9*	19.10	1.909575	1.56	3.63	58.6	30.5	42
WestRes M3 19 9A	1	45	24.34	2.9	44.45	27.36	11.5	20.31	2.030659	1.71	4.59	56.5	30.5	42
WestRes M3 19 9B	2	45	20.45	2.46	39.01	23.2	*8.4*	20.96	2.096221	1.71	4.55	61.1	30.5	42
WestRes M3 19 10A	1	48	273.2	1.97	66.57	39.57	*18.7*	18.89113	1.885447	1.39	4.99	50	30.5	42
WestRes M3 19 10B	2	48	22.395	1.73	52.74	34.33	14.5	18.92779	1.892779	1.39	4.91	40.7	30.5	42

Italics = Below Detectable Limit

Total Metals using EPA Method 3051B for Core #19

Italics = Below Detectable Limit

Metal Core #19		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#19 1	Avg.	9.0100	0.2450	12.6150	765.9500	21.8400
	StDev	*0.37*	*0.06*	*0.71*	*13.93*	*25.40*
Grand Valley#19 2	Avg.	16.1750	0.2000	13.2200	1444.0000	78.3500
	StDev	*1.42*	*0.01*	*2.93*	*48.08*	*4.17*
Grand Valley#19 3	Avg.	11.5950	0.2250	12.3000	583.9500	31.2000
	StDev	*0.64*	*0.02*	*0.23*	*39.24*	*1.27*
Grand Valley#19 4	Avg.	8.2950	0.1900	12.6500	134.0500	6.1500
	StDev	*0.15*	*0.04*	*0.54*	*2.05*	*1.77*
Grand Valley#19 5	Avg.	6.2350	0.2100	14.7700	28.5700	3.2500
	StDev	*0.06*	*0.00*	*0.03*	*3.51*	*0.07*
Grand Valley#19 6	Avg.	6.2500	0.2800	17.8400	16.2350	4.0000
	StDev	*0.07*	*0.04*	*0.66*	*0.35*	*0.57*
Grand Valley#19 7	Avg.	12.3750	0.5000	21.0250	81.1200	8.2000
	StDev	*0.80*	*0.00*	*0.77*	*7.25*	*2.26*
Grand Valley#19 8	Avg.	13.0100	0.6300	19.2750	14.1500	4.0000
	StDev	*5.33*	*0.89*	*7.62*	*6.52*	*4.10*
Grand Valley#19 9	Avg.	22.3950	2.6800	41.7300	25.2800	9.9500
	StDev	*2.75*	*0.31*	*3.85*	*2.94*	*2.19*

Water Soluble metals for Core #19

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
WestRW 19 1A	1	5	0.1090	0.0000	0.6190	2.7510	0.3540	80.46	8.05%	5.03	97	14	44.5
WestRW 19 1B	2	5	0.1080	*0.0010*	0.4140	2.4170	0.3160	81.39	8.14%	5.01	81.3	14	44.5
WestRW 19 2A	1	10	0.1940	0.0000	0.3210	4.2700	0.9950	80.25	8.02%	4.96	105.2	14	44.5
WestRW 19 2B	2	10	0.1910	0.0000	0.3320	4.8040	0.8910	87.46	8.75%	4.77	93.5	14	44.5
WestRW 19 3A	1	15	0.0880	0.0000	0.3240	2.1080	0.3040	53.89	5.39%	4.75	96.4	14	44.5
WestRW 19 3B	2	15	0.0730	0.0000	0.2540	1.6840	0.2940	52.97	5.30%	4.6	74.2	14	44.5
WestRW 19 4A	1	20	*0.0490*	*0.0020*	0.4870	1.0360	*0.0410*	32.12	3.21%	4.67	46.5	16.5	50
WestRW 19 4B	2	20	*0.0300*	*0.0040*	1.3900	3.2760	*0.0220*	34.06	3.41%	4.63	49.3	16.5	50
WestRW 19 5A	1	25	*0.0170*	*0.0030*	0.8950	0.4410	*0.0060*	17.85	1.79%	4.47	48.8	17	50
WestRW 19 5B	2	25	*0.0180*	*0.0020*	0.6150	0.3030	*0.0030*	29.85	2.99%	4.52	45	17	50
WestRW 19 6A	1	30	*0.0030*	*0.0010*	0.4170	0.1100	*0.0050*	12.03	1.20%	4.1	48.4	17	50
WestRW 19 6B	2	30	*0.0130*	*0.0010*	0.4540	0.1320	*0.0070*	12.80	1.28%	4.11	40.9	17	50
WestRW 19 7A	1	35	0.0000	*0.0150*	4.2350	4.1010	*0.0320*	18.50	1.85%	3.46	61	17	50
WestRW 19 7B	2	35	0.0170	*0.0020*	0.9780	0.8610	*0.0080*	17.01	1.70%	3.47	57.8	17	50
WestRW 19 8A	1	40	0.0080	0.0000	0.2590	0.0280	*0.0210*	20.87	2.09%	3.65	65	30.5	42
WestRW 19 8B	2	40	0.0000	*0.0010*	0.8080	0.0210	0.0000	19.10	1.91%	3.63	58.6	30.5	42
WestRW 19 9A	1	45	0.0200	*0.0010*	0.4670	0.0470	*0.0120*	20.31	2.03%	4.59	56.5	30.5	42
WestRW 19 9B	2	45	0.0010	*0.0030*	0.3870	0.0360	*0.0120*	20.96	2.10%	4.55	61.1	30.5	42
WestRW 19 10A	1	48	0.0000	*0.0060*	1.0670	0.1040	0.0000	18.85	1.89%	4.99	50	30.5	42
WestRW 19 10B	2	48	0.0000	*0.0200*	2.5700	0.2680	0.0000	18.93	1.89%	4.91	40.7	30.5	42

Italics = Below Detectable Limit

Water Soluble metals for Core #19

Water Core #19			As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand Valley#19 1		Avg.	0.1085	0.0005	0.5165	2.5840	0.3350
		StDev	*0.00*	*0.00*	*0.14*	*0.24*	*0.03*
Grand Valley#19 2		Avg.	0.1925	0.0000	0.3265	4.5370	0.9430
		StDev	*0.00*	*0.00*	*0.01*	*0.38*	*0.07*
Grand Valley#19 3		Avg.	0.0805	0.0000	0.2890	1.8960	0.2990
		StDev	*0.01*	*0.00*	*0.05*	*0.30*	*0.01*
Grand Valley#19 4		Avg.	0.0395	0.0030	0.9385	2.1560	0.0315
		StDev	*0.01*	*0.00*	*0.64*	*1.58*	*0.01*
Grand Valley#19 5		Avg.	0.0175	0.0025	0.7550	0.3720	0.0045
		StDev	*0.00*	*0.00*	*0.20*	*0.10*	*0.00*
Grand Valley#19 6		Avg.	0.0080	0.0010	0.4355	0.1210	0.0060
		StDev	*0.01*	*0.00*	*0.03*	*0.02*	*0.00*
Grand Valley#19 7		Avg.	0.0085	0.0085	2.6065	2.4810	0.0200
		StDev	*0.01*	*0.01*	*2.30*	*2.29*	*0.02*
Grand Valley#19 8		Avg.	0.0040	0.0005	0.5335	0.0245	0.0105
		StDev	*0.01*	*0.00*	*0.39*	*0.00*	*0.01*
Grand Valley#19 9		Avg.	0.0105	0.0020	0.4270	0.0415	0.0120
		StDev	*0.01*	*0.00*	*0.06*	*0.01*	*0.00*
Grand Valley#19 10		Avg.	0.0000	0.0130	1.8185	0.1860	0.0000
		StDev	*0.00*	*0.01*	*1.06*	*0.12*	*0.00*

Italics = Below Detectable Limit

Plant Available metals extracted with Mehlich III for RC

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
WestRes M3 RC/A	1	5	0.294	0.27	0	6.097	0.118	127.25	12.72%	5.54	936	34.5	42.5
WestRes M3 RC//B	2	5	0.29	0.261	0	6.122	0.102	128.34	12.83%	5.5	941	34.5	42.5
WestRes M3 RC2/A	1	10	0.257	0.27	0	4.163	*0.031*	75.67	7.57%	5.77	696	34.5	42.5
WestRes M3 RC2/B	2	10	0.244	0.304	0	3.969	*0.031*	75.74	7.57%	5.81	705	34.5	42.5
WestRes M3 RC3/A	1	15	0.414	0.314	*0.034*	4.752	*0.039*	89.89	8.99%	5.94	860	34.5	42.5
WestRes M3 RC3/B	2	15	0.408	0.314	0	4.621	*0.022*	87.86	8.79%	5.9	953	34.5	42.5
WestRes M3 RC4/A	1	20	0.26	0.226	0	4.483	*0.04*	41.30	4.13%	6.26	547	32.5	43
WestRes M3 RC4/B	2	20	0.262	0.213	0	4.461	*0.018*	55.16	5.52%	6.28	586	32.5	43
WestRes M3 RC5/A	1	25	*0.088*	0.184	0	3.429	*0.013*	24.50	2.45%	7.05	480	32.5	43
WestRes M3 RC5/B	2	25	*0.084*	0.191	0	3.327	*0.012*	25.61	2.56%	7.12	485	32.5	43
WestRes M3 RC6/A	1	30	*0.066*	0.178	0	3.186	*0.035*	23.11	2.31%	7.21	476	32.5	43
WestRes M3 RC6/B	2	30	*0.067*	0.168	0	3.311	*0.005*	22.55	2.25%	7.24	475	32.5	43
WestRes M3 RC7/A	1	35	*0.075*	0.158	0	3.98	*0.05*	23.38	2.34%	7.16	542	44.5	35.5
WestRes M3 RC7/B	2	35	*0.072*	0.145	0	3.983	*0.036*	23.16	2.32%	7.08	533	44.5	35.5
WestRes M RC 8A	1	40	*0.083*	0.157	0	5.38	*0.093*	22.03	2.20%	7.01	607	44.5	35.5
WestRes M3 RC8/B	2	40	*0.074*	0.124	0	4.956	*0.063*	21.55	2.15%	7.14	656	44.5	35.5
WestRes M3 RC9/A	1	45	*0.072*	0.121	0	4.993	*0.068*	18.83	1.88%	7.12	597	36	47
WestRes M3 RC9/B	2	45	*0.073*	0.136	0	4.933	*0.088*	23.41	2.34%	7.11	598	36	47
WestResM3RC10/A	1	50	*0.07*	0.126	0	4.889	*0.054*	26.12	2.61%	7.26	529	38	43
WestResM3RC10/B	2	50	*0.073*	0.13	0	4.962	*0.09*	22.23	2.22%	7.11	538	38	43
WestRes M RC 11A	1	55	*0.078*	0.157	0	6.206	0.11	22.04	2.20%	7.17	547	38	43
WestRes M RC 11B	2	55	*0.074*	0.151	0	5.505	0.108	21.03	2.10%	7.17	537	38	43
WestRes M RC 12A	1	60	*0.072*	0.159	0	5.589	0.111	22.07	2.21%	7.28	510	40.5	46
WestRes M RC 12B	2	60	*0.073*	0.159	0	5.576	0.138	25.92	2.59%	7.26	506	40.5	46
WestRes M RC 13A	1	66	*0.074*	0.169	0	5.841	0.1	25.91	2.59%	7.21	492	40.5	46
WestRes M RC 13B	2	66	*0.074*	0.169	0	5.716	0.121	22.37	2.24%	7.33	534	40.5	46

Italics= Below Detectable Limit

Plant Available metals extracted with Mehlich III for Reference Core

Mehlich RC		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand ValleyRC 1	Avg.	0.2920	0.2655	0.0000	6.1095	0.1100
	StDev	*0.00*	*0.01*	*0.00*	*0.02*	*0.01*
Grand ValleyRC 2	Avg.	0.2505	0.2870	0.0000	4.0660	0.0310
	StDev	*0.01*	*0.02*	*0.00*	*0.14*	*0.00*
Grand ValleyRC 3	Avg.	0.4110	0.3140	0.0170	4.6865	0.0305
	StDev	*0.00*	*0.00*	*0.02*	*0.09*	*0.01*
Grand ValleyRC 4	Avg.	0.2610	0.2195	0.0000	4.4720	0.0290
	StDev	*0.00*	*0.01*	*0.00*	*0.02*	*0.02*
Grand ValleyRC 5	Avg.	0.0860	0.1875	0.0000	3.3780	0.0125
	StDev	*0.00*	*0.00*	*0.00*	*0.07*	*0.00*
Grand ValleyRC 6	Avg.	0.0665	0.1730	0.0000	3.2485	0.0200
	StDev	*0.00*	*0.01*	*0.00*	*0.09*	*0.02*
Grand ValleyRC 7	Avg.	0.0735	0.1515	0.0000	3.9815	0.0430
	StDev	*0.00*	*0.01*	*0.00*	*0.00*	*0.01*
Grand ValleyRC 8	Avg.	0.0785	0.1405	0.0000	5.1680	0.0780
	StDev	*0.01*	*0.02*	*0.00*	*0.30*	*0.02*
Grand ValleyRC 9	Avg.	0.0725	0.1285	0.0000	4.9630	0.0780
	StDev	*0.00*	*0.01*	*0.00*	*0.04*	*0.01*
Grand ValleyRC 10	Avg.	0.0715	0.1280	0.0000	4.9255	0.0720
	StDev	*0.00*	*0.00*	*0.00*	*0.05*	*0.03*
Grand ValleyRC 11	Avg.	0.0760	0.1540	0.0000	5.8555	0.1090
	StDev	*0.00*	*0.00*	*0.00*	*0.50*	*0.00*
Grand ValleyRC 12	Avg.	0.0725	0.1590	0.0000	5.5825	0.1245
	StDev	*0.00*	*0.00*	*0.00*	*0.01*	*0.02*
Grand ValleyRC 13	Avg.	0.0740	0.1690	0.0000	5.7785	0.1105
	StDev	*0.00*	*0.00*	*0.00*	*0.09*	*0.01*

Italics = Below Detectable Limit

Total metals using EPA Method 3051B for Reference Core

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	Bulk D	pH	Cond (uS/cm)	% clay	% silt
Grand Val T RC 1A	1	5	21.66	2.03	68.58	42.59	1.79	127.25	12.72	0.740911	5.54	936	34.5	42.5
Grand Val T RC 1B	2	5	20.56	1.89	65.86	38.77	15.8	128.34	12.83	0.740911	5.5	941	34.5	42.5
Grand Val T RC 2A	1	10	13.68	1.8	64.38	24.85	12.4	75.67	7.57	1.235871	5.77	696	34.5	42.5
Grand Val T RC 2B	2	10	13.26	1.93	54.29	21.66	12.6	75.74	7.57	1.235871	5.81	705	34.5	42.5
Grand Val T RC 3A	1	15	13.39	1.82	53.27	19.6	*7.3*	89.89	8.99	1.360113	5.94	860	34.5	42.5
Grand Val T RC 3B	2	15	15.65	2.03	59.34	21.83	*9.1*	87.86	8.79	1.360113	5.9	953	34.5	42.5
Grand Val T RC 4A	1	20	8.7	1.18	50.66	15.25	*8.6*	41.30	4.13	1.547288	6.26	547	32.5	43
Grand Val T RC 4B	2	20	9.9	1.35	53.69	16.53	*8.1*	55.16	5.52	1.547288	6.28	586	32.5	43
Grand Val T RC 5A	1	25	6.13	1.3	53.61	15.23	13.9	24.50	2.45	1.686248	7.05	480	32.5	43
Grand Val T RC 5B	2	25	6.22	1.92	53.39	16.31	13.7	25.61	2.56	1.686248	7.12	485	32.5	43
Grand Val T RC 6A	1	30	3.96	1.4	54.28	16.08	14.2	23.11	2.31	1.656478	7.21	476	32.5	43
Grand Val T RC 6B	2	30	2.89	1.2	51.97	14.8	13.5	22.55	2.25	1.656478	7.24	475	32.5	43
Grand Val T RC 7A	1	35	6.69	3.47	67.11	21.22	16.2	23.38	2.34	1.67196	7.16	542	44.5	35.5
Grand Val T RC 7B	2	35	5.81	2.05	61.7	19.65	14.4	23.16	2.32	1.67196	7.08	533	44.5	35.5
Grand Val T RC 8A	1	40	7.01	1.66	65.81	20.17	11.7	22.03	2.20	1.734511	7.01	607	44.5	35.5
Grand Val T RC 8B	2	40	12.04	1.37	56.73	16.63	22.2	21.55	2.15	1.734511	7.14	656	44.5	35.5
Grand Val T RC 9A	1	45	11.4	1.89	54.08	17.09	26.1	18.83	1.88	1.693894	7.12	597	36	47
Grand Val T RC 9B	2	45	3.6	1.27	51.89	15.09	11.6	23.41	2.34	1.693894	7.11	598	36	47
Grand Val T RC 10A	1	50	6.44	8.13	65.44	23.44	14.7	26.12	2.61	1.732122	7.26	529	38	43
Grand Val T RC 10B	2	50	4.42	1.45	58.77	18.27	15.4	22.23	2.22	1.732122	7.11	538	38	43
Grand Val T RC 11A	1	55	5.6	1.6	56.04	17.28	15.3	22.04	2.20	1.702113	7.17	547	38	43
Grand Val T RC 11B	2	55	5.95	1.67	54.82	16.38	15.4	21.03	2.10	1.702113	7.17	537	38	43
Grand Val T RC 12A	1	60	5.93	1.64	62.73	19.11	14.3	22.07	2.21	1.590247	7.28	510	40.5	46
Grand Val T RC 12B	2	60	5.67	1.74	58.69	17.9	14.8	25.92	2.59	1.590247	7.26	506	40.5	46
Grand Val T RC 13A	1	66	5.44	1.61	60.74	17.99	14.5	25.91	2.59	1.684193	7.21	492	40.5	46
Grand Val T RC 13B	2	66	6.05	1.83	68.43	20.33	15.2	22.37	2.24	1.684193	7.33	534	40.5	46

Total metals using EPA Method 3051B for Reference Core

Metal RC		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand ValleyRC 1	Avg.	21.1100	1.9600	67.2200	40.6800	8.7950
	StDev	*0.78*	*0.10*	*1.92*	*2.70*	*9.91*
Grand ValleyRC 2	Avg.	13.4700	1.8650	59.3350	23.2550	12.5000
	StDev	*0.30*	*0.09*	*7.13*	*2.26*	*0.14*
Grand ValleyRC 3	Avg.	14.5200	1.9250	56.3050	20.7150	8.2000
	StDev	*1.60*	*0.15*	*4.29*	*1.58*	*1.27*
Grand ValleyRC 4	Avg.	9.3000	1.2650	52.1750	15.8900	8.3500
	StDev	*0.85*	*0.12*	*2.14*	*0.91*	*0.35*
Grand ValleyRC 5	Avg.	6.1750	1.6100	53.5000	15.7700	13.8000
	StDev	*0.06*	*0.44*	*0.16*	*0.76*	*0.14*
Grand ValleyRC 6	Avg.	3.4250	1.3000	53.1250	15.4400	13.8500
	StDev	*0.76*	*0.14*	*1.63*	*0.91*	*0.49*
Grand ValleyRC 7	Avg.	6.2500	2.7600	64.4050	20.4350	15.3000
	StDev	*0.62*	*1.00*	*3.83*	*1.11*	*1.27*
Grand ValleyRC 8	Avg.	9.5250	1.5150	61.2700	18.4000	16.9500
	StDev	*3.56*	*0.21*	*6.42*	*2.50*	*7.42*
Grand ValleyRC 9	Avg.	7.5000	1.5800	52.9850	16.0900	18.8500
	StDev	*5.52*	*0.44*	*1.55*	*1.41*	*10.25*
Grand ValleyRC 10	Avg.	5.4300	4.7900	62.1050	20.8550	15.0500
	StDev	*1.43*	*4.72*	*4.72*	*3.66*	*0.49*
Grand ValleyRC 11	Avg.	5.7750	1.6350	55.4300	16.8300	15.3500
	StDev	*0.25*	*0.05*	*0.86*	*0.64*	*0.07*
Grand ValleyRC 12	Avg.	5.8000	1.6900	60.7100	18.5050	14.5500
	StDev	*0.18*	*0.07*	*2.86*	*0.86*	*0.35*
Grand ValleyRC 13	Avg.	5.7450	1.7200	64.5850	19.1600	14.8500
	StDev	*0.43*	*0.16*	*5.44*	*1.65*	*0.49*

Italics = Below Detectable Limit

Water Soluble metals for Reference Core

Sample Name	Rep	Depth (cm)	As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)	OM (mg)	OM %	pH	Cond (uS/cm)	% clay	% silt
WestRW RC 1A	1	5	0.716	13.03	0.618	0.308	0.308	127.25	12.72%	5.54	936	34.5	42.5
WestRW RC 1B	2	5	0.158	*0.014*	0.353	0.049	*0.055*	128.34	12.83%	5.5	941	34.5	42.5
WestRW RC 2A	1	10	0.407	*0.094*	1.304	0.372	*0.066*	75.67	7.57%	5.77	696	34.5	42.5
WestRW RC 2B	2	10	0.128	*0.002*	0.828	0.18	*0.024*	75.74	7.57%	5.81	705	34.5	42.5
WestRW RC 3A	1	15	0.346	*0.044*	1.07	0.231	*0.019*	89.89	8.99%	5.94	860	34.5	42.5
WestRW RC 3B	2	15	0.153	*0.002*	0.605	0.089	*0.038*	87.86	8.79%	5.9	953	34.5	42.5
WestRW RC 4A	1	20	0.275	*0.064*	1.685	0.316	*0.027*	41.30	4.13%	6.26	547	32.5	43
WestRW RC 4B	2	20	0.098	0	0.572	0.115	*0.014*	55.16	5.52%	6.28	586	32.5	43
WestRW RC 5A	1	25	0.127	*0.085*	1.458	0.193	*0.007*	24.50	2.45%	7.05	480	32.5	43
WestRW RC 5B	2	25	0.046	*0.013*	2.005	0.278	*0.006*	25.61	2.56%	7.12	485	32.5	43
WestRW RC 6A	1	30	0.11	*0.039*	1.291	0.147	*0.027*	23.11	2.31%	7.21	476	32.5	43
WestRW RC 6B	2	30	0.043	*0.025*	0.382	*0.05*	*0.009*	22.55	2.25%	7.24	475	32.5	43
WestRW RC 7A	1	35	0.12	*0.064*	2.856	0.375	*0.034*	23.38	2.34%	7.16	542	44.5	35.5
WestRW RC 7B	2	35	0.053	*0.005*	1.51	0.207	*0.016*	23.16	2.32%	7.08	533	44.5	35.5
WestRW RC 8A	1	40	0.13	*0.059*	4.498	0.726	*0.042*	22.03	2.20%	7.01	607	44.5	35.5
WestRW RC 8B	2	40	0.107	*0.043*	4.171	0.682	*0.025*	21.55	2.15%	7.14	656	44.5	35.5
WestRW RC 9A	1	45	0.16	0.145	8.851	1.551	*0.037*	18.83	1.88%	7.12	597	36	47
WestRW RC 9B	2	45	0.144	2.222	5.619	0.927	*0.036*	23.41	2.34%	7.11	598	36	47
WestRW RC 10A	1	50	0.201	0.23	11.02	2.141	*0.066*	26.12	2.61%	7.26	529	38	43
WestRW RC 10B	2	50	0.14	0.117	7.627	1.279	*0.037*	22.23	2.22%	7.11	538	38	43
WestRW RC 11A	1	55	0.129	*0.011*	1.183	0.171	*0.034*	22.04	2.20%	7.17	547	38	43
WestRW RC 11B	2	55	0.172	0.116	5.075	0.774	*0.04*	21.03	2.10%	7.17	537	38	43
WestRW RC 12A	1	60	0.155	*0.061*	5.123	0.849	*0.042*	22.07	2.21%	7.28	510	40.5	46
WestRW RC 12B	2	60	0.167	0.175	8.044	1.043	*0.051*	25.92	2.59%	7.26	506	40.5	46
WestRW RC 13A	1	66	0.116	*0.084*	5.356	0.837	*0.036*	25.91	2.59%	7.21	492	40.5	46
WestRW RC 13B	2	66	*0.049*	*0.027*	3.124	0.471	*0.022*	22.37	2.24%	7.33	534	40.5	46

Italics= Below Detectable Limit

	Water RC		As (mg/kg)	Be (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Sb (mg/kg)
Grand ValleyRC 1		Avg.	0.4370	6.5220	0.4855	0.1785	0.1815
		StDev	*0.39*	*9.20*	*0.19*	*0.18*	*0.18*
Grand ValleyRC 2		Avg.	0.2675	0.0480	1.0660	0.2760	0.0450
		StDev	*0.20*	*0.07*	*0.34*	*0.14*	*0.03*
Grand ValleyRC 3		Avg.	0.2495	0.0230	0.8375	0.1600	0.0285
		StDev	*0.14*	*0.03*	*0.33*	*0.10*	*0.01*
Grand ValleyRC 4		Avg.	0.1865	0.0320	1.1285	0.2155	0.0205
		StDev	*0.13*	*0.05*	*0.79*	*0.14*	*0.01*
Grand ValleyRC 5		Avg.	0.0865	0.0490	1.7315	0.2355	0.0065
		StDev	*0.06*	*0.05*	*0.39*	*0.06*	*0.00*
Grand ValleyRC 6		Avg.	0.0765	0.0320	0.8365	0.0985	0.0180
		StDev	*0.05*	*0.01*	*0.64*	*0.07*	*0.01*
Grand ValleyRC 7		Avg.	0.0865	0.0345	2.1830	0.2910	0.0250
		StDev	*0.05*	*0.04*	*0.95*	*0.12*	*0.01*
Grand ValleyRC 8		Avg.	0.1185	0.0510	4.3345	0.7040	0.0335
		StDev	*0.02*	*0.01*	*0.23*	*0.03*	*0.01*
Grand ValleyRC 9		Avg.	0.1520	1.1835	7.2350	1.2390	0.0365
		StDev	*0.01*	*1.47*	*2.29*	*0.44*	*0.00*
Grand ValleyRC 10		Avg.	0.1705	0.1735	9.3235	1.7100	0.0515
		StDev	*0.04*	*0.08*	*2.40*	*0.61*	*0.02*
Grand ValleyRC 11		Avg.	0.1505	0.0635	3.1290	0.4725	0.0370
		StDev	*0.03*	*0.07*	*2.75*	*0.43*	*0.00*
Grand ValleyRC 12		Avg.	0.1610	0.1180	6.5835	0.9460	0.0465
		StDev	*0.01*	*0.08*	*2.07*	*0.14*	*0.01*
Grand ValleyRC 13		Avg.	0.0825	0.0555	4.2400	0.6540	0.0290
			0.05	*0.04*	*1.58*	*0.26*	*0.01*

Italics = Below Detectable Limit

Minimum Detection Limits

Minimum Detection Limit

MDL = $s * t_{(n-1,\ 1-\alpha=0.99)}$ — n = number of replicates (1-5 times the estimated MDL)

s = standard deviation of measured concentrations of replicates

With 7 replicates, t = 3.14 — t = Students' t value at n-1 degrees of freedom and 1-α(99 percent) confidence level

a = level of significance

OR

The detection limit (DL) may be expressed as:=3X STANDRD DEVIATION OF LOW CONCEN/ SLOPE OF THE CALIBRATION LINE

= 3 * StDev / 0.99

Sample-2	Elem	Al3944	As1890	Ba2335	Be2348	Cd2265	Co2378	Cr2677	Cu3247	Fe2382	Fe2404	Fe2598	Mo2045	Ni2216	Pb2203	Se1960	Ti3361	V_2908	Zn2025		Y_3242	Y_3710
	Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm		Cts/S	Cts/S
MDL	Avg	-0.654	0.492	0.502	0.417	0.442	0.495	0.457	0.569	0.427	0.405	0.307	0.443	0.491	0.473	0.574	0.487	0.472	0.487		5017.4	11587.0
	Stddev	0.038	0.002	0.002	0.004	0.002	0.027	0.006	0.003	0.015	0.018	0.019	0.002	0.002	0.002	0.003	0.004	0.013	0.002		23.765	54.814
	MDL	0.118	0.008	0.007	0.012	0.007	0.084	0.019	0.009	0.046	0.056	0.059	0.008	0.007	0.007	0.010	0.013	0.041	0.007			
	DL	0.114	0.007	0.007	0.012	0.007	0.081	0.019	0.009	0.045	0.054	0.057	0.007	0.007	0.007	0.010	0.013	0.040	0.007			

Any values below the MDL would be considered an estimate only. It can be highlight or identified in some way in the table or it can be replaced with BDL (Below Detection Limit) then have another table with your MDLs listed.

Also any values that show a negated value e.g. -0.2360, that value is a zero not a BDL. This means that it is below the blank value therefore it is not detected. This is different from an element that is detected but below the maximum detection limit.

Yittrium (Y) is used as an internal standard to make sure the instrument is working the same from the beginning of analysis to the end of analysis.

	Elem	As1890	As1937	As1972	As2288	Be2348	Be3130	Be3131	Ni2216	Ni2303	Ni2316	Pb2169	Pb2203	Pb2833	Sb2068	Sb2175	Sb2311
0.5 ppm Standard	Avg	.4916	.4523	.4750	i .5882	.4165	i .9105	i .8915	.4914	.2889	.0356	.5009	.4730	.5475	.4524	.5352	.4898
	Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	Stddev	.0024	.0035	.0033	.0031	.0038	.0036	.0036	.0022	.0020	.0022	.0030	.0023	.3116	.0034	.0036	.0044
Unknown	%RSD	.4928	.7649	.7011	.5199	.9142	.3910	.4007	.4536	.6927	6.248	.6036	.4858	56.92	.7624	.6766	.8994
MDL = $s * t_{(n-1,\ 1-\alpha=0.99)}$	MDL	0.008	0.011	0.010	0.010	0.012	0.011	0.011	0.007	0.006	0.007	0.009	0.007	0.979	0.011	0.011	0.014
MDL= 3 * StDev / 0.99	MDL	0.007	0.010	0.010	0.009	0.012	0.011	0.011	0.007	0.006	0.007	0.009	0.007	0.944	0.010	0.011	0.013

APPENDIX B: BULK DENSITY

Bulk Density

Core # 6

Section	Core #6 Depth (cm)	Height of ection (cm)	Weight (g)	Volume	Bulk Density
1	0-5	5	40.02	209.27	0.191
2	5-10	5	63.91	209.274	0.305
3	10-15	5	80.69	209.27	0.386
4	15-20	5	295.92	209.27	1.414
5	20-25	5	362.32	209.27	1.731
6	25-30	5	340.1	209.27	1.625
7	30-35	5	342.7	209.27	1.638
8	35-40	5	326.75	209.27	1.561
9	40-45	5	413.73	209.27	1.977
10	45-50	5	405	209.27	1.935
11	50-55	5	297.36	209.27	1.420
12	55-60	5	397.36	209.27	1.899
13	60-65	5	369.47	209.27	1.766
14	65-70	5	353.48	209.27	1.689
15	70-75	5	343.21	209.27	1.640
					1.412

Core #10

Section	Core #10 Depth (cm)	Height of Section (cm)	Weight (g)	Volume	Bulk Density
1	0-5	5	33.37	209.27	0.159
2	5-8	3	38.47	125.56	0.306
3	8-13	5	51.64	209.27	0.247
4	13-18	5	61.04	209.27	0.292
5	18-23	5	59.67	209.27	0.285
6	23-28	5	78.25	209.27	0.374
7	28-31.5	3.5	86.11	146.49	0.588
8	31.5-36.5	5	251.07	209.27	1.200
9	36.5-41.5	5	226.71	209.27	1.083
10	41.5-46.5	5	296.18	209.27	1.415
11	46.5-50	5	234.42	209.27	1.120
12	50-55	3.5	315.22	146.49	2.152
13	55-60	5	296.95	209.27	1.419
14	60-65	5	293.95	209.27	1.405
15	65-70	5	267.3	209.27	1.277
16	70-75	5	250.74	209.27	1.198
17	75-78	3	147.55	125.56	1.175
					0.9233

Core #19

Section	Core #19 Depth (cm)	Height of Section (cm)	Weight (g)	Volume	Bulk Density
1	0-5	5	191	209.27	0.913
2	5-10	5	219.18	209.27	1.0474
3	10-15	5	247.8	209.27	1.184
4	15-20	5	313.28	209.27	1.497
5	20-25	5	303.52	209.27	1.450
6	25-30	5	331.73	209.27	1.585
7	30-35	5	343.73	209.27	1.642
8	35-40	5	326.88	209.27	1.562
9	40-45	5	357.23	209.27	1.707
10	45-48	3	173.99	125.56	1.386
					1.397

Core #11

Section	Core #11 Depth (cm)	Height of Section (cm)	Weight (g)	Volume	Bulk Density
1	0-5	5	28.34	209.27	0.135
2	5-10	5	57.4	209.27	0.274
3	10-15	5	87.68	209.27	0.419
4	15-20	5	51.93	209.27	0.248
5	20-25	5	57.74	209.27	0.276
6	25-30	5	62.31	209.27	0.298
7	30-33	3	36.74	125.561	0.293
8	33-38	5	272.36	209.27	1.301
9	38-43	5	314.5	209.27	1.503
10	43-48	5	306.59	209.27	1.465
11	48-53	5	351.78	209.27	1.681
12	53-58	5	314.23	209.27	1.502
13	58-61	3	170.36	125.561	1.357
14	61-66	5	258.43	209.27	1.235
15	66-71	5	341.8	209.27	1.633
16	71-76	5	305.16	209.27	1.458
17	76-81	5	315.96	209.27	1.510
18	81-86	5	265.04	209.27	1.267
19	86-88	2	135.25	83.71	1.616
					1.025

Core RC

Section	Core RC Depth (cm)	Height of Section (cm)	Weight (g)	Volume	Bulk Density
1	0-5	5	155.05	209.27	0.741
2	5-10	5	258.63	209.27	1.236
3	10-15	5	284.63	209.27	1.360
4	15-20	5	323.8	209.27	1.547
5	20-25	5	352.88	209.27	1.686
6	25-30	5	346.65	209.27	1.656
7	30-35	5	349.89	209.27	1.672
8	35-40	5	362.98	209.27	1.734
9	40-45	5	354.48	209.27	1.694
10	45-50	5	362.48	209.27	1.732
11	50-55	5	356.2	209.27	1.702
12	55-60	5	332.79	209.27	1.590
13	60-66	6	422.94	251.12	1.684
					1.541

Appendix C: pH and Conductivity Results

Core #6		Core #11		Core #10		Core RC		Core #19	
pH	CD µS	pH	CD µS	pH	CD µS	pH	CD µS	pH	CD µS
4.97	800	5.065	702	4.47	1517	5.52	938.5	5.02	89.15
4.94	591.5	4.905	459	4.255	1569	5.79	700.5	4.865	99.35
4.855	502	4.88	497.5	4.06	1569.5	5.92	906.5	4.675	85.3
4.64	264.5	4.64	747.5	3.895	1796	6.27	566.5	4.65	47.9
4.795	75.65	4.595	599.5	4.005	1427.5	7.085	482.5	4.495	46.9
4.72	65.85	4.66	581	4.115	875.5	7.225	475.5	4.105	44.65
4.895	71	4.55	644.5	4.455	384	7.12	537.5	3.465	59.4
4.915	60.45	4.195	320	3.995	177.8	7.075	631.5	3.64	61.8
5.35	50.1	4.26	168.4	3.84	248.5	7.115	597.5	4.57	58.8
5.645	43.35	4.335	195.9	3.885	127.1	7.185	533.5	4.95	45.35
5.725	50.2	4.38	222	4.065	125.75	7.17	542		
7.05	125.1	5.28	145.3	3.655	110.3	7.27	508		
7	178.15	5.64	149.35	4.02	101.5	7.27	513		
6.99	156.85	4.645	362.5	4.205	115.4				
6.97	159.7	4.59	193.85	4.5	81.85				
		4.45	263.5	4.645	112.45				
		3.27	325.5	4.56	198.6				
		3.265	290						
		3.865	232.5						

APPENDIX D: LOSS OF IGNITION

Loss of Ignition (LOI)

Core # 19 LOI A

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Dry Soil WT (g)	Post Furance Wt + Cru (g)	Wt Difference Post Furnace Soil (g)	LOI %
1	0-5	23.5174	25.869	2.3516	25.6798	0.1892	8.0456%
2	5-10	24.9536	27.3175	2.3639	27.1278	0.1897	8.0249%
3	10-15	24.4096	26.9649	2.5553	26.8272	0.1377	5.3888%
4	15-20	24.9411	27.1859	2.2448	27.1138	0.0721	3.2119%
5	20-25	23.2419	25.6955	2.4536	25.6517	0.0438	1.7851%
6	25-30	38.5268	40.5464	2.0196	40.5221	0.0243	1.2032%
7	30-35	34.1878	37.2264	3.0386	37.1702	0.0562	1.8495%
8	35-40	27.3052	29.231	1.9258	29.1908	0.0402	2.0874%
9	40-45	23.9589	26.4704	2.5115	26.4194	0.051	2.0307%
10	45-48	24.3721	26.8967	2.5246	26.8491	0.0476	1.8854%

Core #19 LOI B

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	23.5476	26.3735	2.8259	26.1435	0.23	8.1390%
2	5-10	16.1293	18.9776	2.8483	18.7285	0.2491	8.7456%
3	10-15	25.1165	27.7294	2.6129	27.591	0.1384	5.2968%
4	15-20	24.9381	27.2604	2.3223	27.1813	0.0791	3.4061%
5	20-25	26.565	29.6569	3.0919	29.5646	0.0923	2.9852%
6	25-30	27.3237	29.6052	2.2815	29.576	0.0292	1.2799%
7	30-35	26.5024	29.0356	2.5332	28.9925	0.0431	1.7014%
8	35-40	26.8994	29.1355	2.2361	29.0928	0.0427	1.9096%
9	40-45	33.9802	36.5181	2.5379	36.4649	0.0532	2.0962%
10	45-48	41.5448	44.2868	2.742	44.2349	0.0519	1.8928%

Core # 6 LOI A

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	22.5088	23.3834	0.8746	22.993	0.3904	44.6375%
2	5-10	28.8023	29.9758	1.1735	29.4708	0.505	43.0337%
3	10-15	26.2039	27.3866	1.1827	27.0659	0.3207	27.1159%
4	15-20	24.906	26.3285	1.4225	26.1753	0.1532	10.7698%
5	20-25	27.8261	32.488	4.6619	31.2728	1.2152	26.0666%
6	25-30	25.6599	27.2819	1.622	27.2671	0.0148	0.9125%
7	30-35	26.2554	30.1526	3.8972	30.0918	0.0608	1.5601%
8	35-40	26.9212	30.8617	3.9405	30.8098	0.0519	1.3171%
9	40-45	24.7468	27.2524	2.5056	27.22	0.0324	1.2931%
10	45-50	34.8357	38.5336	3.6979	38.5175	0.0161	0.4354%
11	50-55	28.8318	31.1744	2.3426	31.1614	0.013	0.5549%
12	55-60	25.1172	28.7215	3.6043	28.6628	0.0587	1.6286%
13	60-65	26.7541	29.8922	3.1381	29.8361	0.0561	1.7877%
14	65-70	26.1761	30.4558	4.2797	30.3077	0.1481	3.4605%
15	70-75	22.508	24.8827	2.3747	24.8467	0.036	1.5160%

Core # 6 LOI B

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	24.0997	25.3069	1.2072	24.6781	0.6288	52.0875%
2	5-10	28.6322	29.7948	1.1626	29.3115	0.4833	41.5706%
3	10-15	28.3357	29.6003	1.2646	29.3475	0.2528	19.9905%
4	15-20	27.4446	29.0749	1.6303	28.9801	0.0948	5.8149%
5	20-25	26.713	30.532	3.819	30.4475	0.0845	2.2126%
6	25-30	24.038	27.2807	3.2427	27.2305	0.0502	1.5481%
7	30-35	24.1074	26.4707	2.3633	26.4364	0.0343	1.4514%

8	35-40	26.0087	29.1403	3.1316	29.108	0.0323	1.0314%
9	40-45	21.5304	24.0636	2.5332	24.0449	0.0187	0.7382%
10	45-50	26.7842	30.2398	3.4556	30.2214	0.0184	0.5325%
11	50-55	27.6992	30.1594	2.4602	30.1474	0.012	0.4878%
12	55-60	23.5485	25.7521	2.2036	25.7154	0.0367	1.6655%
13	60-65	25.5536	28.0795	2.5259	28.0366	0.0429	1.6984%
14	65-70	40.9991	43.2748	2.2757	43.2466	0.0282	1.2392%
15	70-75	23.5266	26.0803	2.5537	26.038	0.0423	1.6564%

Core # 11 LOI A

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	24.4092	25.2745	0.8653	24.7538	0.5207	60.18%
2	5-10	24.2419	25.795	1.5531	25.3864	0.4086	26.31%
3	10-15	26.5646	28.4522	1.8876	27.5779	0.8743	46.32%
4	15-20	24.0929	25.2063	1.1134	24.6069	0.5994	53.84%
5	20-25	24.8196	25.9752	1.1556	25.4253	0.5499	47.59%
6	25-30	26.1347	28.0014	1.8667	27.1694	0.832	44.57%
7	30-33	39.643	40.7297	1.0867	40.264	0.4657	42.85%
8	33-38	24.3718	28.1468	3.775	28.0252	0.1216	3.22%
9	38-43	28.6363	31.7496	3.1133	31.698	0.0516	1.66%
10	43-48	37.1748	39.3099	2.1351	39.2735	0.0364	1.70%
11	48-53	24.5302	28.2902	3.76	28.2239	0.0663	1.76%
12	53-58	27.3018	32.051	4.7492	31.9598	0.0912	1.92%
13	58-61	33.7798	35.5912	1.8114	35.5384	0.0528	2.91%
14	61-66	24.95	27.5212	2.5712	27.42	0.1012	3.94%
15	66-71	16.7347	19.2152	2.4805	19.1586	0.0566	2.28%
16	71-76	23.5212	25.4393	1.9181	25.3993	0.04	2.09%
17	76-81	16.1382	19.865	3.7268	19.8387	0.0263	0.71%

18	81-86	24.9424	27.5545	2.6121	27.5402	0.0143	0.55%
19	86-88	22.5045	25.7701	3.2656	25.7398	0.0303	0.93%

Core # 11 LOI B

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	24.9361	25.2926	0.3565	25.1026	0.19	53.2959%
2	5-10	27.1871	28.1703	0.9832	27.7399	0.4304	43.7754%
3	10-15	27.3221	29.5795	2.2574	28.5168	1.0627	47.0763%
4	15-20	24.9774	26.8577	1.8803	25.8282	1.0295	54.7519%
5	20-25	38.5266	40.117	1.5904	39.339	0.778	48.9185%
6	25-30	26.4967	28.0307	1.534	27.3295	0.7012	45.7106%
7	30-33	23.2408	24.8882	1.6474	24.1512	0.737	44.7372%
8	33-38	23.9658	26.7167	2.7509	26.6375	0.0792	2.8791%
9	38-43	28.3359	30.9183	2.5824	30.8767	0.0416	1.6109%
10	43-48	24.9527	27.2265	2.2738	27.1878	0.0387	1.7020%
11	48-53	28.7997	31.5246	2.7249	31.4903	0.0343	1.2588%
12	53-58	38.0401	41.1671	3.127	41.1106	0.0565	1.8068%
13	58-61	24.1849	26.2774	2.0925	26.1968	0.0806	3.8519%
14	61-66	24.966	26.8143	1.8483	26.7304	0.0839	4.5393%
15	66-71	24.4123	27.8814	3.4691	27.8299	0.0515	1.4845%
16	71-76	25.1202	27.6766	2.5564	27.6336	0.043	1.6821%
17	76-81	23.5498	26.4681	2.9183	26.4488	0.0193	0.6613%
18	81-86	24.0332	27.2926	3.2594	27.2706	0.022	0.6750%
19	86-88	24.0958	26.5359	2.4401	26.5121	0.0238	0.9754%

Core # 10 LOI A

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	25.1184	27.1341	2.0157	25.5938	1.5403	76.4151%
2	5-8	23.9565	26.4675	2.511	24.5289	1.9386	77.2043%
3	8-13	28.644	31.597	2.953	29.2525	2.3445	79.3938%
4	13-18	16.1424	20.0649	3.9225	17.0729	2.992	76.2779%
5	18-23	41.5589	45.1455	3.5866	42.746	2.3995	66.9018%
6	23-28	28.8114	33.0544	4.243	31.1351	1.9193	45.2345%
7	28-31.5	34.2	39.8403	5.6403	38.8247	1.0156	18.0061%
8	31.5-36.5	37.1736	45.3095	8.1359	44.7175	0.592	7.2764%
9	36.5-41.5	26.1489	32.2521	6.1032	31.8136	0.4385	7.1848%
10	41.5-46.5	27.1947	33.0659	5.8712	32.7958	0.2701	4.6004%
11	46.5-50	27.3194	33.1183	5.7989	32.8586	0.2597	4.4784%
12	50-55	27.7094	34.4828	6.7734	34.2609	0.2219	3.2761%
13	55-60	24.9744	29.77	4.7956	29.6062	0.1638	3.4156%
14	60-65	28.3546	32.8716	4.517	32.685	0.1866	4.1311%
15	65-70	16.1371	18.7993	2.6622	18.7331	0.0662	2.4867%
16	70-75	26.2566	28.0525	1.7959	27.9857	0.0668	3.7196%
17	75-78	15.9261	18.4254	2.4993	18.314	0.1114	4.4572%

Core # 10 LOI B

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	16.1306	18.0399	1.9093	16.5965	1.4434	75.5984%
2	5-8	26.0816	28.521	2.4394	26.6328	1.8882	77.4043%
3	8-13	26.4983	29.534	3.0357	27.175	2.359	77.7086%
4	13-18	16.7331	22.342	5.6089	18.0385	4.3035	76.7263%
5	18-23	24.3678	27.9018	3.534	25.5713	2.3305	65.9451%
6	23-28	27.3231	31.343	4.0199	29.5638	1.7792	44.2598%
7	28-31.5	26.8962	30.6275	3.7313	29.929	0.6985	18.7200%

8	31.5-36.5	23.9614	30.4027	6.4413	29.9106	0.4921	7.6398%
9	36.5-41.5	24.888	30.256	5.368	29.8593	0.3967	7.3901%
10	41.5-46.5	26.7803	32.1193	5.339	31.8655	0.2538	4.7537%
11	46.5-50	26.7214	32.458	5.7366	32.2062	0.2518	4.3894%
12	50-55	28.8424	34.2891	5.4467	34.1061	0.183	3.3598%
13	55-60	26.7905	33.1444	6.3539	32.9264	0.218	3.4310%
14	60-65	21.526	26.6154	5.0894	26.4127	0.2027	3.9828%
15	65-70	15.9094	18.2754	2.366	18.2098	0.0656	2.7726%
16	70-75	10.378	13.6097	3.2317	13.492	0.1177	3.6420%
17	75-78	24.1073	26.3757	2.2684	26.2771	0.0986	4.3467%

Core RC LOI A

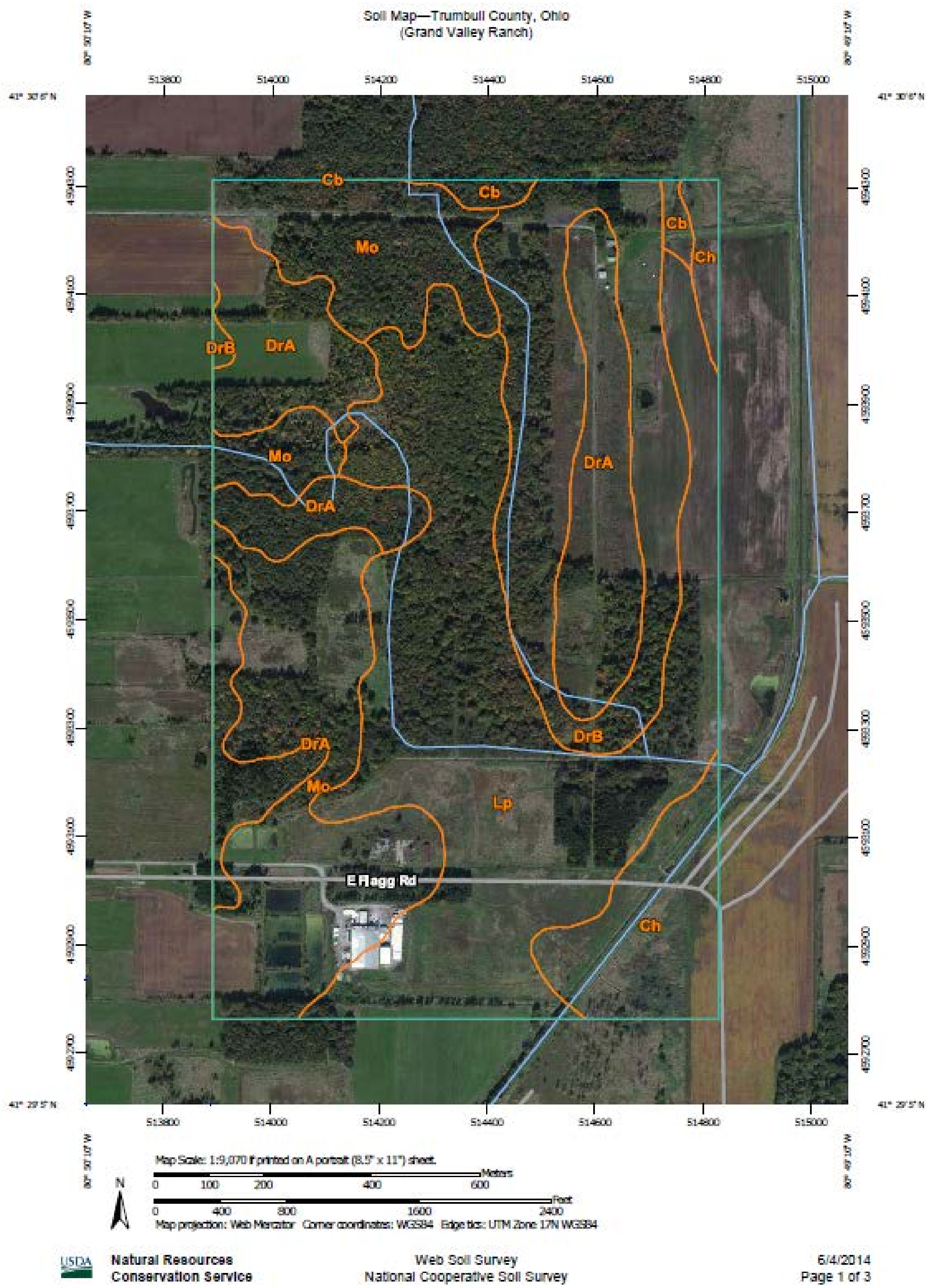
Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	23.4166	26.3204	2.9038	25.9509	0.3695	12.7247%
2	5-10	24.0928	26.0223	1.9295	25.8763	0.146	7.5667%
3	10-15	28.8304	30.9819	2.1515	30.7885	0.1934	8.9891%
4	15-20	26.715	29.4901	2.7751	29.3755	0.1146	4.1296%
5	20-25	25.5524	28.5566	3.0042	28.483	0.0736	2.4499%
6	25-30	26.7536	28.9343	2.1807	28.8839	0.0504	2.3112%
7	30-35	26.2535	28.9996	2.7461	28.9354	0.0642	2.3379%
8	35-40	26.0056	28.8607	2.8551	28.7978	0.0629	2.2031%
9	40-45	27.27	30.3821	3.1121	30.3235	0.0586	1.8830%
10	45-50	26.7853	29.1707	2.3854	29.1084	0.0623	2.6117%

11	50-55	24.9556	26.9431	1.9875	26.8993	0.0438	2.2038%
12	55-60	15.9231	18.4473	2.5242	18.3916	0.0557	2.2066%
13	60-66	24.9424	27.7563	2.8139	27.6834	0.0729	2.5907%

Core RC LOI B

Section	Depth (cm)	Crucible WT	Cru WT and Soil (g)	Actual Soil WT (g)	Heated Weight (g)	Difference in Actual Soil to Heated (g)	LOI %
1	0-5	26.1335	28.1492	2.0157	27.8905	0.2587	12.8343%
2	5-10	28.3351	31.6689	3.3338	31.4164	0.2525	7.5739%
3	10-15	24.8593	26.5824	1.7231	26.431	0.1514	8.7865%
4	15-20	23.5478	26.0442	2.4964	25.9065	0.1377	5.5159%
5	20-25	27.189	29.4299	2.2409	29.3725	0.0574	2.5615%
6	25-30	27.3026	29.7197	2.4171	29.6652	0.0545	2.2548%
7	30-35	22.5053	25.2087	2.7034	25.1461	0.0626	2.3156%
8	35-40	27.7119	29.5451	1.8332	29.5056	0.0395	2.1547%
9	40-45	24.9745	27.2	2.2255	27.1479	0.0521	2.3410%
10	45-50	10.3708	13.0066	2.6358	12.948	0.0586	2.2232%
11	50-55	24.9373	27.1198	2.1825	27.0739	0.0459	2.1031%
12	55-60	24.1058	26.6754	2.5696	26.6088	0.0666	2.5918%
13	60-66	24.0377	26.9924	2.9547	26.9263	0.0661	2.2371%

APPENDIX E: MAPS OF GRAND VALLEY HUNTING RANCH



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Trumbull County, Ohio
Survey Area Data: Version 11, Nov 26, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 7, 2011—Mar 14, 2012

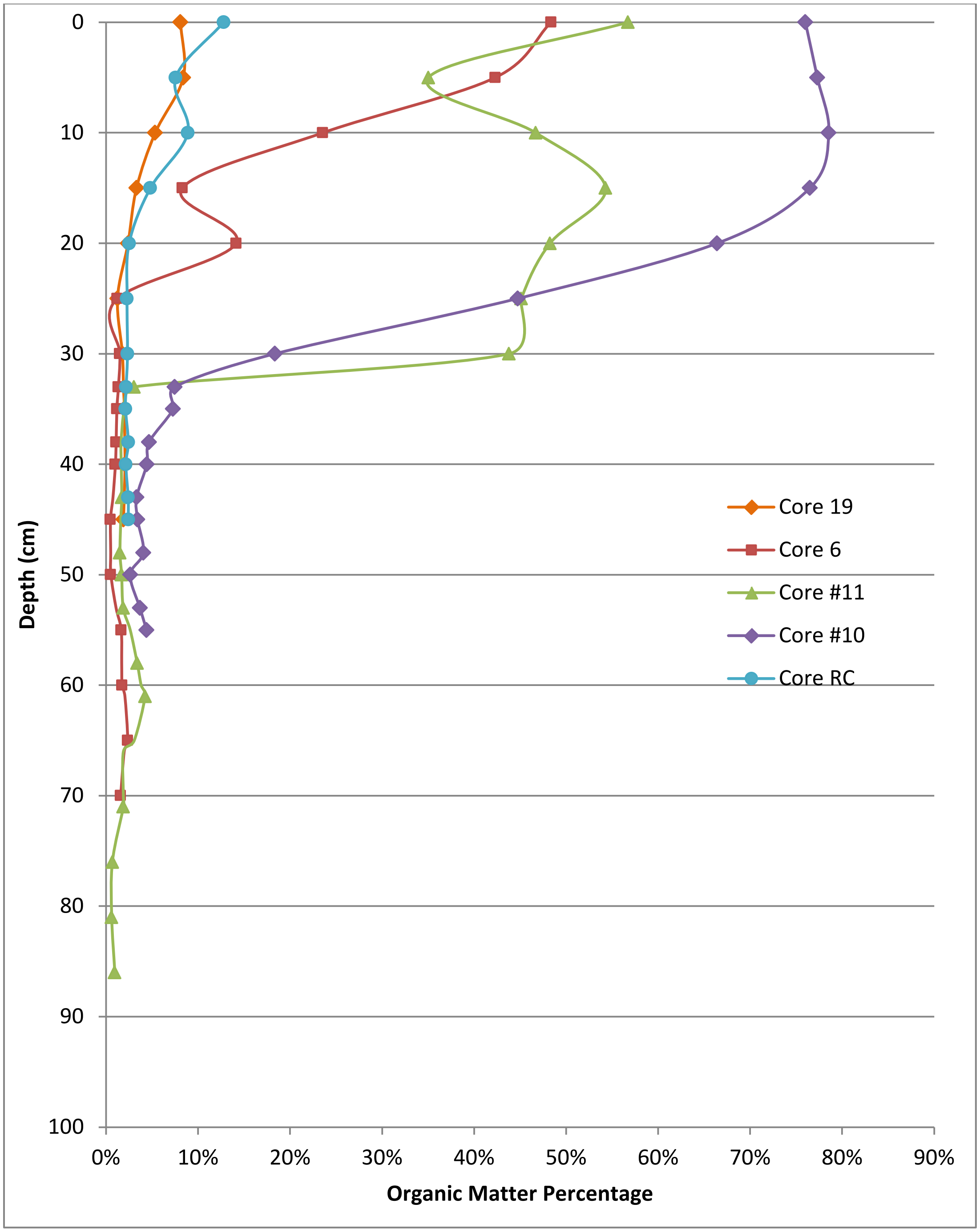
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Trumbull County, Ohio (OH155)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Cb	Canadice silty clay loam	3.6	1.0%
Ch	Carlisle muck, ponded	27.4	7.6%
DrA	Darien silt loam, 0 to 2 percent slopes	64.3	17.9%
DrB	Darien silt loam, 2 to 6 percent slopes	53.8	15.0%
Lp	Lorain silty clay loam, loamy substratum	122.4	34.0%
Mo	Mill silt loam, 0 to 2 percent slopes	88.3	24.5%
Totals for Area of Interest		**359.7**	**100.0%**

Appendix F: Sample Location Information

Sample Location	Latitude Degrees (N)	Longitude Degrees (W)	Pb Conc. % (XRF)	# of Pb Pellets	Core Latitude (N)	Core Longitude (W)
1	41° 29.966'	80° 49.336'	0.11	1		
2	41° 29.961'	80° 49.336'	0.302	1		
3	41° 29.939'	80° 49.341'	0.072	0		
4	41° 29.973'	80° 49.329'	0.105	0		
5	41° 29.972'	80° 49.346'	0.209	4		
6	41° 29.974'	80° 49.347'	0.65	16	41° 29.974'	80° 49.347'
7	41° 29.983	80° 49.346'	0.341	7		
8	41° 29.976'	80° 49.302'	0.012	0		
9	41° 29.979'	80° 49.307'	0.65	0		
10	41° 29.981'	80° 49.318'	0.693	4	41° 29.983'	80° 49.316'
11	41° 29.983'	80° 49.327'	2.062	8	41° 29.983'	80° 49.327'
12	41° 29.988'	80° 49.330'	0.414	3		
13	41° 29.982'	80° 49.334'	0.851	3		
14	41° 29.280'	80° 49.336'	0.192	0		
15	41° 29.964	80° 49.330'	0.192	0		
16	41° 29.966'	80° 49.631'	0.006	0		
17	41° 29.967'	80° 49.639'	0.01	0		
18	41° 29.958'	80° 49.642'	0.048	0		
19	41° 29.951'	80° 49.644'	0.216	3	41° 29.952'	80° 49.643'
20	41° 29.946'	80° 49.641'	0.085	0		
21	41° 29.950'	80° 49.651'	0.079	0		
22	41° 29.967'	80° 49.647'	0.003	0		
RC	N/A	N/a	N/A	N/A	41° 29.617'	80° 49.289'



Depth (cm)
0
10
20
30
40
50
60
70
80
90
100
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
Organic Matter Percentage
Core 19
Core 6
Core #11
Core #10
Core RC

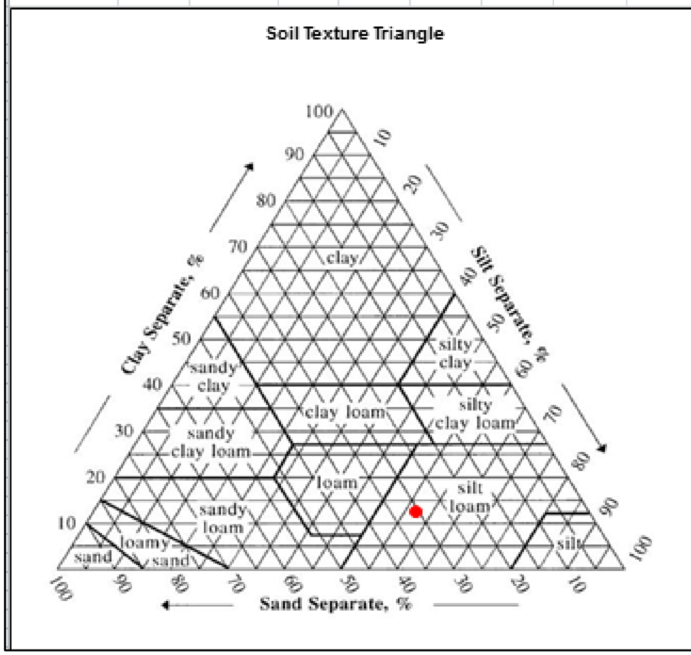
APPENDIX G: PARTICLE SIZE ANALYSIS

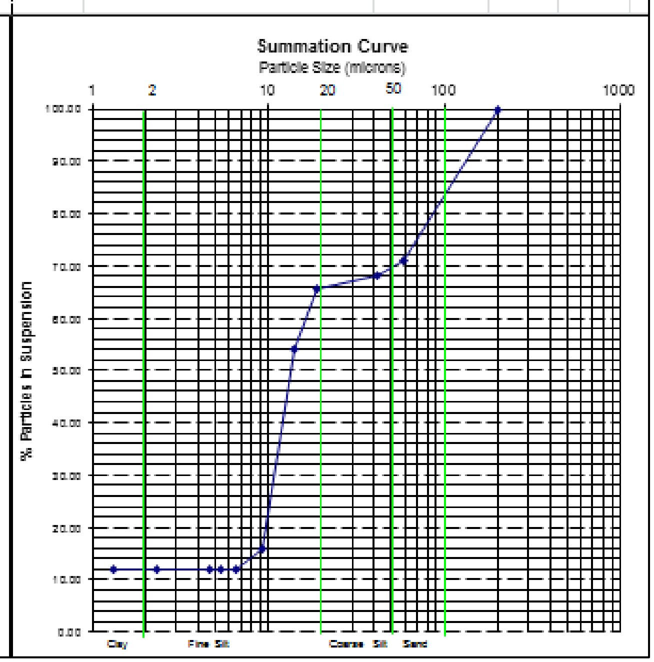
Core #6: AB 0-15 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		SILT LOAM				
Soil Name ==>#6	Sand		Clay		Silt	
Hydrometer:	% Sand	31%	% Clay	12%	% Silt	57%
Adjusted:	% Sand	31%	% Clay	12%	% Silt	57%

Sieved Sand Sizes				
% Very Coarse	0%	x=53	estimated 270 sieve sand %	
% Coarse	0%	70.00	30%	
% Medium	0%			
% Fine	0%	x=47	estimated 300 sieve sand %	
% Very Fine	0%	###	31%	
Total	0%			

Time in minutes	x	y	
0.5	58.44075601	71.00	
1	41.8468279	68.00	
480	2.310731166	12.00	
1440	1.334135902	12.00	
Log Slope of .5 to 1 minute readin	og(y) Intercep	x=50	Sand %
0.001129897	1.7852263	69.46	31%
Log Slope of 480 to 1440 minute rea	og(y) Intercep	x=2	Clay %
0	1.0791812	12.00	12%





Core #6: AB 15-25 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		SILT LOAM				
Soil Name ==> #6		Sand		Clay		Silt
Hydrometer:	% Sand	30%	% Clay	30%	% Silt	40%
Adjusted:	% Sand	30%	% Clay	30%	% Silt	40%

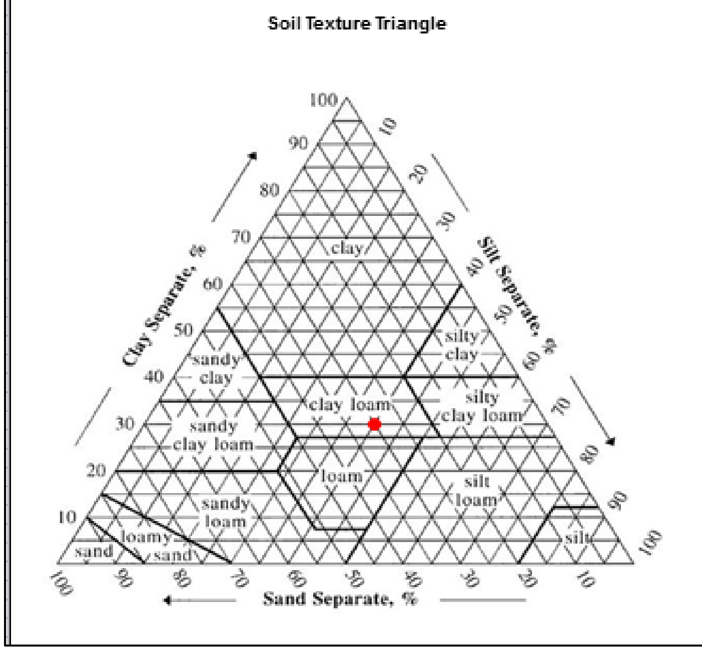
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

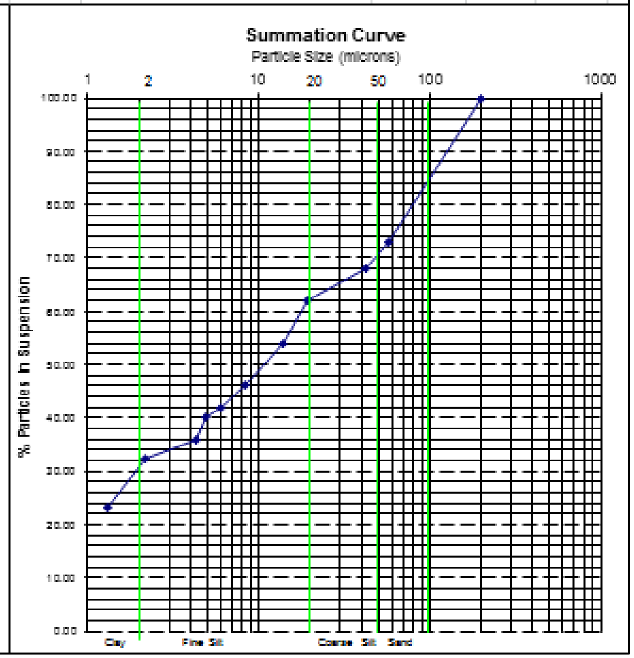
x=53	estimated 270 sieve sand %
1.85	98%
x=47	estimated 300 sieve sand %
1.84	98%

Time in minutes	x	y
0.5	57.942448	73.00
1	41.846828	68.00
480	2.1729588	32.46
1440	1.2919616	23.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001914431	1.7524	70.49	30%

Log Slope of 480 to 1440 minute reading	(y) Interce	x=2	Clay %
0.169831061	1.14231	30.34	30%





Core #6: A 25-40 cm

User Pedon ID ==>				USDA Texture				
Sample Number =>				SILT LOAM				
Soil Name ==> #6			Sand		Clay		Silt	
		Hydrometer	% Sand	39%	% Clay	25%	% Silt	36%
		Adjusted:	% Sand	39%	% Clay	25%	% Silt	36%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

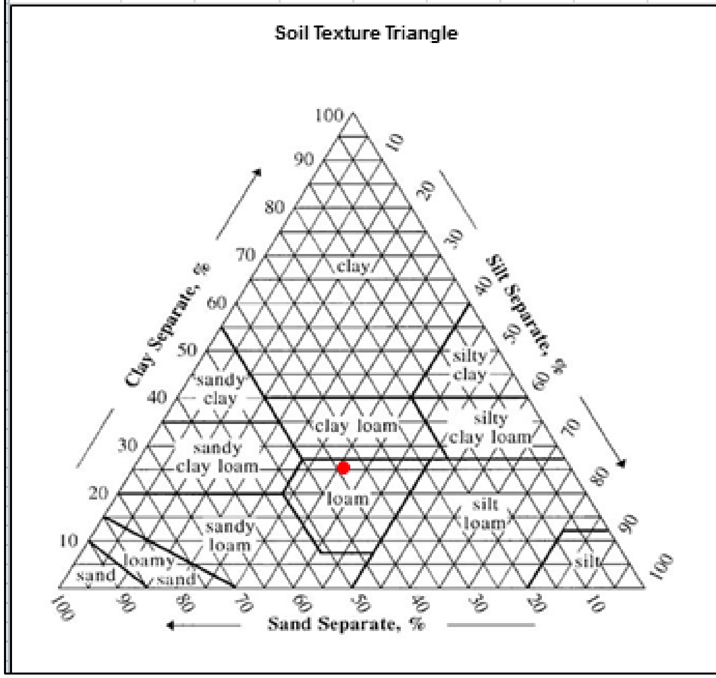
x=53	estimated 270 sieve sand %
1.79	98%

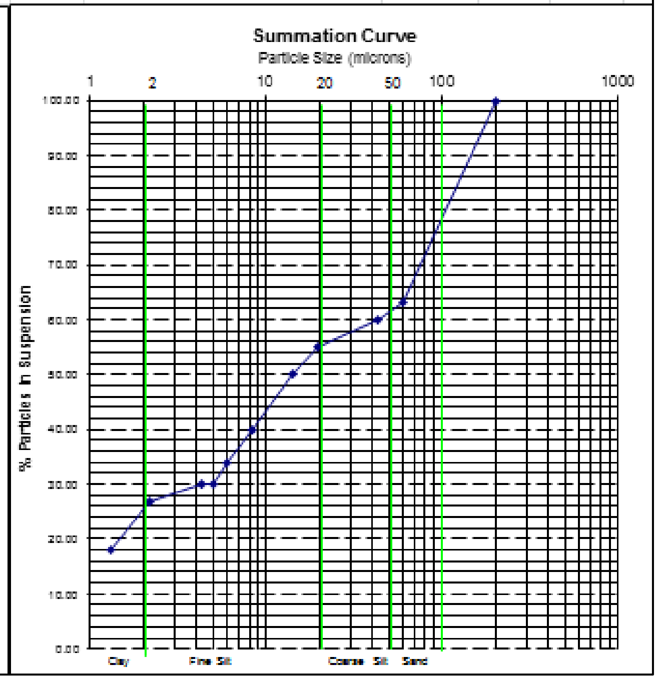
x=47	estimated 300 sieve sand %
1.78	98%

Time in minutes	x	y
0.5	59.687186	63.00
1	42.705568	60.00
480	2.1866407	26.72
1440	1.2359772	18.00

Log Slope of .5 to 1 minute readin	g(y) Interc	x=50	Sand %
0.001247779	1.72486	61.27	39%

Log Slope of 480 to 1440 minute rea	g(y) Interc	x=2	Clay %
0.192624878	1.00564	24.60	25%





Core #6: B 25-40 cm

User Pedon ID ==>				USDA Texture			
Sample Number =>				SILT LOAM			
Soil Name ==> #6			Sand		Clay		Silt
		Hydromet	% Sand	32%	% Clay	27%	% Silt 41%
		Adjusted:	% Sand	32%	% Clay	27%	% Silt 41%

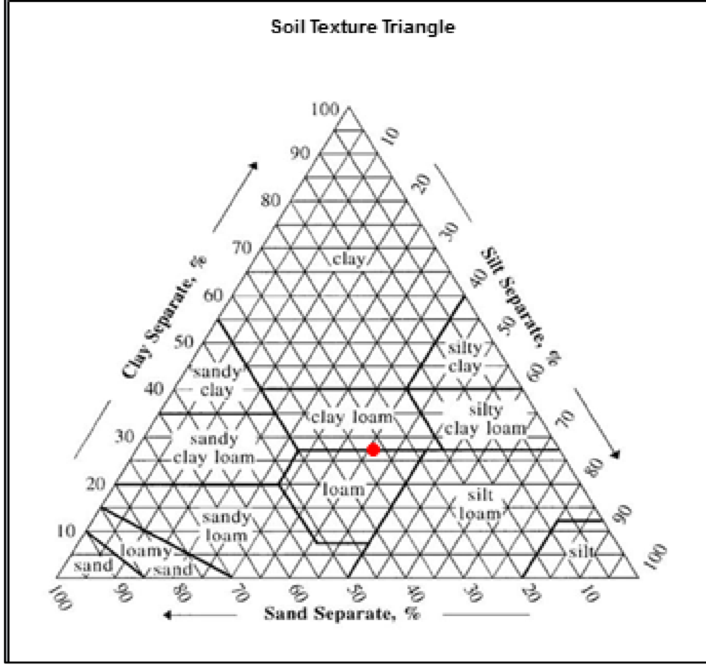
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

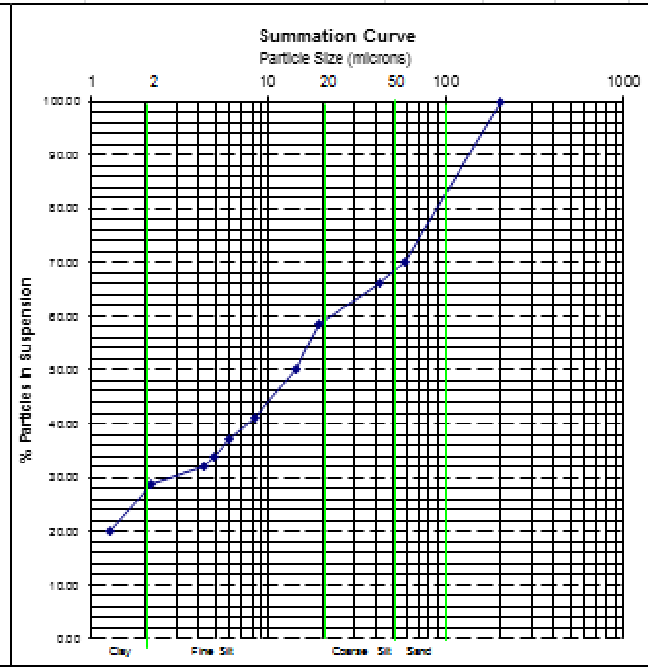
x=53	estimated 270 sieve sand %
1.84	98%
x=47	estimated 300 sieve sand %
1.83	98%

Time in minutes	x	y
0.5	58.002541	70.00
1	41.698856	66.00
480	2.173106	28.72
1440	1.2883663	20.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001567382	1.75419	68.01	32%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.177627867	1.07218	26.76	27%





Core #6: A 40-55 cm

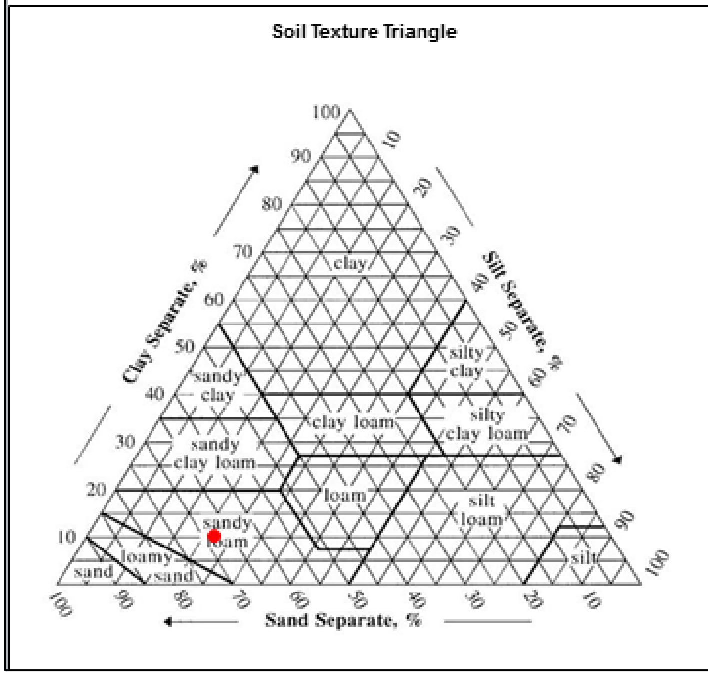
User Pedon ID ==>			USDA Texture				
Sample Number =>			SILT LOAM				
Soil Name ==> #6			Sand		Clay		Silt
	Hydromet	% Sand	68%	% Clay	10%	% Silt	22%
	Adjusted:	% Sand	68%	% Clay	10%	% Silt	22%

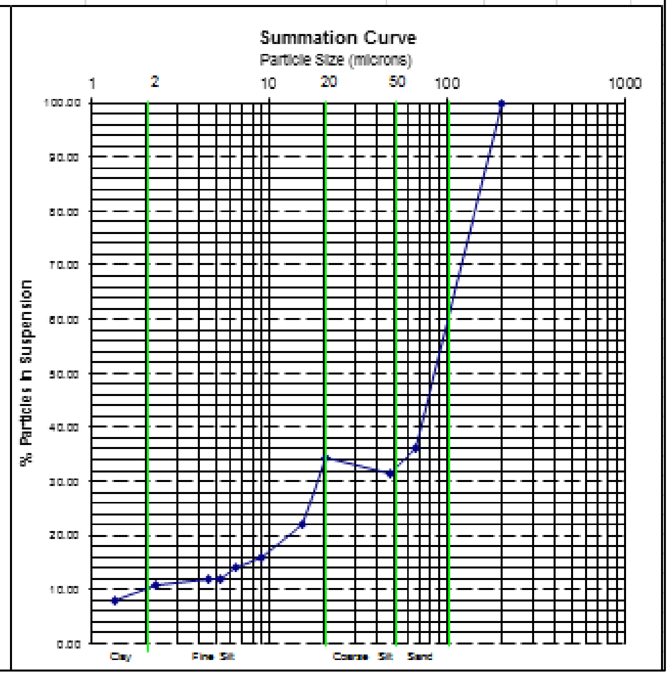
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.52	98%
x=47	estimated 300 sieve sand %
1.50	99%

Time in minutes	x	y
0.5	65.782203	36.00
1	47.195098	31.50
480	2.2908835	10.90
1440	1.3333802	8.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.00312001	1.35106	32.14	68%
Log Slope of 480 to 1440 minute reading	(y) Interce	x=2	Clay %
0.140298743	0.71602	9.92	10%





Core #6: B 40-55 cm

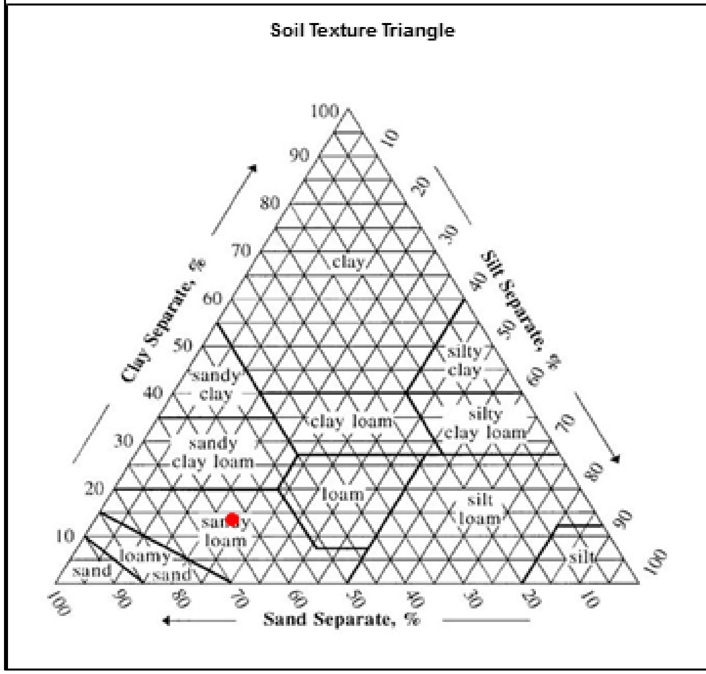
User Pedon ID ==>				USDA Texture			
Sample Number =>				SILT LOAM			
Soil Name ==> #6			Sand		Clay		Silt
		Hydromet	% Sand	63%	% Clay	13%	% Silt	24%
		Adjusted:	% Sand	63%	% Clay	13%	% Silt	24%

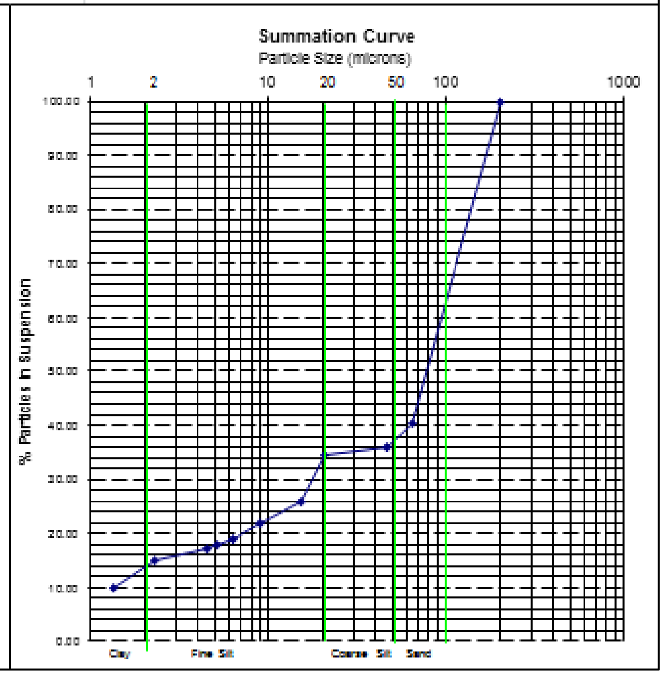
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.57	98%
x=47	estimated 300 sieve sand %
1.56	98%

Time in minutes	x	y
0.5	64.806187	40.50
1	46.515042	36.00
480	2.2636765	15.10
1440	1.325384	10.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.002796573	1.42622	36.82	63%
Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.190869548	0.74691	13.45	13%





Core #6: A 55-75 cm

User Pedon ID ==>			USDA Texture				
Sample Number =>			SILT LOAM				
Soil Name ==> #6		Sand		Clay		Silt	
	Hydromet	% Sand	19%	% Clay	48%	% Silt	33%
	Adjusted:	% Sand	19%	% Clay	48%	% Silt	33%

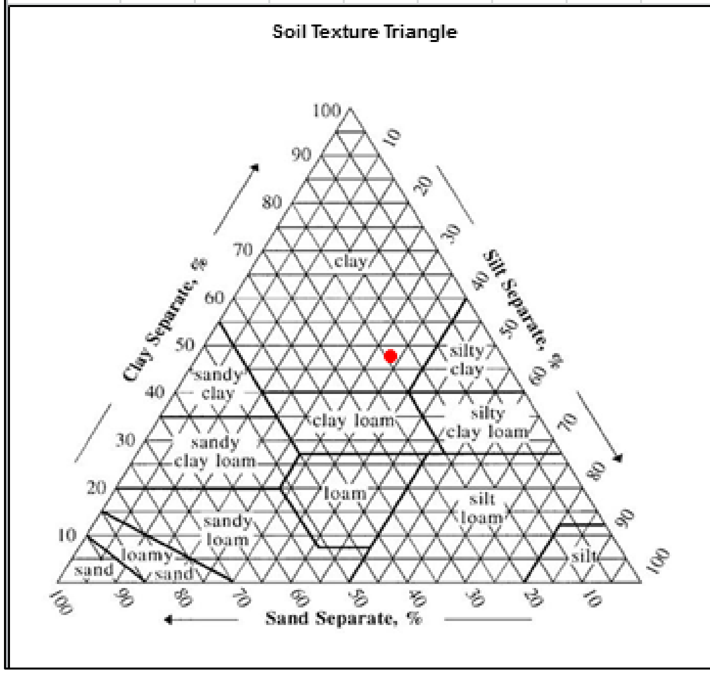
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

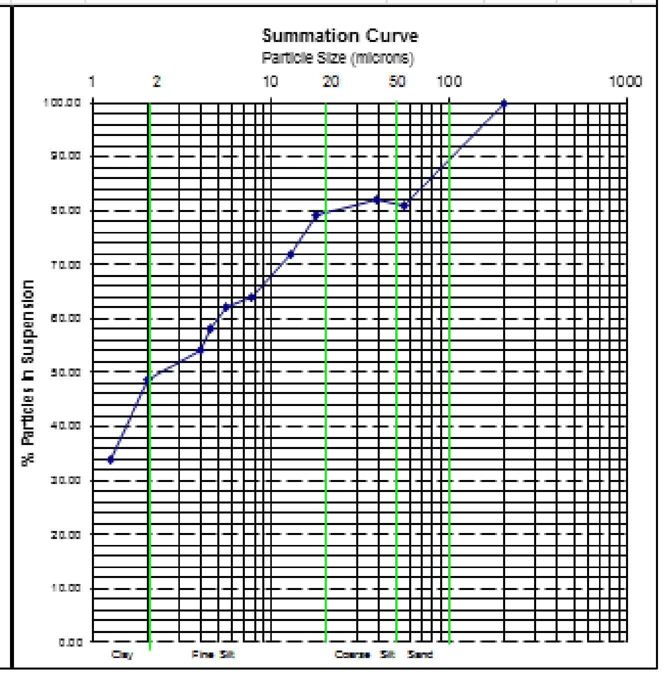
x=53	estimated 270 sieve sand %
1.91	98%
x=47	estimated 300 sieve sand %
1.91	98%

Time in minutes	x	y
0.5	55.251559	81.00
1	38.887088	82.00
480	2.0341152	48.54
1440	1.233776	34.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
-0.000325634	1.92648	81.32	19%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.193194149	1.29312	47.81	48%





Core #6: B 55-75 cm

User Pedon ID ==>		USDA Texture					
Sample Number =>		SILT LOAM					
Soil Name ==> #6		Sand		Clay		Silt	
	Hydrometer	% Sand	18%	% Clay	48%	% Silt	34%
	Adjusted:	% Sand	18%	% Clay	48%	% Silt	34%

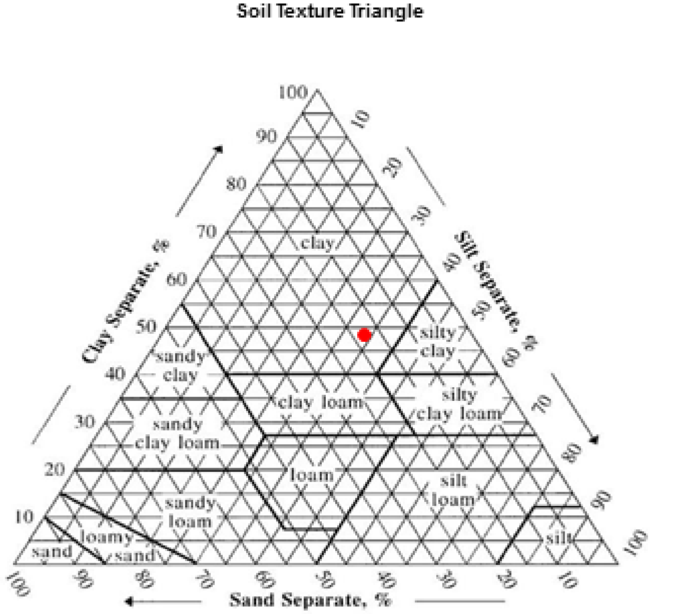
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

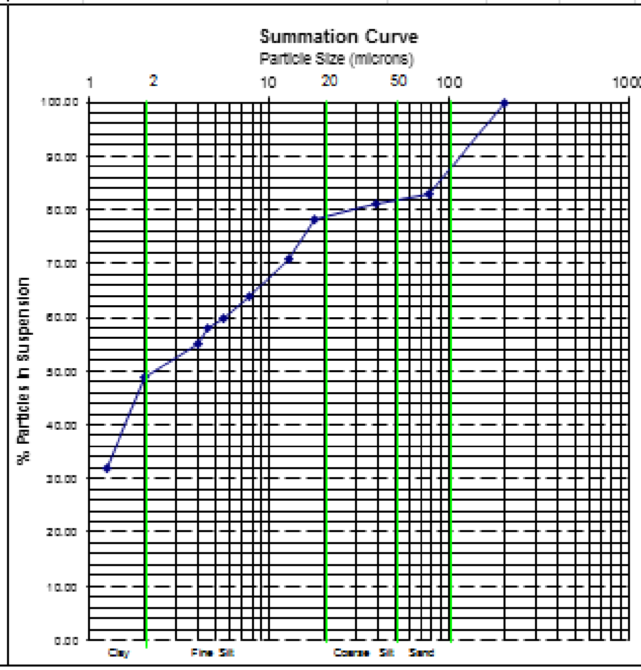
x=53	estimated 270 sieve sand %
1.91	98%
x=47	estimated 300 sieve sand %
1.91	98%

Time in minutes	x	y
0.5	76.581248	83.00
1	39.068752	81.00
480	2.0328094	48.72
1440	1.2417216	32.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.000282388	1.89745	81.58	18%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.230767418	1.2186	47.88	48%





Core #6 Viscosity Information

Parameter	Temperature	Viscosity	Viscosity	H_2O Viscosity	H_2O+HMP Sol. Viscosity
Symbol:	C	mu	mu	mu	mu
Unit:	degrees	N*sec/m2	centipoise	poise	poise
Alt Unit:		Pa*s	cp	p	p
Factor:	CX1	muX1000	muX1	muX1	muX2
	0	1.781	1781	0.01781	0.01819
	5	1.518	1518	0.01518	0.01550
	10	1.307	1307	0.01307	0.01335
	11	1.271	1271	0.01271	0.01298
	12	1.236	1236	0.01236	0.01262
	13	1.202	1202	0.01202	0.01228
	14	1.170	1170	0.01170	0.01195
	15	1.139	1139	0.01139	0.01163
	16	1.110	1110	0.01110	0.01134
	17	1.084	1084	0.01084	0.01107
	18	1.057	1057	0.01057	0.01079
	19	1.029	1029	0.01029	0.01051
	20	1.002	1002	0.01002	0.01023
	21	0.978	978	0.00978	0.00999
	22	0.955	955	0.00955	0.00975
	23	0.933	933	0.00933	0.00953
	24	0.911	911	0.00911	0.00931
	25	0.890	890	0.00890	0.00909
	26	0.871	871	0.00871	0.00889
	27	0.851	851	0.00851	0.00869
	28	0.833	833	0.00833	0.00850
	29	0.815	815	0.00815	0.00832
	30	0.798	798	0.00798	0.00815
	40	0.653	653	0.00653	0.00667
	50	0.547	547	0.00547	0.00559
	60	0.466	466	0.00466	0.00476
	70	0.404	404	0.00404	0.00413
	80	0.354	354	0.00354	0.00362
	90	0.315	315	0.00315	0.00322
	100	0.282	282	0.00282	0.00288

	Density of Water	Water+HMP Sol
Temp °C	density g/mL	density g/mL
0	0.9998425	1.003
4	0.9999750	1.003
5	0.9999668	1.003
10	0.9997026	1.003
11	0.9996084	1.003
12	0.9995004	1.003
13	0.9993801	1.003
14	0.9992474	1.002
15	0.9991026	1.002
16	0.9989460	1.002
17	0.9987779	1.002
18	0.9985986	1.002
19	0.9984082	1.002
20	0.9982071	1.001
21	0.9979955	1.001
22	0.9977735	1.001
23	0.9975415	1.001
24	0.9972995	1.000
25	0.9970479	1.000
26	0.9967867	1.000
27	0.9965162	1.000
28	0.9962365	0.999
29	0.9959478	0.999
30	0.9956502	0.999
35	0.9940349	0.997
37	0.9933316	0.996
40	0.9922187	0.995
100	0.9583665	0.961

Temperature Conversion			
°C To °F		°F To °C	
°C	°F	°F	°C
0	32.0	40	4.4
4	39.2	41	5.0
5	41.0	42	5.6
6	42.8	43	6.1
7	44.6	44	6.7
8	46.4	45	7.2
9	48.2	46	7.8
10	50.0	47	8.3
11	51.8	48	8.9
12	53.6	49	9.4
13	55.4	50	10.0
14	57.2	51	10.6
15	59.0	52	11.1
16	60.8	53	11.7
17	62.6	54	12.2
18	64.4	55	12.8
19	66.2	56	13.3
20	68.0	57	13.9
21	69.8	58	14.4
22	71.6	59	15.0
23	73.4	60	15.6
24	75.2	61	16.1
25	77.0	62	16.7
26	78.8	63	17.2
27	80.6	64	17.8
28	82.4	65	18.3
29	84.2	66	18.9
30	86.0	67	19.4
40	104	68	20.0
50	122	69	20.6
60	140	70	21.1
70	158	71	21.7
80	176	72	22.2
90	194	73	22.8
100	212	74	23.3
		75	23.9
		76	24.4
		77	25.0
		78	25.6
		79	26.1
		80	26.7

Core #10: AB 0-13 cm

User Pedon ID ==>			USDA Texture					
Sample Number =>			SANDY CLAY LOAM					
Soil Name ==>#10			Sand		Clay		Silt	
	Hydrometer:	% Sand	59%	% Clay	20%	% Silt	21%	
	Adjusted:	% Sand	59%	% Clay	20%	% Silt	21%	

Time in minutes	x	y
0.5	65.79703701	43.00
1	46.92277005	40.50
480	2.278193473	21.00
1440	1.323135378	19.00

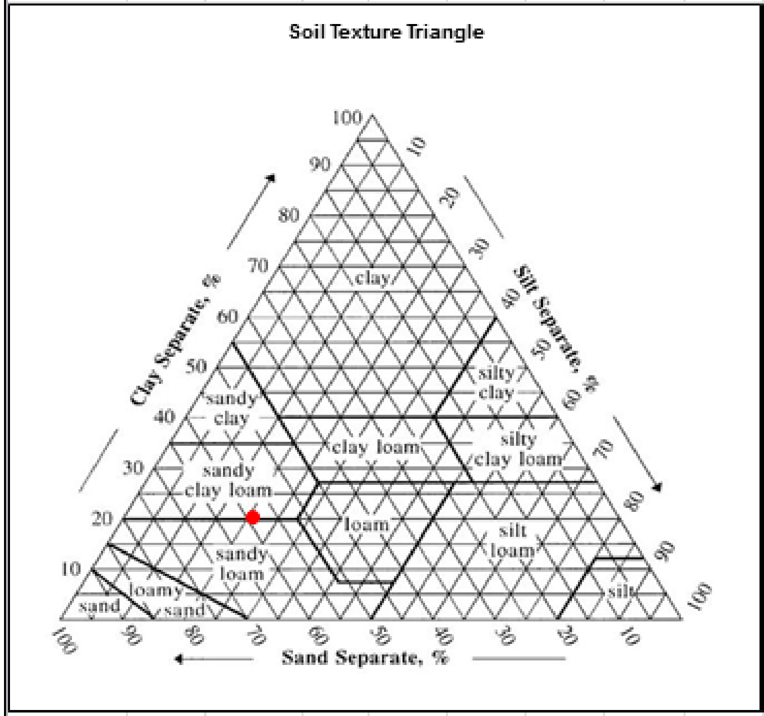
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

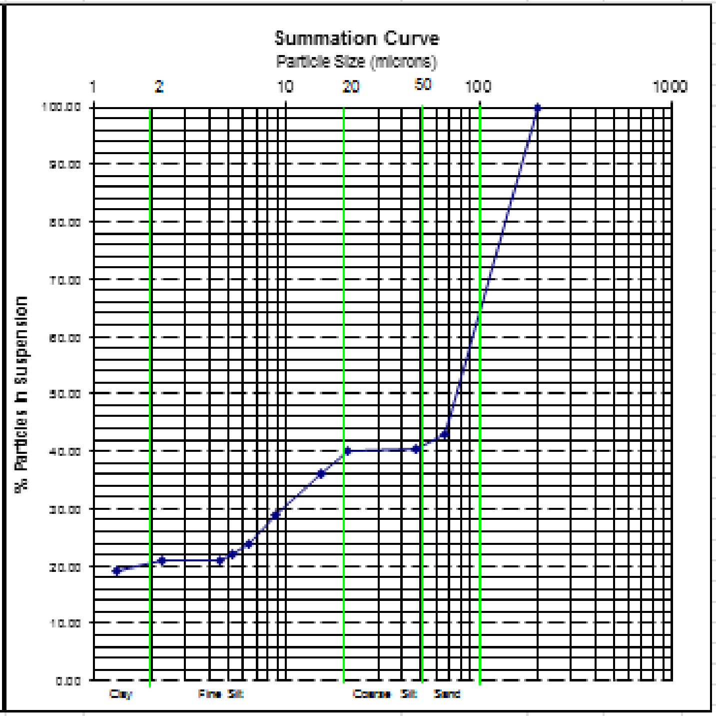
x=53	estimated 270 sieve sand %
41.29	59%

x=47	estimated 300 sieve sand %
40.51	59%

Log Slope of .5 to 1 minute reading	log(y) Intercept	x=50	Sand %
0.001378249	1.5427838	40.90	59%

Log Slope of 480 to 1440 minute reading	log(y) Intercept	x=2	Clay %
0.045510761	1.2185367	20.40	20%





Core #10: A 13-31.5 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY CLAY LOAM				
Soil Name ==> #10		Sand		Clay		Silt
Hydrometer:	% Sand	45%	% Clay	17%	% Silt	38%
Adjusted:	% Sand	45%	% Clay	17%	% Silt	38%

Time in minutes	x	y
0.5	62.557904	57.00
1	44.652738	54.50
480	2.2984769	18.00
1440	1.3386311	15.00

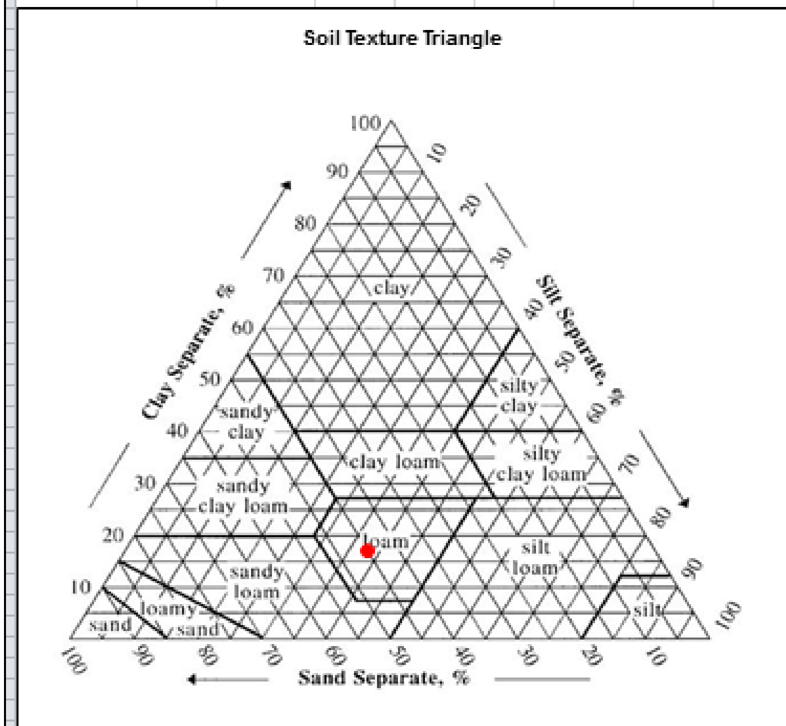
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

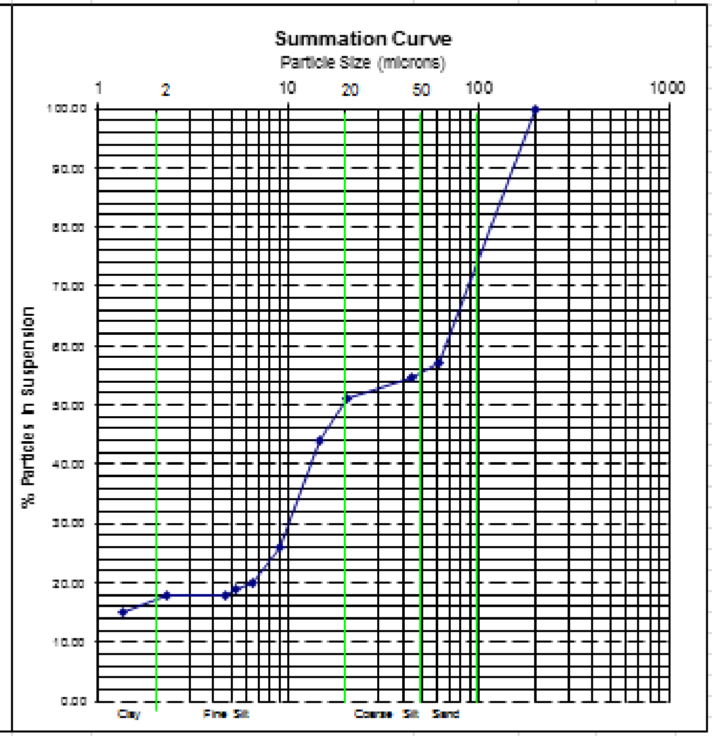
x=53	estimated 270 sieve sand %
1.75	98%

x=47	estimated 300 sieve sand %
1.74	98%

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001087862	1.68782	55.23	45%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.082493711	1.06566	17.01	17%





Core #10: B 13-31.5

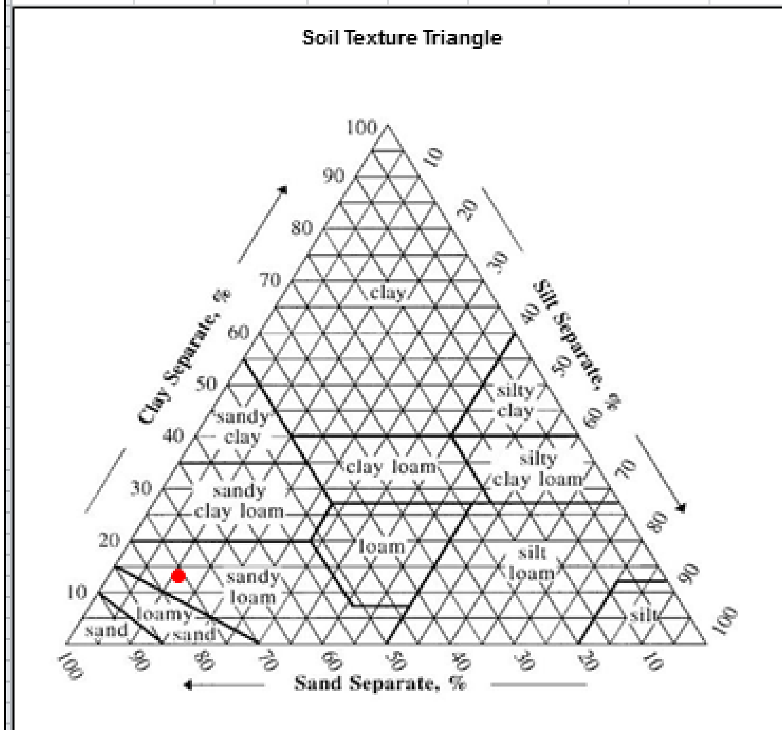
User Pedon ID ==>				USDA Texture				
Sample Number =>				SANDY CLAY LOAM				
Soil Name ==>#10			Sand		Clay		Silt	
	Hydrometer	% Sand	76%	% Clay	13%	% Silt	11%	
	Adjusted:	% Sand	76%	% Clay	13%	% Silt	11%	

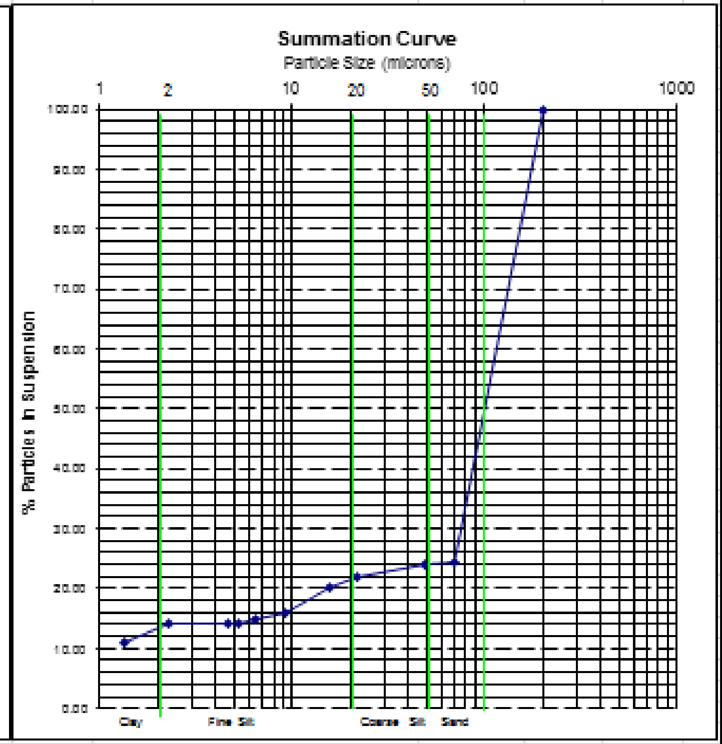
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.38	99%
x=47	estimated 300 sieve sand %
1.38	99%

Time in minutes	x	y
0.5	69.019553	24.50
1	48.878407	24.00
480	2.2976825	14.00
1440	1.337904	11.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.000444604	1.35848	24.03	76%
Log Slope of 480 to 1440 minute reading	**(y) Interce**	**x=2**	**Clay %**
0.109124507	0.89539	12.99	13%





Core #10: A 31.5-50 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY CLAY LOAM				
Soil Name ==> #10		Sand		Clay		Silt
Hydromet	% Sand	24%	% Clay	28%	% Silt	48%
Adjusted:	% Sand	24%	% Clay	28%	% Silt	48%

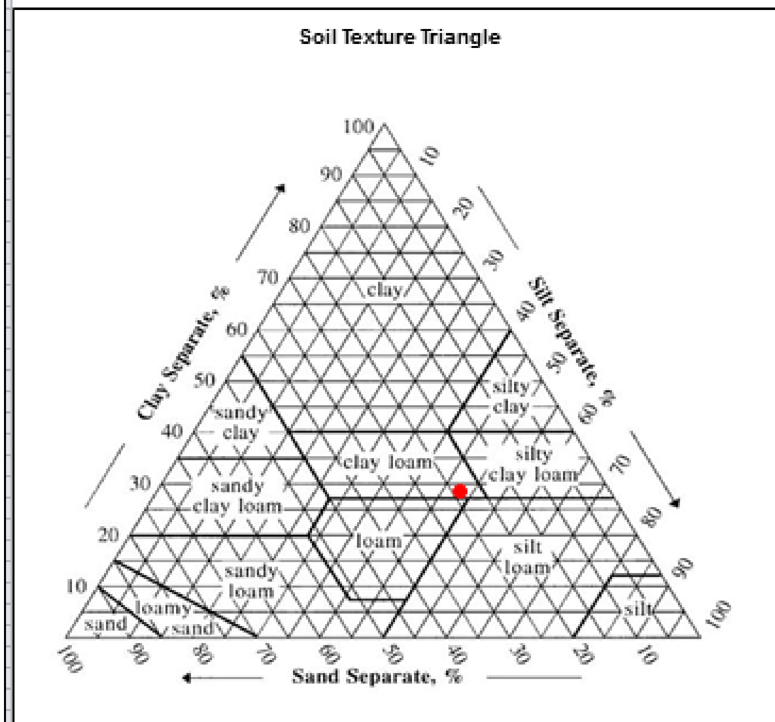
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

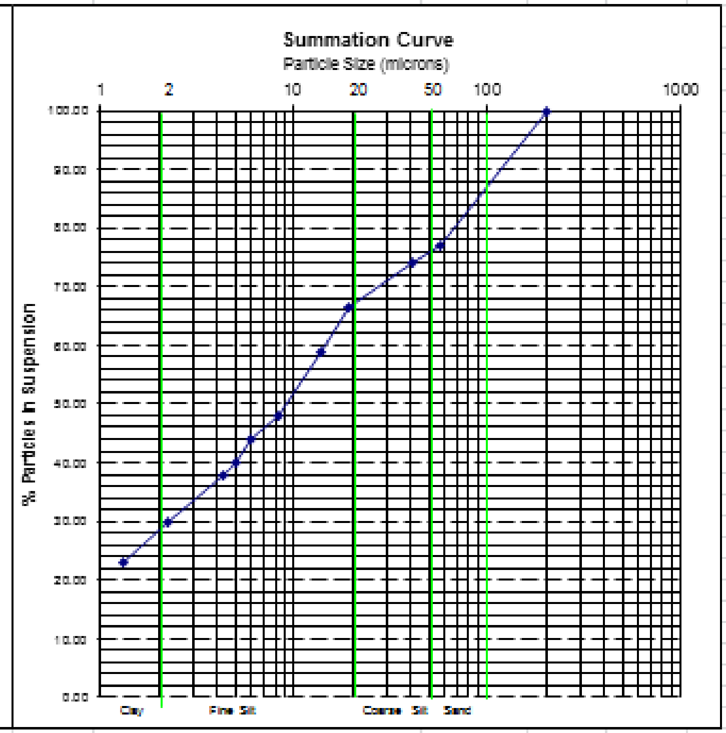
x=53	estimated 270 sieve sand %	
1.88	98%	
x=47	estimated 300 sieve sand %	
1.88	98%	

Time in minutes	x	y
0.5	57.61554	77.00
1	41.28342	74.00
480	2.2162543	30.00
1440	1.3074561	23.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001056752	1.82561	75.59	24%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.12697364	1.19572	28.16	28%





Core #10: B 31.5-50 cm

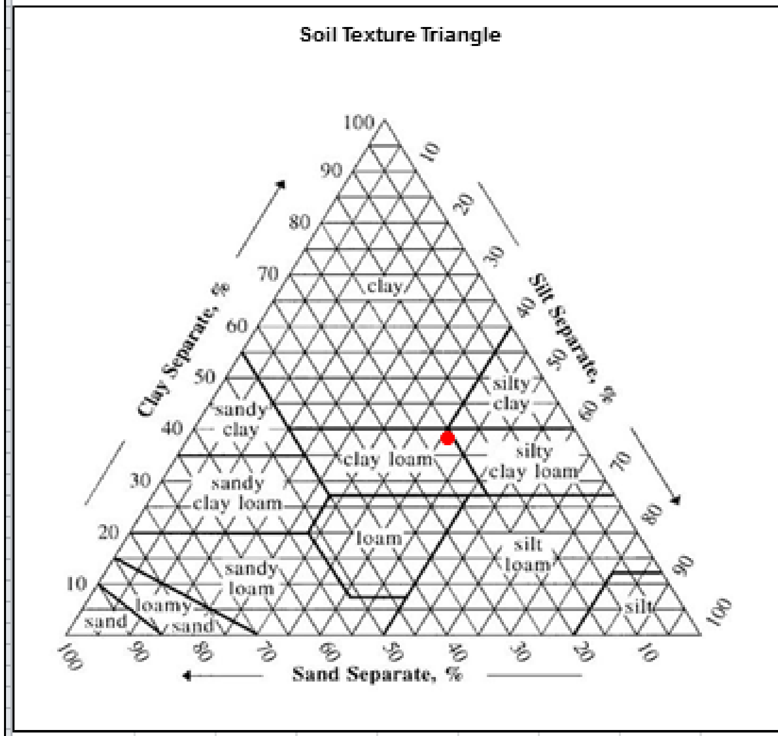
User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY CLAY LOAM				
Soil Name ==> #10		Sand		Clay		Silt
Hydromet	% Sand	21%	% Clay	38%	% Silt	41%
Adjusted:	% Sand	21%	% Clay	38%	% Silt	41%

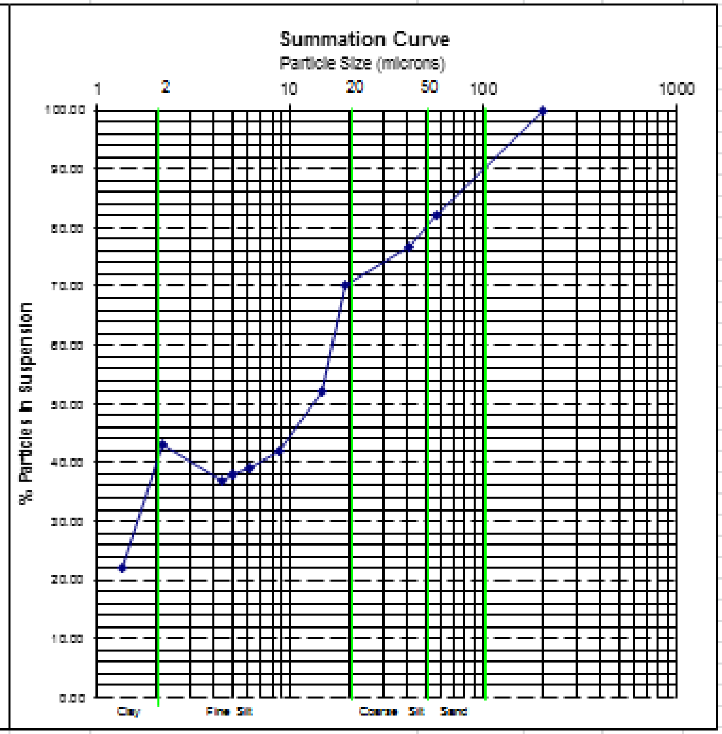
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %	
1.91	98%	
x=47	estimated 300 sieve sand %	
1.89	98%	

Time in minutes	x	y
0.5	56.997335	82.00
1	41.328129	76.50
480	2.1494263	43.00
1440	1.3273485	22.00

Log Slope of .5 to 1 minute readin	q(y) Interce	x=50	Sand %
0.001924311	1.80413	79.50	21%
Log Slope of 480 to 1440 minute rea	**q(y) Interce**	**x=2**	**Clay %**
0.354036527	0.87249	38.07	38%





Core #10: 50-60 cm

User Pedon ID ==>	USDA Texture	
Sample Number =>	SANDY CLAY LOAM	
Soil Name ==> #10		

	Sand		Clay		Silt	
Hydromet	% Sand	15%	% Clay	33%	% Silt	52%
Adjusted:	% Sand	15%	% Clay	33%	% Silt	52%

Time in minutes	x	y
0.5	54.707248	88.00
1	40.18392	80.00
480	2.1810802	35.00
1440	1.2915864	27.00

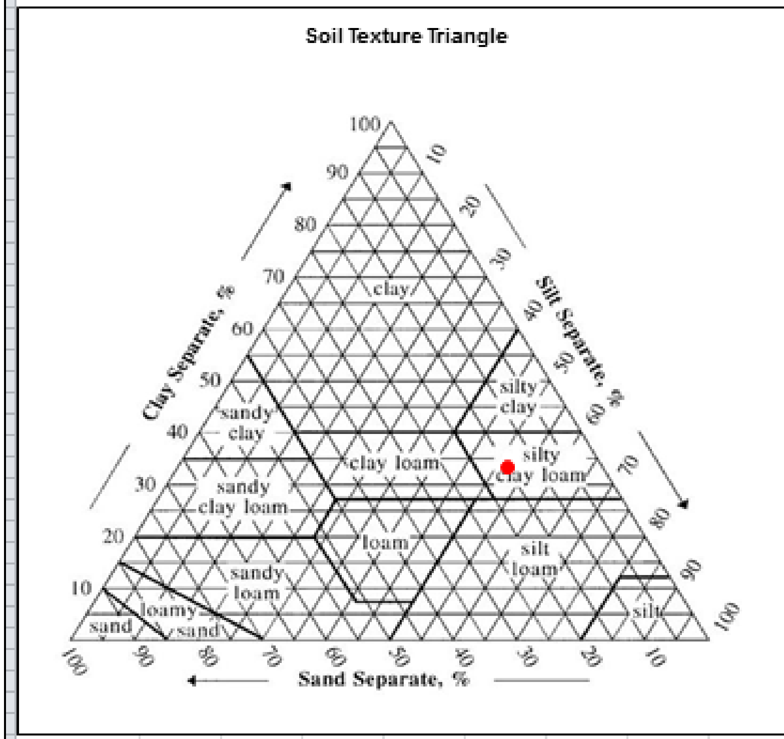
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

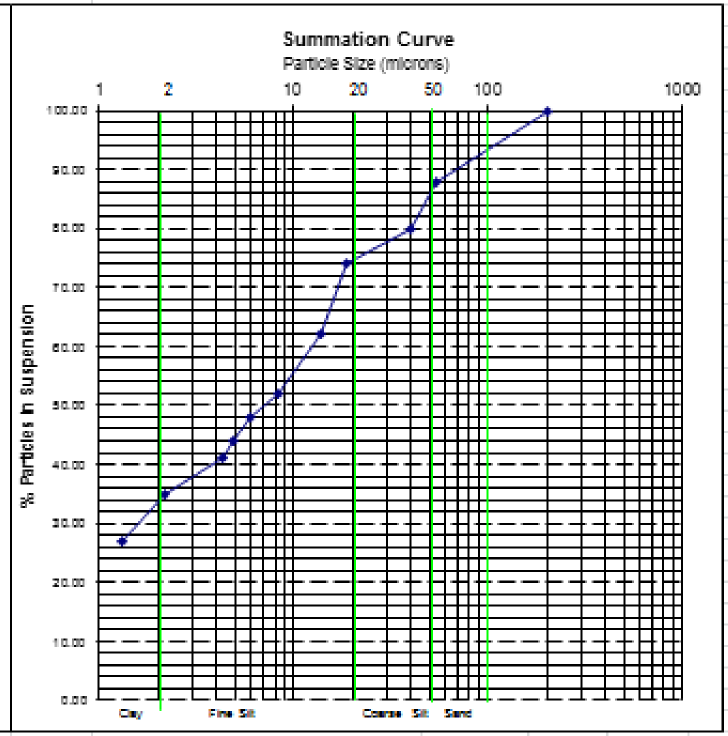
x=53	estimated 270 sieve sand %
1.94	98%

x=47	estimated 300 sieve sand %
1.92	98%

Log Slope of .5 to 1 minute reading	(y) Interc	x=50	Sand %
0.002851261	1.7885	85.32	15%

Log Slope of 480 to 1440 minute rea	(y) Interc	x=2	Clay %
0.126706087	1.26771	33.20	33%





Core #10: B 50-60 cm

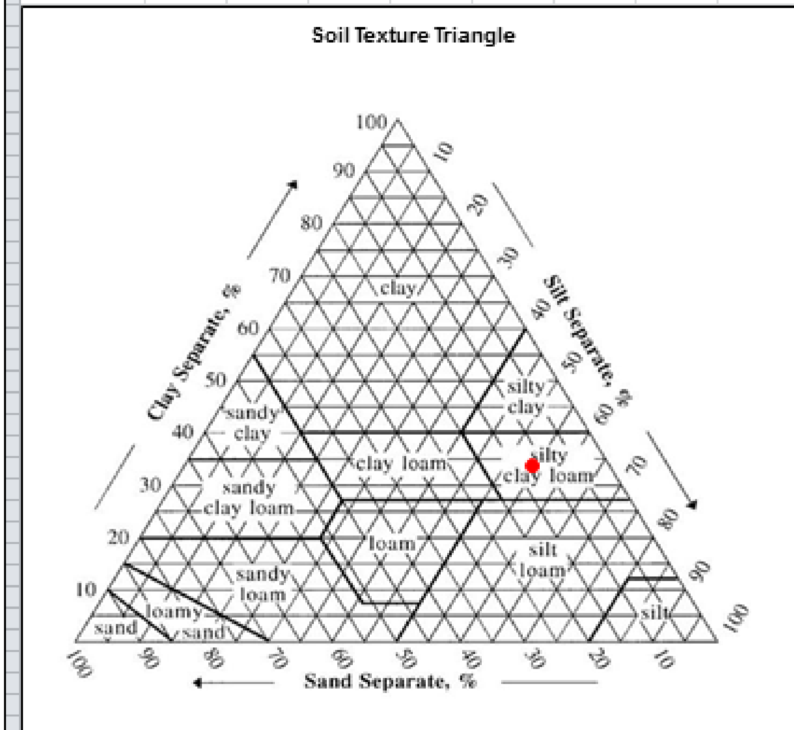
User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY CLAY LOAM				
Soil Name ==> #10		Sand		Clay		Silt
	Hydromet	% Sand	12%	% Clay	34%	% Silt 54%
	Adjusted:	% Sand	12%	% Clay	34%	% Silt 54%

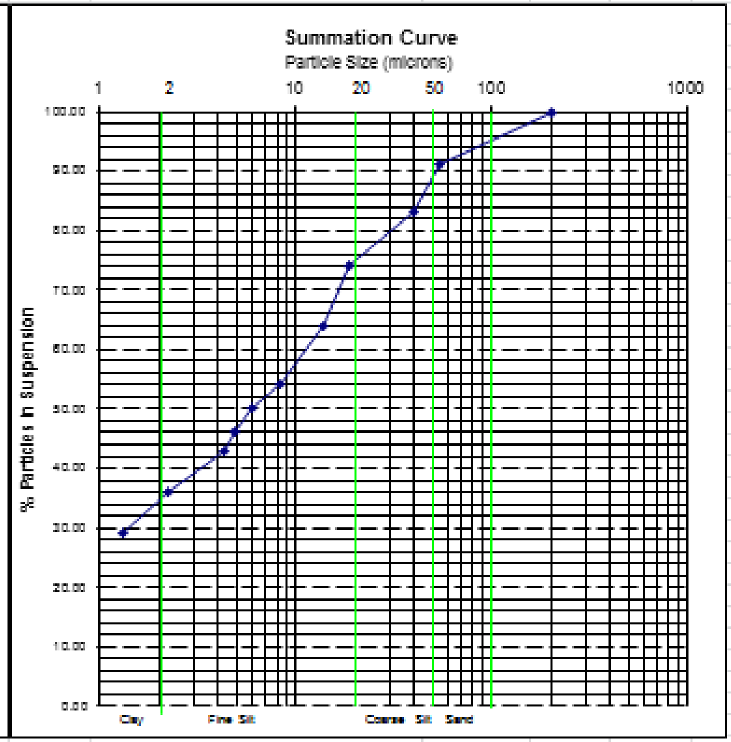
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.95	98%
x=47	estimated 300 sieve sand %
1.94	98%

Time in minutes	x	y
0.5	54.542457	91.00
1	40.114038	83.00
480	2.2004268	36.00
1440	1.2391947	29.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.002769763	1.80797	88.40	12%
Log Slope of 480 to 1440 minute read	(y) Interce	x=2	Clay %
0.104195686	1.32703	34.31	34%





Core #10: A 60-78 cm

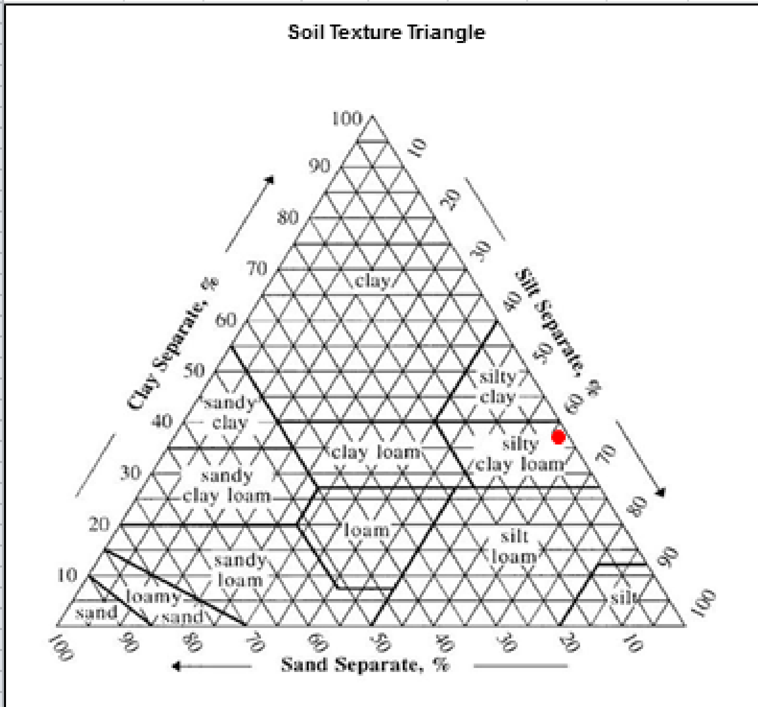
User Pedon ID ==>			USDA Texture				
Sample Number =>			SILTY CLAY LOAM				
Soil Name ==> #10			Sand		Clay		Silt
	Hydrometer:	% Sand	2%	% Clay	37%	% Silt	61%
	Adjusted:	% Sand	2%	% Clay	37%	% Silt	61%

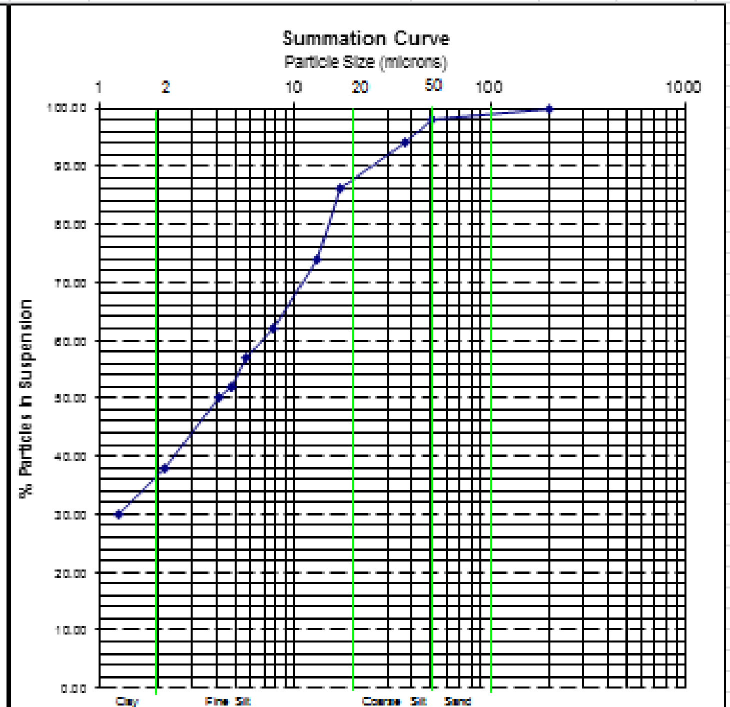
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
###	2%
x=47	estimated 300 sieve sand %
96.77	3%

Time in minutes	x	y
0.5	51.30685653	98.00
1	37.07008852	94.00
480	2.134106589	38.00
1440	1.264391225	30.00

Log Slope of .5 to 1 minute readin	og(y) Intercep	x=50	Sand %
0.001271231	1.9260032	97.63	2%
Log Slope of 480 to 1440 minute rea	**og(y) Intercep**	**x=2**	**Clay %**
0.118041311	1.3278709	36.64	37%





Core #10: B 60-78 cm

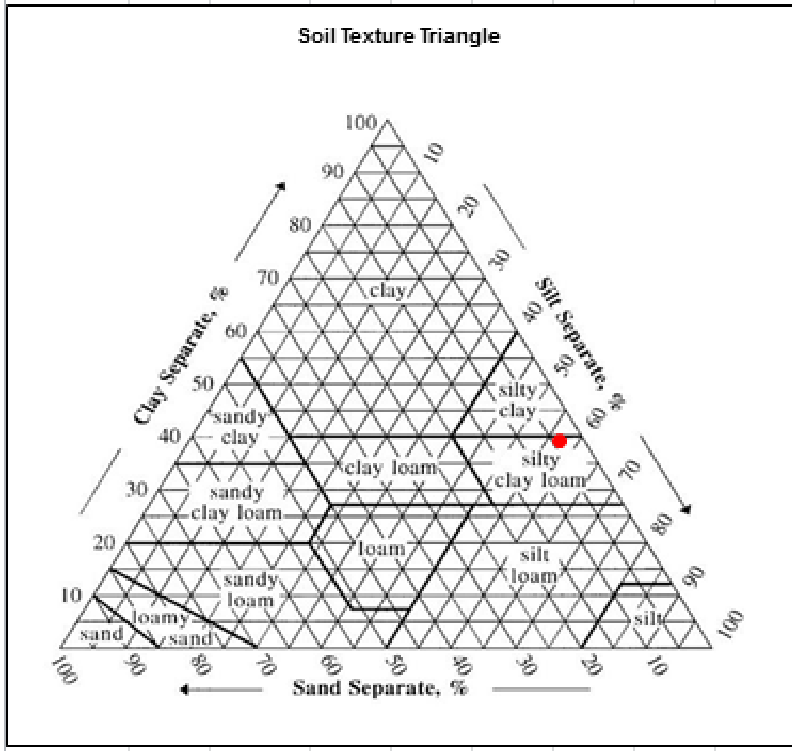
User Pedon ID ==>			USDA Texture				
Sample Number =>			SILTY CLAY LOAM				
Soil Name ==>#10		Sand		Clay		Silt	
	Hydrometer:	% Sand	4%	% Clay	39%	% Silt	57%
	Adjusted:	% Sand	4%	% Clay	39%	% Silt	57%

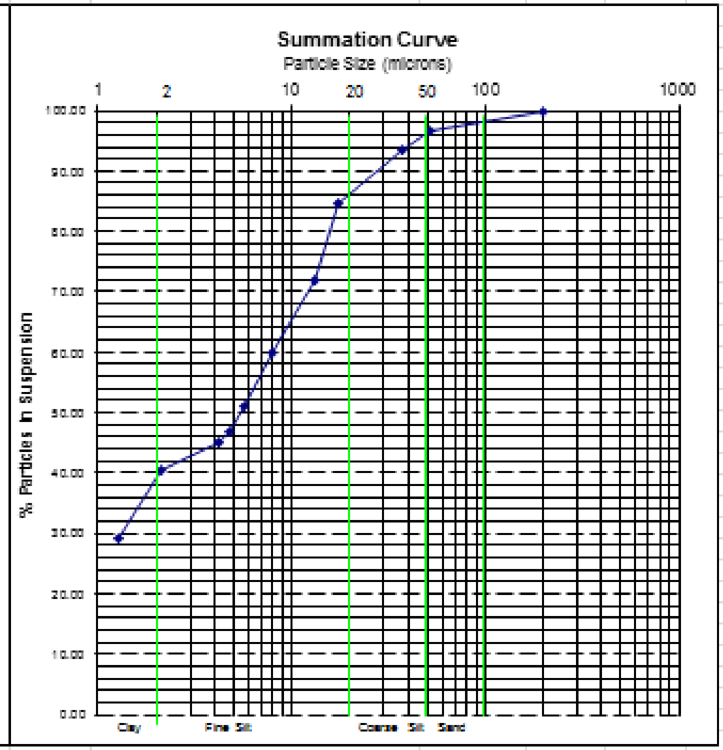
Time in minutes	x	y
0.5	51.729001	96.50
1	37.167739	93.50
480	2.1153412	40.64
1440	1.2683665	29.00

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.99	98%
x=47	estimated 300 sieve sand %
1.98	98%

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.000941931	1.9358	96.14	4%
Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.17303435	1.24293	38.81	39%





Core #10 Viscosity

Parameter	Temperatur	Viscosity	Viscosit	H_2O Viscosity	H_2O+HMP Sol. Viscosity
Symbol:	C	mu	mu	mu	mu
Unit:	degrees	N*sec/m2	centipoise	poise	poise
Alt Unit:		Pa*s	cp	p	p
Factor:	CX1	muX1000	muX1	muX1	muX2
	0	1.781	1781	0.01781	0.01819
	5	1.518	1518	0.01518	0.01550
	10	1.307	1307	0.01307	0.01335
	11	1.271	1271	0.01271	0.01298
	12	1.236	1236	0.01236	0.01262
	13	1.202	1202	0.01202	0.01228
	14	1.170	1170	0.01170	0.01195
	15	1.139	1139	0.01139	0.01163
	16	1.110	1110	0.01110	0.01134
	17	1.084	1084	0.01084	0.01107
	18	1.057	1057	0.01057	0.01079
	19	1.029	1029	0.01029	0.01051
	20	1.002	1002	0.01002	0.01023
	21	0.978	978	0.00978	0.00999
	22	0.955	955	0.00955	0.00975
	23	0.933	933	0.00933	0.00953
	24	0.911	911	0.00911	0.00931
	25	0.890	890	0.00890	0.00909
	26	0.871	871	0.00871	0.00889
	27	0.851	851	0.00851	0.00869
	28	0.833	833	0.00833	0.00850
	29	0.815	815	0.00815	0.00832
	30	0.798	798	0.00798	0.00815
	40	0.653	653	0.00653	0.00667
	50	0.547	547	0.00547	0.00559
	60	0.466	466	0.00466	0.00476
	70	0.404	404	0.00404	0.00413
	80	0.354	354	0.00354	0.00362
	90	0.315	315	0.00315	0.00322
	100	0.282	282	0.00282	0.00288

	Density of Water	Water+HMP Sol
Temp °C	density g/mL	density g/mL
0	0.9998425	1.003
4	0.9999750	1.003
5	0.9999668	1.003
10	0.9997026	1.003
11	0.9996084	1.003
12	0.9995004	1.003
13	0.9993801	1.003
14	0.9992474	1.002
15	0.9991026	1.002
16	0.9989460	1.002
17	0.9987779	1.002
18	0.9985986	1.002
19	0.9984082	1.002
20	0.9982071	1.001
21	0.9979955	1.001
22	0.9977735	1.001
23	0.9975415	1.001
24	0.9972995	1.000
25	0.9970479	1.000
26	0.9967867	1.000
27	0.9965162	1.000
28	0.9962365	0.999
29	0.9959478	0.999
30	0.9956502	0.999
35	0.9940349	0.997
37	0.9933316	0.996
40	0.9922187	0.995
100	0.9583665	0.961

Temperature Conversion			
°C To °F		°F To °C	
°C	°F	°F	°C
0	32.0	40	4.4
4	39.2	41	5.0
5	41.0	42	5.6
6	42.8	43	6.1
7	44.6	44	6.7
8	46.4	45	7.2
9	48.2	46	7.8
10	50.0	47	8.3
11	51.8	48	8.9
12	53.6	49	9.4
13	55.4	50	10.0
14	57.2	51	10.6
15	59.0	52	11.1
16	60.8	53	11.7
17	62.6	54	12.2
18	64.4	55	12.8
19	66.2	56	13.3
20	68.0	57	13.9
21	69.8	58	14.4
22	71.6	59	15.0
23	73.4	60	15.6
24	75.2	61	16.1
25	77.0	62	16.7
26	78.8	63	17.2
27	80.6	64	17.8
28	82.4	65	18.3
29	84.2	66	18.9
30	86.0	67	19.4
40	104	68	20.0
50	122	69	20.6
60	140	70	21.1
70	158	71	21.7
80	176	72	22.2
90	194	73	22.8
100	212	74	23.3
		75	23.9
		76	24.4
		77	25.0
		78	25.6
		79	26.1
		80	26.7

Core #11: A 0-33 cm

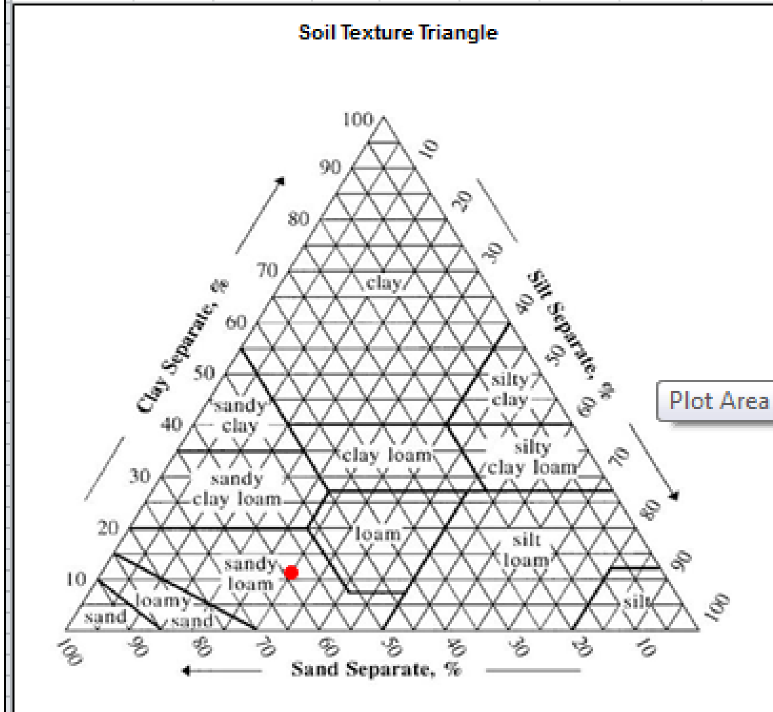
User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY LOAM				
Soil Name ==> #11		Sand		Clay		Silt
Hydrometer:	% Sand	59%	% Clay	11%	% Silt	30%
Adjusted:	% Sand	59%	% Clay	11%	% Silt	30%

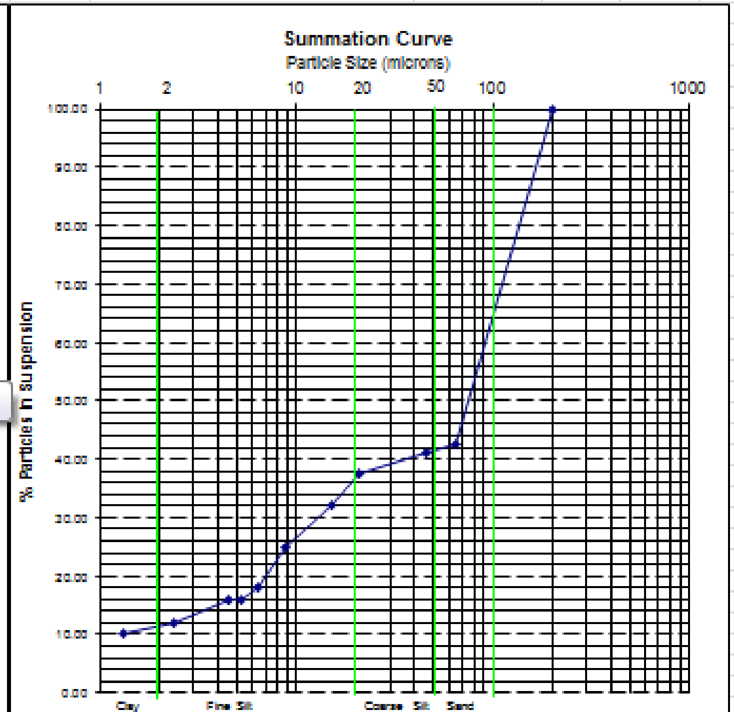
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
41.54	58%
x=47	estimated 300 sieve sand %
41.06	59%

Time in minutes	x	y
0.5	65.12423876	42.52
1	46.28845669	41.00
480	2.366955802	12.00
1440	1.32598399	10.00

Log Slope of .5 to 1 minute readin	og(y) intercep	x=50	Sand %
0.000839328	1.5739327	41.30	59%
Log Slope of 480 to 1440 minute rea	og(y) intercep	x=2	Clay %
0.076064736	0.8991394	11.25	11%





Core #11: B 0-33 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		SANDY LOAM				
Soil Name ==>#11		Sand		Clay		Silt
Hydrometer:	% Sand	68%	% Clay	13%	% Silt	19%
Adjusted:	% Sand	68%	% Clay	13%	% Silt	19%

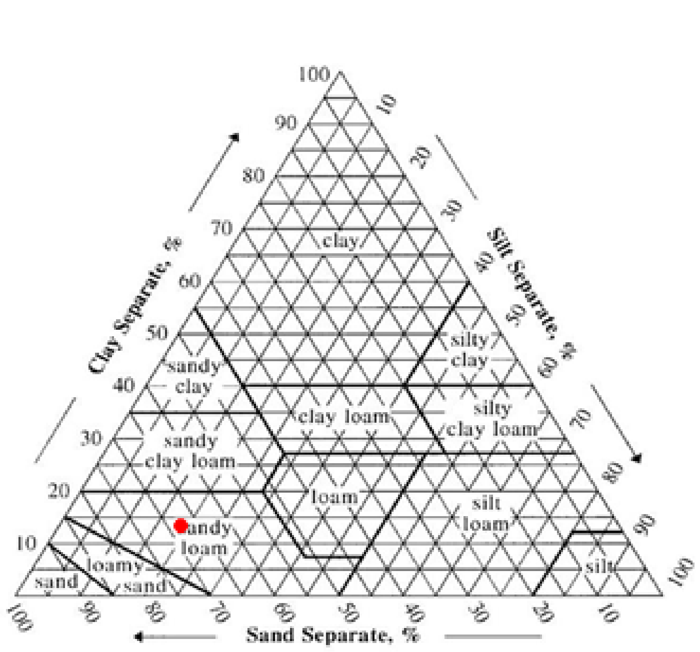
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.51	98%
x=47	estimated 300 sieve sand %
1.50	98%

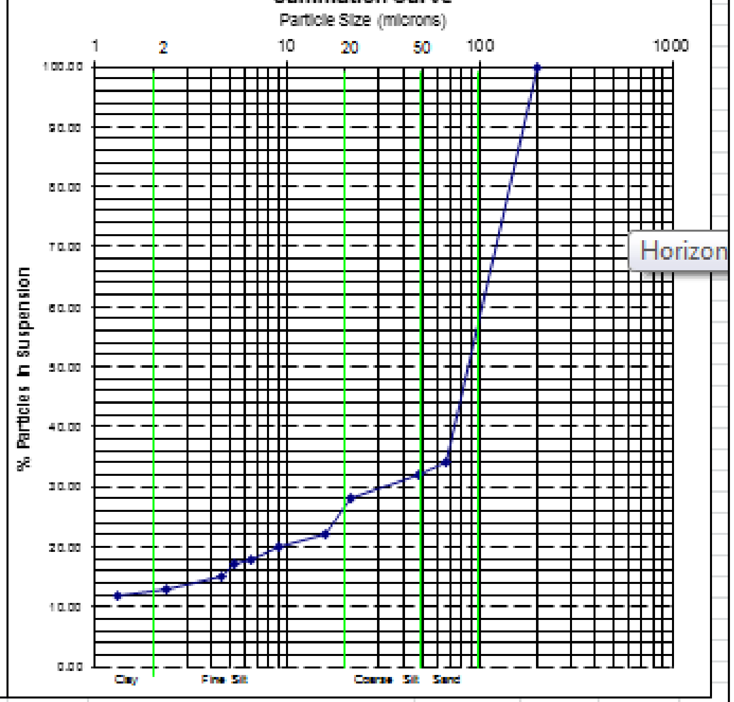
Time in minutes	x	y
0.5	66.994208	34.00
1	47.677136	32.00
480	2.3318808	13.00
1440	1.3185463	12.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001362988	1.44017	32.23	68%
Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.034304669	1.03395	12.66	13%

Soil Texture Triangle



Summation Curve



Core #11: A 33-53 cm

User Pedon ID ==>		USDA Texture
Sample Number =>		SANDY LOAM
Soil Name ==> #11		

	Sand		Clay		Silt	
Hydrometer	% Sand	35%	% Clay	14%	% Silt	51%
Adjusted:	% Sand	35%	% Clay	14%	% Silt	51%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

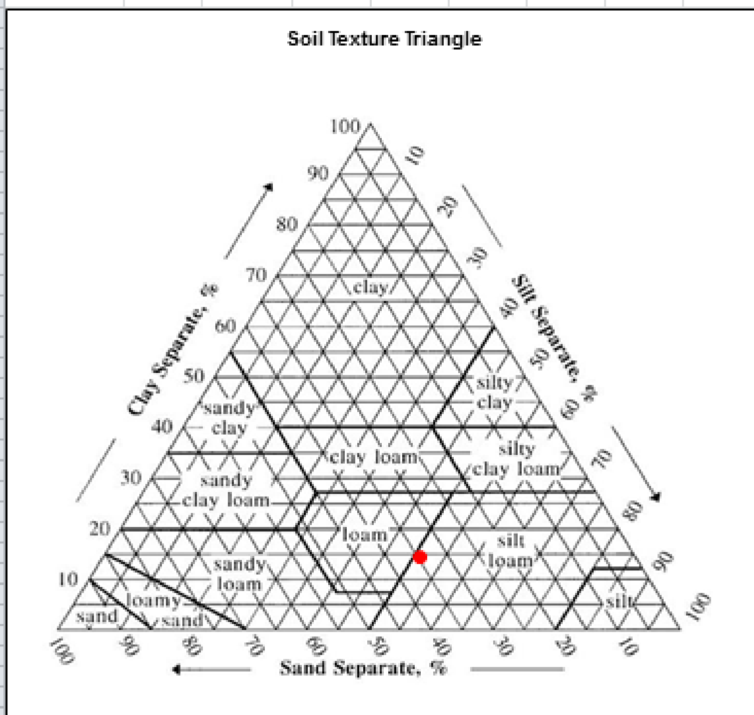
x=53	estimated 270 sieve sand %
1.82	98%

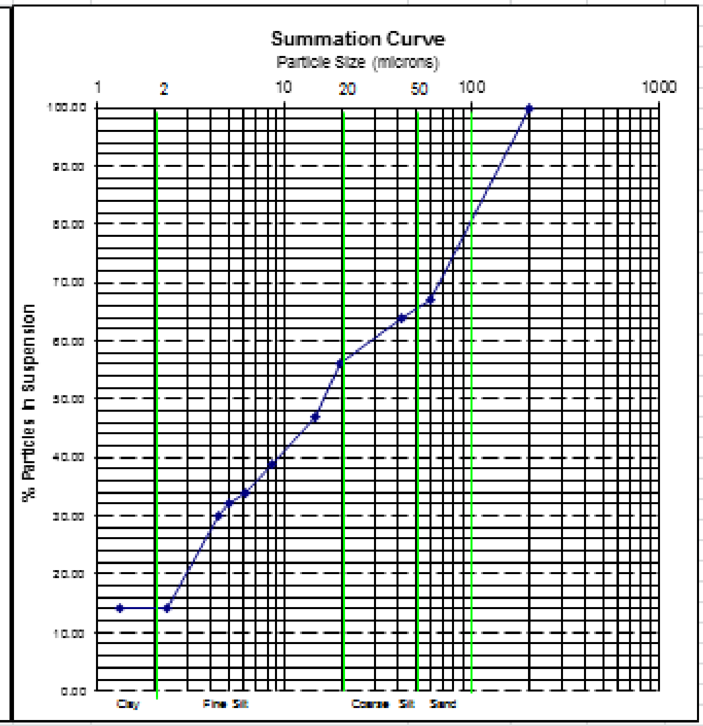
x=47	estimated 300 sieve sand %
1.81	98%

Time in minutes	x	y
0.5	59.424838	67.00
1	42.534124	64.00
480	2.3535285	14.00
1440	1.3110664	14.00

Log Slope of .5 to 1 minute reading	(y) Intercept	x=50	Sand %
0.001177856	1.75608	65.31	35%

Log Slope of 480 to 1440 minute reading	(y) Intercept	x=2	Clay %
0	1.14613	14.00	14%





Core #11: B 33-53 cm

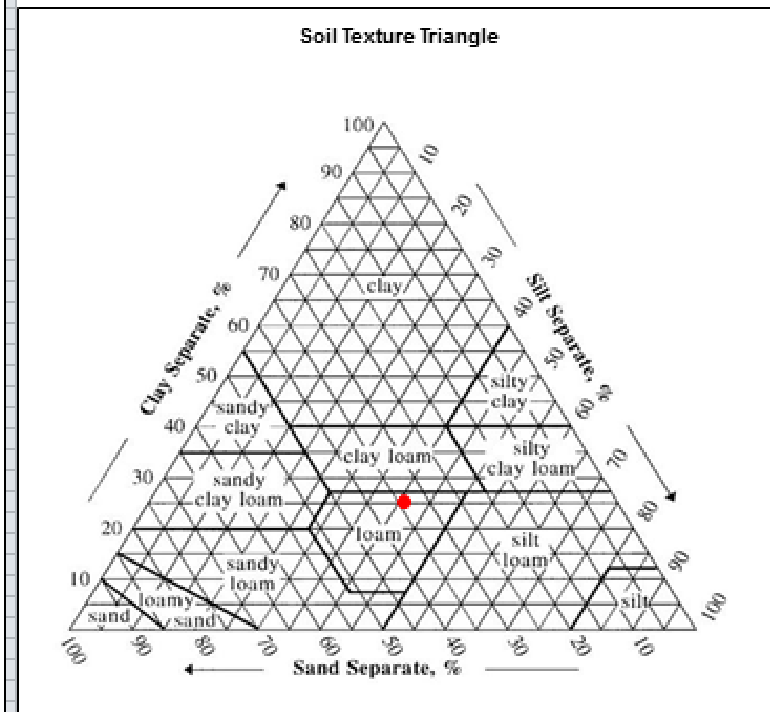
User Pedon ID ==>				USDA Texture			
Sample Number =>				SANDY LOAM			
Soil Name ==> #11		Sand		Clay		Silt	
	Hydromet	% Sand	34%	% Clay	25%	% Silt	41%
	Adjusted:	% Sand	34%	% Clay	25%	% Silt	41%

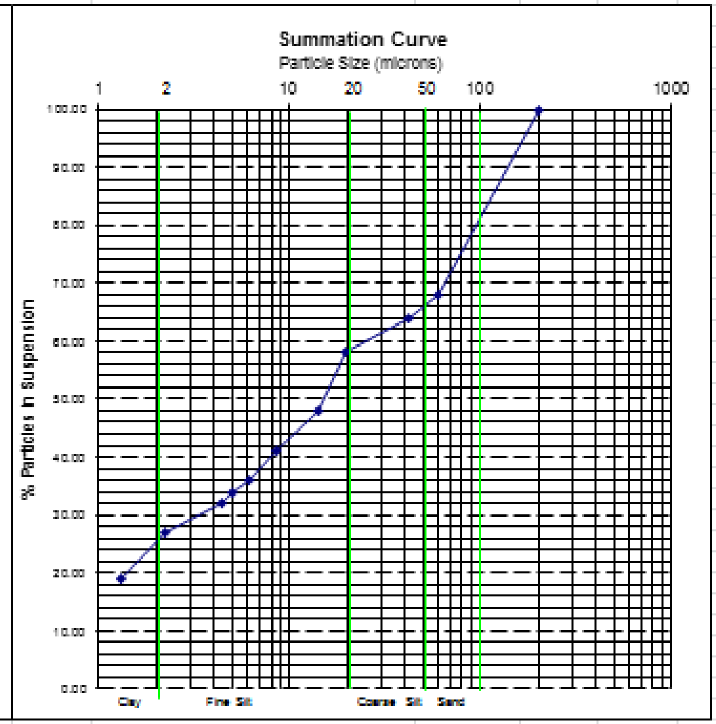
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.82	98%
x=47	estimated 300 sieve sand %
1.81	98%

Time in minutes	x	y
0.5	59.180352	68.00
1	42.534124	64.00
480	2.2105819	27.00
1440	1.3074551	19.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001581676	1.7389	65.76	34%
Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0.168979786	1.05782	24.88	25%





Core #11: A 53-61 cm

User Pedon ID ==>			USDA Texture				
Sample Number =>			SANDY LOAM				
Soil Name ==> #11			Sand		Clay		Silt
		Hydromet	% Sand	41%	% Clay	19%	% Silt 40%
		Adjusted:	% Sand	41%	% Clay	19%	% Silt 40%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.78	98%

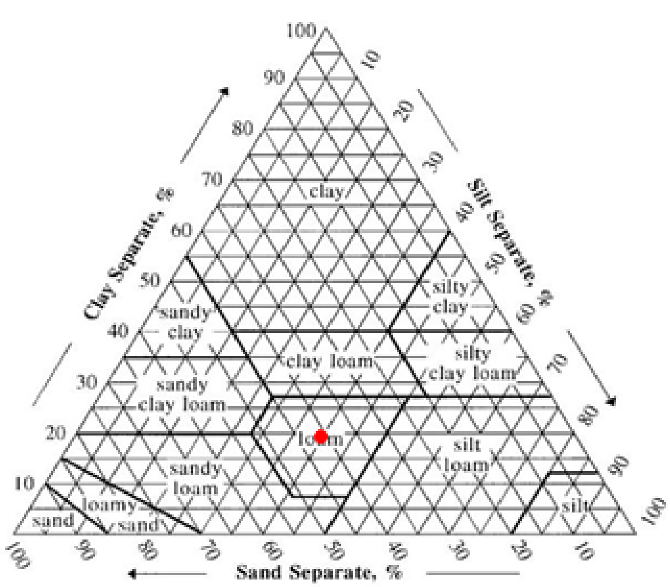
x=47	estimated 300 sieve sand %
1.77	98%

Time in minutes	x	y
0.5	60.632484	62.00
1	43.544733	58.00
480	2.3127788	20.00
1440	1.3035436	16.00

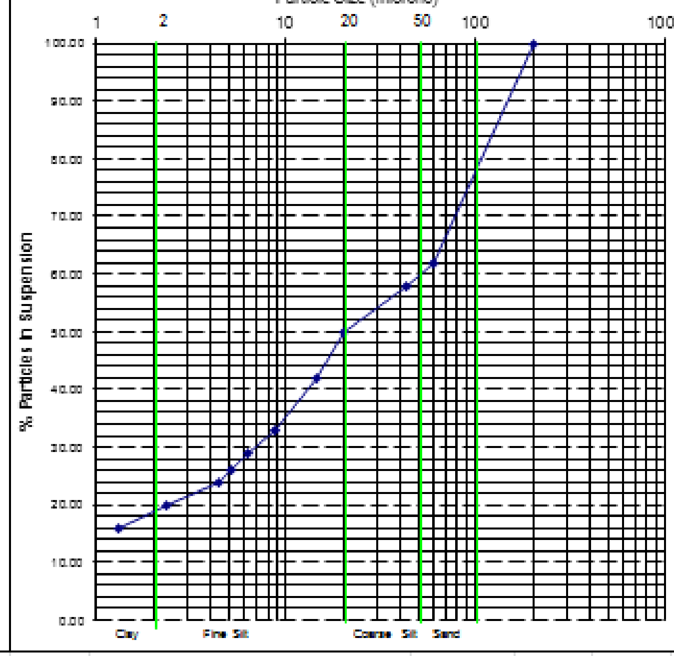
Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001694998	1.68962	59.48	41%

Log Slope of 480 to 1440 minute read	(y) Interce	x=2	Clay %
0.096023219	1.07895	18.66	19%

Soil Texture Triangle



Summation Curve



Core #11: B 53-61 cm

User Pedon ID ==>			USDA Texture			
Sample Number =>			SANDY LOAM			
Soil Name ==>#11		Sand		Clay		Silt
Hydromet	% Sand	39%	% Clay	19%	% Silt	42%
Adjusted:	% Sand	39%	% Clay	19%	% Silt	42%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.79	98%

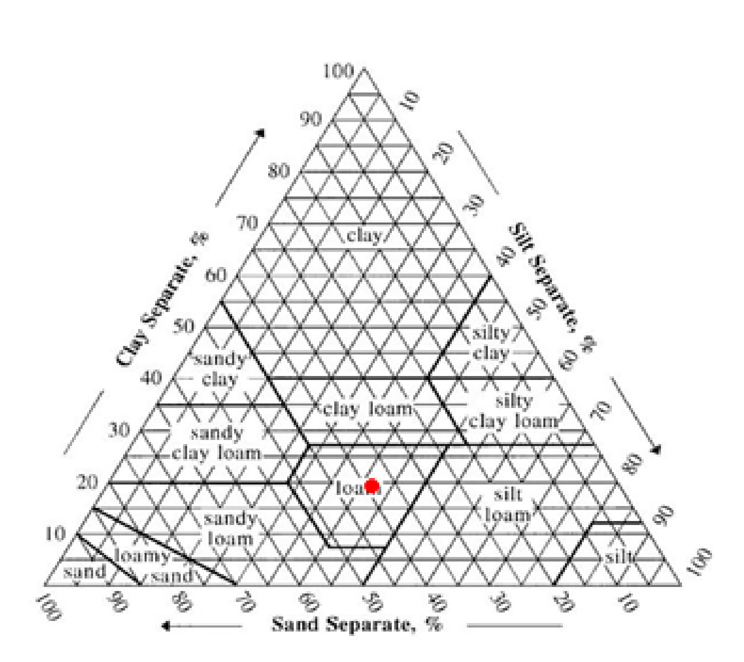
x=47	estimated 300 sieve sand %
1.78	98%

Time in minutes	x	y
0.5	60.272731	63.50
1	43.294292	59.50
480	2.3059172	21.00
1440	1.3035436	16.00

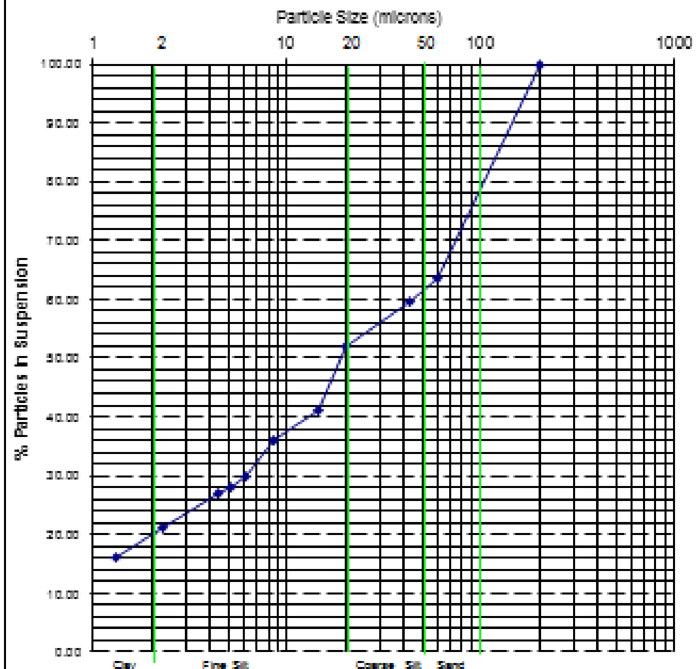
Log Slope of .5 to 1 minute readin	(y) Interc	x=50	Sand %
0.001664273	1.70246	61.05	39%

Log Slope of 480 to 1440 minute rea	(y) Interc	x=2	Clay %
0.117819657	1.05054	19.33	19%

Soil Texture Triangle



Summation Curve



Core #11: A 61-88 cm

User Pedon ID ==>			USDA Texture				
Sample Number =>			SANDY LOAM				
Soil Name ==> #11		Sand		Clay		Silt	
	Hydromet	% Sand	86%	% Clay	4%	% Silt	10%
	Adjusted:	% Sand	86%	% Clay	4%	% Silt	10%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

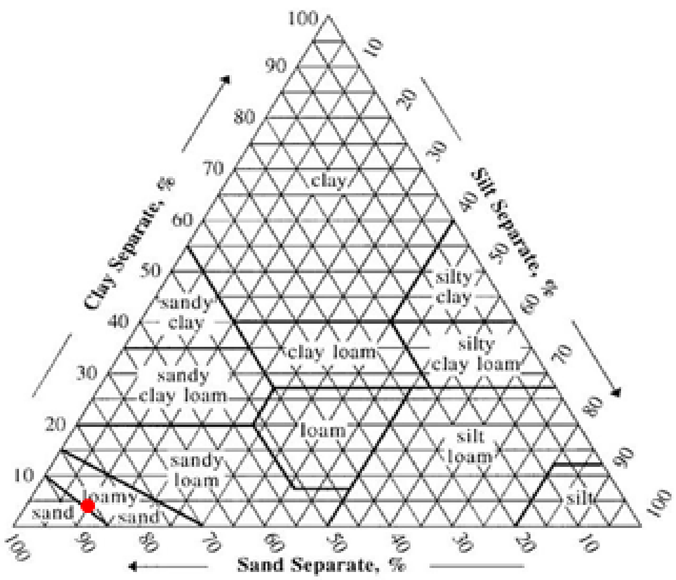
x=53	estimated 270 sieve sand %
1.17	99%
x=47	estimated 300 sieve sand %
1.15	99%

Time in minutes	x	y
0.5	70.782598	16.00
1	50.267645	14.50
480	2.4199202	4.00
1440	1.3480509	4.00

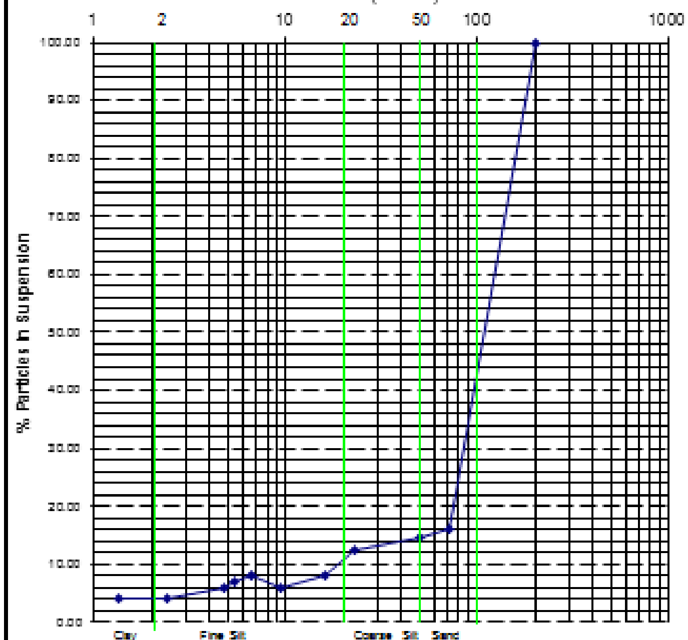
Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.002083942	1.05661	14.48	86%

Log Slope of 480 to 1440 minute read	(y) Interce	x=2	Clay %
0	0.60206	4.00	4%

Soil Texture Triangle



Summation Curve



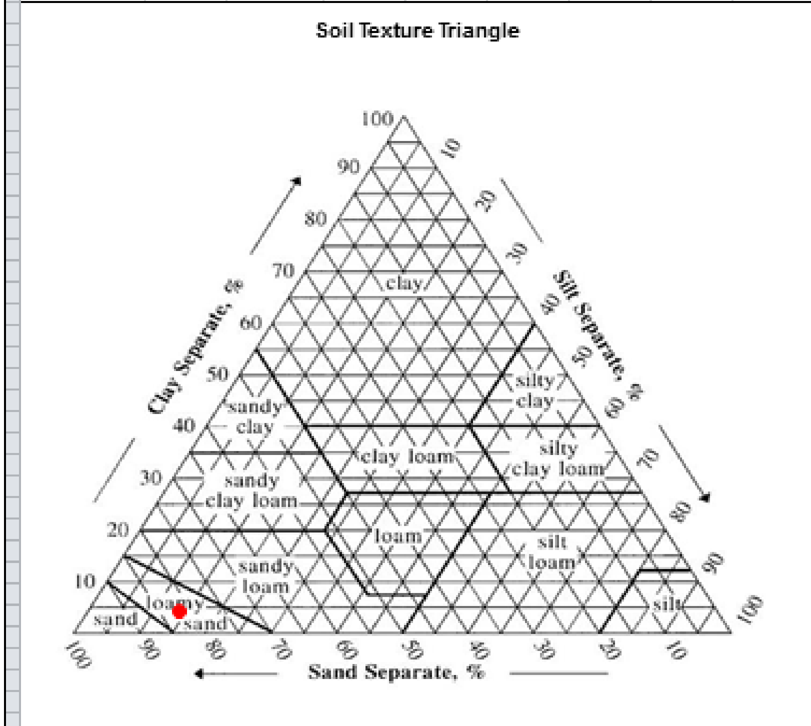
Core #11: B 61-88 cm

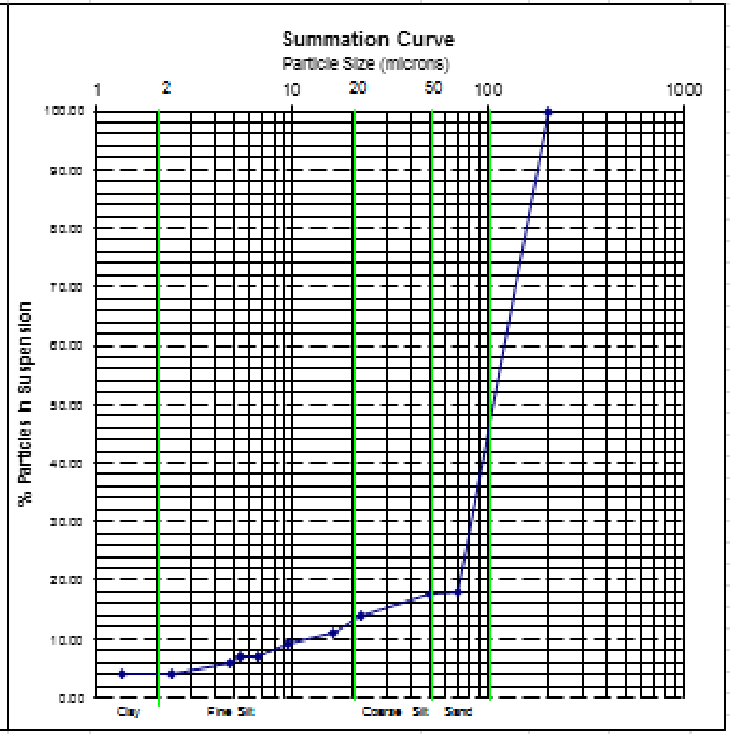
User Pedon ID ==>			USDA Texture					
Sample Number =>			SANDY LOAM					
Soil Name ==> #11			Sand		Clay		Silt	
		Hydrometer	% Sand	82%	% Clay	4%	% Silt	14%
		Adjusted:	% Sand	82%	% Clay	4%	% Silt	14%
Sieved Sand Sizes								
% Very Coarse	0%		x=53	estimated 270 sieve sand %				
% Coarse	0%		1.24	99%				
% Medium	0%							
% Fine	0%		x=47	estimated 300 sieve sand %				
% Very Fine	0%		1.24	99%				
Total	0%							

Time in minutes	x	y
0.5	70.371738	18.00
1	49.833122	17.50
480	2.4199202	4.00
1440	1.3480509	4.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.000595681	1.21335	17.50	82%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
0	0.60206	4.00	4%





Core #11 Viscosity

Parameter	Temperatur	Viscosity	Viscosit	H_2O Viscosity	H_2O+HMP Sol. Viscosity
Symbol:	C	mu	mu	mu	mu
Unit:	degrees	N*sec/m2	centipoise	poise	poise
Alt Unit:		Pa*s	cp	p	p
Factor:	CX1	muX1000	muX1	muX1	muX2
	0	1.781	1781	0.01781	0.01819
	5	1.518	1518	0.01518	0.01550
	10	1.307	1307	0.01307	0.01335
	11	1.271	1271	0.01271	0.01298
	12	1.236	1236	0.01236	0.01262
	13	1.202	1202	0.01202	0.01228
	14	1.170	1170	0.01170	0.01195
	15	1.139	1139	0.01139	0.01163
	16	1.110	1110	0.01110	0.01134
	17	1.084	1084	0.01084	0.01107
	18	1.057	1057	0.01057	0.01079
	19	1.029	1029	0.01029	0.01051
	20	1.002	1002	0.01002	0.01023
	21	0.978	978	0.00978	0.00999
	22	0.955	955	0.00955	0.00975
	23	0.933	933	0.00933	0.00953
	24	0.911	911	0.00911	0.00931
	25	0.890	890	0.00890	0.00909
	26	0.871	871	0.00871	0.00889
	27	0.851	851	0.00851	0.00869
	28	0.833	833	0.00833	0.00850
	29	0.815	815	0.00815	0.00832
	30	0.798	798	0.00798	0.00815
	40	0.653	653	0.00653	0.00667
	50	0.547	547	0.00547	0.00559
	60	0.466	466	0.00466	0.00476
	70	0.404	404	0.00404	0.00413
	80	0.354	354	0.00354	0.00362
	90	0.315	315	0.00315	0.00322
	100	0.282	282	0.00282	0.00288

	Density of Water	Water+HMP Sol
Temp °C	density g/mL	density g/mL
0	0.9998425	1.003
4	0.9999750	1.003
5	0.9999668	1.003
10	0.9997026	1.003
11	0.9996084	1.003
12	0.9995004	1.003
13	0.9993801	1.003
14	0.9992474	1.002
15	0.9991026	1.002
16	0.9989460	1.002
17	0.9987779	1.002
18	0.9985986	1.002
19	0.9984082	1.002
20	0.9982071	1.001
21	0.9979955	1.001
22	0.9977735	1.001
23	0.9975415	1.001
24	0.9972995	1.000
25	0.9970479	1.000
26	0.9967867	1.000
27	0.9965162	1.000
28	0.9962365	0.999
29	0.9959478	0.999
30	0.9956502	0.999
35	0.9940349	0.997
37	0.9933316	0.996
40	0.9922187	0.995
100	0.9583665	0.961

Temperature Conversion			
°C To °F		°F To °C	
°C	°F	°F	°C
0	32.0	40	4.4
4	39.2	41	5.0
5	41.0	42	5.6
6	42.8	43	6.1
7	44.6	44	6.7
8	46.4	45	7.2
9	48.2	46	7.8
10	50.0	47	8.3
11	51.8	48	8.9
12	53.6	49	9.4
13	55.4	50	10.0
14	57.2	51	10.6
15	59.0	52	11.1
16	60.8	53	11.7
17	62.6	54	12.2
18	64.4	55	12.8
19	66.2	56	13.3
20	68.0	57	13.9
21	69.8	58	14.4
22	71.6	59	15.0
23	73.4	60	15.6
24	75.2	61	16.1
25	77.0	62	16.7
26	78.8	63	17.2
27	80.6	64	17.8
28	82.4	65	18.3
29	84.2	66	18.9
30	86.0	67	19.4
40	104	68	20.0
50	122	69	20.6
60	140	70	21.1
70	158	71	21.7
80	176	72	22.2
90	194	73	22.8
100	212	74	23.3
		75	23.9
		76	24.4
		77	25.0
		78	25.6
		79	26.1
		80	26.7

Core #19: A 0-15

User Pedon ID ==>			USDA Texture				
Sample Number =>			LOAM				
Soil Name ==> #19			Sand		Clay		Silt
	Hydrometer:	% Sand	40%	% Clay	14%	% Silt	46%
	Adjusted:	% Sand	40%	% Clay	14%	% Silt	46%

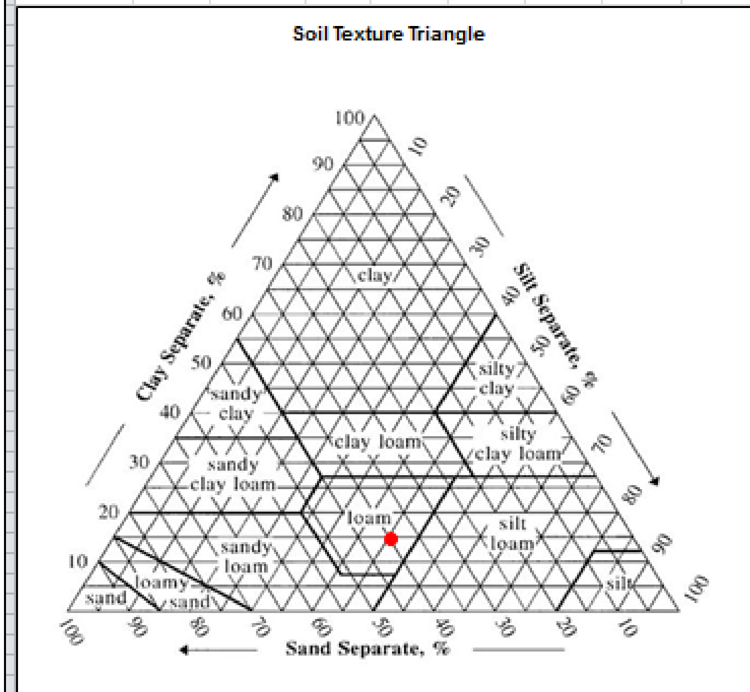
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

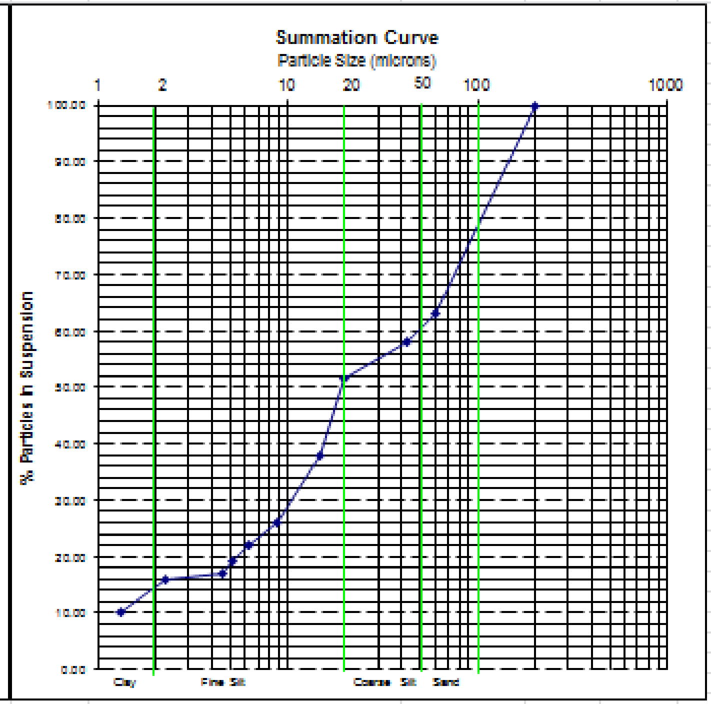
x=53	estimated 270 sieve sand %	
###	39%	
x=47	estimated 300 sieve sand %	
59.15	41%	

Time in minutes	x	y
0.5	59.68718577	63.00
1	43.03590537	58.00
480	2.257803784	16.00
1440	1.32598399	10.00

Log Slope of .5 to 1 minute readin	og(y) Intercep	x=50	Sand %
0.002156744	1.6706105	60.04	40%

Log Slope of 480 to 1440 minute rea	og(y) Intercep	x=2	Clay %
0.219055212	0.7095363	14.05	14%





Core #19: B 0-15 cm

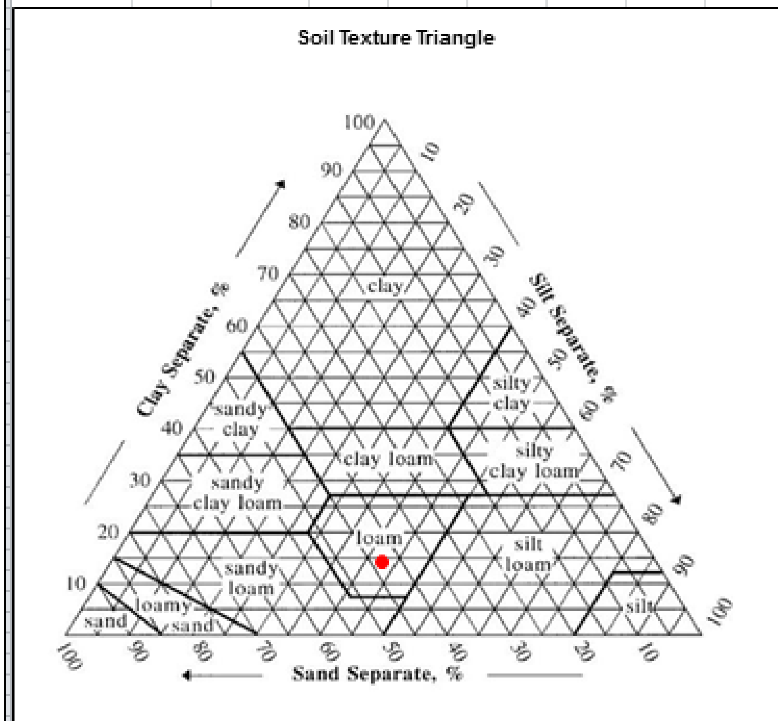
User Pedon ID ==>			USDA Texture				
Sample Number =>			LOAM				
Soil Name ==> #19			Sand		Clay		Silt
	Hydrometer:	% Sand	43%	% Clay	14%	% Silt	43%
	Adjusted:	% Sand	43%	% Clay	14%	% Silt	43%

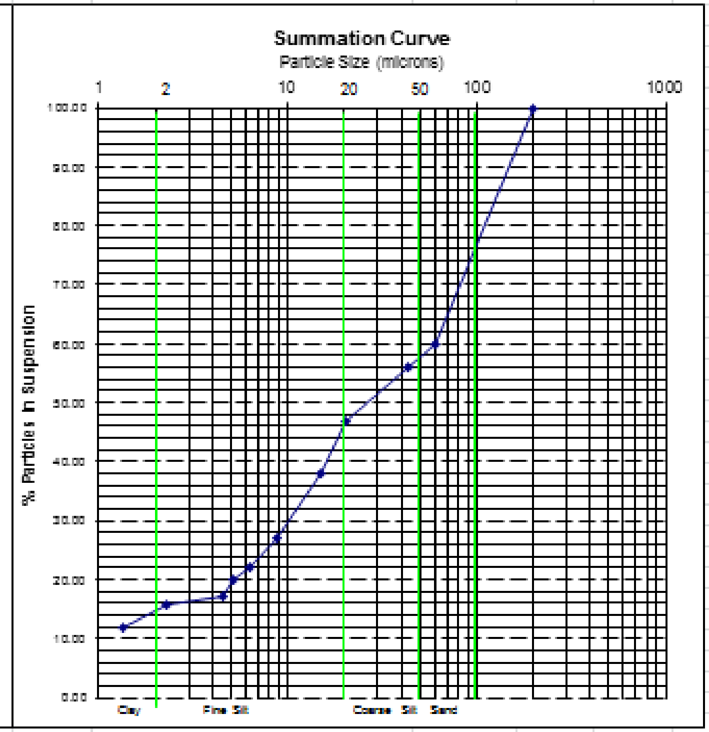
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %	
1.76	98%	
x=47	estimated 300 sieve sand %	
1.75	98%	

Time in minutes	x	y
0.5	61.10886	60.00
1	43.87643	56.00
480	2.2868772	15.64
1440	1.3341359	12.00

Log Slope of .5 to 1 minute reading	(y) Interc	x=50	Sand %
0.001738769	1.6719	57.39	43%
Log Slope of 480 to 1440 minute reading	(y) Interc	x=2	Clay %
0.12076258	0.91807	14.44	14%





Core #19: A 15-20 cm

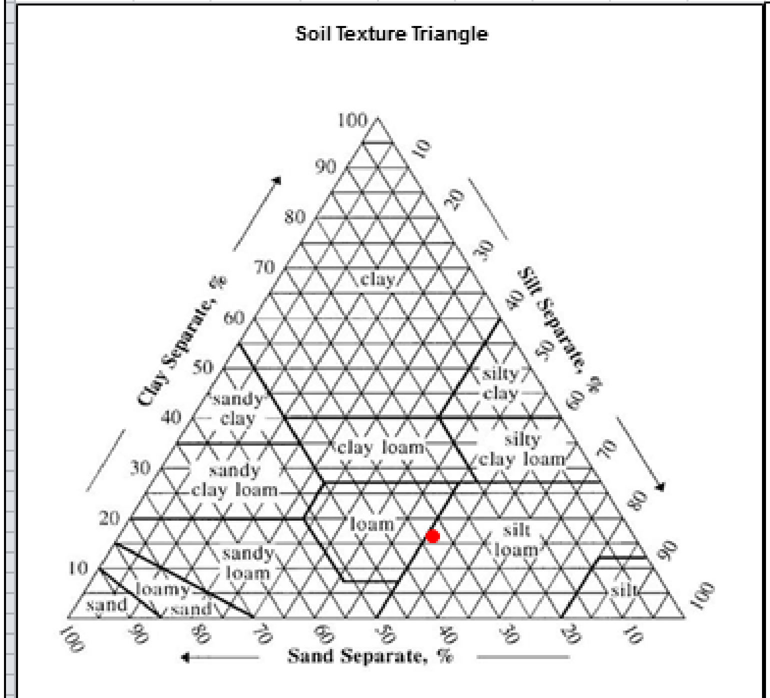
User Pedon ID ==>		USDA Texture				
Sample Number =>		LOAM				
Soil Name ==>#19		Sand		Clay		Silt
Hydrometer	% Sand	33%	% Clay	16%	% Silt	51%
Adjusted:	% Sand	33%	% Clay	16%	% Silt	51%

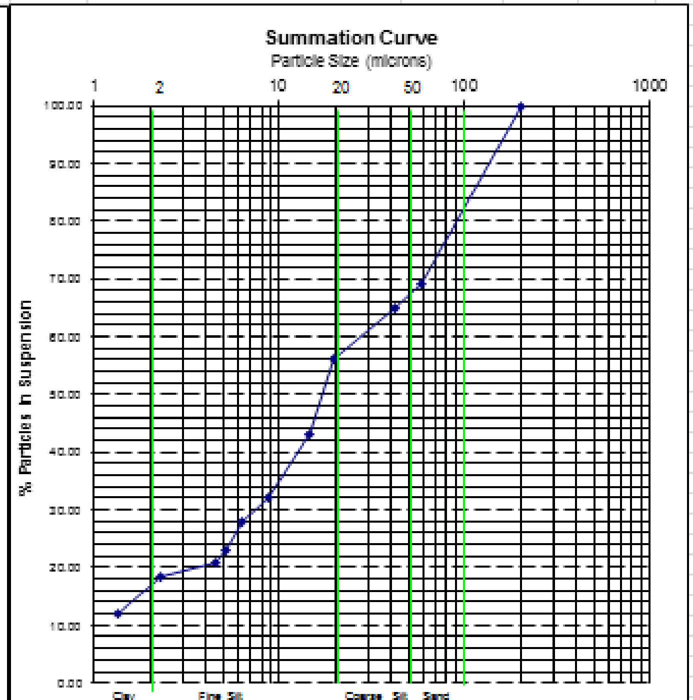
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.83	98%
x=47	estimated 300 sieve sand %
1.82	98%

Time in minutes	x	y
0.5	58.934851	69.00
1	42.363345	65.00
480	2.2676445	18.54
1440	1.3341353	12.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.00156508	1.74661	66.81	33%
Log Slope of 480 to 1440 minute reading	**(y) Interce**	**x=2**	**Clay %**
0.202385381	0.80917	16.37	16%





Core #19: B 15-20 cm

User Pedon ID ==>		USDA Texture			
Sample Number =>		LOAM			
Soil Name ==> #19		Sand	Clay	Silt	
Hydromet	% Sand	34%	% Clay 17%	% Silt	49%
Adjusted:	% Sand	34%	% Clay 17%	% Silt	49%

Time in minutes	x	y
0.5	59.606517	72.00
1	43.742162	63.00
480	2.3196202	19.00
1440	1.3626919	13.00

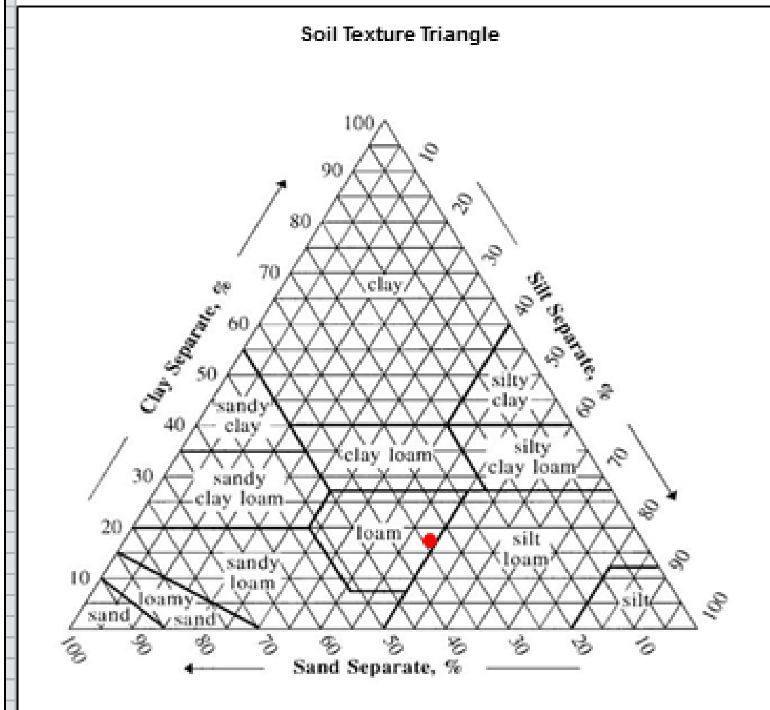
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

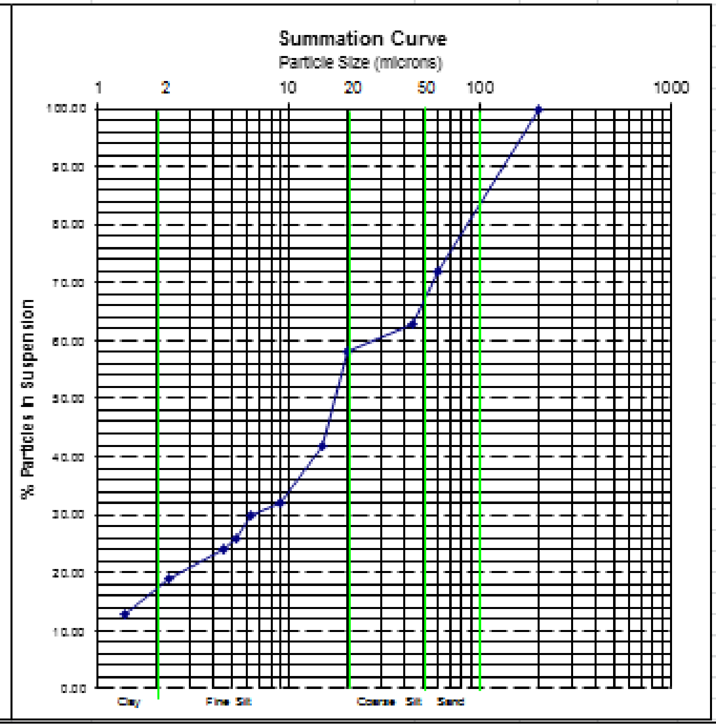
x=53	estimated 270 sieve sand %
1.83	98%

x=47	estimated 300 sieve sand %
1.81	98%

Log Slope of .5 to 1 minute reading	(y) Intercept	x=50	Sand %
0.003655487	1.63944	66.41	34%

Log Slope of 480 to 1440 minute reading	(y) Intercept	x=2	Clay %
0.172228437	0.87925	16.74	17%





Core #19: A 20-35 cm

User Pedon ID ==>			USDA Texture			
Sample Number =>			LOAM			
Soil Name ==> #19		Sand		Clay		Silt
Hydromet	% Sand	34%	% Clay	16%	% Silt	50%
Adjusted:	% Sand	34%	% Clay	16%	% Silt	50%

Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

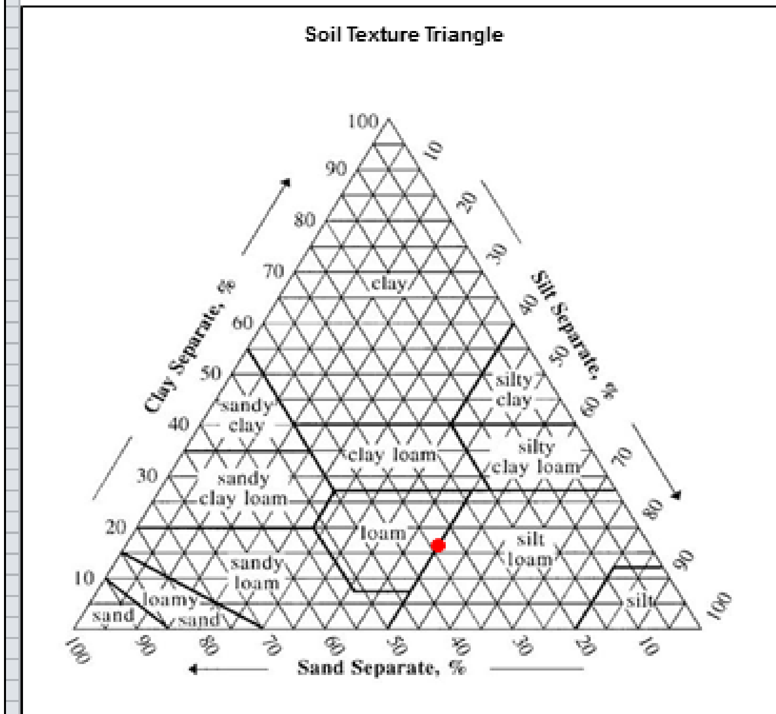
x=53	estimated 270 sieve sand %
1.83	98%

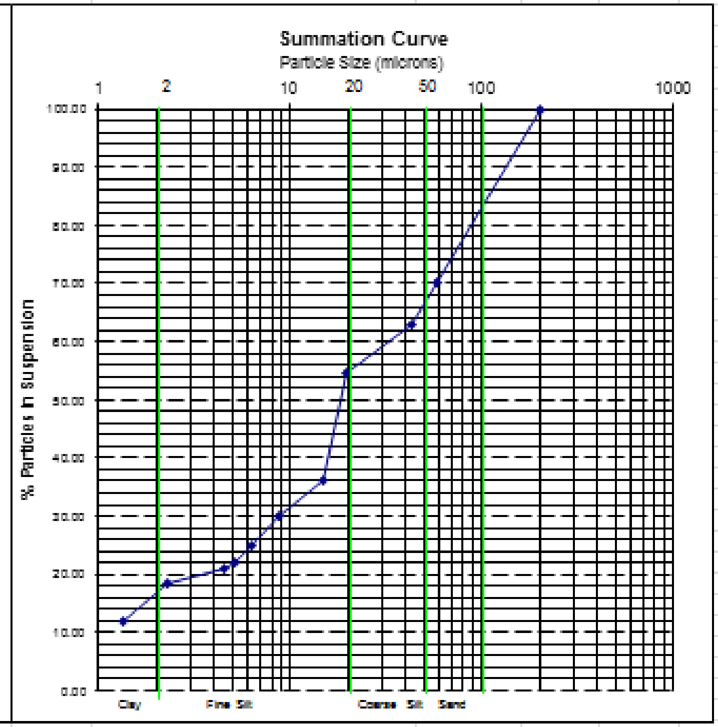
x=47	estimated 300 sieve sand %
1.81	98%

Time in minutes	x	y
0.5	58.686323	70.00
1	42.70422	63.00
480	2.2676445	18.54
1440	1.3341359	12.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.002862687	1.67709	66.10	34%

Log Slope of 480 to 1440 minute read	(y) Interce	x=2	Clay %
0.202385381	0.80917	16.37	16%





Core #19: B 20-35 cm

User Pedon ID ==>		USDA Texture					
Sample Number =>		LOAM					
Soil Name ==> #19		Sand		Clay		Silt	
	Hydromet	% Sand	32%	% Clay	18%	% Silt	50%
	Adjusted:	% Sand	32%	% Clay	18%	% Silt	50%

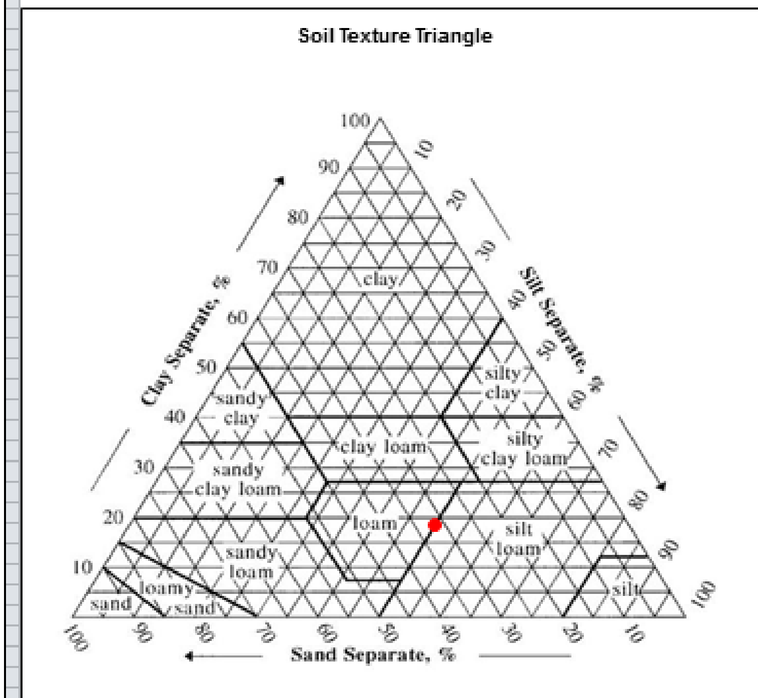
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

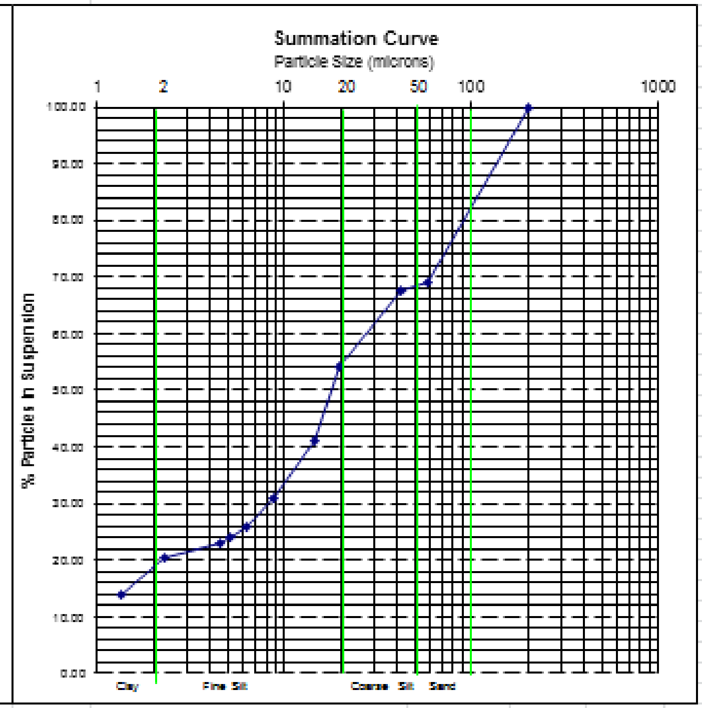
x=53	estimated 270 sieve sand %	
1.84	98%	
x=47	estimated 300 sieve sand %	
1.83	98%	

Time in minutes	x	y
0.5	58.934851	69.00
1	41.933356	67.50
480	2.2542849	20.54
1440	1.3265676	14.00

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.00056144	1.80576	68.21	32%

Log Slope of 480 to 1440 minute reading	(y) Interce	x=2	Clay %
0.179443035	0.90808	18.49	18%





Core #19: A 35-48 cm

User Pedon ID ==>		USDA Texture				
Sample Number =>		LOAM				
Soil Name ==>#19		Sand		Clay		Silt
Hydromet	% Sand	27%	% Clay	32%	% Silt	41%
Adjusted:	% Sand	27%	% Clay	32%	% Silt	41%

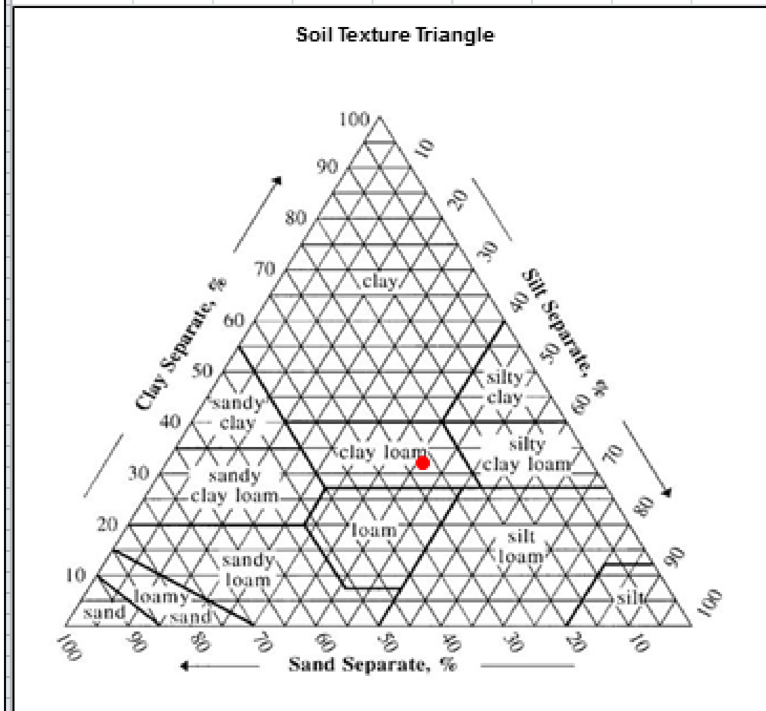
Time in minutes	x	y
0.5	57.69168	74.00
1	41.236048	71.50
480	2.1622288	34.00
1440	1.2802184	26.00

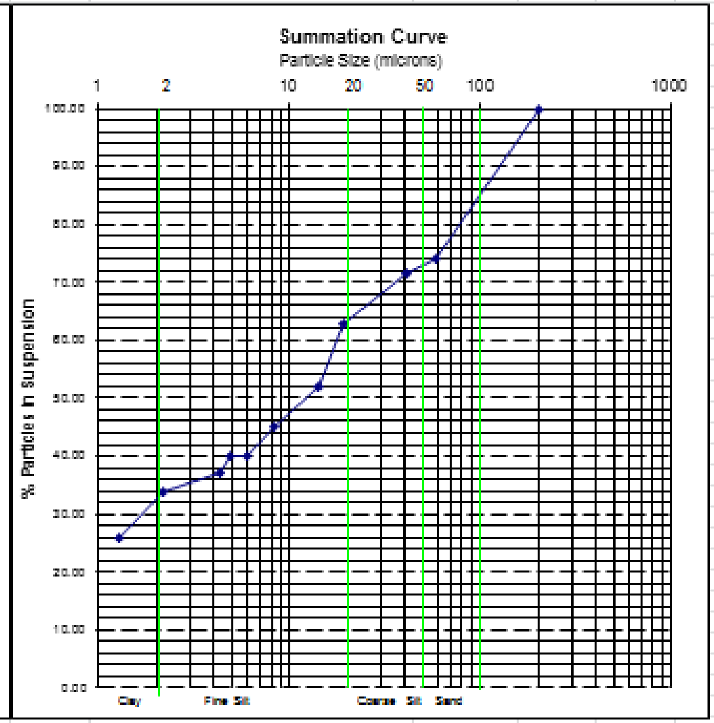
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %
1.86	98%

x=47	estimated 300 sieve sand %
1.86	98%

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.000907026	1.8169	72.82	27%
Log Slope of 480 to 1440 minute rea	(y) Interc	x=2	Clay %
0.132090937	1.24587	32.36	32%





Core #19: B 35-48 cm

User Pedon ID ==>			USDA Texture				
Sample Number =>			LOAM				
Soil Name ==> #19		Sand		Clay		Silt	
	Hydrometer	% Sand	28%	% Clay	29%	% Silt	43%
	Adjusted:	% Sand	28%	% Clay	29%	% Silt	43%

Time in minutes	x	y
0.5	59.093897	74.00
1	42.328246	71.00
480	2.2573019	28.00
1440	1.2787053	34.00

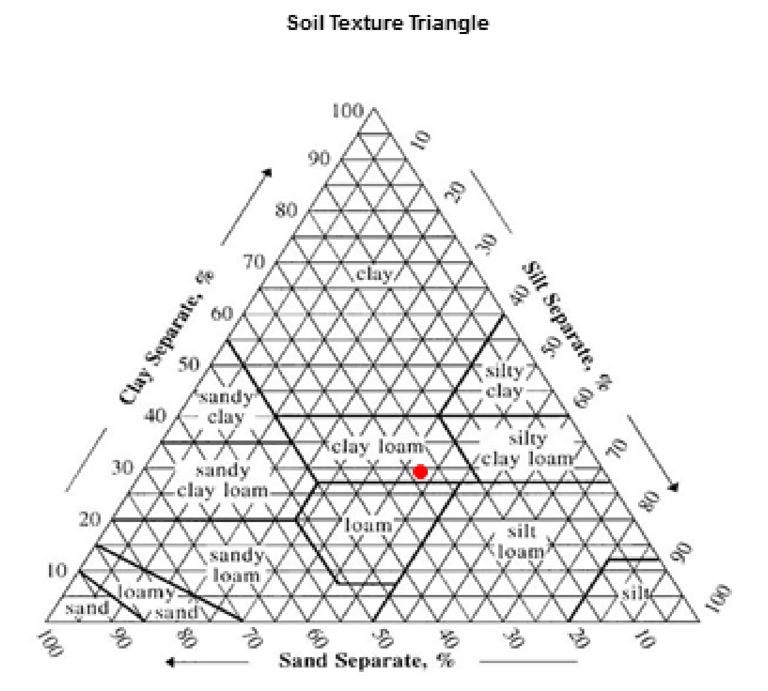
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

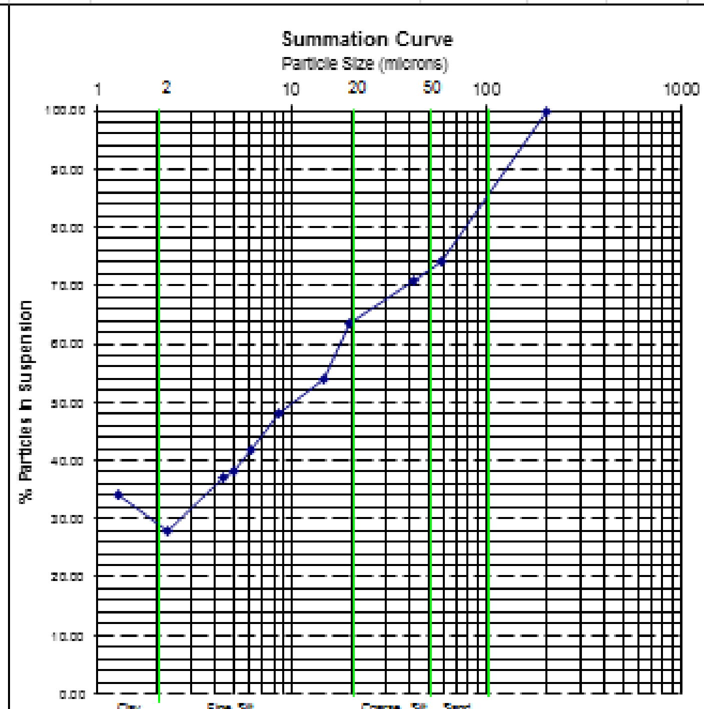
x=53	estimated 270 sieve sand %
1.86	98%

x=47	estimated 300 sieve sand %
1.86	98%

Log Slope of .5 to 1 minute reading	(y) Interce	x=50	Sand %
0.001072035	1.80588	72.36	28%

Log Slope of 480 to 1440 minute rea	(y) Interce	x=2	Clay %
-0.086165108	1.64166	29.47	29%





Core #19 Viscosity

Parameter	Temperature	Viscosity	Viscosity	H_2O Viscosity	H_2O+HMP Sol. Viscosity
Symbol:	C	mu	mu	mu	mu
Unit:	degrees	N*sec/m2	centipoise	poise	poise
Alt Unit:		Pa*s	cp	p	p
Factor:	CX1	muX1000	muX1	muX1	muX2
	0	1.781	1781	0.01781	0.01819
	5	1.518	1518	0.01518	0.01550
	10	1.307	1307	0.01307	0.01335
	11	1.271	1271	0.01271	0.01298
	12	1.236	1236	0.01236	0.01262
	13	1.202	1202	0.01202	0.01228
	14	1.170	1170	0.01170	0.01195
	15	1.139	1139	0.01139	0.01163
	16	1.110	1110	0.01110	0.01134
	17	1.084	1084	0.01084	0.01107
	18	1.057	1057	0.01057	0.01079
	19	1.029	1029	0.01029	0.01051
	20	1.002	1002	0.01002	0.01023
	21	0.978	978	0.00978	0.00999
	22	0.955	955	0.00955	0.00975
	23	0.933	933	0.00933	0.00953
	24	0.911	911	0.00911	0.00931
	25	0.890	890	0.00890	0.00909
	26	0.871	871	0.00871	0.00889
	27	0.851	851	0.00851	0.00869
	28	0.833	833	0.00833	0.00850
	29	0.815	815	0.00815	0.00832
	30	0.798	798	0.00798	0.00815
	40	0.653	653	0.00653	0.00667
	50	0.547	547	0.00547	0.00559
	60	0.466	466	0.00466	0.00476
	70	0.404	404	0.00404	0.00413
	80	0.354	354	0.00354	0.00362
	90	0.315	315	0.00315	0.00322
	100	0.282	282	0.00282	0.00288

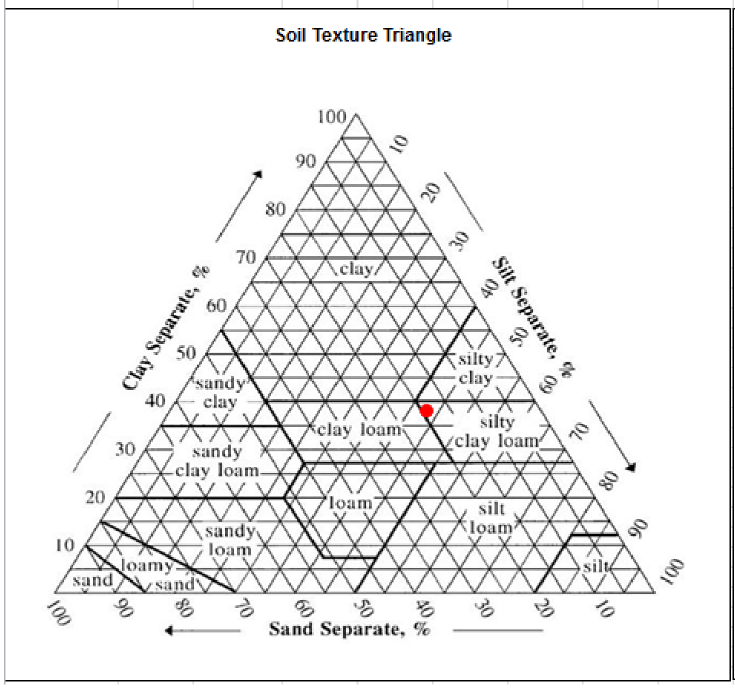
	Density of Water	Water+HMP Sol
Temp °C	density g/mL	density g/mL
0	0.9998425	1.003
4	0.9999750	1.003
5	0.9999668	1.003
10	0.9997026	1.003
11	0.9996084	1.003
12	0.9995004	1.003
13	0.9993801	1.003
14	0.9992474	1.002
15	0.9991026	1.002
16	0.9989460	1.002
17	0.9987779	1.002
18	0.9985986	1.002
19	0.9984082	1.002
20	0.9982071	1.001
21	0.9979955	1.001
22	0.9977735	1.001
23	0.9975415	1.001
24	0.9972995	1.000
25	0.9970479	1.000
26	0.9967867	1.000
27	0.9965162	1.000
28	0.9962365	0.999
29	0.9959478	0.999
30	0.9956502	0.999
35	0.9940349	0.997
37	0.9933316	0.996
40	0.9922187	0.995
100	0.9583665	0.961

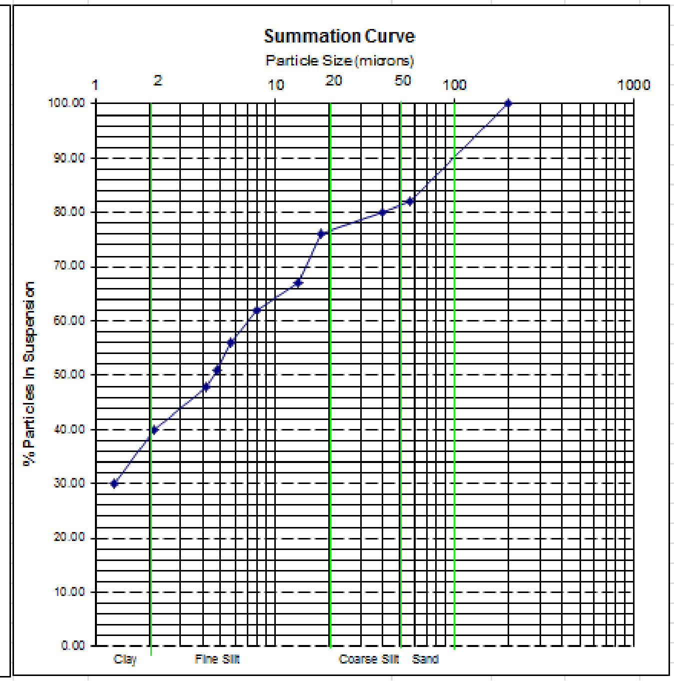
Temperature Conversion			
°C To °F		°F To °C	
°C	°F	°F	°C
0	32.0	40	4.4
4	39.2	41	5.0
5	41.0	42	5.6
6	42.8	43	6.1
7	44.6	44	6.7
8	46.4	45	7.2
9	48.2	46	7.8
10	50.0	47	8.3
11	51.8	48	8.9
12	53.6	49	9.4
13	55.4	50	10.0
14	57.2	51	10.6
15	59.0	52	11.1
16	60.8	53	11.7
17	62.6	54	12.2
18	64.4	55	12.8
19	66.2	56	13.3
20	68.0	57	13.9
21	69.8	58	14.4
22	71.6	59	15.0
23	73.4	60	15.6
24	75.2	61	16.1
25	77.0	62	16.7
26	78.8	63	17.2
27	80.6	64	17.8
28	82.4	65	18.3
29	84.2	66	18.9
30	86.0	67	19.4
40	104	68	20.0
50	122	69	20.6
60	140	70	21.1
70	158	71	21.7
80	176	72	22.2
90	194	73	22.8
100	212	74	23.3
		75	23.9
		76	24.4
		77	25.0
		78	25.6
		79	26.1
		80	26.7

Core RC 0-55 cm

User Pedon ID ==>				USDA Texture					
Sample Number =>				CLAY LOAM					
Soil Name ==>RC			Sand		Clay		Silt		
	Hydrometer:	% Sand	19%	% Clay	38%	% Silt	43%		
	Adjusted:	% Sand	19%	% Clay	38%	% Silt	43%		
Sieved Sand Sizes									
% Very Coarse	0%		x=53	estimated 270 sieve sand %					
% Coarse	0%		1.91	98%					
% Medium	0%								
% Fine	0%		x=47	estimated 300 sieve sand %					
% Very Fine	0%		1.91	98%					
Total	0%								

Time in minutes	x	y	
0.5	56.312212	82.00	
1	40.1899199	80.00	
480	2.14532953	40.00	
1440	1.279555	30.00	
Log Slope of .5 to 1 minute reading	g(y) Interce	x=50	Sand %
0.000665158	1.876357	81.21	19%
Log Slope of 480 to 1440 minute readi	g(y) Interce	x=2	Clay %
0.144308632	1.29247	38.11	38%





Core RC 55-66 cm

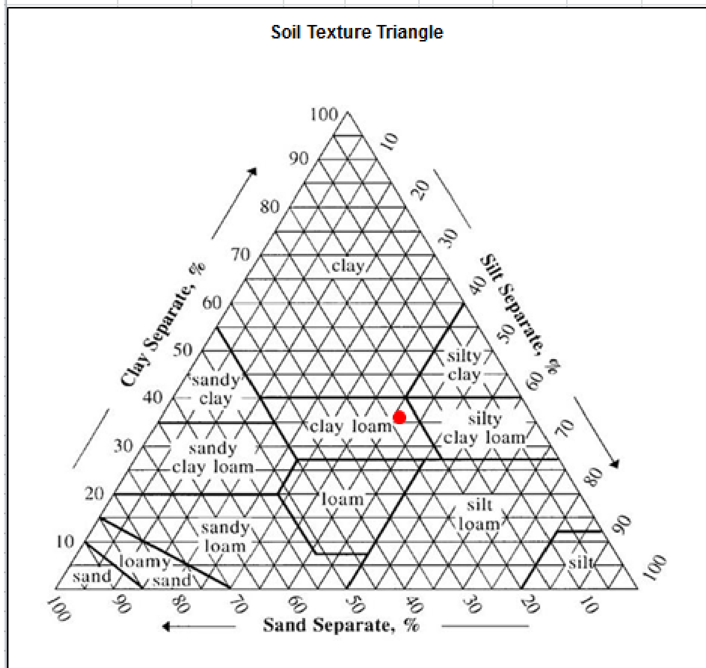
User Pedon ID ==>			USDA Texture				
Sample Number =>			CLAY LOAM				
Soil Name ==>RC		Sand		Clay		Silt	
	Hydrometer:	% Sand	23%	% Clay	36%	% Silt	41%
	Adjusted:	% Sand	23%	% Clay	36%	% Silt	41%

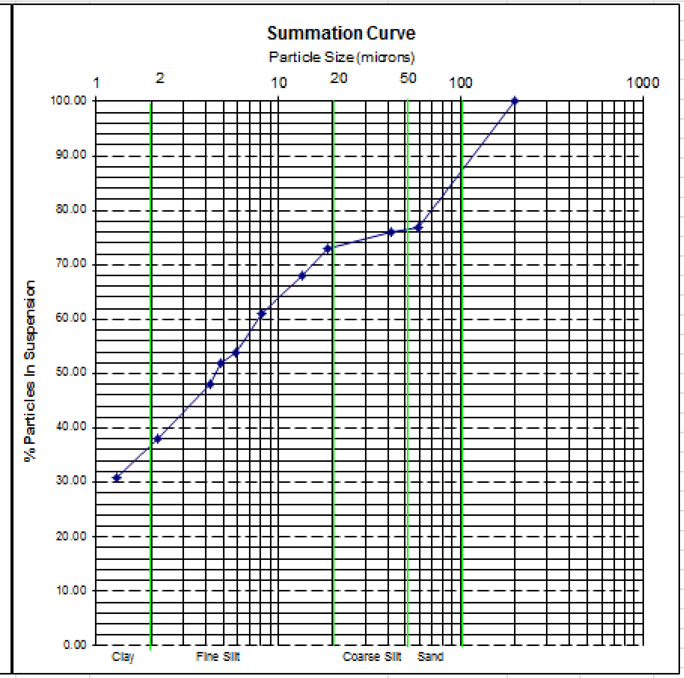
Sieved Sand Sizes	
% Very Coarse	0%
% Coarse	0%
% Medium	0%
% Fine	0%
% Very Fine	0%
Total	0%

x=53	estimated 270 sieve sand %	
76.68	23%	
x=47	estimated 300 sieve sand %	
76.33	24%	

Time in minutes	x	y
0.5	58.31652019	77.00
1	41.42004701	76.00
480	2.18597684	38.00
1440	1.291855928	30.80

Log Slope of .5 to 1 minute reading	.og(y) Intercep	x=50	Sand %
0.000335995	1.86689666	76.51	23%
Log Slope of 480 to 1440 minute readi	.og(y) Intercep	x=2	Clay %
0.102036401	1.35673439	36.38	36%





Core RC Viscosity

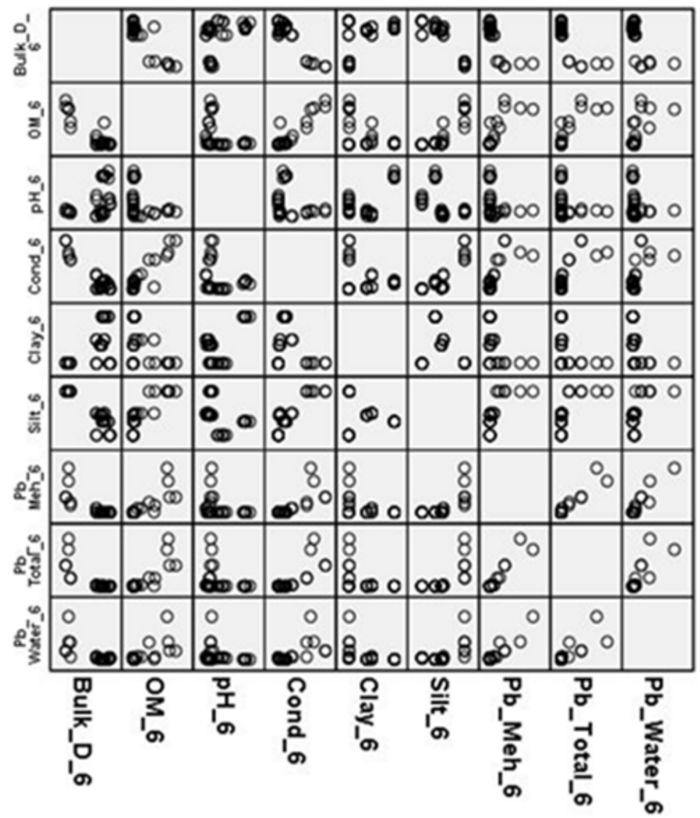
Parameter:	Temperature	Viscosity	Viscosity	H_2O Viscosity	H_2O+HMP Sol. Viscosity
Symbol:	C	mu	mu	mu	mu
Unit:	degrees	N*sec/m2	centipoise	poise	poise
Alt Unit:		Pa*s	cp	p	p
Factor:	CX1	muX1000	muX1	muX1	muX2
	0	1.781	1781	0.0178	0.0182
	5	1.518	1518	0.0152	0.0155
	10	1.307	1307	0.0131	0.0133
	11	1.271	1271	0.0127	0.0130
	12	1.236	1236	0.0124	0.0126
	13	1.202	1202	0.0120	0.0123
	14	1.170	1170	0.0117	0.0119
	15	1.139	1139	0.0114	0.0116
	16	1.110	1110	0.0111	0.0113
	17	1.084	1084	0.0108	0.0111
	18	1.057	1057	0.0106	0.0108
	19	1.029	1029	0.0103	0.0105
	20	1.002	1002	0.0100	0.0102
	21	0.978	978	0.0098	0.0100
	22	0.955	955	0.0096	0.0098
	23	0.933	933	0.0093	0.0095
	24	0.911	911	0.0091	0.0093
	25	0.890	890	0.0089	0.0091
	26	0.871	871	0.0087	0.0089
	27	0.851	851	0.0085	0.0087
	28	0.833	833	0.0083	0.0085
	29	0.815	815	0.0081	0.0083
	30	0.798	798	0.0080	0.0081
	40	0.653	653	0.0065	0.0067
	50	0.547	547	0.0055	0.0056
	60	0.466	466	0.0047	0.0048
	70	0.404	404	0.0040	0.0041
	80	0.354	354	0.0035	0.0036
	90	0.315	315	0.0032	0.0032
	100	0.282	282	0.0028	0.0029

	Density of Water	Density of Water+HMP Sol
Temp °C	density g/mL	density g/mL
0	0.9998	1.003
4	1.0000	1.003
5	1.0000	1.003
10	0.9997	1.003
11	0.9996	1.003
12	0.9995	1.003
13	0.9994	1.003
14	0.9992	1.002
15	0.9991	1.002
16	0.9989	1.002
17	0.9988	1.002
18	0.9986	1.002
19	0.9984	1.002
20	0.9982	1.001
21	0.9980	1.001
22	0.9978	1.001
23	0.9975	1.001
24	0.9973	1.000
25	0.9970	1.000
26	0.9968	1.000
27	0.9965	1.000
28	0.9962	0.999
29	0.9959	0.999
30	0.9957	0.999
35	0.9940	0.997
37	0.9933	0.996
40	0.9922	0.995
100	0.9584	0.961

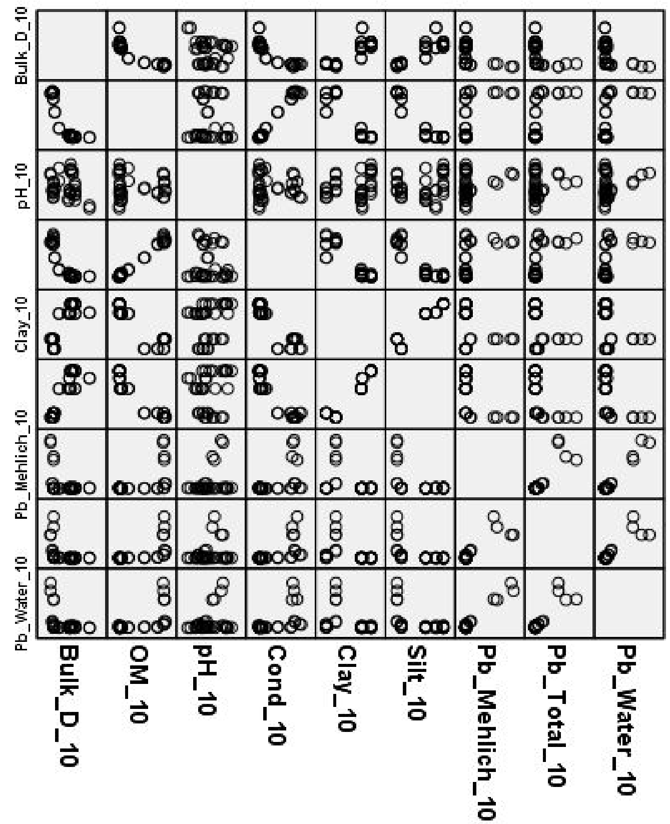
Temperature Conversion			
°C To °F		°F To °C	
°C	°F	°F	°C
0	32.0	40	4.4
4	39.2	41	5.0
5	41.0	42	5.6
6	42.8	43	6.1
7	44.6	44	6.7
8	46.4	45	7.2
9	48.2	46	7.8
10	50.0	47	8.3
11	51.8	48	8.9
12	53.6	49	9.4
13	55.4	50	10.0
14	57.2	51	10.6
15	59.0	52	11.1
16	60.8	53	11.7
17	62.6	54	12.2
18	64.4	55	12.8
19	66.2	56	13.3
20	68.0	57	13.9
21	69.8	58	14.4
22	71.6	59	15.0
23	73.4	60	15.6
24	75.2	61	16.1
25	77.0	62	16.7
26	78.8	63	17.2
27	80.6	64	17.8
28	82.4	65	18.3
29	84.2	66	18.9
30	86.0	67	19.4
40	104	68	20.0
50	122	69	20.6
60	140	70	21.1
70	158	71	21.7
80	176	72	22.2
90	194	73	22.8
100	212	74	23.3
		75	23.9
		76	24.4
		77	25.0
		78	25.6
		79	26.1
		80	26.7

APPENDIX H: PEARSON CORRELATION

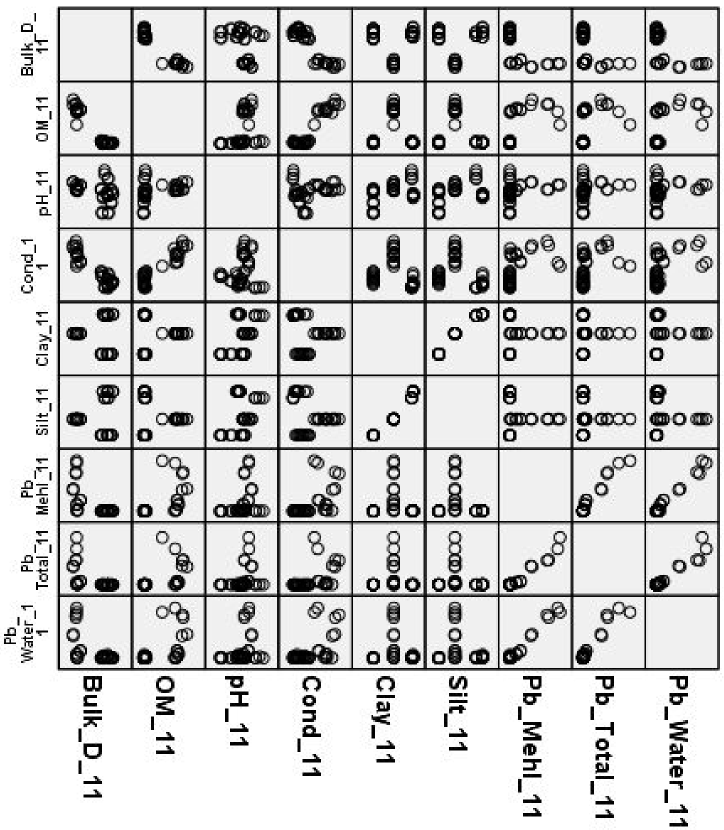
Core #6 Pearson Correlation Scatterplot Matrix



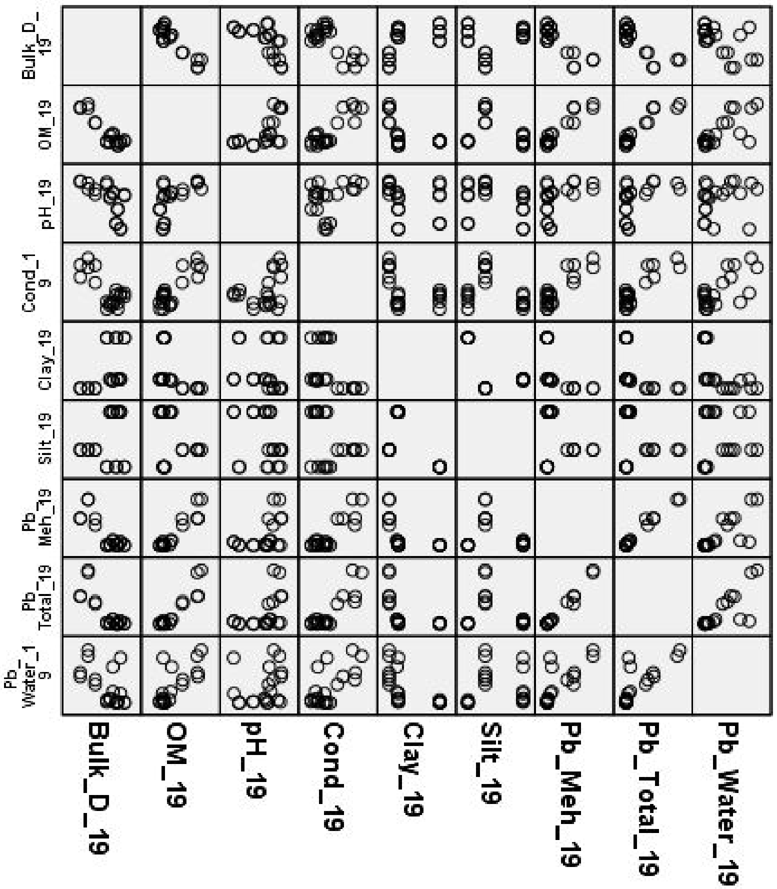
Core #10 Pearson Correlation Scatterplot Matrix



Core #11 Pearson Correlation Scatterplot Matrix



Core #19 Pearson Correlation Scatterplot Matrix



APPENDIX I: BACKWARDS STEPWISE REGRESSION

Core #6: Total Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-12192.244	21909.524		-.556	.583	-57515.548	33131.059
	Bulk_D_6	-1954.349	5672.434	-.172	-.345	.734	-13688.672	9779.975
	OM_6	312.318	129.752	.737	2.407	.025	43.907	580.729
	pH_6	2418.677	1919.827	.337	1.260	.220	-1552.788	6390.142
	Cond_6	-9.005	12.540	-.306	-.718	.480	-34.947	16.936
	Clay_6	-133.027	141.990	-.293	-.937	.359	-426.756	160.702
	Silt_6	175.048	267.312	.294	.655	.519	-377.928	728.024
2	(Constant)	-18494.487	11835.864		-1.563	.131	-42922.509	5933.535
	OM_6	303.983	125.114	.717	2.430	.023	45.761	562.206
	pH_6	2714.404	1685.439	.378	1.611	.120	-764.170	6192.979
	Cond_6	-6.897	10.743	-.234	-.642	.527	-29.070	15.276
	Clay_6	-167.437	99.057	-.369	-1.690	.104	-371.880	37.005
	Silt_6	239.592	187.150	.402	1.280	.213	-146.667	625.851
3	(Constant)	-13615.146	8965.976		-1.519	.141	-32080.918	4850.626
	OM_6	255.613	98.704	.603	2.590	.016	52.329	458.898
	pH_6	2055.051	1320.577	.286	1.556	.132	-664.728	4774.830
	Clay_6	-138.234	86.954	-.304	-1.590	.124	-317.318	40.851
	Silt_6	161.212	140.167	.271	1.150	.261	-127.467	449.891
4	(Constant)	-5064.573	5042.920		-1.004	.324	-15430.444	5301.298
	OM_6	355.156	47.748	.838	7.438	.000	257.007	453.304
	pH_6	1143.119	1062.593	.159	1.076	.292	-1041.072	3327.309
	Clay_6	-76.463	68.808	-.168	-1.111	.277	-217.899	64.974
5	(Constant)	22.463	1757.408		.013	.990	-3583.440	3628.366
	OM_6	349.274	47.572	.824	7.342	.000	251.663	446.884
	Clay_6	-26.573	50.980	-.058	-.521	.606	-131.174	78.029
6	(Constant)	-794.851	783.231		-1.015	.319	-2399.227	809.525
	OM_6	360.062	42.273	.849	8.518	.000	273.470	446.655

a. Dependent Variable: Pb_Total_6

Core # 6: Mehlich III Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-627.750	2131.117		-.295	.771	-5036.302	3780.802
	Bulk_D_6	-345.740	551.752	-.344	-.627	.537	-1487.126	795.646
	OM_6	25.232	12.621	.674	1.999	.058	-.876	51.340
	pH_6	185.150	186.740	.292	.991	.332	-201.150	571.451
	Cond_6	-1.146	1.220	-.440	-.940	.357	-3.669	1.377
	Clay_6	-9.502	13.811	-.237	-.688	.498	-38.073	19.069
	Silt_6	15.725	26.001	.299	.605	.551	-38.062	69.513
2	(Constant)	582.159	724.697		.803	.430	-913.543	2077.861
	Bulk_D_6	-579.598	388.351	-.577	-1.492	.149	-1381.115	221.920
	OM_6	26.966	12.127	.720	2.224	.036	1.937	51.996
	pH_6	95.116	111.238	.150	.855	.401	-134.468	324.700
	Cond_6	-1.099	1.201	-.422	-.915	.369	-3.578	1.380
	Clay_6	-2.354	7.052	-.059	-.334	.741	-16.909	12.200
3	(Constant)	694.753	629.949		1.103	.281	-602.650	1992.156
	Bulk_D_6	-616.023	366.028	-.613	-1.683	.105	-1369.873	137.826
	OM_6	27.426	11.833	.732	2.318	.029	3.055	51.796
	pH_6	75.366	92.516	.119	.815	.423	-115.175	265.907
	Cond_6	-1.187	1.151	-.456	-1.031	.312	-3.557	1.183
4	(Constant)	827.993	604.397		1.370	.182	-414.362	2070.348
	Bulk_D_6	-466.146	314.375	-.464	-1.483	.150	-1112.354	180.061
	OM_6	23.775	10.881	.635	2.185	.038	1.410	46.141
	Cond_6	-.666	.950	-.256	-.700	.490	-2.619	1.288
5	(Constant)	531.664	427.481		1.244	.224	-345.455	1408.783
	Bulk_D_6	-326.940	241.249	-.325	-1.355	.187	-821.943	168.063
	OM_6	19.575	8.993	.523	2.177	.038	1.124	38.027
6	(Constant)	-38.619	76.329		-.506	.617	-194.973	117.734
	OM_6	30.450	4.120	.813	7.391	.000	22.011	38.889

a. Dependent Variable: Pb_Meh_6

Core #6: Water Soluble Pb

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	-18.743	29.485		-.636	.531	-79.737	42.251
	Bulk_D_6	-3.395	7.634	-.297	-.445	.661	-19.186	12.397
	OM_6	.191	.175	.448	1.092	.286	-.171	.552
	pH_6	3.711	2.584	.515	1.436	.164	-1.633	9.056
	Cond_6	-.019	.017	-.636	-1.114	.277	-.054	.016
	Clay_6	-.236	.191	-.517	-1.233	.230	-.631	.160
	Silt_6	.377	.360	.631	1.049	.305	-.367	1.121
2	(Constant)	-29.690	15.955		-1.861	.075	-62.620	3.240
	OM_6	.176	.169	.414	1.045	.307	-.172	.524
	pH_6	4.225	2.272	.586	1.860	.075	-.464	8.914
	Cond_6	-.015	.014	-.512	-1.046	.306	-.045	.015
	Clay_6	-.295	.134	-.648	-2.211	.037	-.571	-.020
	Silt_6	.489	.252	.818	1.940	.064	-.031	1.010
3	(Constant)	-29.792	15.984		-1.864	.074	-62.712	3.127
	pH_6	4.079	2.272	.566	1.795	.085	-.600	8.758
	Cond_6	-.006	.012	-.204	-.521	.607	-.030	.018
	Clay_6	-.319	.132	-.701	-2.423	.023	-.591	-.048
	Silt_6	.526	.250	.879	2.100	.046	.010	1.041
4	(Constant)	-23.056	9.264		-2.489	.020	-42.098	-4.014
	pH_6	3.229	1.559	.448	2.072	.048	.025	6.432
	Clay_6	-.270	.091	-.593	-2.979	.006	-.457	-.084
	Silt_6	.404	.091	.676	4.454	.000	.218	.591

a. Dependent Variable: Pb_Water_6

Core #10: Total Pb

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	-16214.603	4879.214		-3.323	.003	-26225.924	-6203.283
	Bulk_D_10	3000.621	1198.807	.833	2.503	.019	540.873	5460.369
	OM_10	54.393	84.249	.857	.646	.524	-118.472	227.257
	pH_10	3084.524	1373.104	.431	2.246	.033	267.147	5901.901
	Cond_10	.627	3.676	.202	.171	.866	-6.915	8.169
	Clay_10	298.804	92.375	1.322	3.235	.003	109.267	488.341
	Silt_10	-216.701	73.128	-1.646	-2.963	.006	-366.746	-66.655
2	(Constant)	-15929.028	4502.909		-3.537	.001	-25152.820	-6705.236
	Bulk_D_10	2940.907	1126.513	.816	2.611	.014	633.350	5248.463
	OM_10	68.248	22.017	1.076	3.100	.004	23.148	113.347
	pH_10	2986.131	1224.305	.417	2.439	.021	478.257	5494.006
	Clay_10	295.109	88.229	1.305	3.345	.002	114.380	475.839
	Silt_10	-210.034	60.728	-1.595	-3.459	.002	-334.430	-85.637

a. Dependent Variable: Pb_Total_10

Core #10: Mehlich III Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-1584.943	463.173		-3.422	.002	-2535.295	-634.590
	Bulk_D_10	274.983	113.800	.847	2.416	.023	41.484	508.481
	OM_10	9.440	7.998	1.652	1.180	.248	-6.969	25.850
	pH_10	336.045	130.346	.522	2.578	.016	68.598	603.492
	Cond_10	-.219	.349	-.781	-.626	.536	-.934	.497
	Clay_10	23.112	8.769	1.135	2.636	.014	5.120	41.105
	Silt_10	-18.952	6.942	-1.598	-2.730	.011	-33.195	-4.708
2	(Constant)	-1684.460	430.313		-3.915	.001	-2565.915	-803.005
	Bulk_D_10	295.792	107.653	.911	2.748	.010	75.274	516.309
	OM_10	4.612	2.104	.807	2.192	.037	.302	8.922
	pH_10	370.333	116.999	.575	3.165	.004	130.673	609.994
	Clay_10	24.400	8.431	1.198	2.894	.007	7.129	41.671
	Silt_10	-21.275	5.803	-1.794	-3.666	.001	-33.163	-9.387

a. Dependent Variable: Pb_Mehlich_10

Core #10: Water Soluble Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-23.413	6.773		-3.457	.002	-37.309	-9.516
	Bulk_D_10	4.005	1.664	.817	2.407	.023	.591	7.419
	OM_10	.124	.117	1.431	1.056	.300	-.116	.363
	pH_10	4.906	1.906	.504	2.574	.016	.996	8.817
	Cond_10	-.002	.005	-.508	-.421	.677	-.013	.008
	Clay_10	.352	.128	1.144	2.745	.011	.089	.615
	Silt_10	-.281	.102	-1.567	-2.764	.010	-.489	-.072
2	(Constant)	-24.391	6.268		-3.892	.001	-37.229	-11.552
	Bulk_D_10	4.209	1.568	.859	2.685	.012	.998	7.421
	OM_10	.076	.031	.882	2.483	.019	.013	.139
	pH_10	5.243	1.704	.539	3.077	.005	1.753	8.734
	Clay_10	.365	.123	1.185	2.969	.006	.113	.616
	Silt_10	-.303	.085	-1.694	-3.589	.001	-.477	-.130

a. Dependent Variable: Pb_Water_10

Core #11: Total Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5912.639	5622.583		1.052	.301	- 5554.696	17379.973
	Bulk_D_11	- 5655.750	2395.192	-1.549	-2.361	.025	########	-770.724
	OM_11	-60.786	66.932	-.637	-.908	.371	-197.294	75.722
	pH_11	620.973	840.539	.168	.739	.466	- 1093.317	2335.264
	Cond_11	-2.407	6.223	-.220	-.387	.702	-15.099	10.285
	Clay_11	-472.623	841.590	-1.354	-.562	.578	- 2189.058	1243.812
	Silt_11	209.673	384.298	1.284	.546	.589	-574.107	993.453
2	(Constant)	4564.024	4351.942		1.049	.302	- 4300.591	13428.640
	Bulk_D_11	- 5277.355	2157.048	-1.445	-2.447	.020	- 9671.119	-883.592
	OM_11	-76.282	52.899	-.799	-1.442	.159	-184.034	31.469
	pH_11	696.433	806.648	.188	.863	.394	-946.654	2339.521
	Clay_11	-358.070	777.220	-1.026	-.461	.648	- 1941.215	1225.075
	Silt_11	159.681	357.070	.978	.447	.658	-567.647	887.010
3	(Constant)	5468.701	3806.179		1.437	.160	- 2275.027	13212.430
	Bulk_D_11	- 4905.472	1966.034	-1.343	-2.495	.018	- 8905.399	-905.545
	OM_11	-79.663	51.717	-.834	-1.540	.133	-184.883	25.556
	pH_11	467.799	616.325	.126	.759	.453	-786.124	1721.721
	Clay_11	-11.371	54.355	-.033	-.209	.836	-121.957	99.216
4	(Constant)	5642.210	3662.097		1.541	.133	- 1800.067	13084.487
	Bulk_D_11	- 4931.702	1934.244	-1.350	-2.550	.015	- 8862.560	-1000.845
	OM_11	-79.859	50.976	-.836	-1.567	.126	-183.455	23.738
	pH_11	406.212	533.796	.110	.761	.452	-678.591	1491.016
5	(Constant)	7328.703	2897.801		2.529	.016	1445.855	13211.552
	Bulk_D_11	- 4884.693	1921.598	-1.338	-2.542	.016	- 8785.745	-983.641
	OM_11	-74.878	50.250	-.784	-1.490	.145	-176.890	27.134
6	(Constant)	3096.620	585.125		5.292	.000	1909.931	4283.309
	Bulk_D_11	- 2115.129	496.150	-.579	-4.263	.000	- 3121.368	-1108.889

a. Dependent Variable: Pb_Total_11

Core #11: Mehlich III Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	692.141	859.490		.805	.427	-1060.801	2445.083
	Bulk_D_11	-652.987	366.138	-1.132	-1.783	.084	-1399.731	93.757
	OM_11	-2.140	10.231	-.142	-.209	.836	-23.007	18.727
	pH_11	72.546	128.488	.124	.565	.576	-189.507	334.599
	Cond_11	-.400	.951	-.231	-.420	.677	-2.340	1.540
	Clay_11	-64.619	128.649	-1.172	-.502	.619	-327.000	197.762
	Silt_11	28.690	58.745	1.113	.488	.629	-91.121	148.502
2	(Constant)	683.732	845.624		.809	.425	-1038.748	2406.212
	Bulk_D_11	-625.612	336.794	-1.085	-1.858	.072	-1311.638	60.415
	pH_11	69.040	125.472	.118	.550	.586	-186.538	324.618
	Cond_11	-.519	.751	-.300	-.691	.494	-2.048	1.010
	Clay_11	-73.188	120.113	-1.327	-.609	.547	-317.851	171.475
	Silt_11	32.489	55.027	1.260	.590	.559	-79.597	144.574
3	(Constant)	1012.807	591.488		1.712	.096	-190.585	2216.198
	Bulk_D_11	-610.814	332.153	-1.059	-1.839	.075	-1286.584	64.956
	Cond_11	-.599	.728	-.346	-.822	.417	-2.081	.883
	Clay_11	-33.855	95.502	-.614	-.355	.725	-228.155	160.444
	Silt_11	15.056	44.513	.584	.338	.737	-75.507	105.619
4	(Constant)	915.747	510.436		1.794	.082	-121.585	1953.078
	Bulk_D_11	-527.245	219.083	-.914	-2.407	.022	-972.476	-82.015
	Cond_11	-.504	.663	-.291	-.760	.453	-1.851	.844
	Clay_11	-1.665	7.823	-.030	-.213	.833	-17.562	14.233
5	(Constant)	857.197	424.020		2.022	.051	-3.610	1718.005
	Bulk_D_11	-509.664	200.119	-.884	-2.547	.015	-915.927	-103.401
	Cond_11	-.448	.600	-.259	-.746	.461	-1.667	.771
6	(Constant)	547.646	86.828		6.307	.000	371.550	723.742
	Bulk_D_11	-370.972	73.625	-.643	-5.039	.000	-520.291	-221.654

a. Dependent Variable: Pb_Mehl_11

Core #11: Water Soluble Pb

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3.427	8.761		.391	.698	-14.441	21.295
	Bulk_D_11	-5.202	3.732	-.925	-1.394	.173	-12.813	2.410
	OM_11	-.025	.104	-.168	-.236	.815	-.237	.188
	pH_11	.821	1.310	.144	.627	.536	-1.851	3.492
	Cond_11	.000	.010	-.014	-.024	.981	-.020	.020
	Clay_11	-.656	1.311	-1.220	-.500	.620	-3.330	2.019
	Silt_11	.303	.599	1.205	.506	.616	-.918	1.524
2	(Constant)	3.295	6.765		.487	.630	-10.484	17.074
	Bulk_D_11	-5.165	3.353	-.918	-1.540	.133	-11.994	1.665
	OM_11	-.026	.082	-.178	-.318	.752	-.194	.141
	pH_11	.828	1.254	.145	.660	.514	-1.726	3.382
	Clay_11	-.645	1.208	-1.199	-.534	.597	-3.106	1.816
	Silt_11	.298	.555	1.186	.537	.595	-.832	1.429
3	(Constant)	1.863	4.982		.374	.711	-8.274	11.999
	Bulk_D_11	-4.286	1.877	-.762	-2.283	.029	-8.105	-.467
	pH_11	.832	1.237	.146	.673	.506	-1.684	3.348
	Clay_11	-.700	1.179	-1.302	-.594	.557	-3.099	1.699
	Silt_11	.323	.542	1.286	.597	.555	-.779	1.426
4	(Constant)	3.390	4.225		.802	.428	-5.197	11.977
	Bulk_D_11	-3.296	.855	-.586	-3.856	.000	-5.034	-1.559
	pH_11	.345	.916	.061	.377	.709	-1.517	2.207
	Silt_11	.003	.038	.010	.068	.946	-.075	.081
5	(Constant)	3.321	4.041		.822	.417	-4.883	11.524
	Bulk_D_11	-3.279	.803	-.583	-4.083	.000	-4.909	-1.649
	pH_11	.372	.814	.065	.457	.650	-1.280	2.024
6	(Constant)	5.123	.880		5.822	.000	3.338	6.907
	Bulk_D_11	-3.404	.746	-.605	-4.563	.000	-4.918	-1.891

a. Dependent Variable: Pb_Water_11

Core #19: Total Pb:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-1133.690	3110.554		-.364	.721	-7853.633	5586.253
	Bulk_D_19	316.734	517.156	.176	.612	.551	-800.514	1433.982
	OM_19	150.099	59.648	.842	2.516	.026	21.238	278.959
	pH_19	16.084	124.653	.018	.129	.899	-253.213	285.381
	Cond_19	5.928	6.450	.259	.919	.375	-8.005	19.862
	Clay_19	-2.808	27.929	-.043	-.101	.921	-63.144	57.529
	Silt_19	1.361	51.153	.010	.027	.979	-109.149	111.870
2	(Constant)	-1055.963	1026.623		-1.029	.321	-3257.849	1145.924
	Bulk_D_19	323.554	432.787	.180	.748	.467	-604.681	1251.789
	OM_19	150.072	57.471	.842	2.611	.021	26.808	273.336
	pH_19	15.438	117.818	.017	.131	.898	-237.256	268.132
	Cond_19	5.812	4.571	.254	1.271	.224	-3.992	15.617
	Clay_19	-3.522	7.399	-.054	-.476	.641	-19.390	12.346
3	(Constant)	-958.430	683.491		-1.402	.181	-2415.256	498.395
	Bulk_D_19	303.865	392.343	.169	.774	.451	-532.394	1140.124
	OM_19	152.541	52.486	.856	2.906	.011	40.670	264.412
	Cond_19	5.534	3.913	.242	1.414	.178	-2.806	13.874
	Clay_19	-3.156	6.623	-.048	-.477	.641	-17.272	10.961
4	(Constant)	-1023.729	653.238		-1.567	.137	-2408.532	361.074
	Bulk_D_19	301.366	382.715	.168	.787	.443	-509.953	1112.685
	OM_19	159.158	49.378	.893	3.223	.005	54.481	263.834
	Cond_19	5.240	3.769	.229	1.390	.184	-2.751	13.230
5	(Constant)	-524.606	156.177		-3.359	.004	-854.110	-195.102
	OM_19	127.566	28.462	.716	4.482	.000	67.516	187.616
	Cond_19	5.826	3.653	.255	1.595	.129	-1.882	13.535
6	(Constant)	-296.481	65.318		-4.539	.000	-433.709	-159.253
	OM_19	167.011	14.675	.937	11.381	.000	136.181	197.841

a. Dependent Variable: Pb_Total_19

Core #19: Mehlich III Pb

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	714.439	969.975		.737	.474	-1381.064	2809.942
	Bulk_D_19	138.402	161.267	.211	.858	.406	-209.993	486.797
	OM_19	48.789	18.600	.750	2.623	.021	8.606	88.973
	pH_19	-10.400	38.871	-.032	-.268	.793	-94.376	73.575
	Cond_19	.758	2.011	.091	.377	.712	-3.587	5.103
	Clay_19	-10.803	8.709	-.451	-1.240	.237	-29.618	8.012
	Silt_19	-16.373	15.951	-.340	-1.026	.323	-50.833	18.088
2	(Constant)	603.701	847.655		.712	.488	-1214.339	2421.741
	Bulk_D_19	146.992	152.708	.224	.963	.352	-180.535	474.519
	OM_19	47.206	17.038	.726	2.771	.015	10.662	83.749
	Cond_19	1.009	1.718	.121	.587	.566	-2.676	4.694
	Clay_19	-10.604	8.384	-.442	-1.265	.227	-28.586	7.379
	Silt_19	-15.541	15.118	-.323	-1.028	.321	-47.965	16.883
3	(Constant)	928.054	628.892		1.476	.161	-412.399	2268.506
	Bulk_D_19	191.335	129.810	.292	1.474	.161	-85.350	468.019
	OM_19	51.536	15.021	.792	3.431	.004	19.519	83.553
	Clay_19	-13.677	6.406	-.571	-2.135	.050	-27.332	-.022
	Silt_19	-21.546	10.891	-.448	-1.978	.067	-44.758	1.667
4	(Constant)	914.787	651.462		1.404	.179	-466.251	2295.824
	OM_19	40.666	13.557	.625	3.000	.008	11.926	69.405
	Clay_19	-10.451	6.238	-.436	-1.675	.113	-23.674	2.772
	Silt_19	-15.983	10.584	-.332	-1.510	.150	-38.420	6.453
5	(Constant)	-65.007	61.210		-1.062	.303	-194.149	64.135
	OM_19	59.165	6.023	.910	9.823	.000	46.458	71.873
	Clay_19	-1.603	2.220	-.067	-.722	.480	-6.287	3.081
6	(Constant)	-106.232	21.789		-4.876	.000	-152.008	-60.456
	OM_19	61.631	4.895	.948	12.590	.000	51.347	71.916

a. Dependent Variable: Pb_Meh_19

Core #19: Water Soluble Pb

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound
1	(Constant)	-22.202	18.217		-1.219	.245	-61.558	17.153
	Bulk_D_19	1.667	3.029	.266	.550	.591	-4.876	8.210
	OM_19	.672	.349	1.080	1.923	.077	-.083	1.427
	pH_19	-.228	.730	-.074	-.312	.760	-1.805	1.349
	Cond_19	.035	.038	.437	.925	.372	-.047	.117
	Clay_19	.107	.164	.468	.656	.523	-.246	.461
	Silt_19	.337	.300	.732	1.125	.281	-.310	.984
2	(Constant)	-24.630	15.935		-1.546	.145	-58.808	9.549
	Bulk_D_19	1.855	2.871	.296	.646	.529	-4.302	8.013
	OM_19	.637	.320	1.024	1.989	.067	-.050	1.324
	Cond_19	.040	.032	.506	1.253	.231	-.029	.110
	Clay_19	.112	.158	.487	.709	.490	-.226	.450
	Silt_19	.355	.284	.772	1.250	.232	-.254	.965
3	(Constant)	-28.044	14.740		-1.903	.076	-59.460	3.373
	OM_19	.513	.252	.825	2.040	.059	-.023	1.049
	Cond_19	.051	.028	.636	1.845	.085	-.008	.109
	Clay_19	.167	.130	.727	1.283	.219	-.110	.444
	Silt_19	.457	.232	.994	1.975	.067	-.036	.951
4	(Constant)	-9.759	3.832		-2.547	.022	-17.883	-1.635
	OM_19	.287	.183	.461	1.569	.136	-.101	.674
	Cond_19	.034	.025	.420	1.369	.190	-.018	.085
	Silt_19	.174	.072	.379	2.431	.027	.022	.326
5	(Constant)	-6.867	3.278		-2.095	.051	-13.784	.050
	OM_19	.504	.093	.809	5.388	.000	.306	.701
	Silt_19	.141	.069	.306	2.037	.058	-.005	.287

a. Dependent Variable: Pb_Water_19

APPENDIX J: CORE COMPARISONS

Different lead fractions: Total Lead (EPA Method 3050B), Plant Available (Mehlich III extraction) and water soluble with depth of five soil cores from the Gran Valley Ranch.

Core #6			
Depth (cm)	Total Pb mg/kg	Mehlich III Pb mg/kg	Water Soluble Pb mg/kg
5	121	89.8	6.81
10	244	221	23.6
15	47	50.8	7.71
20	5.69	25	2.21
25	0.698	3.15	0.305
30	0.274	1.29	0.414
35	0.212	1.01	0.187
40	0.192	0.605	0.201
45	0.139	0.488	1.15
50	0.202	0.461	1.59
55	0.319	1.622	1.05
60	0.183	0.261	0.126
65	0.164	0.397	0.03
70	0.148	0.409	0.238
75	0.485	1.94	0.137

Core #10			
Depth (cm)	Total Pb mg/kg	Mehlich III Pb mg/kg	Water Soluble Pb mg/kg
5	4758	673	1
8	7410	431	0.697
13	1506	70.4	0.153
18	650	6.51	0.086
23	163	1.08	0.018
28	80.9	0.697	0.019
31.5	58.1	0.347	0.008
36.5	20.9	0.937	0.016
41.5	17.3	0.864	0.007
46.5	17.5	5.38	0.025
50	19	5.8	0.031
55	18.7	5.58	0.001
60	17	4.51	0.014
65	20.2	4.58	0.017
70	23.2	5.78	0.05
75	22.1	6.39	0.014
78	19	6.15	0.004

Core #11			
Depth (cm)	Total Pb mg/kg	Mehlich III Pb mg/kg	Water Soluble Pb mg/kg
5	3572	529	5.39
10	8074	1198	11.2
15	638	264	1.68
20	4763	930	9.8
25	407	162	0.938
30	51.6	37.4	0.182
33	22.4	13.7	0.075
38	19.6	9.32	0.362
43	16.3	6.64	0.354
48	14.5	6.64	0.517
53	12.5	5.16	0.045
58	11	3.93	0.064
61	12.4	3.72	0.186
66	6.45	2.91	0.022
71	2.87	1.47	0.032
76	2.44	1.37	0.008
81	2.47	1.02	0.142
86	2.69	0.577	0.028
88	3.25	0.94	0.026

Core #19			
Depth (cm)	Total Pb mg/kg	Mehlich III Pb mg/kg	Water Soluble Pb mg/kg
5	766	298	2.58
10	1444	504	4.54
15	584	259	1.9
20	134	55.8	2.16
25	28.6	10.8	0.372
30	16.2	4.1	0.121
35	81.1	40.4	2.48
40	14.2	6.39	0.025
45	25.3	4.91	0.042
48	37	4.42	0.186

Reference Core			
Depth (cm)	Total Pb mg/kg	Mehlich III Pb mg/kg	Water Soluble Pb mg/kg
5	40.7	6.11	0.179
10	23.3	4.07	0.276
15	20.7	4.69	0.16
20	15.9	4.47	0.216
25	15.8	3.38	0.236
30	15.4	3.25	0.099
35	20.4	3.98	0.291
40	18.4	5.17	0.704
45	16.1	4.96	1.24
50	20.9	4.93	1.71
55	16.8	5.86	0.473
60	18.5	5.58	0.946
66	19.2	5.78	0.654

Soil properties determined by backward stepwise regression significant to the modeling of total Pb, plant available Pb and water soluble Pb fractions.

Soil Core	Total Pb Model	Plant Available (Mehlich III) Model	Water Soluble Model
#6	%Soil Organic Matter	%Soil Organic Matter	%Silt, %Clay, pH
#10	%Silt, %Clay %Soil Organic Matter Bulk Density, pH	Silt, clay %Soil Organic Matter BD, pH	Silt, clay %Soil Organic Matter Bulk Density, pH
#11	Bulk Density	Bulk Density	Bulk Density
#19	%Soil Organic Matter	%Soil Organic Matter	%Silt, %Soil Organic Matter