HYDROGEOLOGICAL ASSESSMENT AT THE CLARINGTON TRANSFORMER STATION

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HYDROGEOLOGICAL ASSESSMENT AT THE CLARINGTON TRANSFORMER STATION USING A CONVENTIONAL WELL CLUSTER WITH RECOMMENDATIONS TO ESTABLISH AN ADVANCED GROUNDWATER MONITORING STATION

By:

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Title: Hydrogeological Assessment at the Clarington Transformer Station using a Conventional Well Cluster with Recommendations to Establish an Advanced Groundwater Monitoring Station

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LAY ABSTRACT

This thesis concerns the geology and groundwater conditions at the Hydro One transformer station under construction in the Municipality of Clarington, located near the southwestern periphery of the Oak Ridges Moraine (ORM). The ORM, throughout its full extent north of Lake Ontario, has aquifers supplying drinking water to more than 200,000 people, some near the transformer station. The thesis, which is the first phase of a longer term study, uses information obtained from a borehole that provided continuous core samples from near ground surface down through deposits formed by Pleistocene glaciers and into the shale bedrock at 127 m depth. This borehole and four monitoring wells installed by Hydro One nearby, provide the first deep groundwater information of its type available from this part of the ORM and indicate the presence of two deep regional sand aquifers and suggest the occurrence of two thin intermediate depth sand aquifers.

ABSTRACT

Aquifers associated with the Oak Ridges Moraine (ORM) supply drinking water to more than 200,000 people. These aquifers are often overlain by relatively lower permeability till deposits (aquitards) often considered to provide protection to underlying aquifers. A transformer station is under construction by Hydro One (H1) on 11 hectares of H1 owned land on the ORM in the Municipality of Clarington, Ontario. The surficial geology is mapped as till. It is important to consider potential groundwater impacts of this transformer project. As part of the environmental assessment conducted by H1, groundwater information was collected from the property and from nearby homeowner wells. This thesis concerns the geology and groundwater conditions beneath the property utilizing both existing information and also study of a drill hole, commissioned by H1, continuously cored into bedrock at 127.76 m depth. There is a paucity of deep hydrogeological information over the eastern half of the ORM. This thesis reports on the hydrogeology of the local area, which is in a hydrologic setting common throughout much of the ORM, thereby providing valuable information to inform the regional context. The cored hole showed the presence of two deep regional sand aquifers, known as the Thorncliffe and Scarborough aquifers, overlying bedrock. The surficial till unit is interpreted to be over 75 m thick and includes a near-surface sand layer and two deeper, thin sandy layers within this very dense till. This study, conducted as a collaboration between the Universities of Guelph and McMaster, represents the first phase of a

continuing study of the hydrogeology of the H1 property and adjacent area. The next phase includes installation of a depth-discrete, multilevel monitoring system (MLS) for water level measurement and groundwater sampling at 16 different depths. This thesis includes a design for this MLS to be installed beside the deep hole.

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I thank Dr. James E. Smith, McMaster University, who provided the overall supervision of my work on this thesis; Dr. Emmanuelle Arnaud, University of Guelph for additional guidance concerning the geological aspects of the thesis; and Drs. Beth Parker and John Cherry, University of Guelph for guidance concerning the hydrogeological aspects of the thesis. These faculty members provided guidance on thesis drafts. Additional helpful comments on thesis drafts were provided by Dr. Rick Gerber, Oak Ridges Moraine Groundwater Program of the Central Lake Ontario Conservation Authority, and Mr. Steve Usher, SLR Consulting. Dr. Gerber also provided unpublished information concerning the regional hydrogeology.

The key data used in this thesis resulted from the drilling of a continuous cored hole through the Quaternary deposits into the top of bedrock on land owned by Hydro One. Hydro One provided site access and paid for the drilling of the hole, collection of geophysical data, and installation of monitoring wells. The Municipality of Clarington helped facilitate drilling and provided the services of their experts at SLR Consulting. Additionally, the Municipality of Clarington funded moisture content analyses, triaxial permeability testing, and geochemical analyses. Many types of data were acquired by field personnel from McMaster University, the University of Guelph, and Stantec Consulting Ltd. These data were collected from the core, the borehole, and from four conventional monitoring wells installed by Stantec

Consulting Ltd. commissioned by Hydro One. The conventional monitoring wells are located beside the deep hole and one monitoring well was installed at the bottom of the deep hole. The two universities provided field personnel needed during the drilling of the deep hole to do core logging, core sampling, and packaging.

Many people provided assistance with the collection of data from the field site. Jeff Cridland (Hydro One) who facilitated much of the on-site field work by coordinating site access for all in the field party, coordinating workers on site to improve access to the drill site, providing safety training, and providing excellent working facilities to analyse and sample the cores; Dr. Rick Gerber (Oak Ridges Moraine Groundwater Program, CLOCA) who provided guidance during drilling and well installation, and with sampling procedures and who has liaised with Hydro One on various matters; Kelly Whelan (McMaster University), and Tara Harvey (University of Guelph) who helped with the data collection; Dr. Emmanuelle Arnaud (University of Guelph) who supervised the collection of geological data during this field campaign; Steve Usher who provided guidance on sampling procedures as well as assistance with the delivery of samples to commercial labs for analysis; Brant Gill and Natalie Spina (Stantec) who worked collaboratively alongside of us during data collection and installation of the well on site and who arranged for the collection of downhole geophysical data by Lotowater Technical Services Inc; and lastly, Dr. Hazen Russell and Ross Knight (Geological Survey of Canada) who conducted grain size and elemental chemical analyses on these sample and who provided the results for use

in this thesis. Clearly, this project could not have happened without the hard work and dedication of all parties involved.

The multilevel monitoring system (MLS) part of my research project is a collaborative effort lead by the University of Guelph and involving McMaster University, the Oak Ridges Moraine Groundwater Program of CLOCA, the Municipality of Clarington, and the Enniskillen Environmental Association. In the initial plan for this thesis I was to design and participate in the installation of this depth-discrete, MLS in rotosonic holes located beside the deep hole to obtain comprehensive information in the form of depth profiles of various types of hydrogeologic and hydrochemical parameters. However, although the MLS was designed as described in this thesis and the system purchased, ultimately timely access to the site for the drilling and installation could not be accomplished.

Without the MLS installation I made use of the publically available information from the five conventional monitoring wells installed by Hydro One. Unfortunately this information was very limited, and I discuss the limitations herein. As part of the effort to select alternative sites for the rotosonic hole for the MLS, sites off the Hydro One property were considered and in this endeavor, much assistance was provided by members of the Enniskillen Environmental Association, most notably Mr. Doug Taylor, Mr. Jim Sullivan, Mrs. Sally Hillis, and Mr. Clint Cole. These local residents

also contributed much of their time informing me about the local terrain and groundwater use.

In addition to various costs paid by our collaborators mentioned above, logistical and personnel costs were covered by research funds from Dr. James E. Smith (Natural Sciences and Engineering Research Council), Dr. Beth Parker and Dr. John Cherry (University Consortium for Field-Focused Groundwater Contamination Research and Dr. Emmanuelle Arnaud. This financial support is greatly appreciated.

PREFACE

Construction of the Clarington Transformer Station (CTS) is ongoing at a Hydro One Networks Inc. (Hydro One) property located in southern Ontario. The project is a high profile, large infrastructure project, consisting of the construction of two 500/230 kV transformers, a 500 kV switchyard, a 230 kV switchyard, two relay buildings, one electrical panel building, the associated buswork, and equipment (Stantec Consulting Ltd., 2014). Proposals for the CTS were first made public in November of 2012 and the site is now in the final stages of construction. The CTS is being constructed by Hydro One on 11 hectares of a 63-hectare property that was purchased by Hydro One in 1978. The regulatory agency overseeing the project is the Ontario Ministry of the Environment and Climate Change.

Following a Class Environmental Assessment (EA) by the Ministry of the Environment and Climate Change (MOECC), the project was approved on January 2nd, 2014. As a condition to the EA approval, Hydro One was required to prepare and implement a groundwater and surface water monitoring plan and to conduct site monitoring through to 2019. On October 2, 2014 Hydro One was granted road allowance access from the Municipality of Clarington for the construction of an access road into the CTS. As a requirement of the easement agreement, Hydro One was to construct a deep borehole to bedrock for the collection of geologic information. Drilling occurred in November and December of 2014. Three new monitoring wells, each installed in a separate borehole, were placed adjacent to two existing wells to complete a five well cluster for future groundwater monitoring and sampling. The water used to mix the drilling mud was sampled for tritium and tagged with sodium bromide to facilitate interpretation of future groundwater chemistry samples. Sediment samples were collected for analysis and downhole geophysics was completed at the time of drilling (Table i).

Since the proposal for the CTS project became public, there has been controversy and public debate concerning the potential environmental impacts of the CTS due to the site's proximity to the Oak Ridges Moraine (ORM). The Enniskillen Environmental Association (EEA), a group of local homeowners, expressed concerns in regards to the CTS and the safety of the local water resources (Ormsby, 2015). The EEA engaged the G360 Center for Applied Groundwater Research at Guelph University in 2013. An independent review was prepared by G360 that outlined the need for additional investigation of the groundwater flow system at the CTS (Cherry *et al.,* 2013).

There are many stakeholders connected to the CTS. Primary stakeholders in this project include: the landowner (Hydro One); multiple research organizations (G360 at the University of Guelph, McMaster University, University of Ottawa, Geological Survey of Canada, Oak Ridges Moraine Groundwater Program); various consultants (SLR Consulting, Stantec Consulting Ltd.); local, regional, and provincial government departments (Municipality of Clarington, Municipality of Durham Region, Ministry of Environment and Climate Change); Central Lake Ontario Conservation Authority; and a local resident group (Enniskillen Environmental Association).

At this time, the CTS is an active construction site and the construction schedule resulted in obstacles for drilling a rotosonic hole to install a comprehensive multilevel monitoring system (MLS) adjacent to the conventional well cluster in time to meet this thesis deadline. As a result, only the results from the conventional well installation and the design of the planned MLS are presented here, whereas Kelly Whelan's thesis incorporates other on-site data and new hydrogeochemistry data that have been collected to date. It is expected that the MLS design presented in this thesis will be the design adopted for installation of the MLS (with modification based on new borehole data at the time of installation) when site access approval is obtained to allow drilling of rotosonic boreholes and installation of a high-resolution MLS. Once this is accomplished, future research using this infrastructure will allow delineation of key hydrogeologic units and a better understanding of the groundwater flow system both locally and regionally.

Table i: Summary of analyses conducted on samples from the Clarington borehole.

Summary of Samples Obtained from the Clarington Borehole					
Sample Analysis:	**#**	**Date:**	**Analyzed By:**	**Location:**	**Funded By:**
Grain Size Distribution	96	26-Feb-2015	GSC	Ottawa, ON	GSC
Moisture Content by Mass	81	Nov-Dec-2014	Stantec	Markham, ON	Clarington
Triaxial Permeability	6	22-Dec-2014	Golder	Mississauga, ON	Clarington
Geophysics (gamma) *	1	8-Dec-2014	Lotowater	Clarington, ON	Hydro One
Geophysics (electrical resistivity) *	2	8-Dec-2014	Lotowater	Clarington, ON	Hydro One
Portable X-Ray Fluorescence +	96	26-Feb-2015	GSC	Ottawa, ON	GSC
Isotopic Analysis for Drill Water (^{18}O, ^{2}H and ^{3}H)	7	Nov-Dec-2014	UofW	Waterloo, ON	Rick Gerber, CLOCA
Sodium Bromide (For Drilling Mud)	7	Nov-Dec-2014	Maxxam	Mississauga, ON	Clarington
Pore Salt Analysis	34	Nov-Dec-2014	UofW	Waterloo, ON	Rick Gerber, CLOCA
Isotopic Analysis for Drill Water (^{18}O, ^{2}H and ^{3}H)	7	Nov-Dec-2014	UofW	Waterloo, ON	Rick Gerber, CLOCA

* Stantec Consulting Ltd., 2015a

+ Knight *et al.,* 2016a

GSC: Geological Survey of Canada

Lotowater: Lotowater Technical Services Inc.

Golder: Golder Associates

Clarington: Municipality of Clarington

UofW: University of Waterloo

CLOCA: Central Lake Ontario Conservation Authority

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1.0 Introduction

The Oak Ridges Moraine (ORM) is one of Ontario's most significant landforms because it is a major recharge area for the Greater Toronto Area and supplies drinking water to more than 60,000 wells (Sharpe *et al.,* 2007) or approximately 200,000 people (Dyke, 1999; Plummer *et al.,* 2007). This geomorphic feature located in south-central Ontario (Gerber and Howard, 2002) rests in eight upper-tier municipalities, 32 local municipalities, and nine conservation authorities (Bradford, 2008).

In the area where the CTS is being constructed, groundwater flow is predominantly south or southeast towards Lake Ontario with minor deviations locally to rivers and creeks (Gerber and Howard, 2000). The potentiometric surface of the Oak Ridges Moraine (ORM) follows the topography and ranges in elevation from 320 masl to 220 masl (Howard *et al.,* 1995). The average horizontal hydraulic gradient for the region is 0.012 with a range of 0.004 near the middle of the moraine to 0.025 near the discharge points (Howard *et al.,* 1995).

In the Oak Ridges Moraine area, there are three aquifers: upper (ORM), middle (Thorncliffe Formation), and lower (Scarborough Formation) (Gerber and Howard, 2000). Local residents, in Clarington and surrounding municipalities, source their drinking water from sediments comprising the ORM, sand lenses in the till deposits flanking the ORM ridge (e.g. Newmarket Till) or from deeper geologic formations situated beneath the ORM (e.g. Thorncliffe Formation, Scarborough Formation). Characterization of these aquifers is essential to natural resource management, specifically groundwater management. Understanding how groundwater moves through the subsurface to the aquifer units is critical to understanding the fate and transport of both contaminants and recharge as water infiltrates towards these aquifer units.

Multilevel systems (MLS) are engineered systems that allow collection of high resolution depth-discrete hydrogeological data that result in more accurate identification of hydrogeologically significant units and consequently more robust site conceptual models (Meyer *et al.,* 2008, 2014). To date, there are no locations on the Oak Ridges Moraine with a high-resolution multilevel installation. There are, however, locations with high-quality monitoring stations, which are research sites with a cored borehole equipped with three or more piezometers used by the Geological Survey of Canada and the Oak Ridges Moraine Groundwater Program to monitor to ORM (Figure 1).

A conventional well cluster was established on the Hydro One property in Clarington, Ontario to assess the hydrogeological properties at the site. The conventional well cluster will provide more detailed site characterization than had been achieved through the current site-wide monitoring program, leading to better protection and understanding of the ORM. Also, the conventional well cluster will be used as a reference for comparison of high-resolution data to be acquired from the proposed multilevel system (MLS) that will be used to strengthen the understanding of the regional groundwater flow system.

Investigation using state-of-the-science practices (e.g. multilevel systems, geochemical and geophysical analyses, etc.) will provide enhanced datasets from which to characterize the groundwater flow system in this region. The high resolution data sets that will come from the future installation of the MLS will allow us to identify hydrogeological units (HGUs) that are based on the integration of directly measured hydraulic, geological, geophysical, and geochemical data sets (Meyer *et al.,* 2014). This will be an improvement on the current site conceptual model that relies heavily on the regional geological conceptual model and regional hydrostratigraphic framework. The completed monitoring station will be integrated into the High-Quality Monitoring Network being established across Ontario by the Geological Survey of Canada and the Oak Ridges Moraine Groundwater Program. While many of the existing high density monitoring locations are found in the western half of the ORM, this location will supplement information in the eastern half of the ORM.

1.1 Objectives and Approach

The purpose of this research is to better understand the aquifer-aquitard system at the CTS. This thesis aims to: (i) characterize the Quaternary sediments at the CTS using core analysis techniques in a hydrogeological framework; (ii) examine the vertical component of the hydrogeologic domain in terms of hydrogeologic properties including the vertical component of hydraulic gradient; and (iii) provide design recommendations for a high-resolution engineered multilevel system (MLS) on site to obtain detailed vertical profiles of hydraulic head and water chemistry. It was intended that the MLS be installed as part of this thesis but this was not possible because permission to drill the required boreholes was not granted within the time frame of the thesis. This thesis focuses entirely on the datasets obtained from a continuous core and conventional monitoring well cluster on site. A second thesis, by Kelly Whelan is designed to make use of additional pre-existing datasets on site as well as new hydrogeochemical data from surrounding private wells to strengthen our hydrogeological understanding of the subsurface in this area of the Oak Ridges Moraine.

The objectives of this thesis were pursued by obtaining 129 m of continuously cored sediment from surface into the top of bedrock and by logging this sediment in detail at the centimeter scale. The sediment core was subsequently sampled for moisture content, grain size, portable x-ray fluorescence, and triaxial permeability. Downhole geophysics (gamma, electrical conductivity) was completed within the Clarington borehole to aid in identification of low K_v zones. Three conventional wells were installed adjacent to two existing wells to form a conventional five well cluster. Water levels from the conventional well cluster combined with the sediment core analyses were used to design a MLS that will be used to assess hydraulic properties and geochemistry at the CTS in high-resolution detail.

1.2 Thesis Organization

This thesis is organized into two main chapters. Chapter 2 focuses on sample collection and results from the deep Clarington borehole, MW5-14D and MW5-14D(2), located at the CTS. Chapter 3 provides a design and recommendations to install an advanced, high-resolution groundwater monitoring station adjacent to the MW5-14 well cluster.

2.0 Hydrogeological Characterization Using a Conventional Well Cluster

2.1 Introduction

Understanding the subsurface geology of complex glacial systems is of considerable importance for hydrological assessment of groundwater systems. Understanding the stratigraphy and sedimentology of these deposits allows for better prediction of hydraulic interaction and connectivity of aquifers and of the capability of an aquitard to provide protection to underlying aquifers, which is referred to as aquitard integrity (Cherry *et al.,* 2006). Characterizing the nature of subsurface materials and their spatial distribution, in turn helps to determine hydraulic properties of such sediment types. Together with directly measured hydraulic data, a robust site conceptual model (SCM) can be developed to determine flow paths and travel times and identify potential contaminant pathways from surface through aquitards to deep aquifer systems. Ultimately, this SCM can be tested utilizing relatively larger-scale tests such as pumping tests, groundwater chemistry, and tracer concentrations.

Aquitards are low permeability units that have the ability to store groundwater and slowly transmit it from one aquifer to another (Freeze and Cherry, 1979). Aquitards may be the most important component of a groundwater system as they control the movement of groundwater and contaminants to adjacent aquifers (Cherry *et al.,* 2006). Defining intrinsic parameters of aquitards is critical to adequately defining groundwater flow systems. Aquitards are considered contaminant barriers as their low intrinsic permeability inhibits the flow of groundwater and contaminants, offering protection to many residential and rural water wells.

Aquitard integrity is multifactorial and depends on the hydrogeologic nature of the aquitard (Farah *et al.,* 2012). A typical range of hydraulic conductivity values in an intact aquitard is 10^{-8} m/s to 10^{-13} m/s (Freeze and Cherry, 1979). The hydrogeologic properties of the aquitard are affected by depositional processes, geologic structures, and secondary permeability features (e.g. sand lenses, fractures, macropores), which, if hydraulically connected, may allow for increased groundwater flow and contaminant migration (Harrington *et al.,* 2007; Meyer *et al.,* 2014).

In previously glaciated settings, fractures may be present in clayey aquitards. In southern Ontario, till deposited under the Laurentide Ice Sheet experienced subsequent withdrawal of the mass of the overlying ice, which likely resulted in the expansion of till sediment and did result in rebound of the Earth's crust (Clark, et a., 1994; Drzyzga *et al.,* 2012). This process can create a network of fractures, which increases the effective bulk hydraulic conductivity of the sediment (Cherry *et al.,* 2006) and contributes to the groundwater flow and contaminant migration pathways.

Identification of fractures in aquitards is dependent on many factors including the aquitard thickness; the number of visible fractures in cores, boreholes, or outcrops; the matrix plasticity; the aquitard field vs. laboratory hydraulic conductivity values; the response to pumping or recharge; vertical hydraulic gradients within or across the aquitard; penetration of tracers (isotopes, chloride, contaminants) into the aquitard; and the spatial variation within or across the aquitard in piezometric head and chemistry (Bradbury *et al.,* 2006). It is important to note, when evidence of fractures is absent in the vertical datasets, fractures may exist regardless of whether or not the constructed boreholes intersect the fractures (Farah *et al.,* 2012).

While the ideal aquitard is a completely impermeable boundary, virtually all aquitards in true groundwater systems are not fully isolated from sources of vertical groundwater recharge (Freeze and Cherry, 1979). This allows groundwater to flow into and out of the aquitard if the hydraulic gradient is favourable. Identifying physical and geochemical characteristics of the groundwater flow system can be diagnostic in determining the ability for an aquitard to impede groundwater flow and provide protection to underlying aquifers.

The Geological Survey of Canada and the Oak Ridges Moraine Groundwater Program are working to establish a High-Quality Monitoring Network across the moraine. At this time, there are approximately 16 locations within the Oak Ridges Moraine Study Area with a cored borehole with three or more piezometers (Figure 1), constituting a high-density monitoring location. The conventional well cluster installed at the Clarington Transformer Station (CTS), and the proposed installation of a MLS, will be incorporated into the High-Density Monitoring Network and provide an additional monitoring location with a continuous core record to bedrock. The data obtained from the conventional well cluster and the proposed MLS will provide valuable information for assessing the local groundwater flow system that can be applied to the regional groundwater flow system.

The CTS is located in an area with a complex glacial history. The subsurface consists of units of interbedded aquifers (e.g. sand) and aquitards (e.g. till). Generally, tills are found to be laterally extensive and are commonly considered as homogeneous units that offer protection to underlying aquifers from contamination sources above (Boyce and Eyles, 2000; Sharpe *et al.,* 2002). However, the sediments in this region are poorly sorted and heterogeneous. Vertical heterogeneities result from stacked till units separated by finer or coarser grained layers (Eyles *et al.,* 1983; Gerber and Howard, 2002; Meriano and Eyles, 2009), while horizontal heterogeneities may be caused by changes in depositional processes and sediment sources (Narloch *et al.,* 2015). Horizontal and vertical fracturing have also been observed in the Newmarket Till (Gerber *et al.,* 2001). Thus, the construction of a large infrastructure project on the edge of this hydraulically significant feature has prompted some concerns in terms of the potential impact on the underlying groundwater resources.

The primary concerns regarding the CTS revolve around the physical changes to the landscape; the potential effects to surface water features (e.g. streams and wetlands); the use of transformer insulating mineral oil; and potential impacts on the quantity and quality of the drinking water supply (Cherry *et al.,* 2013). The area where the transformers are being installed has been re-graded with a cut and fill approach where earth has been removed from the higher elevation areas, while the lower elevations areas have been filled in to create an even surface for construction (Stantec Consulting Ltd., 2015a). A network of drainage infrastructure will be installed to collect precipitation falling within the development area to divert the precipitation away from the transformer infrastructure (Stantec Consulting Ltd., 2015a, 2015b, 2014). Each transformer will hold up to 165,000 litres of mineral oil (Clarington Transformer Station Safety by Design Fact Sheet, www.hydroone.com). Oil-water separator holding tanks have been installed onsite to contain an accidental release of transformer insulating mineral oil (Stantec Consulting Ltd., 2015a); although, a release of mineral oil entering the groundwater system may impact groundwater quality by changing the groundwater chemistry and microbiology, which in turn can affect other contaminants and the groundwater quality (Cherry *et al.,* 2013).

2.2 Background

2.2.1 Site Characteristics

Hydro One Networks Inc. (Hydro One) is in the process of constructing a transformer station located on a 63-hectare property owned by Hydro One in the Municipality of Clarington, Ontario within the Region of Durham (Figure 2).

The Clarington Transformer Station (CTS) is located northeast of the intersection of Winchester Road East and Townline Road North in Clarington, Ontario. The primary land use surrounding the CTS is agricultural. It falls within the Central Lake Ontario Conservation Authority (CLOCA) management area and within the Harmony/Farewell/Black Creeks Watershed (Enviroscape Consulting and Oak Ridges Moraine Foundation, 2011). The CTS site boundary falls on the edge of, but within, the *Countryside Area* and *Oak Ridges Moraine Conservation Plan Area* according to the *Oak Ridges Moraine Conservation Plan Land Use Designation Map (Ontario Ministry of Natural Resources, 2002)*. The *Oak Ridges Moraine Conservation Plan Area* is made up of the Boundary of Oak Ridges Moraine Conservation Area, (Ontario Regulation 140/02, 2002), and the Plan of the Boundary of Oak Ridges Moraine Area (Ontario Regulation 01/02, 2002). The field site is located just north of the southern edge of the Oak Ridges Moraine planning boundary (Figure 3). The boundary of the *Oak Ridges Moraine Conservation Plan Area* is delineated by topographical, geomorphological, and geological attributes, as well as the 245 m elevation contour under the Oak Ridges Moraine Conservation Act (2001). The area is hilly, sloping towards the south from 280 meters above sea level (masl) to 220 masl (Figure 4).

A monitoring well network had been established onsite prior to the arrival of McMaster University and University of Guelph (G360) investigators to the site. This monitoring network is designed to satisfy Ministry of the Environment and Climate Change (MOECC) requirements for the construction of the CTS. The boreholes and monitoring wells previously installed on site by Stantec provided a basic framework of the geologic profile at the site and helped to guide drilling as part of this investigation. The complete monitoring network, including other borehole and monitoring well locations, is shown on Figure 4.

The boreholes drilled on site for previous monitoring requirements (prior to December of 2014) terminated at depths less than 16 m below ground surface (m bgs), excluding MW5-14 where a borehole was drilled to 40.1 m bgs. The MW5-14 monitoring location (installed in October of 2014) was outfitted with 2 monitoring wells as part of the Site Monitoring Plan conducted by Stantec Consulting Ltd. (Stantec). These monitoring wells are labelled MW5-14S and MW5-14I. Due to the presence of two established monitoring depths and the opportunity to have a cluster covering the full depth of the succession down to bedrock, this was the site chosen for the deep groundwater exploration program as required by the easement agreement (Stantec Consulting Ltd., 2015a, 2015b). Three additional monitoring wells were installed at the MW5-14 monitoring location in December of 2014, labelled MW5-14S(2), MW5-14D, and MW5-14D(2). The borehole for the deepest monitoring interval was cored to a total depth of 129.54 m bgs.

2.2.2. Regional Geology

The advances and retreats of the Laurentide ice sheet during the Wisconsinan glacial period have largely shaped the Quaternary geology of southern Ontario. During the last glaciation, 20,000 years ago, the Laurentide Ice Sheet reached its maximum size and thickness covering most of northern North America (Barnett *et al.,* 1998). This ice sheet was irregular in shape and consisted of many lobes (Barnett *et al.,* 1998) that deposited mainly glacial, unconsolidated sediments, which cover Paleozoic bedrock (Sharpe and Russell, 2016). The complex movement of the ice sheet deposited the main geomorphic feature in the south-central Ontario region called the Oak Ridges Moraine (ORM) (Gerber and Howard, 2002). The ORM, first formally described by Taylor (1913), is situated near the southern margin of the former Laurentide Ice Sheet (Barnett *et al.,* 1998). The ORM was created toward the end of the last glaciation between the Ontario lobe and the Simcoe lobe during the retreat of the ice sheets 13,000 years ago and is considered an interlobate moraine (Boyce *et al.,* 1995; Howard *et al.,* 1995). Chapman and Putnam, for the Ontario Research

Foundation, produced the first surficial map of the ORM in 1951 (Chapman and Putnam, 1951).

The ORM is a discontinuous massive ridge 160 km long that extends west-east, North of Toronto, from the Niagara Escarpment to beyond Rice Lake forming a drainage divide between Lake Ontario and Georgian Bay (Figure 5) (Barnett *et al.,* 1998; Bradford, 2008; Gwyn and Cowan, 1978; Howard *et al.,* 1995; Sharpe *et al.,* 2007). The moraine is approximately 1900 km^2 and varies in width from 5–15 km but may be more extensive in the subsurface (Sharpe *et al.,* 1999). The highest crest of the moraine reaches approximately 100 m above the surrounding terrain with a maximum elevation of 370 masl (Gwyn and Cowan, 1978; Sharpe *et al.,* 2007). The topography of the southern flank of the ORM is hummocky with kettle depressions (Barnett *et al.,* 1998), while the northern flank is more flat with large areas forming sand plains (Barnett *et al.,* 1998; Gwyn and Cowan, 1978). It consists of four large, wedge-shaped bodies: Albion Hills, Uxbridge, Pontypool, and Rice Lake (Barnett *et al.,* 1998). The CTS is located within the Pontypool wedge.

The sediment located in the ORM area is up to 200 m thick and consists of some of the oldest Quaternary sediment in southern Canada (Figure 5) (Sharpe *et al.,* 2007). The ORM is built on a high-relief, erosional unconformity (Figure 5) that consists of drumlin uplands and deep, steep-walled, interconnected valleys called tunnel channels (Figure 1; tunnel channels are primarily on the north flank of the ORM)

(Barnett *et al.,* 1998). The ORM has a significant amount of fine-grained sediments, which can be correlated to deposition in a glaciolacustrine environment (Barnett *et al.,* 1998). Barnett *et al.,* (1998) integrated landscape analysis, mapping, sedimentology, shallow geophysics, and borehole data to construct a conceptual model for the formation of the ORM including a description of the subsurface geology and timing of development. The model describes the development of the ORM occurring in four stages from subglacial to proglacial conditions: (i) subglacial sedimentation; (ii) subaqueous fan sedimentation; (iii) fan to delta sedimentation; and (iv) ice-marginal sedimentation (Barnett *et al.,* 1998).

Below the ORM rests the Newmarket Till (also referred to as Northern Till, Figure 5), which was mapped in 1972 by Gwyn (Howard *et al.,* 1995). The Newmarket Till is sandy silt/silty sand diamicton that contains sand and gravel interbeds (Howard *et al.,* 1995). The Lower sediments (Thorncliffe Formation, Sunnybrook Till, Scarborough Formation) are found below the Newmarket Till. They are up to 150 m thick consisting of alternating 20-30 m thick layers of sand, silt, clay, till, and organic-rich, fossil-bearing beds (Sharpe *et al.,* 2007). The Lower sediments directly overlie the Blue Mountain Formation (OGS, 1991), an irregular channelled shale bedrock surface (Barnett *et al.,* 1998).

The sediments of the ORM include diamicton and thick units of alternating beds of silt, sand, and gravel of glaciofluvial and glaciolacustrine origin (Barnett *et al.,* 1998).

Diamicton is a descriptive term that refers to poorly sorted sediments displaying a wide range of grain sizes and that can result from a variety of processes (Eyles and Eyles, 1983; Hambrey and Glasser, 2003), whereas till is an interpretive term for diamicton that was deposited directly by glacial ice (Eyles and Eyles, 1983; Hambrey and Glasser, 2003). Distinguishing between diamicton of different origins is important as their depositional history will often impact their physical and hydrogeological properties.

2.2.2.1 Existing Conceptual Models of the Oak Ridges Moraine Area

There are various conceptual models for the Oak Ridges Moraine (ORM). These models vary slightly, yet all describe thick sequences (~200 m) of Quaternary sediments overlying Paleozoic bedrock (Barnett *et al.,* 1998; Desbarats *et al.,* 2001; Gerber *et al.,* 2001; Gerber and Howard, 2000; Logan *et al.,* 2000; Sharpe *et al.,* 2007; Sharpe and Russell, 2013).

Typically the sediments in this region are grouped into four main units that overlie Paleozoic bedrock (Figure 6): (i) Lower (sub-Newmarket) sediments; (ii) Newmarket Till; (iii) Oak Ridges Moraine; and (iv) Halton Till (Sharpe *et al.,* 2007; Sharpe and Russell, 2016). The four stratigraphic units vary in their defining characteristics, each described below.

2.2.2.2.1 Lower Sediments

The Lower sediments are various units of Illinoian to mid-Wisconsinan age (Sharpe *et al.,* 2007). They are up to 150 m thick consisting of sand, silt, clay, diamicton, and organic-rich, fossil-bearing beds with a planar upper surface and horizontal internal architecture (Sharpe *et al.,* 2007). Alternating 20-30 m thick layers of silt-clay and sand units are common (Sharpe *et al.,* 2007). The Lower sediments directly overlie Blue Mountain Formation (OGS, 1991), which is composed of blue grey non-calcareous shale bedrock from the Upper Ordovician time period (458.4 - 443.8 million years ago).

The Scarborough Formation, directly overlying bedrock, is a deltaic deposit (Gerber *et al.,* 2001; Eyles *et al.,* 1983) that progresses upwards from muddy silt-clay rhythmites (Eyles and Clarke, 1988) and massive silt to thick sand (Sharpe *et al.,* 1999). The Scarborough Formation commonly contains disseminated organic material and wood fragments (Sharpe *et al.,* 1999). Radiocarbon dating (^{14}C) techniques have been applied to plant detritus within the unit to estimate a date of origin greater than 54,000 years (Karrow, 1990).

The Sunnybrook Drift (also referred to as the Sunnybrook Till) is a grey coloured massive clayey-silt diamicton embedded with rare pebbles and boulders (~1%) (Eyles *et al.,* 1983; Eyles and Eyles, 1983; Eyles and Clarke, 1988; Sharpe *et al.,* 1999). The diamicton matrix contains a highly variable sand fraction and clast composition (Eyles and Eyles, 1983). Near Lake Ontario at the Scarborough Bluffs, this sedimentary unit contains rhythmites and massive clay in the uppermost section, which suggests deposition on the floor of a glacial lake (Eyles and Eyles, 1983). However, striated stones found near the base of the unit and deformation structures indicative of shear suggest that it may be a till in some locations (Hicock and Dreimanis, 1989; Sharpe *et al.,* 1999). Thermoluminescence dating techniques have been used to date the diamicton unit to approximately 66,500 ± 6800 years (Karrow, 1990).

The Thorncliffe Formation, deposited between 30,000 to 50,000 years ago (Barnett, 1992; Karrow, 1990), contains one of Ontario's largest aquifers in thickness and extent (Gerber and Howard, 1996; Sharpe *et al.,* 1999). The Thorncliffe Formation consists of primarily fine-grained cross-laminated and cross-bedded sand with intervening deltaic silt-clay rhythmites (Eyles and Eyles, 1983; Sharpe *et al.,* 1999). The most frequent sand facies is a massive or crudely bedded silty-sand (Eyles *et al.,* 1983). The Thorncliffe Formation consists of three sandy aquifer units (upper, middle, lower) with intervening diamicton/aquitards (Meadowcliffe, Seminary) (Eyles *et al.,* 1983; Sharpe *et al.,* 2007); although, the Seminary and Meadowcliffe Tills are known to pinch out inland within a few km of the Scarborough Bluffs (Eyles *et al.,* 1985; Karrow, 1967). Single and multiple graded silt laminations with clay caps are found within the lower Thorncliffe Formation (Eyles and Clarke, 1988).

2.2.2.2.2 Newmarket Till

The Newmarket Till (also referred to as the Northern Till), a regional Late Wisconsinan unit shaped by the overlying regional unconformity and erosional landforms, is a dense, ~1 - 69 m thick, stony (5-15% gravel), sandy-silt to silty-sand diamicton, with thin sand and silt lenses deposited subglacially during the maximum advance of the Laurentide Ice (Boyce and Eyles, 2000; Gerber *et al.,* 2001; Kjarsgaard *et al.,* 2016; Sharpe *et al.,* 1999, 2004, 2007; Sharpe and Russell, 2016, 2013). It is over-consolidated and calcite cemented with granitic, gneissic, and carbonate pebble and boulder sized clasts within a silty-sand to sandy-silt matrix (Boyce and Eyles, 2000; Gerber *et al.,* 2001; Gerber and Howard, 2000; Kjarsgaard *et al.,* 2016). The Newmarket Till has a very low percentage (<1%) of open pore space, resulting in very low permeability (Kjarsgaard *et al.,* 2016). The Newmarket Till upper surface is commonly drumlinized, from the flow of the Laurentide Ice Sheet, with a north-northeast to south-southwest orientation (Barnett *et al.,* 1998; Sharpe *et al.,* 2007, 1999).

The internal stratigraphy of the Newmarket Till consists of 3-5 m thick till units interbedded with continuous sheet-like sand and gravel, and boulder pavements (Boyce and Eyles, 2000; Gerber *et al.,* 2001; Sharpe and Russell, 2016). Within till units exist discontinuous sand and gravel lenses as well as fractures (Gerber *et al.,* 2001).

Compared to the younger Halton Till, the Newmarket Till has a higher density (2.2 – 2.4 g/cm^3), is more stony (5-15% gravel), has a high sand content (37%) with a silt matrix (~47%), and a lower water content (10%) (Kjarsgaard *et al.,* 2016; Sharpe and Russell, 2013). On seismic profiles, the Newmarket Till forms a continuous, diagnostic, high-velocity reflector (2200 m/s to 2800 m/s) (Boyce and Koseoglu, 1995; Kjarsgaard *et al.,* 2016; Pullan *et al.,* 2000).

2.2.2.2.3 Oak Ridges Moraine Sediments

The ORM sediment rests atop a regional unconformity and is found in tunnel channels within the Newmarket Till (Sharpe *et al.,* 2007). These sediments also form the prominent east-west ridge creating a drainage divide between Lake Ontario and Georgian Bay (Barnett *et al.,* 1998; Gwyn and Cowan, 1978; Sharpe *et al.,* 2007). The ORM consists mostly of silt and fine sand, whereas gravel is significant in the east with a tendency to grade upwards into a muddy texture (Sharpe *et al.,* 2007; Sharpe and Russell, 2013). The ORM likely formed during a rapidly deposited sequence of high-energy, west-flowing meltwater events (Sharpe and Russell, 2016). Cross-bedded sand can be found within the Oak Ridges Moraine (Sharpe and Russell, 2013).

The ORM often acts as a stratigraphic marker to distinguish the Halton Till from Newmarket Till (Gerber and Howard, 2000; Sharpe and Russell, 2013). On the southern edge of the ORM, where these sediments pinch out, it can become difficult to differentiate the Halton Till from Newmarket Till (Sharpe and Russell, 2013), though the density differences between the two tills (i.e. the Newmarket Till being more dense and requires drilling rather than augering) and the more heterogeneous nature of the Halton Till (more lenses/layers and pods of sand, silt and clay) can sometimes be used to distinguish between the two (Rick Gerber, personal communications, September 2016).

2.2.2.2.4 Halton Till

The Halton Till is a low permeability unit (Sharpe and Russell, 2013) that is most extensive west of Toronto and is typically less than 15 m thick but may be up to 30 m thick in local areas (Sharpe *et al.,* 2007). The Halton Till is finer grained and thicker in the west, more scattered in the east, and is found to thin southward (Sharpe and Russell, 2013). It is made up of interbedded low stone content (1-2%) diamicton, silty-clay sediments, and sand lenses (Sharpe and Russell, 2016, 2013). The Halton Till is often found in one of two ways: (i) transitioning upward from Oak Ridges Moraine sand to units of graded sand, silt, and clay; or (ii) discontinuously overlying Newmarket Till (Sharpe and Russell, 2016, 2013). Halton sediments are found to correlate well with ORM sediments where the Halton drapes ORM, thinning over topographic highs and filling topographic lows (Sharpe and Russell, 2016, 2013).

Various, competing interpretations of the origin of the Halton Till have evolved with time. Halton Till sediments were identified south of the ORM as drumlins and flutes that would indicate a depositional, subglacial origin (Sharpe, 1988). These were later interpreted as erosional landforms cut into Newmarket Till, and form part of the Peterborough drumlin field (Sharpe *et al.,* 2004). Gerber et al. (2001) indicated the Halton Till was deposited from a final ice re-advance toward the northwest from Lake Ontario (Gerber *et al.,* 2001). Sequences of fining upwards laminated units and interbedded diamicton are common within the Halton Till and are interpreted as glaciolacustrine in origin formed as a result of subaqueous debris flows (Sharpe, 1988; Sharpe *et al.,* 2007). Sharpe and Russell (2013) have shown evidence that the Halton Till formed as an ice-marginal or subglacial glaciolacustrine deposit in a distal, deep water basin (Sharpe and Russell, 2013). Most recently, Sharpe and Russell (2016) reinterpreted the Halton Till to be deposited by an ice-marginal or subglacial lake related to late ORM meltwater deposition (Sharpe and Russell, 2016). Clay and silt laminations, diamicton interbeds, and intraclasts indicate ponding, debris flows, and periodic ice loading, respectively (Sharpe and Russell, 2016).

In Sharpe and Russell's 2016 model, there are four main facies that occur within Halton Till sediments and these are: (i) diamicton; (ii) laminated silt and clay; (iii) sand and gravel; and (iv) deformed facies (Sharpe and Russell, 2016, 2013), as such, the Halton Till has been reclassified as the Halton formation by Sharpe and Russell (2016).

The diamicton facies is the most common. It consists of 1-5 m thick beds of clayey silt to fine sandy silt with a low stone content (1-2%) (Sharpe and Russell, 2016, 2013). There may be intraclasts of 2-5 mm of silt and clay or 5-10 cm of sand (Sharpe and Russell, 2013). Pebbles found within the diamicton are sub-rounded to subangular carbonate, siltstone, shale, and gneiss (Sharpe and Russell, 2016, 2013). The lower contact can be sharp or gradational (Sharpe and Russell, 2013). Moving upward in the unit, the diamicton becomes finer grained and more massive with a lower gravel content (Sharpe and Russell, 2016, 2013).

The laminated silt and clay facies within the Halton Till consists of fining upwards beds of silt and clay (Sharpe and Russell, 2013). Clay beds are thin (5 mm) and massive while silt beds are larger (1-30 mm) with some sand at the contact, rarely containing dropstones (2-3 cm) (Sharpe and Russell, 2013). Sand facies and gravel facies can occur within the Halton Till (Sharpe and Russell, 2013). The gravel facies contains thin interbeds of diamicton and laminated silt and clay (Sharpe and Russell, 2013).

The lower contact of the Halton Till may be gradational with Oak Ridges Moraine sand, gravel, and silt or abruptly transition from Newmarket Till (Sharpe and

Russell, 2013). On seismic profiles, the Halton Till forms a diagnostic low-velocity reflector (1500 m/s to 2200 m/s) (Boyce and Koseoglu, 1995).

2.2.3 Regional Hydrogeology

The hydrogeological properties of the thick succession of Quaternary sediments that overlie bedrock in this area (Figure 7) have been characterized in various studies (Logan *et al.,* 2000; Sharpe *et al.,* 2002, 2007; Sharpe and Russell, 2013, 2016). These properties are detailed below for each of the key stratigraphic units on site.

2.2.3.1 Newmarket Till

At various landfill sites in the Greater Toronto Area, the Newmarket Till (Northern Till) has been used as a base for landfill development (Boyce *et al.,* 1995). Traditionally, tills have been thought of as low permeability barriers to groundwater flow. Till is an ideal base strata for landfill development because of their large horizontal extent, thickness, over-consolidation and low permeability (Boyce *et al.,* 1995). However, since then, problems have arisen with higher than expected groundwater flow rates and migration of contaminants through the till layers to underlying aquifer systems (Boyce *et al.,* 1995). Studies completed within the Newmarket Till have repeatedly shown that an active groundwater system with high vertical groundwater velocities (>1 m/year) exists in an otherwise thick, sandy-silt till aquitard (Gerber *et al.,* 2001; Gerber and Howard, 1996). One indication of high vertical groundwater velocities is the finding of young waters (<55 years) containing the environmental tracer tritium at numerous depths within the aquitard and underlying aquifer (Gerber *et al.,* 2001). The pathways for environmental tracers and contaminants are poorly understood (Boyce and Eyles, 2000; Boyce *et al.,* 1995).

Laboratory testing has put matrix values of hydraulic conductivity in the Newmarket Till in the range of 10^{-11} to 10^{-10} m/s (Gerber and Howard, 2000). Slug tests, pump tests, and water balance approaches put bulk values of hydraulic conductivity in the range of 10^{-12} to 10^{-5} m/s (Gerber and Howard, 2000). Gerber and Howard (2000) developed a model that demonstrated regional bulk vertical hydraulic conductivity values for the Newmarket Till ranged from 5×10^{-10} to 5×10^{-9} m/s, which puts regional recharge values at 30 - 35 mm/year (Gerber and Howard, 2002, 2000; Sharpe and Russell, 2013). The bulk vertical hydraulic conductivity is increased due to heterogeneities such as fractures, sand lenses, and boulder pavements between the top of the Newmarket Till and the underlying Thorncliffe Formation aquifer. Hydrogeochemistry supports the finding of much greater groundwater velocities (Boyce *et al.,* 1995), which suggests that there are likely hydraulic windows and pathways that cannot be captured at the laboratory scale.

2.2.3.2 Oak Ridges Moraine

The potentiometric surface of the Oak Ridges Moraine (ORM) follows the topography and ranges in elevation from 320 masl to 220 masl (Howard *et al.,* 1995). The average horizontal hydraulic gradient for the region is 0.012 with a range of 0.004 near the middle of the moraine to 0.025 near the discharge points (Howard *et al.,* 1995). The high hydraulic gradients at the discharge points indicate that the ORM Complex provides a significant amount of groundwater to streams such as the East Duffins Creek and East Holland River (Howard *et al.,* 1995).

The ORM is also a major recharge area for the Greater Toronto Area and supplies water to more than 60,000 wells (Sharpe *et al.,* 2007) or more than 200,000 people (Plummer *et al.,* 2007). Regionally, groundwater flow is predominantly south or southeast towards Lake Ontario with minor deviations locally to rivers and creeks (Gerber and Howard, 2000).

2.2.3.3 Halton Till

Typical values of vertical hydraulic conductivity for the massive diamicton lithofacies of the Halton Till range from $1x10^{-9}$ to $8x10^{-9}$ m/s, while the sand and gravel lithofacies range in hydraulic conductivity from $4x10^{-6}$ to $5x10^{-6}$ m/s (Sharpe and Russell, 2013). Weathered sections of Halton Till near surface have highly variable hydraulic conductivity values up to $2x10^{-5}$ m/s (Sharpe and Russell, 2013).

Fractures may also be present in sections of Halton Till enhancing infiltration and recharge (Sharpe and Russell, 2013). The observed depth of weathering is approximately 3-6 m (Sharpe and Russell, 2013). Recharge has been estimated at 125 to 350 mm/year through the Halton Till (Sharpe and Russell, 2013, Sharpe *et al.,* 2007). Gerber and Howard (1996) conducted environmental isotope investigations that suggested a large portion of recharge to the underlying ORM aquifer complex is delivered via till that is mapped on the flanks of the ORM due to the presence of modern waters (post-1952). Water balances studies corroborate this conclusion of recent waters (Gerber and Howard, 2000).

2.2.4 Site Conceptual Models for Aquifer-Aquitard Systems

A site conceptual model (SCM) is an important tool used to aid in interpretation of spatial and temporal data and to guide evidence based decisions. These models are used to assess existing and future threats to groundwater that may be used as a drinking water source. An SCM incorporates geology, hydrogeology, and geochemistry to form a comprehensive model specific to the site of interest. Development of an SCM begins with a focus on geology; a preliminary SCM can be developed based on available geologic information. Obtaining additional datasets, including hydraulic data and contaminant distributions, informs the SCM with the goal of developing a robust conceptual model of the groundwater flow system. Hydrogeologic units (HGU), which are the building blocks of the SCM, are partitions of the groundwater flow domain with contrasting hydraulic conductivities at a specified scale (Meyer *et al.,* 2008, 2014). The delineation of HGUs relies on both detailed hydraulic data and detailed geologic data (Meyer *et al.,* 2008, 2014). As the installation of the proposed MLS was delayed, the current hydrogeological study focuses on the geological properties of the cored hole and some basic hydraulic data in the conventional well cluster to define hydrogeological features and properties of the sediments on site. Once the MLS is installed and high resolution data is collected, HGUs can be defined and the site conceptual model refined.

An SCM should be flexible enough to incorporate new features as additional information is gathered that may support or refute the current understanding of the flow system. It is possible to have more than one valid conceptual model, which until proven otherwise, should be considered to reduce the uncertainty in the overall study (Bradbury *et al.,* 2006). The thickness and areal extent of identified geologic layers may change as additional data is acquired (Bradbury *et al.,* 2006). For example, hydraulic conductivity data may indicate that the portion of a geologic unit serving as an aquitard is much thinner than would be defined by geologic data. The data from the proposed MLS will therefore be critical in defining HGUs and assessing the role of various units in their effect on the groundwater flow system at this site. This has implications for groundwater and contaminant travel times.

Interbedded glacial deposits can be highly variable in thickness and areal extent. They may contain a wide variety of facies including diamicton, sand, gravel, and fine-grained silt and clay. Various phases of deposition of glacial sediments can result in interbedded aquifer and aquitard materials. The complexity of glacial deposition can result in preferential flow paths within these aquitards (Gerber *et al.,* 2001; Gerber and Howard 1996) due to the presence of discontinuous sand and gravel lenses (Bradbury *et al.,* 2006) or erosive processes creating large-scale high permeability windows for contaminant transport (Bradbury *et al.,* 2006; Desbarats *et al.,* 2001) in an otherwise extensive aquitard.

High-resolution data, such as the datasets presented in this thesis, may be used to update or modify the regional conceptual models. Hydrogeological information that may be obtained from a MLS proposed for installation at the CTS will help to characterize the hydrostratigraphy locally and regionally.

2.3 Methods

2.3.1 Deep Borehole Drilling and Installation of a Conventional Monitoring Well Cluster in Mud-Rotary Boreholes

A detailed site investigation was carried out at the CTS in November and December of 2014 at the MW5-14 well cluster (Clarington borehole). Field activities involved: drilling and coring a borehole into the shale bedrock at the MW5-14 monitoring location; obtaining a continuous sediment core from surface to bedrock; and extracting sub-samples from the core for various analyses.

The MW5-14 well cluster consisted of two existing monitoring wells; the well screens were located between 3.1 - 6.1 m bgs and 37.1 - 40.1 m bgs for MW5-14S and MW5-14I, respectively. A total of three new boreholes were drilled and continuously cored. MW5-14S(2), a relatively shallow borehole, was drilled using a 108 mm inner diameter hollow-stem auger to place a well within the weathered zone. MW5-14D and MW5-14D(2) were drilled using a track mounted CME 75 drill rig (Figure 8a) equipped with a 101.6 mm inner diameter PQ-size tube. While drilling MW5-14D, medium-fine sand was encountered at 52.12 m bgs, which became difficult to drill through. The drilling contractor (Aardvark Drilling Inc.) felt uncomfortable drilling deeper with a 2.44 m steel casing borehole set-up, as this was not deep enough to help control the borehole to further depths. As a result, the MW5-14D well was installed and the drill rig was moved over to begin drilling MW5-14D(2) with an appropriate steel surface casing depth of 9.14 m.

The PQ mud-rotary coring method consists of PQ-size diameter rods extending the length of the drill string to the core barrel and cutting bit. The rods are advanced by rotation and drilling mud is used as lubrication. The water that was used to mix the drilling mud was sampled for tritium and tagged with sodium bromide to facilitate future interpretation of water geochemistry samples. Inside the core barrel is a 1.5

m long inner tube that locks in place and catches the core sample as the drill string is advanced into the subsurface. The inner tube is retrieved through a wireline system lowered into the drill string that grabs the inner tube (Figure 8b). When the core reaches surface, the core must slide out of the inner tube onto a core tray (Figure 8c).

As the recovered core was withdrawn from the subsurface, it was laid atop a table and each end of the core tube was labelled with its vertical orientation (top or bottom), depth, borehole number, and run number. The core was measured for recovery length. Due to the drilling method, the core was coated in a drilling fluid and scraping tools (putty knife, filing knife) were used to remove the film (Figure 9).

2.3.2 Installation of Monitoring Wells

Each of the three new boreholes was completed with a 1.5 m long, 5 cm inner diameter (ID) PVC monitoring well. The monitoring wells were constructed from Slot # 10, Schedule 40 or 80 flush threaded PVC casing with rubber O-rings at the joints. The PVC monitoring well intervals were created using No. 1 or No. 2 silica sand, while the remainder of each borehole annulus was backfilled using a series of bentonite pellets, bentonite grout, and bentonite chips above the sand pack to surface to create a hole plug. All three wells were completed with a cement pad at surface. The PVC casings were capped with removable J-plugs and a protective blue steel casing was placed over each of the PVC stick-ups. Table 1 contains additional well completion details.

Table 1: Borehole and monitoring well construction details for the 50 mm diameter PVC conventional wells installed at the MW5-14 monitoring well cluster.

Well Construction Details at MW5-14					
Well ID **Install Date**	**MW5-14S** **08-Oct-2014**	**MW5-14S(2)** **25-Nov-2014**	**MW5-14I** **08-Oct-2014**	**MW5-14D** **01-Dec-2014**	**MW5-14D(2)** **22-Dec-2014**
Surface Elevation (masl)	252.60	252.60	252.60	252.44	252.44
Surface Casing (m bgs)	N/A	N/A	N/A	2.59	9.14
Stick Up (m)	0.75	0.91	0.83	0.78	1.08
Schedule # PVC	40	40	40	80	80
No. # Slot Screen	10	10	10	10	10
Top of Screen (m bgs)	3.10	2.60	37.10	52.43	112.01
Bottom of Screen (m bgs)	6.10	4.11	40.10	53.95	113.54
Top of Sandpack (m bgs)	2.5	2.2	36.2	51.7	111.3
Bottom of Sandpack (m bgs)	6.1	4.1	40.1	55.0	115.4
Sandpack Size (Silica No.)	3	2	3	1	1
Borehole Depth (m bgs)	6.10	4.18	40.10	54.99	129.54

These three monitoring wells, labelled MW5-14S(2), MW5-14D, and MW5-14D(2), combined with two existing piezometers, labelled MW5-14S and MW5-14I, completed a multilevel well cluster with a combined total of five monitoring zones (Figure 10).

2.3.3 Purging of Newly Installed Monitoring Wells

The newly installed monitoring wells were allowed to settle for a two-week period following installation. In January 2015, each monitoring well was purged to evacuate drilling fluids in order to acquire a representative sample of the formation water in subsequent samplings. As a minimum requirement, 10 purge volumes were removed or the monitoring well was pumped dry three times (Table 2), whichever occurred first. Purging was accomplished with either HDPE tubing attached to a Waterra foot valve or an airlift pump. Field parameters (electrical conductivity and pH) were monitored by Stantec personnel for stabilization to indicate a representative sample of formation water.

Table 2: Number of purge volumes removed for each installed monitoring well.

Purge Volumes			
Monitoring Well ID	Well Screen Interval		Number of Purged Well Volumes
	Top Depth (m bgs)	Bottom Depth (m bgs)	
MW5-14S(2)	2.60	4.11	10
MW5-14D	52.43	53.95	15
MW5-14D(2)	112.01	113.54	53

2.3.4 Photography

Immediately after extraction, the sediment cores were carried into the work trailer and placed into queue for photographing. A full-length core photo was taken (Figure 11a) followed by approximately five enlarged photos of 30 cm long core sections (e.g. Figure 11b). Additional photos were taken in instances where unique sedimentary structures were observed in the sediment core (e.g. fine laminations).

2.3.5 Visual Core Logging

After photography, each 1.5 m core was transferred to the core logging table where the cores were logged in detail (to the centimeter scale) using a detailed core logging template (Figure 12). The sediment cores experienced some stress relief and expansion over the course of several days after being extracted from the subsurface. It was important to collect measurements of recovery and complete core logging before the core had the opportunity to expand. Grain size classification was made using the Wentworth size classification (Wentworth, 1922) and the Hambrey and Glasser (2003) classification for identifying diamicton (Figure 13).

2.3.6 Sample Collection and Procedures for Analysis

Samples were obtained for moisture content and triaxial permeability (where required), immediately after photography. Once they were logged in detail, cores were subsequently sampled for grain size and portable x-ray fluorescence analysis. Cores were stored on site in plastic PVC tubes, taped at each end with a PVC end cap, until it was disposed of on site in early 2016 Sampling frequency varied and sampling locations were chosen based on visual markers such as lithology, colour, and density changes.

2.3.6.1 Moisture Content

Moisture content samples were taken at regular intervals with depth and at major lithologic changes; 81 moisture content samples were obtained. The regular sampling location was 30 cm from the bottom of each core. Samples were extracted from the core and placed in laboratory provided glass containers within 30 minutes of the core being removed from the ground to limit the amount of time the core had been exposed to the air. Samples jars were tightened securely and seals were checked daily. Samples were picked up regularly and taken to Stantec in Markham, Ontario for analysis. Results of this analysis are presented in Section 2.4.3.

Porosity values were calculated from measured moisture content in samples obtained within the saturated zone. It was assumed that the particle density for all samples is 2.69 g/cm^3 and that the density of water is 1 g/cm^3. The following equation, based on void ratio, is used to relate porosity (n) and moisture content:

$$n\ (\%) = \frac{\rho_s \cdot \frac{MC}{100}}{\left(1 + \rho_s \cdot \frac{MC}{100}\right)} \cdot 100\ (1)$$

where MC is the moisture content by mass (%); and ρ_s is the particle density (kg/m^3).

2.3.6.2 Portable X-Ray Fluorescence

Samples were obtained from the sediment cores for portable x-ray fluorescence (p-XRF) analysis. Samples that were collected for grain size, as described below, were split for grain size analysis and p-XRF analysis at the Geological Survey of Canada (GSC). Prior to p-XRF analyses, the sediment was disaggregated and sieved to <63 µm at the GSC Sedimentology Laboratories in Ottawa, Ontario (Knight *et al.,* 2016a).

A Camsizer particle scanner and a Lecotrac LT100 laser diffractometer were used to determine grain size for each sample being analysed for geochemistry (Knight *et al.,* 2016a). Grains measuring more than 2 mm in diameter were removed prior to p-XRF analysis (Knight *et al.,* 2016a).

Samples were analysed in Soil and Mining Modes, which use Compton normalization for elements expected to occur with < 1% concentration and Fundamental Parameters for elements expected to exceed >1% concentration, respectively (Knight *et al.,* 2016a). The results of the p-XRF analysis and the resultant chemostratigraphic profiles are significant in that they complement lithostratigraphy, providing a secondary dataset to incorporate into the geologic model. Results of the p-XRF analysis are discussed in Section 2.4.4.

2.3.6.3 Grain Size Distribution

The field program yielded 96 grain size samples that were analysed in the summer of 2015 at the Geological Survey of Canada in Ottawa, Onatrio via a Camsizer and Lecotrac LT100. Representative grab samples were obtained within 72 hours of core recovery using hand tools (hammer, wedge, scoop) and placed into labelled Ziploc bags (Figure 14). Sample locations were identified primarily by changes in sediment characteristics (e.g. grain size, sorting, colour). Samples were stored onsite in coolers and were transported for further storage at Guelph University until March of 2015 at which time the grain size samples were transported to the Geological Survey of Canada (GSC) in Ottawa, Ontario for analysis. Results of the grain size analysis are discussed in Section 2.4.5.

2.3.6.4 Empirical Equations for Hydraulic Conductivity

Hydraulic conductivity can be estimated empirically from grain size analysis and is related to grain-size distribution, effective porosity, grain shape, and packing of sediments (Kasenow, 2002). Many empirical equations exist to calculate saturated hydraulic conductivity (K_{sat}) from grain size data. These methods are frequently used to determine K_{sat} because of their simplicity, low cost, and ease of data acquisition. However, hydraulic conductivity estimates from grain-size distributions may provide varying results that are dependent on the method (Bradbury and Muldoon, 1990).

For this study, the modified Hazen (Batu, 1998; Freeze and Cherry, 1979; Rosas *et al.,* 2014), and the Kozeny-Carmen (Batu, 1998; Freeze and Cherry, 1979; Rosas *et al.,* 2014) methods were used to empirically calculate hydraulic conductivity values. The results of this analysis are discussed in Section 2.5.2.

Porosity values used in the hydraulic conductivity calculation were first estimated from grain size distributions. Grain size samples were analysed using the Gradistat Program (Blott and Pye, 2001) to obtain values of d_{10} and d_{60} for use in the following equation (Appendix B). Istomina (1957) presents the following equation for estimation of porosity from grain-size analysis:

$$n = 0.255\ (1\ +\ 0.83^{Cu})\ (2)$$

where, Cu is the coefficient of uniformity (d_{60}/d_{10}). The coefficient of uniformity is expressed as a ratio proposed by Hazen (1911):

$$Cu = \frac{d_{60}}{d_{10}}\ (3)$$

where d_{60} is equal to 60% of the sample passing by weight; and $d_{10}$is equal to 10% of the sample passing by weight.

A large Cu value represents a more heterogeneous, poorly sorted sample with a larger range of grain sizes, while a small Cu value represents a more homogeneous, well sorted sample with a smaller range of grain sizes. A soil with a uniformity coefficient equal to or greater than 15 is typically classified as a diamicton (Svensson, 2014).

Equation (2), and (3) were applied to all sieved samples to determine their 'calculated' porosity value and were used in calculation of K_{sat} for all empirical grain-size methods. Equation (2) for estimating porosity offers reasonable results for natural sand, gravely sand, and gravel (Kasenow, 2002). The literature commonly uses equation (2) for estimation of porosity from grain-size analysis (Kasenow, 2002; Vukovic and Soro, 1992).

The Hazen method (Batu, 1998; Freeze and Cherry, 1979; Rosas *et al.,* 2014) is the most commonly used empirical formula to estimate saturated hydraulic conductivity (K_{sat}) values from grain size data. This equation is expressed as:

$$K\left(\frac{cm}{s}\right) = \beta \cdot C \cdot \ d_{10}^{2} \ (4)$$

Where $\beta = 1$; C is the Hazen coefficient equal to 125 ($1/[cm \cdot s]$); and d_{10} is the effective grain size of the finest 10% of sample (cm).

The Kozeny-Carmen (Batu, 1998; Freeze and Cherry, 1979; Rosas *et al.,* 2014) equation is also a commonly used empirical formula to estimate K_{sat}. It is applicable to silt, sand, and gravelly sand. Usage criteria dictate that the d_{10} value must be less than 3mm (Trapp, 2015). This equation is expressed as:

$$K\left(\frac{m}{s}\right) = \frac{g}{v} \cdot 5.56x10^{-3} \cdot \left[\frac{n^3}{(1-n)^2}\right] \cdot d_{10}^2 \ (5)$$

where g is the acceleration due to gravity (m/s^2); v is the kinematic viscosity of water (m^2/s); n is porosity (-); and d_{10} is the effective grain size of the finest 10% of sample (m).

The empirical grain size methods used above require a disturbed sample to obtain grain size distribution curves; a process that destroys the secondary sediment characteristics and can significantly affect the estimated values of K_{sat} from grain size analysis. However, each empirical equation contains a coefficient of proportionality (C) to account for all other secondary factors that affect K_{sat} including grain shape, structure, packing, and clay content. Using the triaxial permeability results (a direct measure of hydraulic conductivity), the coefficient of proportionality can be locally calibrated for the sediments with an associated triaxial permeability sample.

The following equation for a calibration factor was applied to the existing coefficients in the appropriate empirical grain size equation to yield a local calibration coefficient for the sedimentary units with triaxial permeability samples.

$$Calibration\ Factor: \frac{GM_{measured}}{GM_{calculated}} \ (6)$$

where $GM = geometric\ mean\ Ksat$

2.3.6.5 Triaxial Permeability

Golder Associated Ltd. analyzed five samples collected for triaxial permeability. Each sample was approximately 30 cm in length and taken from a clean, undisturbed section of core. The block of core was shrink wrapped in at least two layers of cellophane wrap and inserted into a Ziploc bag with as much air removed as possible. The Ziploc bag was then taped shut. Samples were placed in a cooler until sent to the lab. Samples were obtained from various depths as seen in Table 3. Of the five samples analyzed, three were located in the thick diamicton sequence and two were located in the clay and diamicton units below 104 m bgs. The results of the triaxial permeability analysis are discussed in Section 2.5.3.

Table 3: Location of triaxial permeability samples within the Clarington borehole.

Location of Triaxial Permeability Samples				
Sample ID	**Run #**	**Top Depth (masl)**	**Bottom Depth (masl)**	**Material Description**
CLA-MW5-14D-TP-001	8	242.80	242.49	Diamicton
CLA-MW5-14D-TP-002	20	224.76	224.45	Diamicton
CLA-MW5-14D(2)-TP-003 *	1	202.61	202.27	Diamicton
CLA-MW5-14D(2)-TP-004	2	201.69	201.39	Diamicton
CLA-MW5-14D(2)-TP-005	39	146.40	146.13	Clay
CLA-MW5-14D(2)-TP-006	41	143.41	143.11	Diamicton

* Not analyzed due to cost and proximity of sample to TP-004

2.3.6.6 Simple Approximations of Travel Times Assuming Flow Through Homogeneous, Unfractured Porous Media and a Constant Gradient

The Darcy Flux may be estimated between monitoring intervals using an average value of calculated K_{sat} and calculated vertical hydraulic head gradients:

$$q = -K \cdot \frac{dh}{dl} \ (7)$$

where q is the Darcy Flux (m/s); K is the saturated hydraulic conductivity (m/s); dh is the change is hydraulic head (m); and dl is the change in length over which the head change is measured (m).

The average linear porewater velocity may be estimated using the Darcy Flux and a bulk porosity value:

$$v = \frac{q}{n} \ (8)$$

where v is the average linear pore water velocity (m/s); q is the Darcy Flux (m/s); and n is porosity (-).

A simple approximation of groundwater travel time between monitoring locations may be estimated using the calculated velocity and a sample distance of aquitard (e.g. ten-meters). The calculated travel times are discussed in Section 2.5.4.

$$Time = \frac{Distance}{Velocity} \ (9)$$

2.4 Geological Results

2.4.1 Mud-Rotary Drilling

The three newly installed boreholes, MW5-14S(2), MW5-14D, and MW5-14D(2), terminated at depths of 4.18 m bgs, 54.99 m bgs, and 129.54 m bgs, respectively (Clarington borehole). The core recovery for all cores was excellent with no large gaps in the data (all gaps < 70 cm) and a single washed out section of 33.5 cm in length in run 4 of MW4-14D (Figure 15). The overall recovery for MW5-14D was 99.7% and the overall recovery for MW5-14D(2) was 94.5%. There were 18 core runs that amounted to greater than 100% recovery. This was often due to small pieces (≤ 15 cm) of diamicton breaking off from a previous run and being brought up with the subsequent run or due to minor sloughing/expansion of sand. Core recoveries are displayed in Table A1.

2.4.2 Sedimentary Facies

The dominant sediment types found below the MW5-14 cluster are diamicton and sand. The 129.54 m core is characterized by five sediment packages (Figures 16-18) overlying shale bedrock (found at 127.76 m bgs): three lower packages consisting of a fine to very fine sand (A), a silty diamicton (B), a massive clay (C); a middle package of variable texture, laminated sand (D); and a thick package of stony, dense, over-consolidated diamicton (E) (Figure 16). These sedimentary packages were defined by changes in sediment characteristics including grain size, sorting, colour, and sedimentary structures, if present.

The lowermost sand package (A), directly overlying bedrock, consists of a grey, well to very well sorted sand (111.97 – 127.76 m bgs). This package consists of alternating units of medium, fine, and very fine sand with muddy silt-clay laminations throughout most of the unit (Figure 17). Below approximately 122 m bgs, the alternating beds are approximately 5 – 75 cm in thickness; above 122 m bgs, the beds are approximately 30 – 170 cm in thickness. There is a one bed that shows normal grading.

The lowermost diamicton package (B) is a very dense, clast-poor, muddy diamicton consisting of 15 – 310 cm thick beds of grey, very poorly sorted, silty-clay matrix with pebbles (107.08 – 111.98 m bgs). There are a few alternating 20 – 70 cm thick beds where the primary grain size is silt, found near the bottom of the sediment package (Figure 17). Gravel estimates are approximately 1%, which increase with depth to 5%. Average clast size is approximately 2 mm (maximum 12 mm). Clasts were mainly carbonate or shale.

The thin package of grey, very well sorted, massive clay (C), found between 104.78 – 107.08 m bgs (Figure 17), contains a 100 mm bed of silt that separates two distinct layers of clay. Above this silt bed is a 2 mm thick clay lamination and a 60 mm thick section of sandy-silt laminations. At the base of the package, the clay contains black coloured laminations, each approximately 10 mm in thickness.

The middle package of grey, well to very-well sorted sand (D), found between 76.69 – 104.78 m bgs, contains alternating variable textured sand beds that are 6 – 130 cm in thickness (Figure 17) with thin (< 6 mm) black horizontal coloured laminations throughout. There are numerous beds that show normal and reverse grading.

The uppermost diamicton package (E) is a very dense, clast-poor, intermediate diamicton consisting of a relatively homogeneous grey, poorly sorted, silty-sand matrix (Figure 17) with granules, pebbles, and few sporadic cobbles (0 – 76.69 m bgs). The unit is crudely bedded based on tertiary grain size and colour. The primary grain size is fine sand. While all recorded sediment characteristics remained the same (primary, secondary, and tertiary grain size; sorting; clast shape and lithology; colour), a hardness contact (commonly referred to a hardpan in water well records) was encountered at 4.99 m bgs where the diamicton unit became much harder to penetrate or cut with a knife. Below this hardness contact, the remainder of the package is dense, over-consolidated, and calcite cemented requiring hand tools to break apart for sampling. Near surface (< 5 m), field estimates of gravel content range from 3 – 10%. The gravel content remains consistent through much of the package at 1 – 5%. Below approximately 29 m bgs, the gravel content drops slightly to 1 – 3%. Granule, pebble, and boulder clasts are sub-rounded to rounded. Average clast sizes ranges from 2 – 20 mm in individual runs. Clasts were mainly carbonate; some granite clasts were present. Below approximately 62 m bgs, the unit becomes less homogeneous with 3 – 25 cm thick beds of sand, silt, and clay interbedded with diamicton.

Within the uppermost diamicton package, there were three significant sand beds encountered (E1, E2, E3). A shallow sand bed (E3) was encountered between 0.67 – 2.94 m bgs (Figure 19a) consisting of alternating layers of very-fine, fine, medium, and coarse sand. Clasts, when present, were carbonate, sandstone, and granite. Thin (1 – 3 mm) dark coloured horizontal laminations are present within the upper portion of the sand bed.

At a greater depth, another significant sand bed (E2) was encountered (Figure 19b) when drilling MW5-14D at 52.31 m bgs. This sand bed extended to the borehole termination depth at 54.99 m bgs and was therefore at least 2.86 m in height. A sand bed was encountered in MW5-14D(2), located approximately 3 m away from MW5-14D, at 52.46 m bgs and terminated at 53.34 m bgs, making it relatively thinner at 0.88 m. In both boreholes, the sand bed consists of medium, well sorted sand with a handful of thin (< 10 mm) silt laminations. The upper half of the sand bed was massive without any notable clasts, while the lower half of the sand bed contained interbedded clay layers (average size 10 mm, maximum size 32 mm). The lateral correlation of these sand beds shows the degree of spatial heterogeneity in the sand bed thickness within the uppermost diamicton package (Figure 19b).

A third sand bed (E1) was encountered between 66.75 – 69.98 m bgs. This sand bed consists of very-fine, fine, and medium sand layers. Alternating sections of normally graded and reversely graded sand is present from 66.78 to 69.05 m bgs. Thin clay laminations (average 20 mm) and clay beds (95 mm) are present throughout the sand bed with few clay clasts (5 mm).

2.4.3 Moisture Content by Mass

Average moisture content of the diamicton samples was generally quite low (8.2%) relative to the moisture content of the sand (18.6%) and silt/clay samples (19.6%), although the range in values for the diamicton samples was greater (4.6% - 20.5%) than for the sand (10.0% - 23.9%) or silt/clay samples (17.4% - 22.8%) (Figure 17). The moisture content of the near-surface diamicton samples ranges from 5.6 to 6.8% (Figure 20). These values are consistent with Newmarket Till (<10%) (Sharpe and Russell, 2016). Seven of the deeper diamicton samples have reported moisture contents in the range of 10-20%, although these samples are often clast poor and/or are in close proximity to sand units (Table A2).

Calculated values of porosity showed similar trends to moisture content (Figure 17). The calculated porosity values within the diamicton samples ranged from 11.0 % to 35.5% (average 17.8%). The values for the sand ranged from 21.2% to 39.1% (average 33.1%) and the values for the silt/clay ranged from 31.9% to 38.0% (average 34.4%).

2.4.4 Portable X-Ray Fluorescence

In both Soil Mode and Mining Mode the produced geochemical profiles are similar (Figures 21, 22). Soil Mode (Compton normalization) is most effective with trace elemental concentrations (<1%), while Mining Mode (Fundamental Parameters) is best suited for relatively higher elemental concentrations (>1%) (Knight *et al.,* 2016a). For several elements (e.g. Fe, Mn Ti, V, Zr), the Newmarket Till shows little variation in elemental concentration when compared to the Thorncliffe Formation. Although, the Newmarket Till above 50 m bgs shows higher concentrations of select elements (e.g. Ca, K and S) than the Newmarket Till found below this depth. The Newmarket Till may contain reworked sediments from the underlying Thorncliffe Formation or these sediment groups may have similar origin (Knight *et al.,* 2016a). The large variations exhibited in zircon (Zr) concentrations in the Lower sediments (78 -127 m bgs) may be due to preferential concentration in sand compared to till (Knight *et al.,* 2016a).

For other elements (e.g. Rb, Si, Sr) there is little change within the sediment core regardless of sediment type; excluding the diamicton sediments between 107 – 112 m bgs, which show a fairly consistent change in elemental concentration from the surrounding sediments (e.g. Ba, Si, Ti, V, and Zr show a decrease in concentration; Ca, Sr, and Zn show an increase in concentration). Conversely, a change in elemental concentration is observed in the thin (30 cm) silty sand layer encounter at approx. 64.7 – 65.0 m bgs in which a slight increase in elemental concentration (e.g. Ba, Ce, Fe, and V) or decrease (e.g. Ca) is observed. Additionally, a marked change is observed in elemental concentration in the sand bed found within the large diamicton package at a depth of 52.3 – 55.0 m bgs, which displays an increase in elemental concentration (e.g. Ba, Fe, Mn, Ni, Ti, V, and Zr). The complete results of the p-XRF analysis can be found in Knight *et al.,* 2016a.

Elevated sulphur and higher calcium concentrations in both Soil Mode and Mining Mode (Figures 21, 22) may suggest dissolution of gypsum ($CaSO_4 \cdot 2H_2O$) minerals (Dyke, 1999). Sulphur may also originate from the weathering of pyrite (Dyke, 1999). In recharge areas, sulphate may be reduced to sulphide and precipitated or transformed to HS^- of H_2S (Dyke, 1999); the distinct scent of sulphur was present in the core below a depth of 73 m bgs, which corresponds to where the sulphur concentration began to increase towards bedrock, where there is a large spike in the sample obtained directly above bedrock at 127.41 m bgs (above 2000 ppm).

2.4.5 Grain Size Distributions

Grain size results have been plotted against depth with multiple samples from each of the identified sedimentary packages (Figure 23). Average matrix grain size composition for each of the identified sedimentary packages has been calculated (Table 4). The complete series of grain size summary sheets produced using Gradistat are presented in Appendix B. Observable trends are described below:

The lowermost sand unit (A) consists of alternating units of primarily fine and very fine sand. A thin (1 m) bed of silt is found at approximately 122 m bgs.
For the lowermost diamicton unit (B), there are two grain size samples that confirm that this diamicton is a clast-poor, muddy diamicton with only 20 - 24% sand. The one sample within the relatively homogeneous, massive clay unit (C) suggests a silty-clay composition (72% clay) with trace amounts of sand. The uppermost sand unit (D) shows 1 - 8 m thick successions of alternating normally and reversely graded packages of sediments. The primary grain size is highly variable and ranges from very fine to very coarse sand. The clay content remains relatively low throughout the unit (0 – 1.7%) with interbeds displaying higher clay content (5.7-71.9%). The uppermost diamicton unit (E) is a silty-sand diamicton, with a significant amount of clay (15%). The portion of diamicton between 67 – 76 m bgs is relatively heterogeneous with variable proportions of sand. The composition of the diamicton (E) from surface to approximately 67 m bgs remains quite constant,

although clay content is higher above 50 m bgs than below. The sand content increases and the clay content decreases in the near-surface grain size samples.

Table 4: Percent volume of the sand-silt-slay portion of grain size samples.

	Percent Volume of Sand-Silt-Clay (<2 mm)		
Sediment Packages	**Sand**	**Silt**	**Clay**
Diamicton (E)	50.8	34.1	15.1
Sand (D)	42.1	52.4	5.5
Clay (C)	1.2	26.9	71.9
Diamicton (B)	21.9	53.6	24.4
Sand (A)	44.5	53.7	1.8

The near-surface sediments were heavily sampled to help determine the origin of the diamicton units. The sample locations within the first four runs are displayed alongside selected grain size characteristics (Figure 24).

2.5 Hydrogeological Results

2.5.1 Hydraulic Head Monitoring

Static water levels were reported for the MW5-14 well cluster in October of 2015 by Stantec, excluding the deepest monitoring zone for which a water level has not yet been reported since installation of the well (Stantec Consulting Ltd., 2015a). It is not known whether or not representatives for Hydro One have measured the water level in the deepest monitoring well. Permission to access the conventional well cluster to obtain a coincident set of water levels has not been granted as land access agreement are still being finalized. The low temporal resolution of hydraulic head monitoring necessitates use of two temporally separated measurements to obtain a complete series of water levels. A combination of water levels from October of 2015 and January of 2015 (post-installation of the deep wells) have been used to identify vertical gradients within the monitored zone (Table A3). This is a reasonable approximation of the vertical hydraulic gradient because water levels at this depth are not expected to vary significantly at this time scale. As demonstrated in MW5-14D, the water level appears to fluctuate less than 1 m between these two times of measurements. In January of 2015, the water level in MW5-14D was measured at 212.94 masl and in October of 2015 the water level was measured to be 212.28 masl. If the water level of MW5-14D(2) were to fluctuate a similar amount, it would not have a significant effect on the apparent gradient observed between these monitoring intervals.

A large change in hydraulic head is observed with depth in the conventional well cluster at MW5-14 (Figure 25). A downward gradient exists from surface to the intermediate and deep wells through the large diamicton unit (E). Below MW5-14D, an upward gradient may exist through the lower section of the diamicton and sand aquifer, although this will need to be confirmed with higher resolution sampling. It is unlikely that a constant gradient exists across this interval, as there are several finer-grained aquitard units with sand and intervening aquifer units.

Of particular interest is the large hydraulic gradient that is present between MW5-14I and MW5-14D that is approximately 2.07 m/m (Figure 26). It is likely that this large hydraulic head differential is occurring across a low vertical hydraulic conductivity (K_v) zone. Relative changes in gamma count rates can be used to qualitatively estimate changes in grain size (Crow *et al.,* 2015). The gamma log from this borehole reveals a zone of higher gamma counts per second (cps) relative to the surrounding sediments between approximately 48.50 – 50.25 m bgs (Figure 26), thus higher gamma counts observed in this zone may be associated with an increase in clay and/or silt content as clay and silt sized material emit more gamma radiation than coarser grained sands and gravels (Crow *et al.,* 2015). In turn, this slight change in clay and/or silt content may be responsible for the large hydraulic head differential. Higher resolution data acquired with the proposed MLS will allow us to better constrain the thickness of the low K_v zone.

2.5.2 Hydraulic Conductivity Estimation

Hydraulic conductivity values were estimated using two grain size methods (Figure 27, Table 5). As expected, the hydraulic conductivity values of the sand units are higher than the hydraulic conductivity values of the diamicton and clay units. The empirical grain size methods tend to over predict a K_{sat} value when compared to the triaxial permeability methods. This can be attributed to the disturbance of the samples during grain size analyses, which does not preserve the sample pore structure or bulk densities. Of note, is that while most of the calibration factors are in the same order of magnitude, the calibration factors for the Kozeny-Carmen equation, when applied to diamicton samples, is an order of magnitude higher than all other values (Table 6). The calibrated values of K_{sat} can be found in Table A5.

Table 5: Average values of hydraulic conductivity after calibration, if applicable.

	Average Hydraulic Conductivity After Calibration (m/s)			
Unit	**Calibrated***	**Hazen**	**Kozeny - Carmen**	**Triaxial Permeability**
Diamicton (A)	Yes	3.5E-10	3.6E-10	3.3E-10
Sand (B)	No	1.6E-06	5.8E-07	--
Clay (C)	Yes	7.8E-11	8.8E-11	8.7E-11
Diamicton (B)	Yes	7.9E-11	7.8E-11	7.9E-11
Sand (A)	No	4.4E-06	2.4E-06	--

*Calibration with triaxial permeability results

Table 6: Calibration factors for three sedimentary packages encountered at the MW5-14 well cluster.

	Calibration Factor	
Unit	**Hazen**	**Kozeny-Carmen**
Diamicton (E)	0.0043	0.041
Clay (C)	0.0033	0.0043
Diamicton (B)	0.0058	0.050

While there are 96 grain size samples for this set of boreholes, providing a good resolution of sampling, it should be noted that the K_{sat} values determined from empirical grain size methods are considered the least accurate when compared to direct measurement (Kasenow, 2002). The five triaxial permeability samples (described in the following section) are regarded as more accurate measurements of hydraulic conductivity. As such, the triaxial permeability values have been used to calculate the travel time through the diamicton as discussed below.

2.5.3 Triaxial Permeability

Laboratory obtained values of hydraulic conductivity from triaxial permeability tests (Table A6) for the diamicton sediment range from 1.85×10^{-10} m/s to 1.05×10^{-9} m/s (Figure 28). Two triaxial permeability samples were collected below the sand package (D) in clay (sediment package C) and diamicton (sediment package A). The results of these tests were 8.71×10^{-11} m/s and 7.86×10^{-11} m/s, respectively. Using the values of hydraulic conductivity, it is possible to estimate a travel time through the matrix material within the diamicton.

2.5.4 Simple Approximations of Travel Times Assuming Inter-Granular Flow Through Homogeneous, Unfractured Porous Media and a Constant Gradient

The average hydraulic conductivity value obtained from the triaxial permeability tests within the large diamicton unit is 3.3×10^{-10} m/s. The gradients were calculated between each monitored interval. A simple approximation of travel time assuming inter-granular flow through homogeneous, unfractured porous media and a constant gradient suggest a rate of travel on the order of hundreds of years across a ten-meter distance within the diamicton unit (Table 7).

Table 7: Simple approximations of groundwater travel time between monitoring intervals assuming inter-granular flow through homogeneous, unfractured porous media and a constant gradient.

		Direction of Vertical Groundwater Flow	
Parameter	**Units**	**MW5-14S(2) to MW5-14I**	**MW5-14I to MW5-14D**
Gradient, i	(m/m)	0.34	2.07
Darcy Flux, q	(m/s)	1.1E-10	6.83E-10
Porosity*, n	(-)	0.26	0.26
Velocity, v	(m/s)	4.20E-10	2.63E-09
Distance, d	(m)	10	10
Time, t	years	750	120

* Porosity calculated using Istomina (1957), average of diamicton samples.

An alternate scenario may be proposed where the assumption is made that the hydraulic gradient is not occurring evenly through the diamicton unit and the largest head differential occurs across the zone with a lower vertical component of hydraulic conductivity. The gamma log shows a 1.75 m zone of high gamma count that may indicate a relatively silt or clay rich zone (i.e. a low K_v unit). Applying the change in hydraulic head between MW5-14I and MW5-14D (25.5 m differential) across this 1.75 m zone would result in a much higher gradient of approximately 14.5 m/m.

2.6 Discussion

2.6.1 Identification of Geologic Formations and Hydrogeologic Units

Part of one of the objectives of this study was to characterize the near-surface sediments (Late Wisconsinan) present at this site, which included determining if the near-surface sand sediments were of Oak Ridges Moraine origin and to classify the near-surface diamicton unit as Halton Till or Newmarket Till. Characterization of the sediment is significant because it locates the CTS relative to the ORM, which is a major aquifer complex in southern Ontario. Five possible conceptual models were identified based on the initial visual core log and the existing regional stratigraphic framework (Figure 29): (i) Halton Till at surface with ORM sand and Newmarket Till below; (ii) Halton Till directly overlying Newmarket Till with an interbedded sand within the Newmarket Till; (iii) Newmarket Till at surface with an interbedded sand; (iv) Halton sand separating Halton Till above and Newmarket Till below; or (v) Halton Till containing a sand interbed with Newmarket Till below. Each model has different implications for groundwater flow and contaminant transport. For example, if the ORM were to be identified at or near surface, this would imply that the site could potentially be hydraulically connected to this major aquifer.

Distinguishing the near-surface diamicton, as Halton Till or Newmarket Till, was critical to identify which of the five possible conceptual models is most plausible.

There are four material properties that consistently distinguish the Newmarket Till from the Halton Till: (i) sandier (37%) with a silt matrix; (ii) higher stone content (5%– 15%); (iii) lower water content (about 10%); and (iv) higher density (N values, 50–100) (Sharpe and Russell, 2016). The following results suggest that the Newmarket Till may be found at surface.

A plot of matrix grain size composition for all of the grain size samples identified during core logging as diamicton in composition (Figure 30) displays a relatively similar grouping of grain size composition. The grouping identified is sandy (>40%) with a silt matrix. Excluding a handful of samples, the clay content for all diamicton samples is below 20% (Appendix B). Comparison of this grouping of diamicton samples obtained from the Clarington borehole with generalized grain size plots compiled by Sharpe and Russell (2016) from more than 700 samples analyses (Figure 30) shows good agreement that the diamicton found at surface is of Newmarket origin. The single point outside of the Newmarket grouping is found at 63.5 m bgs and could not be of Halton origin because it is found below a large section of diamicton that, based on stratigraphic position, thickness, and over-consolidation, is most likely to be Newmarket Till. In addition, field estimates of percent gravel (stone content) in the near-surface diamicton unit were in the range of 5-10% (Figure 24), which is similar to values reported for Newmarket Till (Sharpe and Russell, 2016). Stone content was found to decrease to 1-3% with depth (>15 m bgs).

As reported previously, the moisture content of the near-surface diamicton samples ranges from 4.6 to 7.6% (Figure 17, 20). The static water level in MW5-14S(2), the shallow water table well is 2.82 m bgs, therefore it is assumed that the diamicton samples are located below the water table and are fully saturated samples. These values are therefore considered consistent with Newmarket Till (<10%) (Sharpe and Russell, 2016). A handful of the deeper diamicton samples have reported moisture contents in the range of 10-20%, although these samples are often clast poor and/or are in close proximity to sand units (Table A2).

The results presented here suggest that the Newmarket Till can be found at ground surface based on three of four material properties that consistently distinguish the Newmarket Till from the Halton Till: sand content, stone content, and water content. The fourth material property, density as measured by penetration resistance blow counts, was not recorded in this study. Thus, based on available data at this time, the 'Newmarket Till at surface with an interbedded sand' conceptual model (Figure 29C) is identified as the most plausible model to describe the near-surface sediments at the Clarington borehole. By identifying the surface diamicton unit as Newmarket Till, the sand features present near surface are likely not of ORM origin (Figure 31).

Below the Newmarket Till (E), alternating units of various textured sand (D) marks the change to the Thorncliffe Formation (Figure 31). The clay (C) and sand (D) units have been grouped together and identified as the Thorncliffe Formation as the massive clay unit (C) is more similar to the muddy Thorncliffe Formation identified in the nearby Purple Woods borehole (discussed in the following section) than to the underlying diamicton unit (B). The remaining Lower sediments at this location likely consist of Sunnybrook Till, identified by an over-consolidated, grey coloured, massive, clayey-silt diamicton (B), and a Scarborough Formation equivalent, identified by alternating units of medium, fine, and very fine sand with muddy silt-clay laminations (Figure 31). The lowermost sand unit (A) has been identified as a Scarborough Formation equivalent as the extent of the Scarborough Formation is thought to be restricted away from sections described at the Scarborough Bluffs (Eyles and Eyles, 1983).

2.6.2 Comparison of Core Log to Nearby Golden Spike Holes

A golden spike borehole is one that is continuously cored to a target formation and involves core recovery, detailed sediment logging, sampling, and data processing (Sharpe *et al.,* 2003). This is in contrast to the many boreholes collected in the context of site assessments, waterwell drilling, and other geotechnical applications where continuous core is not recovered and description of subsurface materials is based on drill cuttings of split spoon samples. Continuous core logging is more often practiced as part of environmental research because it has a higher cost than other types of drilling. In some geotechnical studies, split spoons samples are collected at a specified interval equalling less than a continuous core sample; in other cases, the purpose of drilling is to find water and collecting geological information is not the focus, resulting in variable quality (Russell *et al.,* 1998). In this context, MW5-14D and MW5-14D(2) can together be considered a golden spike borehole; of the other holes at the CTS, eight boreholes are continuously cored with core recovery and detailed sediment logging, although all terminate at depths less than 17 m bgs and don't have the same frequency of sampling or range of analyses, excluding MW4-15 and MW5-14I (25.1 and 40.1 m bgs, respectively). Split spoon sampling occurred in all other boreholes completed on the CTS (Stantec Consulting Ltd., 2014, 2015b).

Seven golden spike boreholes (Figure 32) have been drilled within approximately 60 km of the Clarington borehole (Knight *et al.,* 2016a, 2016b; Sharpe and Russell, 2016; Sharpe *et al.,* 2003). The closest golden spike borehole, the Purple Woods borehole, is approximately 9 km northwest from the Clarington borehole (Knight *et al.,* 2016a, 2016b; Sharpe and Russell, 2016) and, like the Clarington borehole, is located in the Pontypool sector of the ORM. There are four major stratigraphic units present in the Purple Woods borehole: (i) bedrock of the Blue Mountain Formation; (ii) Thorncliffe Formation, (iii) Newmarket Till; and (iv) Oak Ridges Moraine sediments. At the Purple Woods borehole, the sediments consist of 45 m of Thorncliffe Formation, overlain by 69 m of Newmarket Till with 34 m of Oak Ridges Moraine sediment above for a total overburden succession of 152 m (Knight *et al.,* 2016b). The thickness of the overburden becomes progressively thicker with distance northward from the Lake Ontario shoreline (Knight *et al.,* 2016b). The

Clarington borehole is consistent with this description as the overburden thickness at the Clarington borehole is 127.76 m.

Similar to the Purple Woods borehole (Figure 32), the Clarington borehole does not contain sediments consistent with descriptions of the Seminary Till and the Meadowcliffe Till (Knight *et al.,* 2016b) as the Newmarket Till is found to directly overlie sand, silt, and clay of the Thorncliffe Formation at both boreholes. The Seminary and Meadowcliffe Tills are known to pinch out inland within a few km of the Scarborough Bluffs and would not be expected in these boreholes (Eyles *et al.,* 1985; Karrow, 1967). The Thorncliffe Formation at the Purple Woods borehole consists of a 45 m succession of mud units with a few sand and gravel beds (Knight *et al.,* 2016b). The 1 - 4 cm thick mud units are interbedded with up to 5 cm thick laminated silt beds. This is in contrast to the Thorncliffe Formation found at the Clarington borehole, which is made up of alternating variable textured sand beds. The Newmarket Till (stony, sandy-silt diamicton) in the Purple Woods borehole is similar in lithology with the Newmarket Till (stony, silty-sand diamicton) found at the Clarington borehole. Based on p-XRF data from the Purple Woods borehole, there does not appear to be a significant weathered section within the Newmarket till as the elemental concentrations for the upper Newmarket Till are very consistent (eg. K, Rb, and Sr) regardless of changes in grain size data (coarsening upwards trend) (Knight *et al.,* 2016b). Above the Newmarket Till at Purple Woods rests 34 m of ORM sediments consisting of sand with interbedded silt and minor gravel beds (Knight *et al.,* 2016b).

The Pontypool borehole is approximately 21 km northeast of the Clarington borehole (Figure 32) (Knight *et al.,* 2016a; Sharpe and Russell 2016.). There are three major stratigraphic units present in the Pontypool borehole: (i) limestone bedrock, (ii) Lower sediments, and (iii) Oak Ridges Moraine sediments. At the Pontypool borehole the sediments consist of 75 m of Lower sediments overlain by 96 m of Oak Ridges Moraine sediment for a total overburden succession of 171 m (Russell *et al.,* 2004). Lower sediments are found to outcrop north and south of the Oak Ridges Moraine (Russell *et al.,* 2003b). There is no distinction of Thorncliffe Formation within the Lower sediments and it may be absent from the core log as ORM sediment directly overlies diamicton (Russell *et al.,* 2003b). Newmarket Till is truncated west of the borehole and is absent from the Pontypool core log (Russell *et al.,* 2003b). Also of note, is that Halton Till is not found in the direct vicinity of the Pontypool borehole; maps indicate a discontinuous layer of Halton Till found more than 6 km to the south (Russell *et al.,* 2003b). This borehole is also consistent with the overburden becoming progressively thicker with distance northward from the Lake Ontario shoreline (Knight *et al.,* 2016b).

To the northwest of the Clarington borehole, within a 15 km radius of Aurora, is a group of five continuously cored boreholes (Figure 32) (Sharpe *et al.,* 2003).

Stratigraphic layers present in the five boreholes vary. The Scarborough Formation and Sunnybrook Till are present in four of five of the boreholes. Thorncliffe Formation rests atop bedrock in the fifth borehole and is present in only three of five boreholes. In the two boreholes without Thorncliffe Formation, ORM sediments lie atop a regional unconformity that cuts into the Sunnybrook Till. A relatively thin section of Newmarket Till (8 – 12 m) is present in only two of five boreholes. The lithology of the Newmarket Till (stony, sandy-silt diamicton), where present, is consistent with the Newmarket Till at the Clarington borehole. Oak Ridges Moraine sediment is present at surface in all five boreholes. Halton sediment (sand and silt) is only found in one borehole and is less than 8 m thick.

The variability observed in the golden spike boreholes in terms of the thickness of the Newmarket Till is consistent with the kind of variability previously documented in the literature (e.g. Logan *et al.,* 2000; Sharpe *et al.,* 2002; Russell *et al.,* 2003a). The Newmarket Till contains tunnel channels and has been eroded, in some cases, down to underlying sediments (Barnett *et al.,* 1998). Similarly, the Thorncliffe and Lower sediments may have been eroded away to the point where ORM sediments rest atop bedrock in tunnel channels (Barnett *et al.,* 1998).

While many golden spike boreholes were strategically placed within the ORM, the Clarington borehole is located on the southern edge of the ORM. Therefore, this borehole provides a different view of the subsurface as it encounters a large succession of Newmarket Till that escaped erosional processes. The Clarington borehole provides a new end member in the ORM area for the range of thickness of the Newmarket Till sequence. The Clarington borehole also provides one of the thickest successions of pre-ORM sediments when compared to other golden spike boreholes (e.g. Knight *et al.,* 2016b; Sharpe *et al.,* 2003), which may be of similar length but contain larger percentages of ORM sediments.

2.6.3 Integrity of the Newmarket Till

Sand interbeds were observed in the Newmarket Till both near surface and at depth. The presence of these sand interbeds has implications for estimated travel time of groundwater and potential contaminants to underlying aquifers. If these are connected in 3-dimensions via vertical fractures, as has been documented elsewhere (Gerber and Howard, 2000), the higher permeability sand may increase the bulk vertical hydraulic conductivity, and as such would have an effect on the integrity of the Newmarket Till. These sand interbeds are spatially variable, as observed by the change in thickness of the sand bed between MW5-14D and MW5-14D(2), which makes estimating an accurate groundwater travel time to an underlying aquifer much more challenging. If the sand interbeds are not accounted for in estimation of bulk vertical hydraulic conductivity, the travel times to underlying aquifers may be overestimated.

The simple approximations of groundwater flow velocities and travel times within the Newmarket Till using triaxial permeability data, results in velocities of 0.01 - 0.08 m/yr and estimates of travel times across distances equivalent to the depth of the Thorncliffe Formation on the order of thousands of years. The estimated values of velocity and travel time are consistent with other predicted values for the Newmarket Till (Gerber and Howard, 2000); although higher vertical groundwater flow velocities have been reported in excess of 1 m/year estimated by field-based hydrogeologic investigation and numerical modeling (Gerber *et al.,* 2001). The high resolution data sets that will be acquired with the proposed MLS on site, will allow us to explore more fully this issue of connectivity of sand beds and aquitard integrity.

2.6.3.1 Comparison of Hydraulic Conductivity Values

Two lab based methods were used to estimate hydraulic conductivity for the samples obtained within the Clarington borehole: empirical grain size calculations and triaxial permeability. Average K_{sat} estimated from two grain size methods agree quite well for each sample, within an order of magnitude. Based on the conclusions of Odong (2007) and Trapp (2015), empirical grain size equations are likely to produce realistic K_{sat} values, however, these methods are not applicable to diamicton. Although, hydraulic conductivity values were estimated for all sediment types but may only be representative for the silt, sand, and gravelly sand units.

The average triaxial permeability values are approximately two orders of magnitude lower than those calculated from grain size. This may be explained by the nature of the analysis. Grain size analysis is a destructive method that destroys some internal structure of the sediment. As the Newmarket Till is calcified, there may be additional resistance to groundwater flow due to calcified pore space. The triaxial permeability samples use an intact sample core thus incorporating the structure of the sediment.

In addition to the sample analysis performed above, Stantec completed slug tests in 14 wells installed on site (Table 8). The slug test data was analyzed by Stantec using the Bouwer-Rice method (Stantec Consulting Ltd., 2015b). Of the wells installed within the Newmarket Till, the measured values of hydraulic conductivity ranged from $3x10^{-10}$ to $7x10^{-6}$ m/s; these values are consistent with values measured by Gerber and Howard (2000). These values have a larger range than the triaxial permeability tests or the grain size estimations. This may in part be explained by the fact that the slug test results cover a greater range of depths than the triaxial samples results. In addition, slug tests are a field scale measurement of hydraulic conductivity that are more likely to account for field-scale heterogeneities such as fractures, macropores, and sand lenses.

Table 8: Hydraulic conductivity values obtained from slug tests completed by Stantec. Results are reported in the 2015 annual groundwater monitoring report.

Slug Test Results (Stantec)				
Well ID	**Top Depth (masl)**	**Bottom Depth (masl)**	**Material Description**	**Hydraulic Conductivity (m/s)**
MW1-13S	259.47	256.42	Silty Sand Till	9.E-08
MW1-13D	250.33	247.28	Silty Sand Till	9.E-06
MW2-13S	248.90	245.85	Silty Sand Till	2.E-07
MW2-13D	238.21	235.16	Silty Sand Till	1.E-07
MW3-13S	240.21	237.16	Silty Sand Till	7.E-09
MW4-13S	237.34	234.29	Sand & Silty Sand Till	1.3E-05
MW4-15D	218.83	215.78	Silty Sand Till	2.8E-10
MW5-14S	249.50	246.50	Sand & Sandy Silt Till & Silty Sand Till	1.6E-05
MW5-14S(2)	250.12	248.60	Sand	2.8E-07
MW5-14I	215.50	212.50	Silty Sand Till	1.3E-09
MW5-14D	200.01	198.49	Sand	3.3E-07
MW6-14	254.70	253.20	Silt Till	4.3E-07
MW7-14	255.65	254.15	Silt Till & Sandy Silt Till	8.4E-07
MW8-15	240.71	239.19	Silty Till & Silty Sand to Sandy Silt Till	7.4E-06

Source: Stantec Consulting Ltd., (2015b).
Note that MW1-13D screen may be tapping into a sand lens within the till as per note on the borehole log (Steve Usher, personal communication, September 2016).

As expected, the measured values of hydraulic conductivity increase with the scale of measurement (laboratory vs. field scale), which is consistent with findings from Bradbury and Muldoon (1990). It is important to note, that lab-scale measurements such as triaxial permeability analysis provide a measure of the hydraulic conductivity of the matrix material. This laboratory scale method may not account for large-scale heterogeneities that are important controls on hydraulic conductivity

(Hart *et al.,* 2006; Shaw and Hendry, 1998) such as fractures; macro pores; or sand stringers and lenses. Some of these features have been demonstrated to exist in the Clarington borehole and have been shown to be significant in other locations (Gerber *et al.,* 2001; Gerber and Howard, 2000; Sharpe *et al.,* 2007). Therefore the groundwater flow velocities estimated from the triaxial permeability results are likely skewed towards a longer travel time. It is critical to perform additional field scale testing (e.g. pumping tests, groundwater chemistry, tracer concentrations) using a multilevel well installation, together with the existing monitoring network, in order to adequately define the groundwater system at this site.

2.7 Conclusions

The purpose of this research was to characterize the Quaternary sediment stratigraphy at the CTS and to determine its hydrogeologic properties, while developing a site conceptual model for the CTS site based on currently available geologic, hydrologic, and geophysical methods. To achieve this aim, two Masters level projects were designed: one that focuses on data from the conventional well cluster (this thesis), and the other (thesis by Kelly Whelan) which incorporates other on site data as well as results from hydrogeochemical analyses from neighbouring private wells.

In this study, three continuously cored boreholes and existing geologic data from the conventional well cluster were used to characterize the Quaternary sediment stratigraphy. Detailed core logging was combined with the collection and analysis of moisture content, portable x-ray fluorescence, and grain size data to support the classification of sedimentary units. The results of this analysis suggest that Newmarket Till is found at surface with the Thorncliffe Formation and Lower sediments found below and that the Newmarket Till contains several interbeds of sand at various depths below this site. While this provides a refined conceptual understanding of the stratigraphy on site, additional hydraulic and geological data are needed to assess the interconnectivity of shallow and deep sand beds.

Triaxial permeability was measured for suspected low permeability units at locations where an intact sample could be obtained to study the vertical component of hydraulic conductivity through aquitard units. These results combined with hydraulic data obtained from a conventional five well cluster provided the basis for estimating simplified approximations of groundwater velocity and travel time through a length of Newmarket Till assuming inter-granular flow through homogenous, unfractured porous media and a constant gradient. These values provide basic insights into the vertical component of groundwater flow, although it is important to note that field-scale heterogeneities are not accounted for and where present, are expected to impact those estimates.

In addition, hydraulic conductivity was estimated using two empirical grain size methods. The calculated values were compared with triaxial permeability results and slug tests that were completed by Stantec. The variability in estimated or measured hydraulic conductivity of these three methods (i.e. empirical grain size, triaxial permeability, slug tests) is on the order of six orders of magnitude. This also demonstrates the need for additional field-scale hydraulic testing as laboratory-scale measurements likely do not account for field-scale heterogeneities that would play an important role in this groundwater flow system.

3.0 Recommendation for Installation of a Multilevel System

3.1 Introduction

In practice, monitoring well nests and monitoring well clusters are installed to monitor aquifer-aquitard systems. Monitoring wells installed in nests (in a single borehole) and clusters (in multiple boreholes) allow for sampling to occur at multiple depths at a single monitoring location. Newer techniques for hydraulic head and geochemistry monitoring are becoming increasingly popular driven by a need to better characterize groundwater systems (Meyer *et al.,* 2014). Engineered multilevel systems (MLS) can be used to obtain high-resolution profiles of hydraulic head and geochemistry. While these MLS are a state-of-the-science technology, they are not often used in groundwater investigations due to their upfront costs and the lack of policy requiring the use of MLS.

Multilevel sampling first began appearing in the 1980's. Cherry and Johnson (1982) developed one of the first multilevel systems for monitoring groundwater flow and contaminant concentrations in fractured rock. The device was constructed of a series of PVC tubes containing smaller diameter tubing terminating at various depths for discrete-depth sampling. Multilevel sampling has evolved much since the first simple systems. Four commercially available multilevel systems currently exist: the Westbay MLS offered by Westbay Instruments Inc. (www.westbay.com), the Waterloo and Continuous Multichannel Tubing (CMT) systems offered by Solinst

Canada Ltd. (www.solinst.com), and the FLUTe liner system offered by Flexible Liner Underground Technologies Ltd. (www.flut.com).

The installation of an MLS provides the ability to monitor both aquifers (e.g. sand and gravel) and aquitards (e.g. silt, clay, diamicton) due to the small olume of the sample port, which in turn allows for quicker response to natural and induced changes in hydraulic head. Consequently, this allows for comprehensive understanding of the groundwater flow system as a whole.

Sampling only aquifers provides no protection against contamination; after a detection of notable contaminant concentration in an aquifer, the damage has already occurred. Monitoring of confining aquitards offers the ability for early detection of contamination prior to arrival in aquifers. Early detection of contaminants is a key aspect of protecting drinking water sources and avoiding health related issues. The recommended installation of a MLS will allow monitoring of the Newmarket Till throughout the lifetime of the CTS and will allow for early detection of contaminants, should the CTS safety measures fail. Early detection of concerning contaminants allows for mitigation measures to be initiated and the impact to underlying aquifers minimized.

3.1.1 Utility of a Multilevel System (MLS)

Multilevel systems (MLS) have been used at various sites to obtain hydraulic head, geochemistry, and contaminant distribution profiles in overburden and bedrock applications (Chapman *et al.,* 2015; Meyer *et al.,* 2014; Parker *et al.,* 2006; Twining and Fisher, 2015).

Detailed, high-resolution vertical profiles of hydraulic head versus depth are essential to understanding a groundwater flow system as they provide direct hydraulic measurements that can be used to define hydrogeological units in a site conceptual model (Meyer, 2014, 2013; Meyer *et al.,* 2014, 2007; Parker *et al.,* 2006). In contrast to hydrostratigraphic units, which are primarily derived from geological data and literature-based hydraulic conductivities for various sediment types, hydrogeological units that incorporate high resolution datasets collected from MLSs allow us to resolve the hydraulically significant geological features in a system, thus resulting in a much more robust site conceptual model.

High resolution profiles can help to identify large head differentials that exist across low hydraulic conductivity layers in an interval that visually appears homogeneous or where no core was recovered (Parker *et al.,* 2006). This is significant because large head differentials are diagnostic of relatively low vertical hydraulic conductivity units (Parker *et al.,* 2006). Very large vertical hydraulic gradients, exceeding one meter of head per meter of vertical distance, have been identified using MLSs (Parker *et al.,* 2006). The large distances between monitoring zones may dampen the effect that large vertical conductivity contrasts have on hydraulic gradients, resulting in low hydraulic conductivity layers not being properly identified (Parker *et al.,* 2006).

Geochemical profiles of major ions and stable isotopes can be constructed to help characterize the hydrogeology of complex aquitard systems (Hendry *et al.,* 2011, 2004, 2000; Hendry and Wassenaar, 2000). The increased spatial resolution for sampling MLSs compared to conventional monitoring wells creates a more detailed geochemical profile from which to characterize the system. Major ions and stable isotopes used in this practice are SO^{4-}, Na^{+}, Mg^{2+}, and K^{+} (Hendry and Wassenaar, 2000), ^{36}Cl and $\delta^{37}C1$ (Hendry *et al.,* 2000), $\delta^{2}H$ and $\delta^{18}O$ (Hendry *et al.,* 2011, 2004), as well as many others.

In terms of contaminant distribution profiles, MLSs can help to identify zones with high contaminant concentrations (Parker *et al.,* 2006). Lower-resolution sampling using conventional well clusters may miss thin zones of high concentration. Alternately, where conventional monitoring wells, with longer screened monitoring zones, do intercept high contaminant concentration zones, the peak concentration may be diminished if sample blending occurs across the well screen (Einarson, 2006). This may result in inaccurate estimations of contaminant fluxes.

Each of the commercial MLSs are geared towards different installation requirements (Table 9). Site-specific monitoring requirements will constrain the available MLS options. For example, CMT™ systems are well suited to shallow installations, while Westbay™ systems are well suited for very deep installations. The number of ports desired for a particular installation will affect the choice of MLS.

Table 9: Commercial multilevel system comparison.

Description	Westbay MP® System	Solinst Waterloo™ System	Solinst CMT™ System	Water FLUTe™ System
Maximum Installation Depth (m)	1200	230	100	300
Maximum Number of Sampling Ports	20 per 30 m	15	7	20+
Recommended Borehole Diameter (cm)	7.5 - 15	7.5 - 15	7.5 - 15	7.5 - 25

One of the limitations to the use of these commercially available MLSs globally, is that the manufacturing process takes place in North America. Once a MLS is manufactured and shipped to an international destination, often requiring import duties, generally the cost is much higher than if installation were to occur in North America. As an alternative to the commercially available MLSs, a prototype G360 MLS has been recommended for installation at the Clarington site because of its low cost of manufacture and flexibility of in-field design. The G360 MLS has been chosen over the other commercially available system for two reasons: (i) the system is manufactured in-house at Guelph university, which translates to a lower cost per system than a commercially available system; and (ii) the G360 MLS outer casing is larger than the comparable Solinst Waterloo™ System, which allows for more ports within the G360 system.

3.1.2 G360 Multilevel Monitoring System (MLS)

A prototype MLS is under development at Guelph University. This system, the G360 multilevel system (G360 MLS), is currently undergoing field trials. The G360 MLS is a modular multilevel system used for high resolution monitoring of hydraulic head and geochemistry that evolved from the initial Waterloo Systems (Cherry and Johnson, 1982).

Like the commercially available MLSs, the modular design of the G360 MLS allows for in field, post-drilling design and installation. The system consists of outer casing, monitoring ports, and internal sample tubing. The casing lengths are produced in 30, 60, 90, 150, or 300 cm lengths, to accommodate borehole specific designs. The G360 MLS is being designed specifically to enable manufacture within a traditional machine shop from PVC pipe. This will allow for widespread use of the MLS as casing lengths and ports can be manufactured locally, near the installation site. This also reduces the overall cost.

3.2 Methods

3.2.1 Physical and Logistical Constraints to a G360 MLS Design

The number of monitoring zones that may be installed within a G360 MLS is dictated the site geology and depth of the water table, the inner diameter (ID) of the borehole, the inner diameter (ID) of the MLS casing and the outer diameter (OD) of the sample tubing, as the sampling tubes are required to fit within the MLS casing (Figure 33). The of the borehole is dependent on the type of drill rig and associated drilling equipment available for the project. Not every drilling company will be able to provide all borehole diameter options, as borehole diameter is equipment specific. Typical borehole diameters are 76, 96, 123 mm (NQ, HQ, and PQ) and larger tri-coned holes (152 - 203 mm). There are four nominal diameter outer MLS casing sizes to choose from: 50, 65, 80, 100 mm. This size selection offers the ability of installing a MLS in various borehole diameters and allows for consideration of water sampling requirements (e.g. peristaltic pump connected to sampling tubing at surface for shallow water levels less than 8.2 m bgs vs. double value pumps or triple tube samplers placed within a 12.7 mm ID or larger sample tube for water levels below 8.2 m bgs). As an example, the 65 mm casing systems allows for up to 8 monitoring intervals (Figure 33c), each with 12.7 mm inner diameter tubing running from the monitoring port to surface. The 12.7 mm diameter tubing allows for insertion of removable miniature pumps for water sampling and transducers for continuous pressure recording.

The spacing of monitoring ports is also dependent on the practical minimum sand pack and bentonite seal lengths. The recommended length of a sand pack is approximately 60 cm and the recommended length of a bentonite sealed zone is at least one meter. This length is recommended in order to achieve a high-integrity seal (Figure 33b). These recommended lengths may limit the number of monitoring zones that could be installed in a shallow installation. However, beyond the requirement of minimum sand pack and seal lengths, the arrangement and spacing of backfill materials can be adapted to site-specific geological conditions. Alternatively, packers may be used to seal the borehole in stable rock holes.

The modular design of the G360 MLS does allow for design and assemblage in the field, post-drilling. There is flexibility in port placement as the design of the system can be modified once geologic information is obtained during drilling. However, the amount of flexibility is dependent on the chosen casing lengths. There is more flexibility in design if smaller casing lengths are used than would be if 150 or 300 cm lengths are used. The MLS components require prior manufacture if immediate installation following drilling is planned, in which case the casing lengths have to be pre-ordered. The cost of manufacturing many small casing lengths is higher than manufacturing fewer long casing lengths, therefore an increased amount of flexibility in design is positively correlated to the cost of the system. However, it is important to note that the cost of drilling multiple boreholes for installation of a conventional well cluster far outweighs the cost of installation of a MLS in a single borehole. In the end, ordering a combination of short and long casing lengths with at least 10% of the total length worth of spare 30, 60, and 90 cm lengths allows for the most flexibility for in-field design and construction.

3.2.2 Geologic and Hydraulic Constraints to a G360 MLS Design

One of the objectives of using an MLS to characterize the subsurface is to identify and observe inflections in hydraulic head that can in turn be used to better define an aquifer-aquitard system. With carefully selected port locations, high-resolution monitoring is unique in that it can more accurately identify areas where hydraulic head inflections occur (Parker *et al.,* 2006). This results in a better understanding of vertical hydraulic gradients, the integrity of an aquitard unit, and its ability to offer protection for confined aquifer systems.

Ideal port placement includes ports: (i) below the upper contact boundary of a geological unit that is likely hydraulically distinct from adjacent units; (ii) within the centre of that unit; and (iii) above the lower contact boundary of that unit (Jessica Meyer, personal communication, Feb. 2016) to help constrain the thickness of hydrogeologically significant units. It is important to note that choosing port locations that will accurately identify areas of hydraulic head inflections can prove challenging. It has been observed by Parker et al. (2006) that detailed visual inspection of sediment core may not lead to accurate identification of specific depths where the hydraulic head inflections occur (Parker *et al.,* 2006). Small, possibly unrecognizable, differences in grain size or sorting characteristics can cause a change in the order of magnitude of hydraulic conductivity (Parker *et al.,* 2006). Even if subtle changes in sediment characteristics are recorded, identifying which ones will matter hydraulically is challenging because of the 3D geometry of groundwater flow systems. The sediment characteristics observed in a 1D core log may not produce notable contrasts in hydraulic parameters at the field-scale. In the end, all available geological, geophysical, and hydraulic data are used to mitigate these challenges and to provide the best possible MLS design.

3.2.3 Using Secondary Datasets for Multilevel System Design

Secondary datasets (e.g. existing hydraulic data, geophysics) can be used to further justify MLS port placement. These datasets can be used to identify anomalous changes in sediment packages, which may help to identify changes in sediment characteristic leading to changes in hydraulic conductivity, causing inflections in hydraulic head.

Geophysics can be useful for identifying sand and silt beds within larger sediment packages. These layers can be identified in the subsurface by zones of decreased gamma and variations in electromagnetic conductivity (Boyce *et al.,* 1995). Natural gamma and electrical resistivity were completed in MW5-14D to 53.95 m bgs within a 5 cm diameter PVC casing and in MW5-14D(2) within an open tri-coned borehole to 49.68 m bgs. A schematic has been provided in Figure 34 displaying the geophysical logs as produced by Stantec Consulting Ltd. (2015b). These geophysical logs were used to help assign monitoring port locations within the proposed G360 MLSs. For example, monitoring ports have been placed above and below layers that are thought to contain higher silt and clay content, based on increases in gamma and decreases in resistivity, to determine if there are hydraulic head inflections across these layers.

3.3 Results: Proposed Advanced Multilevel Monitoring Station

A preliminary design was constructed for a G360 MLS based on the continuous core obtained in December of 2014 from the Clarington borehole. The initial design of the MLS is based on various datasets, which guided the placement of monitoring ports (Figure 35). In short, the port placement was based on:

- Identification of major lithological changes;
- Identification of bulk vertical hydraulic gradients;
- Locations of existing PVC monitoring wells (for direct data comparison); and
- Identification of higher silt and clay content via geophysical logs.

Rationale for each individual port placement is further outlined in Figure 35.

3.3.1 Preliminary Design of a G360 MLS

The design consists of two adjacent G360 prototype multilevel systems (MLS) with a combined total of 16 depth-discrete monitoring zones. Each system consists of a 65 mm nominal diameter schedule 80 PVC outer casing placed within 168 mm sonic drilled boreholes. This size of outer casing was selected to fit within the inner rotosonic casing. Ideally the G360 MLSs will be located adjacent to the MW5-14 well cluster (Figure 36).

The two-system design consists of a deep system and a shallow system (Figure 35). The deep system is designed to a target depth of 90 m bgs with eight monitoring zones located below 45 m bgs (Figure 35). The upper half of the deep MLS should be installed with 'blank' casing. The complementary shallow system was designed to monitor the interval from surface to 45 m bgs with eight monitoring zones (Figure 35). This monitoring station permits a monitoring zone frequency of approximately one zone per 5.5 m, which will provide significantly more data through the Newmarket Till aquitard and the top of the underlying Thorncliffe Formation aquifer compared to the existing conventional well cluster (Figure 36).

Each of the monitoring zones will be connected to a 12.7 mm ID sample tube. The 12.7 mm ID sample tubes were chosen because the site water levels are beyond peristaltic pump limits and will require thicker tubes to accommodate sampling equipment (e.g. double-valve pumps, triple-tube samplers) and hydraulic head measurement (e.g. Teflon-coated coaxial water level tapes, micro cable pressure transducers).

The design will aid in the investigation of the strong downward hydraulic gradient (2.07 m/m) zone between MW5-14I and MW5-14D that has an associated gamma spike (48.50 – 50.25 m bgs) indicating the possibility of a low K_v zone (Figure 37). Below MW5-14D, an upward gradient was observed in the conventional well cluster, although it is unlikely that a constant gradient exists across this interval, as there are several aquitards with sand and intervening aquifer units. The proposed design of the MLS has incorporated monitoring ports to assess the gradient across this assemblage of aquifers and aquitards with a terminal point in the Thorncliffe Formation (Figure 36). Additionally, this will facilitate a direct comparison between a state-of-the-practice method (conventional well cluster) and a state-of-the-science method (engineered MLS) for measuring hydraulic head and groundwater chemistry.

The MLS described above has been designed for site-specific conditions based on the core recovered from the mud rotary drilling program at the Clarington site in December of 2014. The above design is preliminary and subject to change based on the sediment conditions encountered in the field once drilling, core recovery, and detailed core logging occurs.

3.3.2 Installation of a G360 MLS in a Rotosonic Borehole

The installation of the G360 MLS would be part of a field demonstration of the application of this technology in a backfill installation within a rotosonic borehole. Although various types of drilling equipment are suited to unlithified deposits (e.g. hollow stem augers, direct push, mud rotary), rotosonic drilling is preferred for installation of the G360 MLS at the MW5-14 well cluster for the following reasons: (1) avoids the use of mud that may clog the formation and affect geochemical samples; (2) facilitates accurate placement of sand packs and seals; (3) advances steel casing while taking continuous core; (4) advances holes through nearly all types of unlithified deposits, as well as boulders, and into bedrock (Bradbury *et al.,* 2006); and (5) rotosonic minimizes the chance of bridging of backfill materials with vibration of the casing string.

The G360 MLSs will be installed down the inside of the drill casing. Sand packs and bentonite seals will be emplaced, as the casing is withdrawn, similar to conventional monitoring well designs. Coated bentonite pellets and bentonite chips have been recommended for use because they expand at a much slower rate compared to non-coasted pellets or granules. Bentonite chips have a high moisture content and can be dropped through a standing water column up to 150 m without bridging (Nielsen, 2005). The backfill method results in a permanent emplacement of the G360 MLS.

3.4 Conclusions

An objective of this thesis was to provide recommendations regarding the installation of a high-resolution engineered multilevel system at the CTS to obtain detailed vertical profiles of hydraulic head and geochemistry. Generally speaking, multilevel systems (MLS) allow for better characterization of complex glacial systems than do conventional monitoring techniques. MLSs offer the ability to obtain high-quality, high-resolution data from multiple depth-discrete sample locations. With this density of sampling, high-resolution vertical profiles of various parameters can be developed to better understand this groundwater system, particularly the distribution of hydrogeological units that are defined by directly measured hydraulic and hydrogeochemistry data.

A preliminary design of two complementary G360 MLSs was constructed based on sediment core descriptions from the deep Clarington borehole (see Chapter 2). The installation of two 8 port MLSs would provide a combined total of 16 depth-discrete monitoring intervals over a depth of 90 m. This installation will provide enhanced monitoring capabilities compared to the existing MW5-14 well cluster. This MLS would provide a method for early detection of contaminants moving through the Newmarket Till, if safety measures in place at the CTS were ever to fail. Given the regional extent of the Newmarket till across much of south-central Ontario and its function as a protective aquitard overlying regional deep aquifer systems, the knowledge gained at the CTS is expected to be applicable both locally and regionally.

4.0 Summary and Conclusion

The Clarington Transformer Station (CTS) is being constructed just north of the southern edge of the Oak Ridges Moraine (ORM) Planning Boundary. A hydrogeological investigation was undertaken, in the form of cored boreholes and installation of conventional monitoring wells in November and December of 2014. This investigation provided evidence to support that, of the five possible conceptual models identified (Figure 29), the Newmarket Till is likely present at surface with a shallow sand bed within this Newmarket Till. This interpretation is based on three of four material properties that consistently distinguish the Newmarket Till from the Halton Till: sand content, stone content, and water content. While the data presented here supports this conceptual model, the site conceptual model proposed here is meant to be revisited as new data is acquired on site following installation of the proposed multilevel monitoring station.

By identifying the surface diamicton unit as Newmarket Till, the sand features present near surface are not likely to be of ORM origin. While ORM sediments were not identified within the Clarington borehole, the integrity of the Newmarket Till is still of considerable importance due to the underlying Thorncliffe Formation, which is used as a regional aquifer and the presence of productive sand beds within the Newmarket Till.

The continuous core log obtained from the Clarington borehole revealed heterogeneity within the Newmarket Till in the form of sand beds. These sand beds are variable in size, as demonstrated by the change in thickness between MW5-14D and MW5-14D(2) (Figure 19). This is supported by the wide variation in hydraulic conductivity values measured via slug tests performed by Stantec.

Water levels obtained from the conventional well cluster demonstrate that strong downward gradients are found onsite within a portion of the Newmarket Till (up to 2.07 m/m). Vertical groundwater velocities (0.01 - 0.07 m/yr) and vertical groundwater travel times (100's of years per 10 m distance) have been estimated using triaxial permeability and hydraulic gradients within the conventional well. While these values suggest long travel times through the Newmarket Till to underlying aquifers, this method fails to incorporate field-scale heterogeneities such as fractures, macropores, and sand lenses. The presence of at least some of these heterogeneities on site makes it difficult to estimate accurate groundwater flow velocities and travel times with the currently available dataset. Further studies on site using the proposed multilevel monitoring design will provide much needed hydraulic and geochemical datasets that will enhance the understanding of the groundwater flow system.

4.1 Future Work at the Clarington Transformer Station

It is recommended that future work at the CTS include installation of a high-resolution groundwater monitoring station. Information obtained from this type of monitoring installation will provide high-quality, high-resolution data to better understand the regional groundwater flow system as well as the integrity of the Newmarket Till. This type of monitoring installation also provides valuable information for site-specific investigations, especially in a complex glacial system such as the ORM, and will be useful for developing a robust site conceptual model (SCM).

There are many reasons to pursue high-resolution sampling at the CTS. The Newmarket Till is generally thought of as a good aquitard providing protection to the underlying aquifers. Hydraulic conductivity estimates from triaxial permeability and hydraulic gradients measured within the conventional well cluster imply long travel times through the Newmarket Till (100's of years per 10 m distance); however, hydraulic conductivity estimates from slug tests are orders of magnitude higher than hydraulic conductivity from triaxial permeability. Hydraulic and geochemical data obtained from a high-resolution groundwater monitoring station can then be used to refine our assessment of hydraulic conductivity within the Newmarket Till and delineate hydraulically-calibrated hydrogeological units, thus providing critical datasets to assess aquitard integrity, recharge, and contaminant pathways.

Ideally, large-scale hydraulic testing (e.g. a long-term pumping test) should be carried out to determine the bulk hydraulic conductivity of various hydrogeological units. The results of the lab-scale measurements (e.g. triaxial permeability), lab-scale estimations (e.g. empirical grain size calculations), and small field-scale measurements (e.g. slug tests) provide limited insights into a local or regional groundwater flow system. With information obtained from large-scale hydraulic testing and long-term detailed hydraulic and geochemical monitoring, it will be possible to better define the groundwater flow system and predict groundwater flow velocity and travel time from surface to underlying aquifer units.

Additionally, the installation of a MLS adjacent to a conventional well cluster will provide an opportunity to compare and contrast a state-of-the-science monitoring system (MLS) to a state-of-the-practice monitoring system (conventional well clusters). This comparison may provide useful information about the discrepancies in data that is collected for research purposes to that which is traditionally acquired in industry.

5.0 Figures

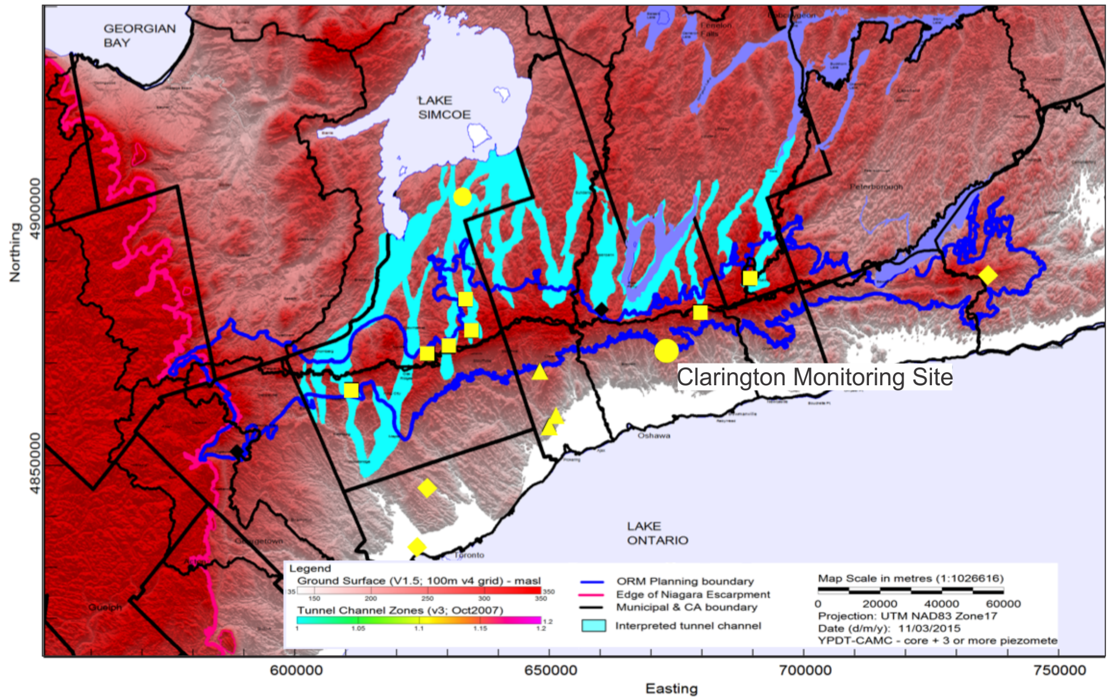

Figure 1: Map showing locations within the ORM Study Area with a high-quality monitoring site (cored boreholes with 3+ piezometers). Wells installed by the Geological Survey of Canada (GSC) operated by the Provincial Groundwater Monitoring Network (PGMN) or local conservation authority (e.g. CLOCA) (squares); Oak Ridges Moraine Groundwater Program (YPDT-CAMC) wells operated by YPDT-CAMC or PGMN (diamonds); the Interim Waste Authority (IWA) landfill site and Rick Gerber's PhD thesis (triangles); IWA landfill investigation (small circle). Map courtesy of Dr. Rick Gerber.

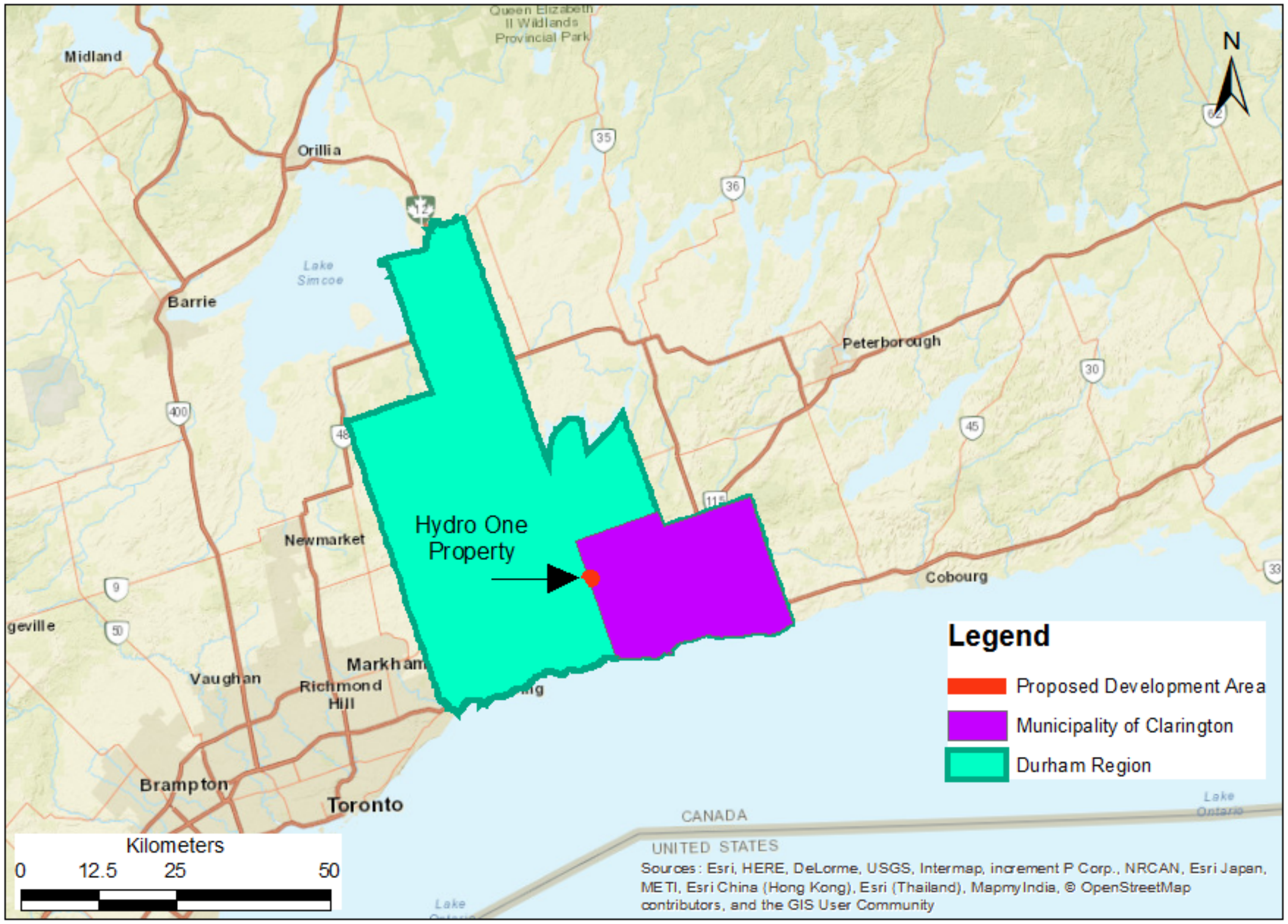

Figure 2: Map showing the location of the Hydro One property in relation to the Municipality of Clarington and the regional Municipality of Durham.

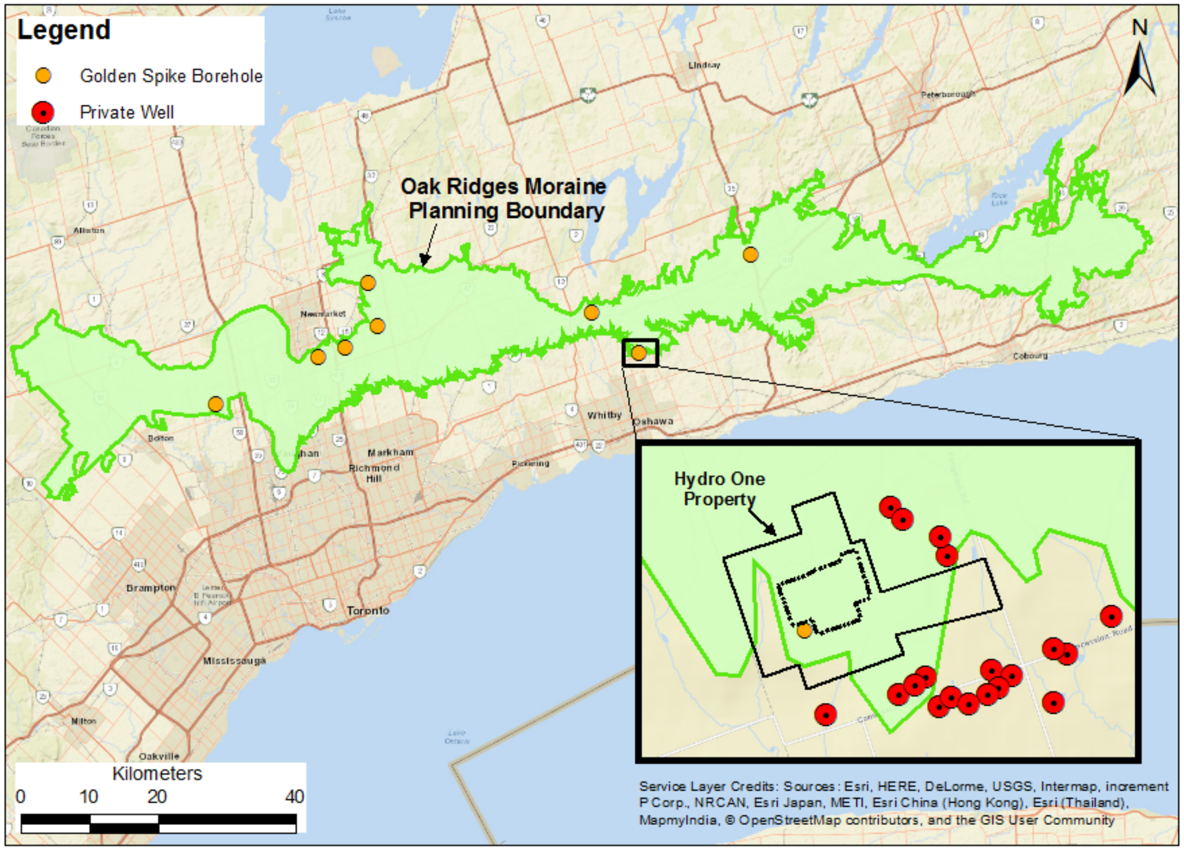

Figure 3: Map showing the location of the Hydro One property relative to the Oak Ridges Moraine Planning Boundary and seven 'Golden Spike" boreholes (continuously cored, core recovery, detailed sediment logging, sampling, and data processing) within ~60 km of the Hydro One property (Knight *et al.,* 2016b; Russell *et al.,* 2003b; Sharpe *et al.,* 2003). The Hydro One property is located just north of the southern edge of the ORM Planning Boundary (inset image).

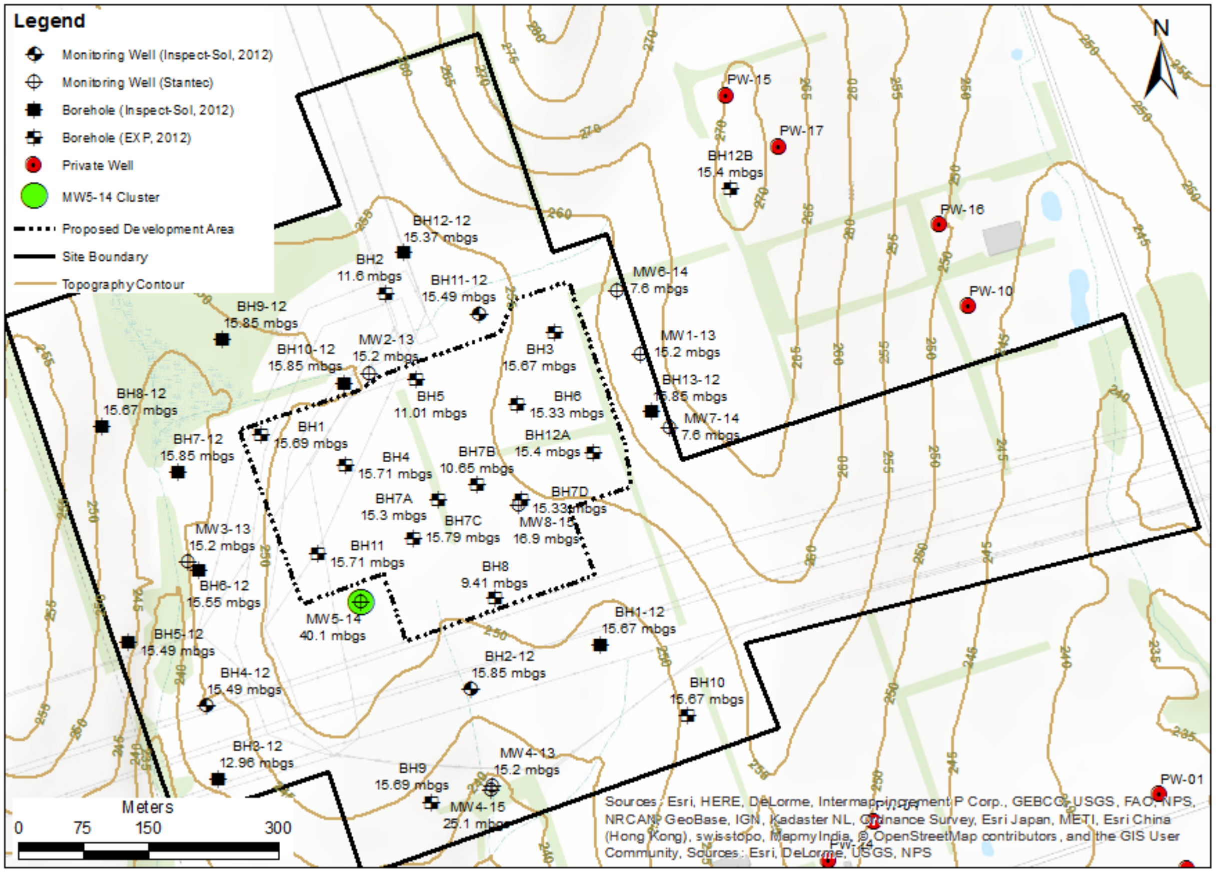

Figure 4: Map showing the topography of the study area, monitoring well network, and private residential wells within the vicinity of the Hydro One property. The topography was mapped using 10 m contours from the ESRI database. The area where the Hydro One property is located slopes towards the south.

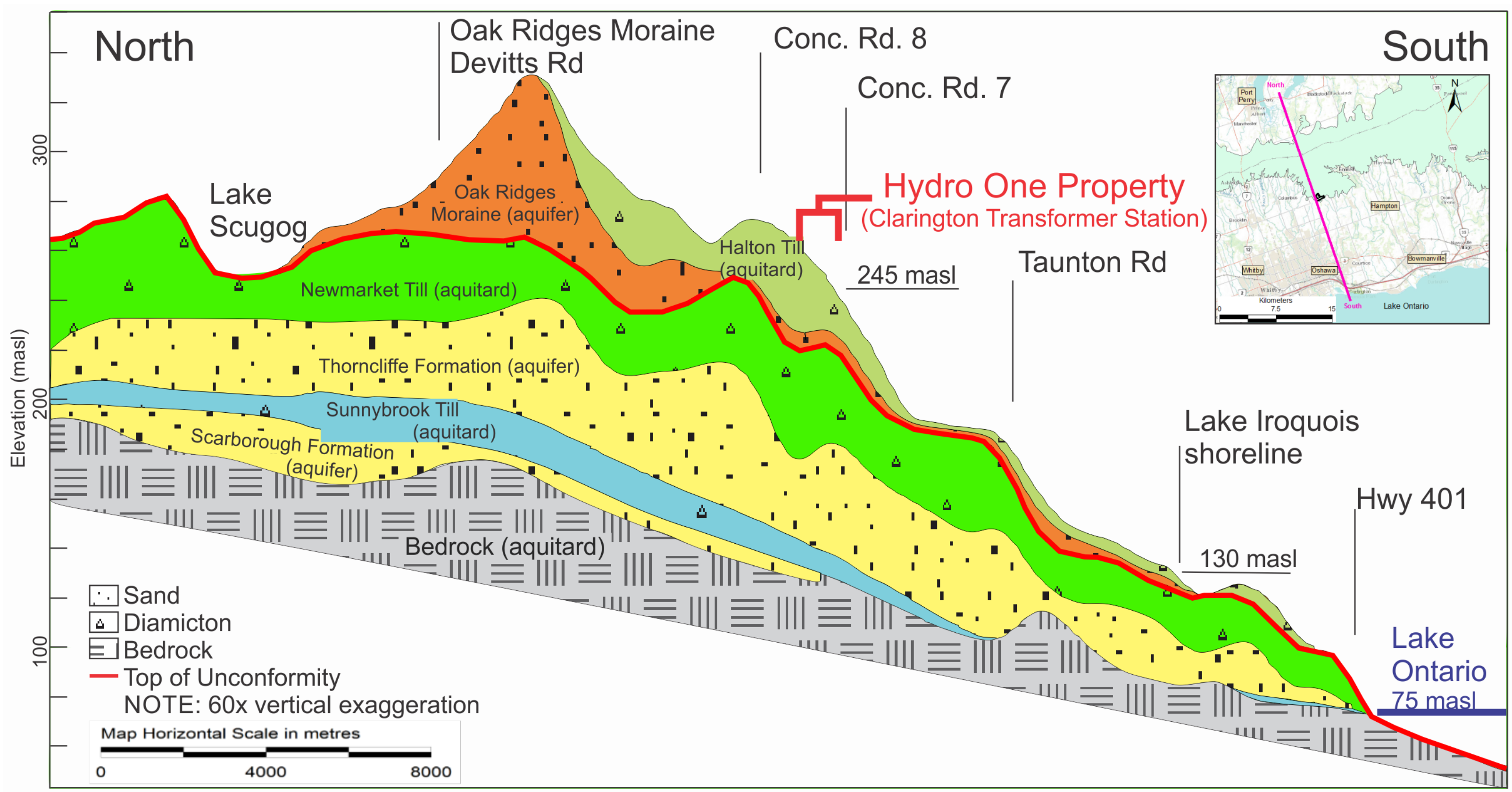

Figure 5: Geological cross-section through the Oak Ridges Moraine showing key stratigraphic units, topography, and location of the Hydro One property (modified from figure courtesy of Rick Gerber, 2015). Cross section runs across the Oak Ridges Moraine from Rice Lake to the North down to Oshawa in the South (inset). Note that the ORM creates a drainage divide between Georgian Bay to the north and Lake Ontario to the South.

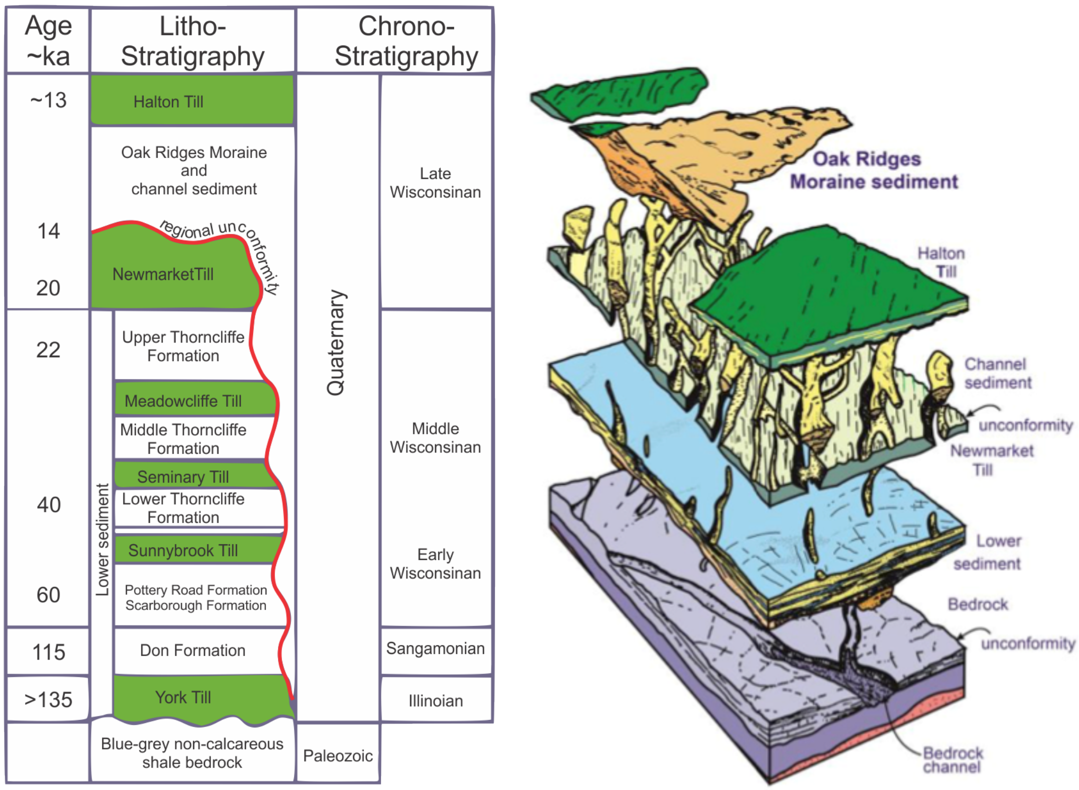

Figure 6: The current regional conceptual geologic model for the Oak Ridges Moraine area (Logan *et al.,* 2000). From Paleozoic bedrock to surface, the sediments are grouped as follows: Lower (sub-Newmarket) sediments; Newmarket Till; Oak Ridges Moraine; and Halton Till. Figure modified from Sharpe et al. (2002).

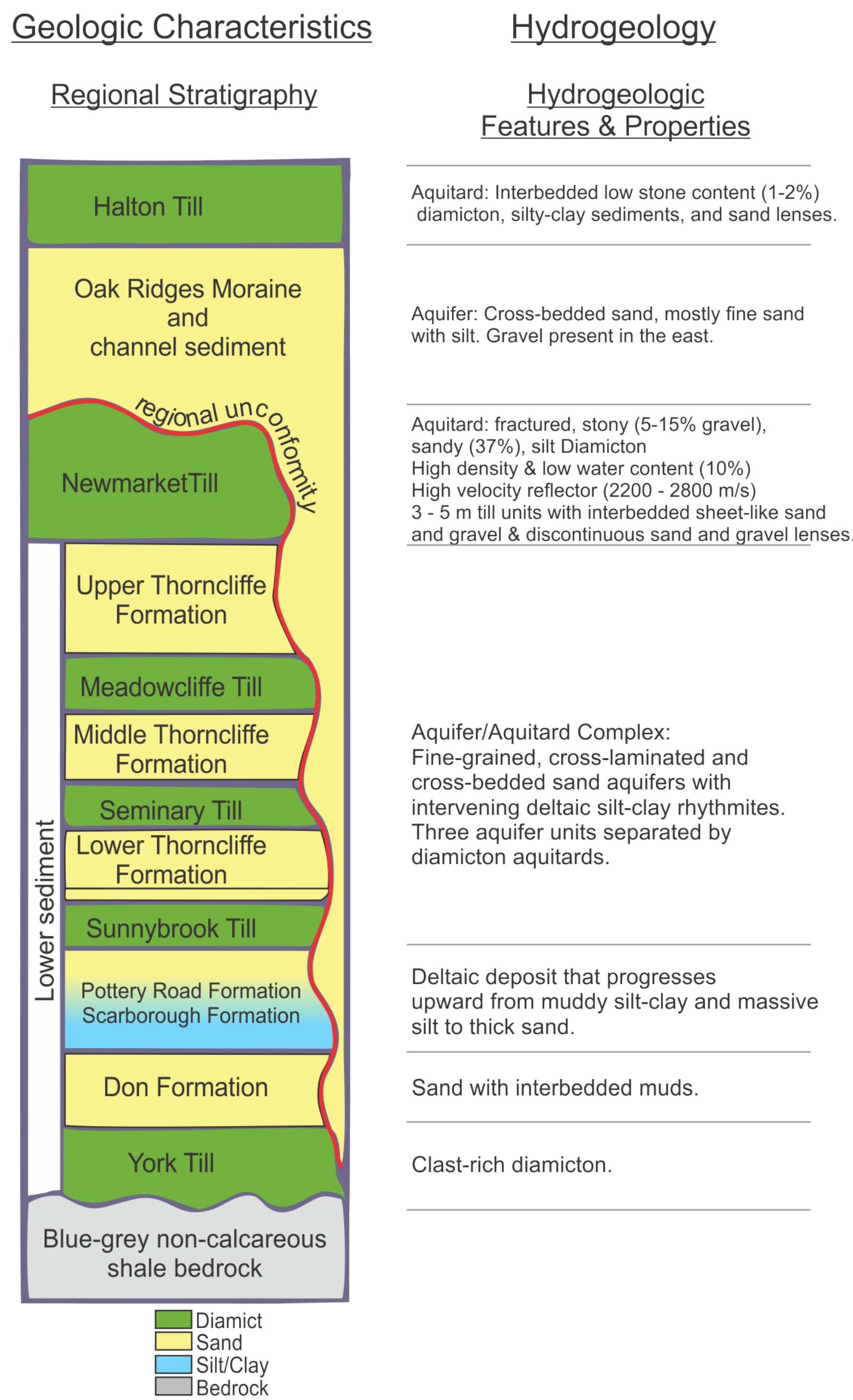

Figure 7: Hydrogeologic features of the Quaternary sediments based on previous studies (Logan *et al.*, 2000; Sharpe *et al.*, 2002, 2007; Sharpe and Russell, 2003).

Figure 8: Field activities at the CTS: (a) a CME 75 track mounted drill rig used to core new boreholes at MW5-14; (b) extraction of the core from the subsurface via a wireline core retrieval system; and (c) 1.5 m long, PQ sized (85 mm) sediment cores placed in PVC core tubes awaiting sampling.

Figure 9: Drilling fluid coats the sediment core. Scraping tools are used to remove the film.

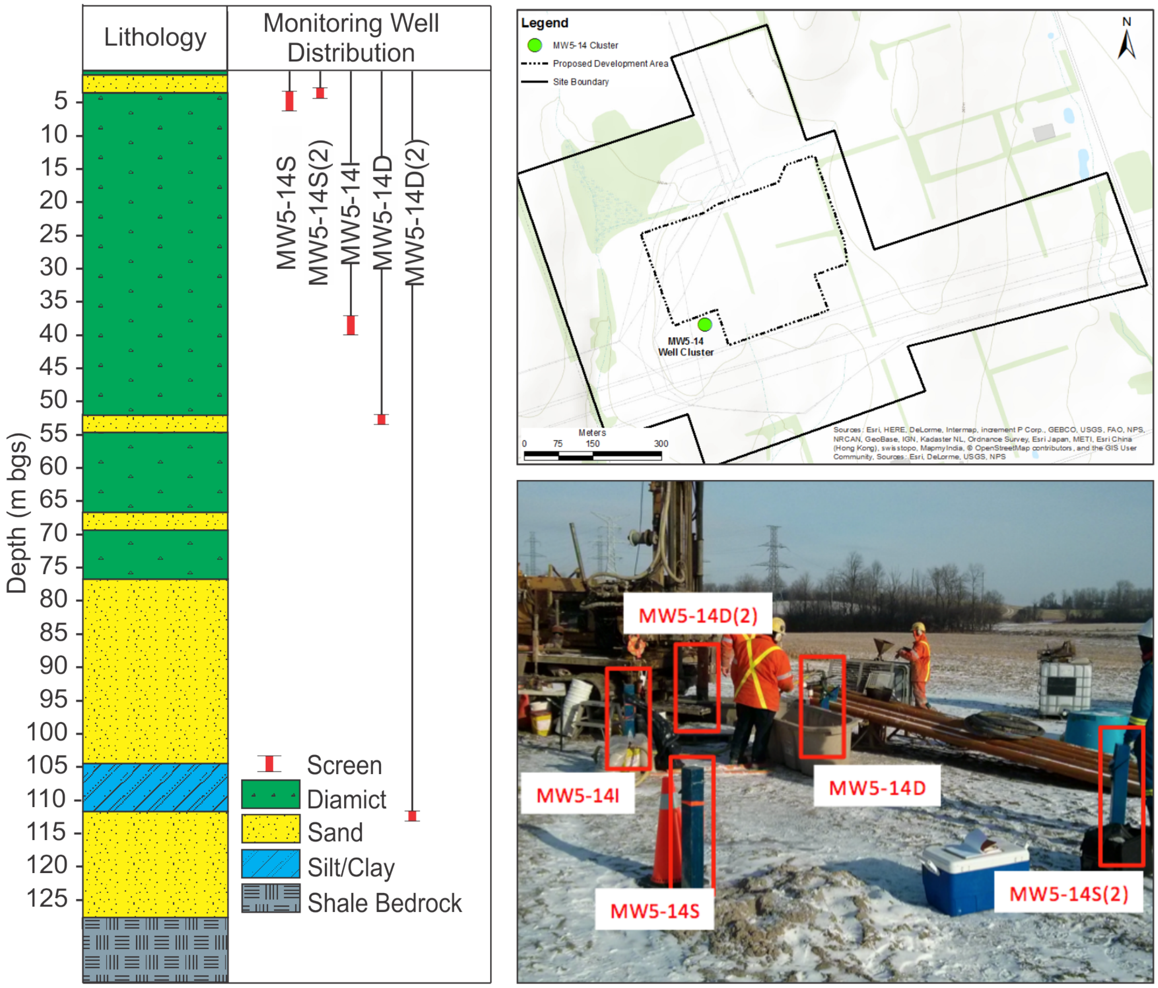

Figure 10: Monitoring wells installed by Hydro One at the MW5-14 monitoring location. MW5-14S and MW5-14I were installed in October of 2014. The remaining three wells were installed in November and December of 2014 as a condition of the access road easement agreement between Hydro One and the Municipality of Clarington. MW5-14D(2) is installed in the deep borehole drilled into the top of bedrock.

a)

b)

Figure 11: Immediately after extraction, each 1.5 m core section (a) was photographed in its entirety. Close-up photos (b) were taken to complement the 1.5 m photo and capture details within the sediments. This photo set is an example of the Newmarket Till, a stony, sandy-silt diamicton. The depth of the core run is 26.0 - 27.6 m bgs.

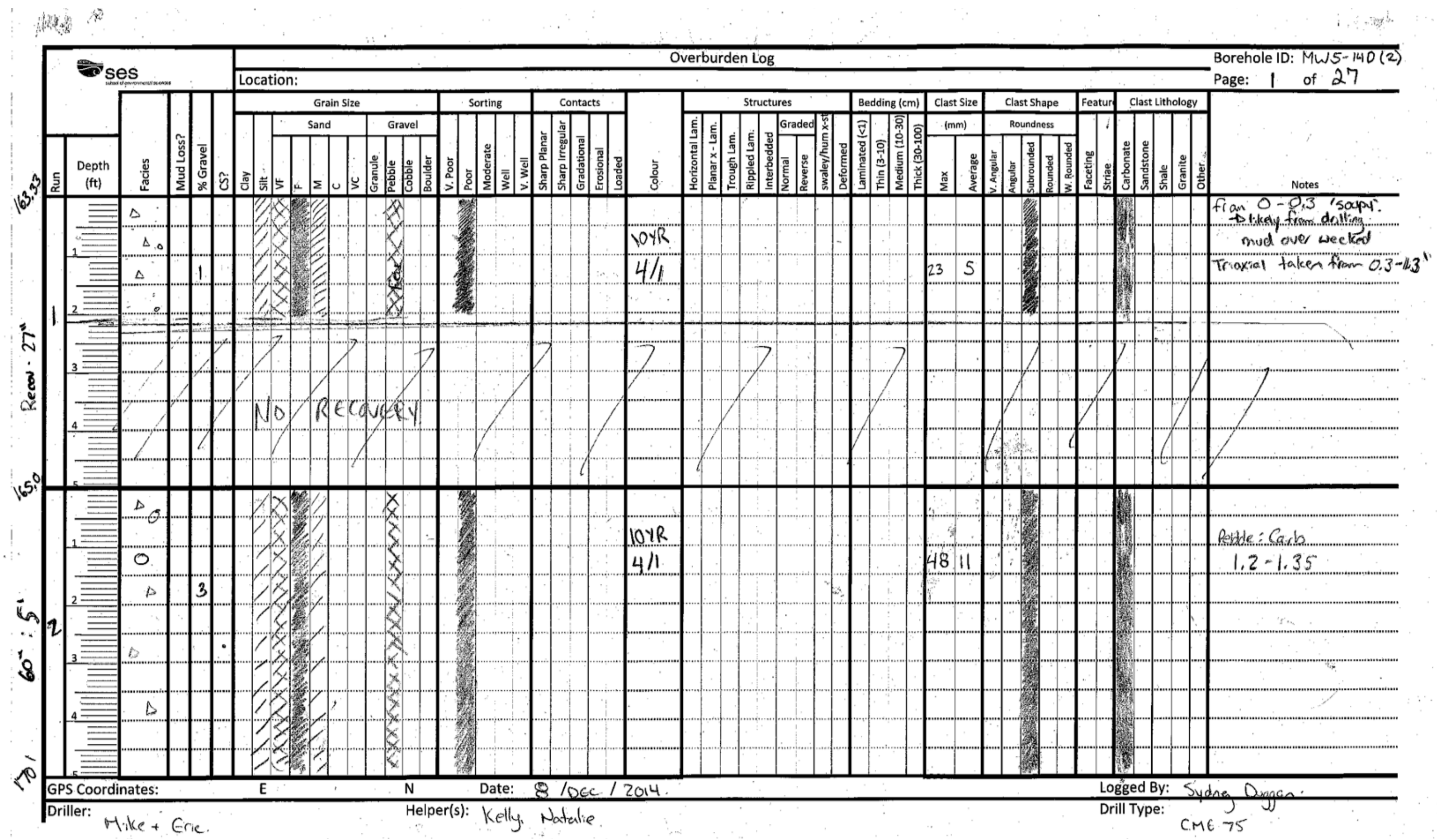

Figure 12: A completed core logging template filled out by Sydney Duggan. Sediment cores were logged for facies type, grain size characteristics, colour, and visible structures. Core logging template was developed by members of the Glacial Geology Lab, University of Guelph.

		Estimated Percent Gravel (whole sample)	
		1-5%	5-50%
Percent Sand in Matrix	0-33%	clast-poor muddy diamicton	clast-rich muddy diamicton
	33-66%	clast-poor intermediate diamicton	clast-rich intermediate diamicton
	66-90%	clast-poor sandy diamicton	clast-rich sandy diamicton

Figure 13: Classification of a diamicton, which refers to poorly sorted sediments displaying a wide range of grain sizes that can result from a variety of processes, not solely of glacial origin. A diamicton consists of a sand and mud matrix with < 50% gravel content. Modified from Hambrey and Glasser (2003).

Figure 14: Obtaining grain size samples from the Newmarket Till required a hammer and wedge because the core material was over-consolidated and cemented.

Figure 15: A washed out section of core approximately 33.5 cm in length located within the uppermost diamicton unit (Newmarket Till). This core section is located 2.99 – 4.63 m bgs.

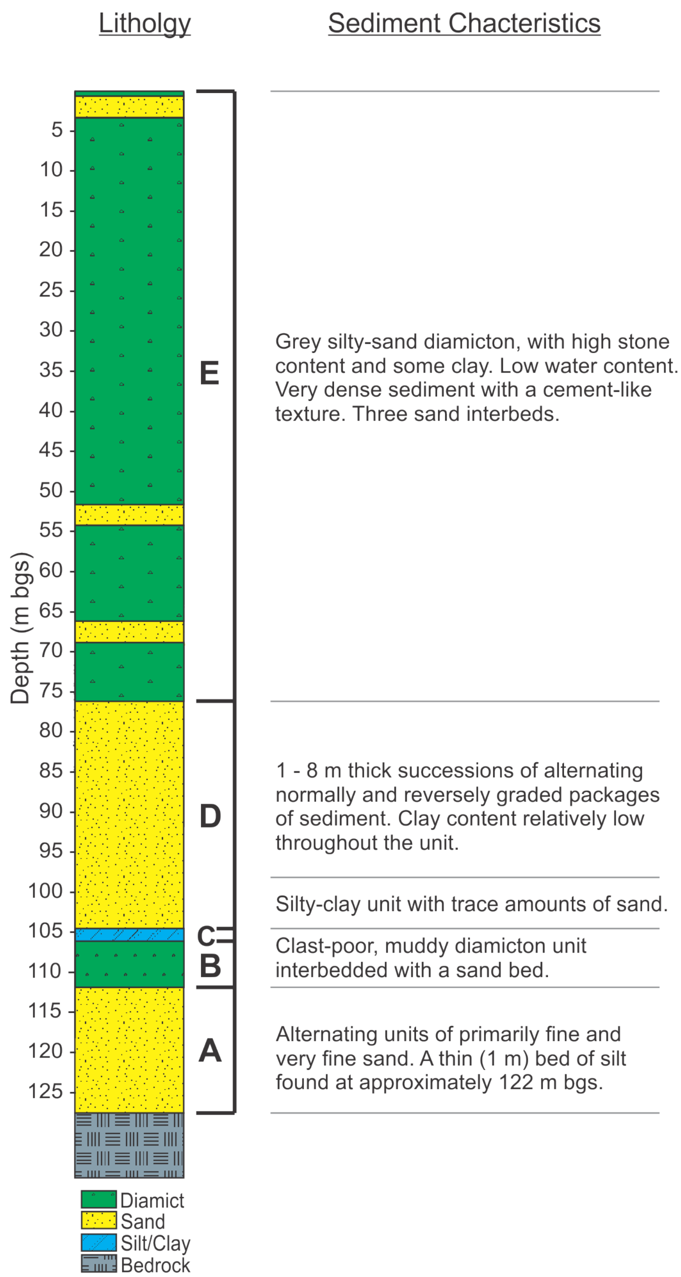

Figure 16: Sedimentary packages, identified by dominant lithology, in the deep, continuously cored Clarington borehole.

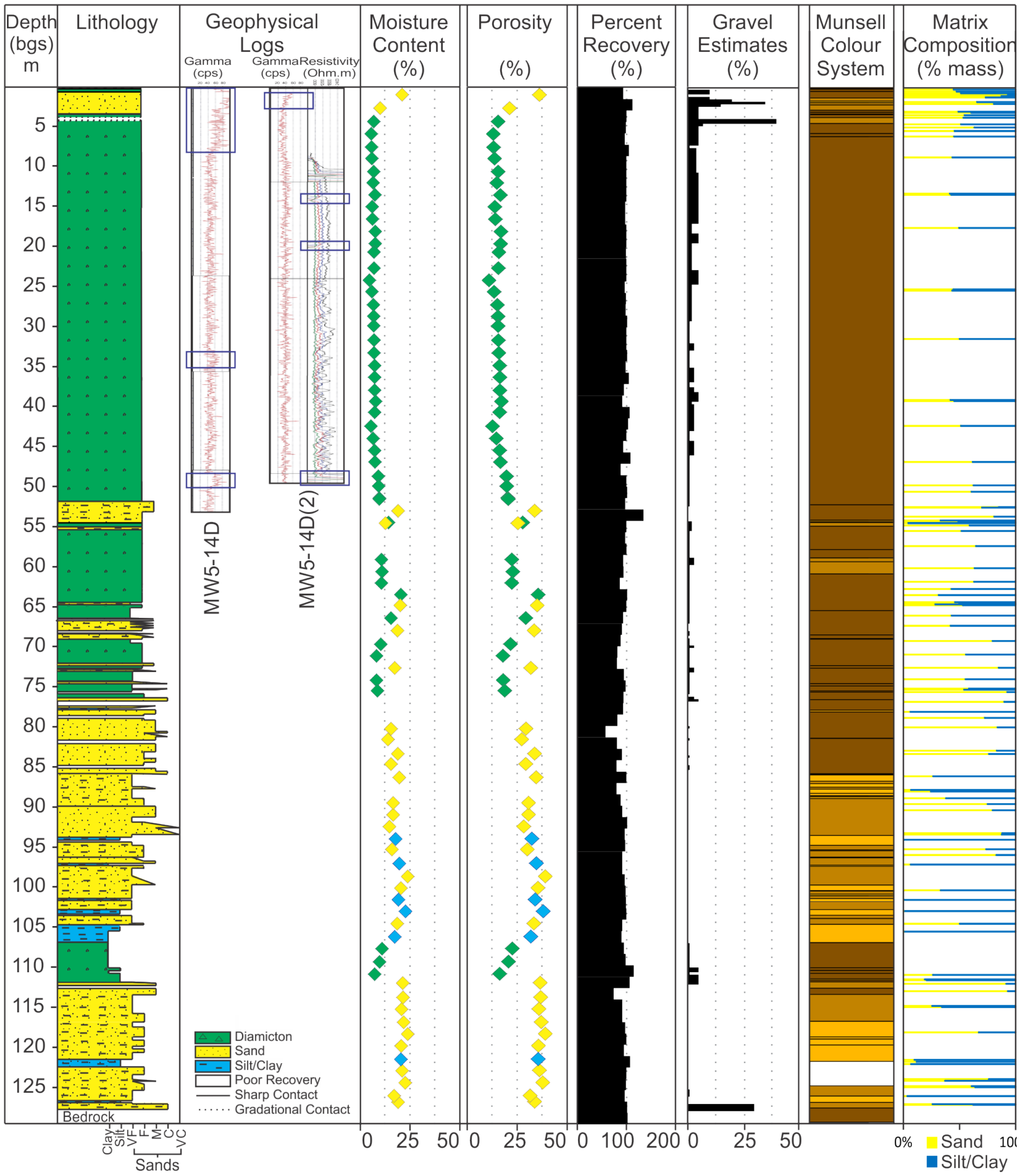

Figure 17: Detailed log and vertical profiles of associated sedimentary and geophysical characteristics. The uppermost diamicton unit is relatively consistent in all quantitative and qualitative sediment characteristics, while the underlying sediments display relatively more variability in such characteristics. Porosity is calculated using the void ratio and moisture content by mass (equation 1).

Figure 18: Representative 1.5 m core runs of each sedimentary package overlying Bedrock (Blue Mountain Formation shale): (A) sand, (B) diamicton, (C) clay, (D) sand, and (E) diamicton

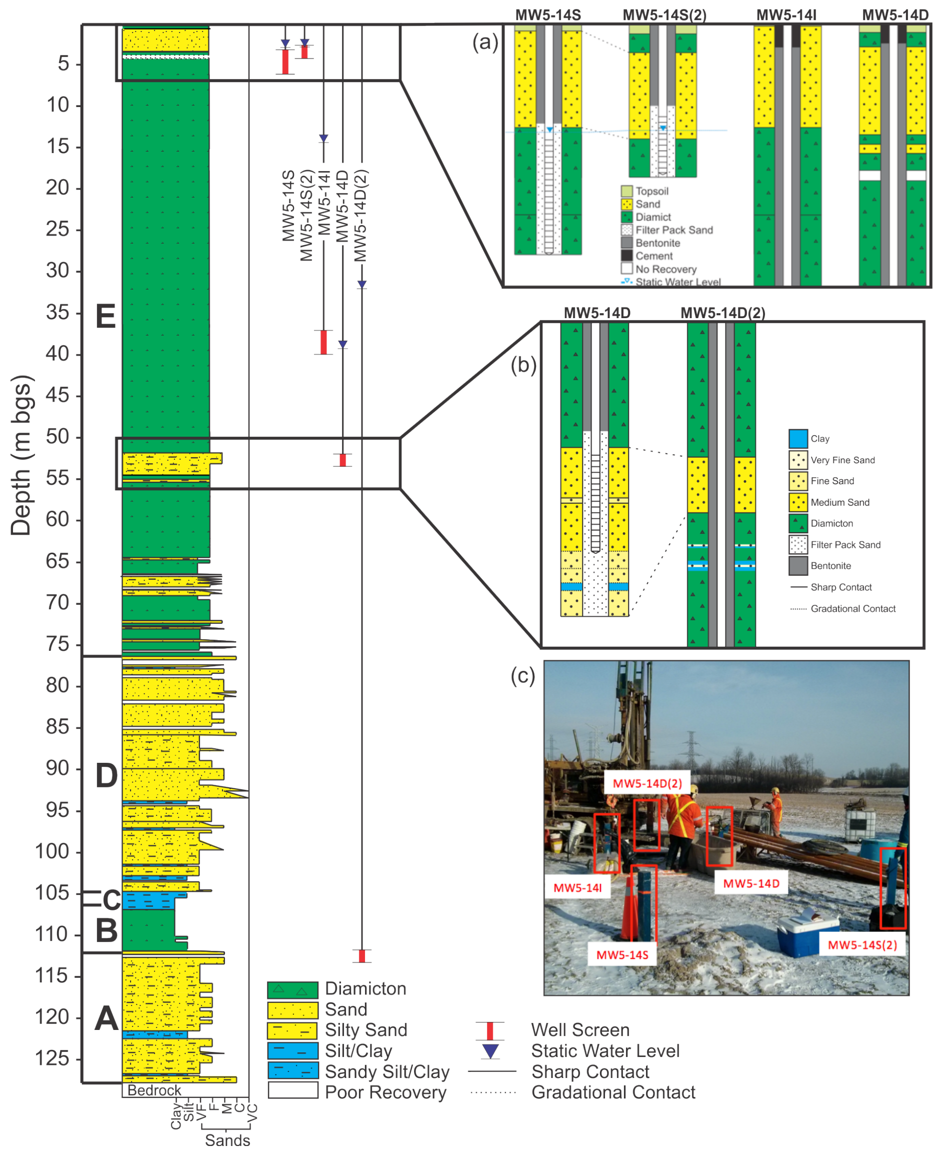

Figure 19: A detailed composite lithological log constructed from the Clarington borehole sediment core with expanded insets of the lateral correlation of sand beds encountered within the thick diamicton package (E): a shallow sand bed found between 0.67-2.94 m bgs (a); and a deep sand bed found between 52.31-54.99 m bgs (b). Inset (c) displays the MW5-14 monitoring well cluster showing the close proximity (meter scale) of these wells.

Figure 20: Lithological descriptions and results of moisture content (MC) by mass accompany sample locations (MC-##) in the first five core runs. The moisture content of the diamicton units are below 10%, which is consistent with Newmarket Till (Sharpe and Russell, 2016). Note: the static water levels in the shallow water table well, MW5-14S(2), is 2.82 m bgs, therefore it is assumed that the diamicton samples are saturated samples.

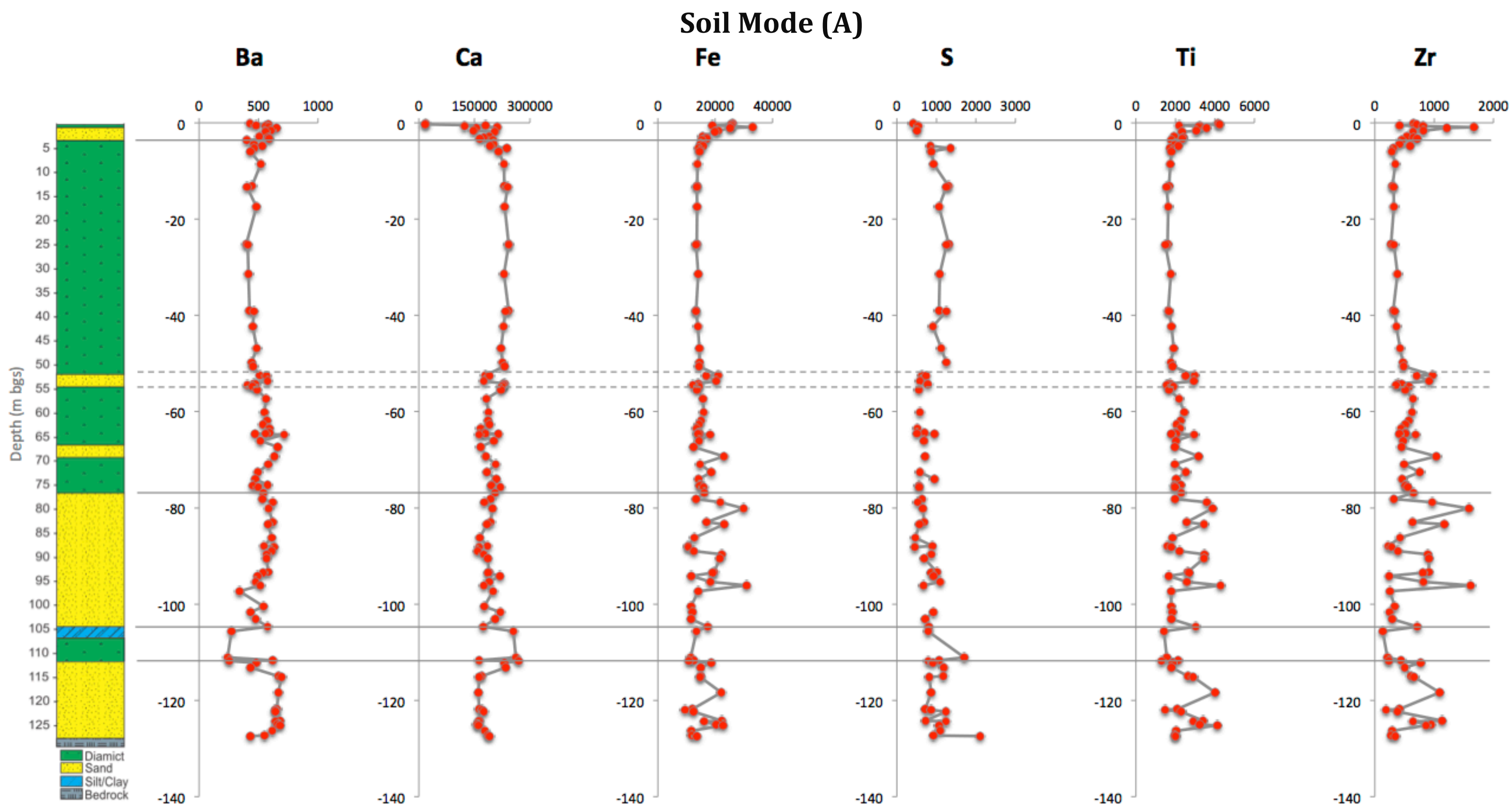

Figure 21: Selected results from the p-XRF analysis conducted in Soil Mode (A). Of note are the consistent changes in elemental concentration within the diamicton and silt sediments found between 107 – 112 m bgs and the sand bed within the uppermost diamicton found between 52.3 – 55.0 m bgs compared to surrounding sediments.

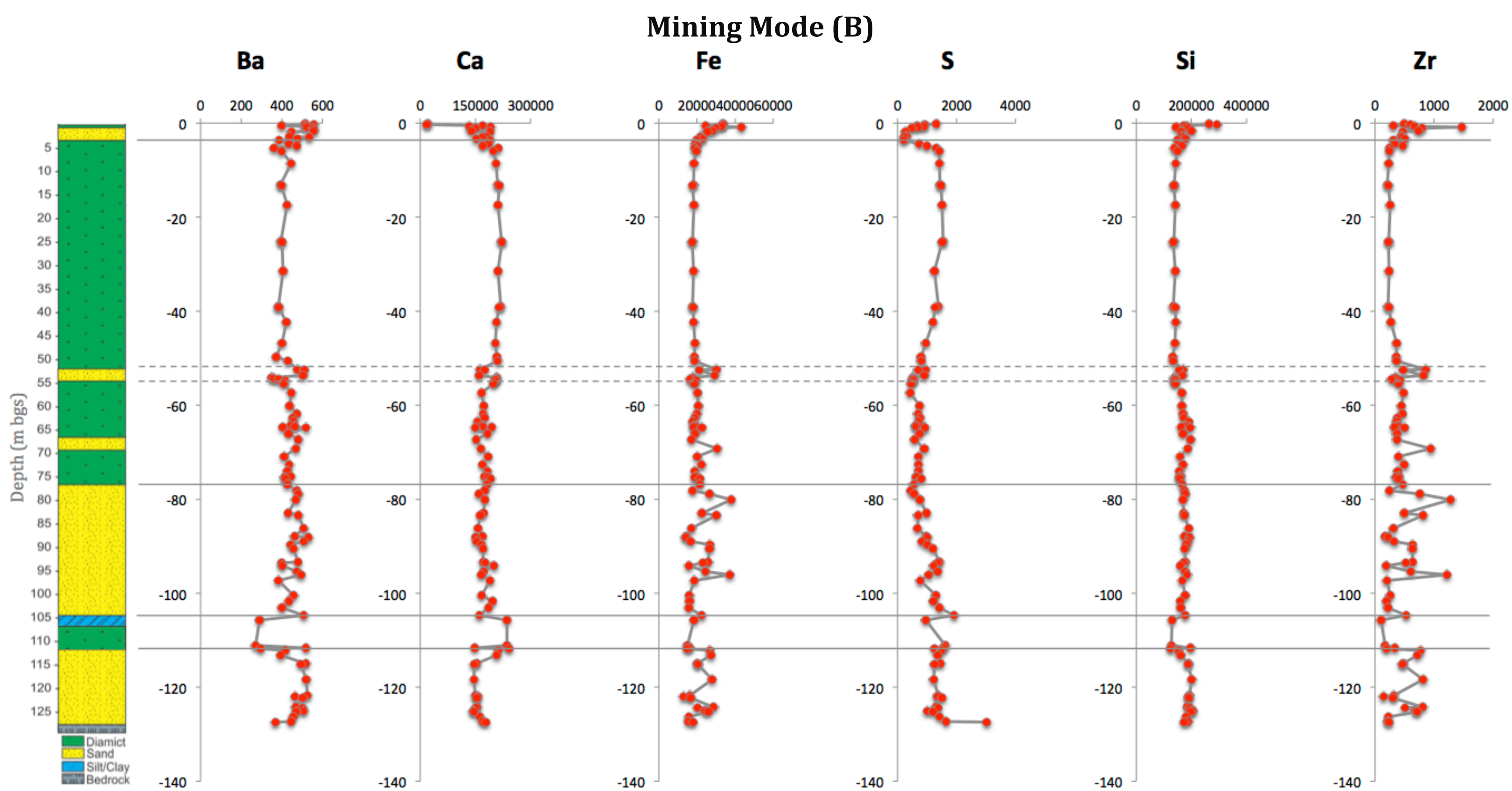

Figure 22: Selected results from the p-XRF analysis conducted in Mining Mode (B). Of note are the consistent changes in elemental concentration within the diamicton and silt sediments found between 107 – 112 m bgs and the sand bed within the uppermost diamicton found between 52.3 – 55.0 m bgs compared to surrounding sediments.

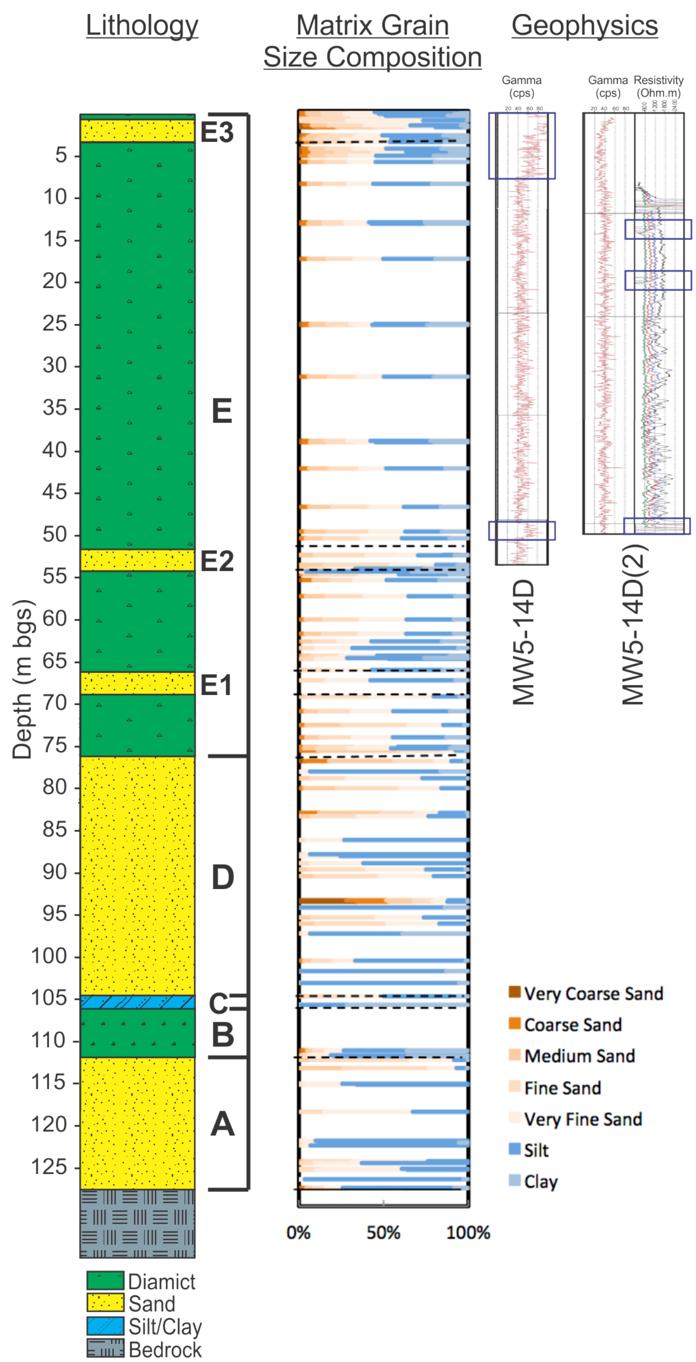

Figure 23: Percent sand, silt, and clay for the grain size fraction <2 mm. The uppermost diamicton (E) displays a relatively consistent composition of matrix grain size, while the underlying sediments display relatively more variation.

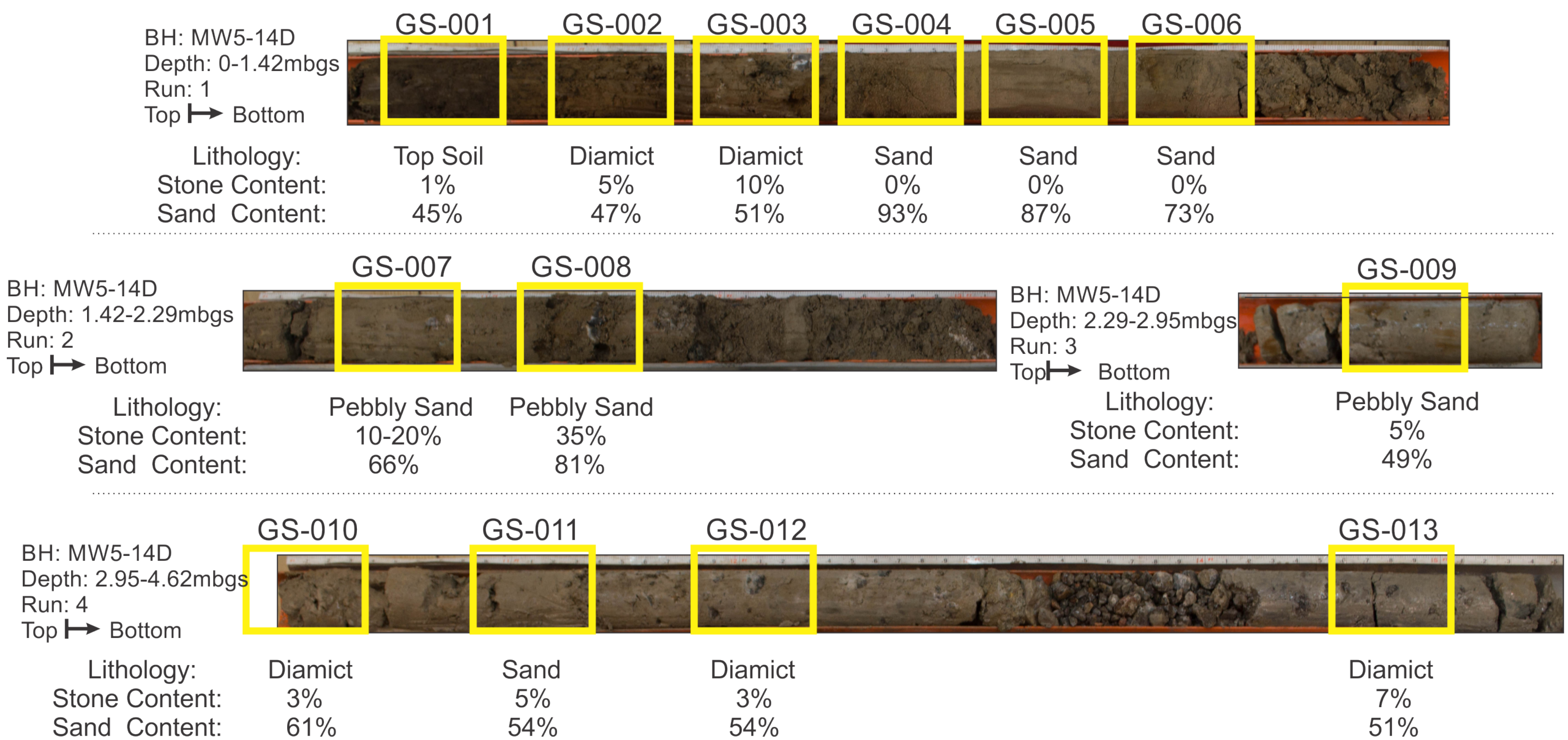

Figure 24: Lithological descriptions and grain size distribution values accompany sample locations (GS-##) in the first four core runs. The high gravel estimates (stone content) (5-15%) and high sand content (>37%) within the diamicton samples are consistent with Newmarket Till (Sharpe and Russell, 2016).

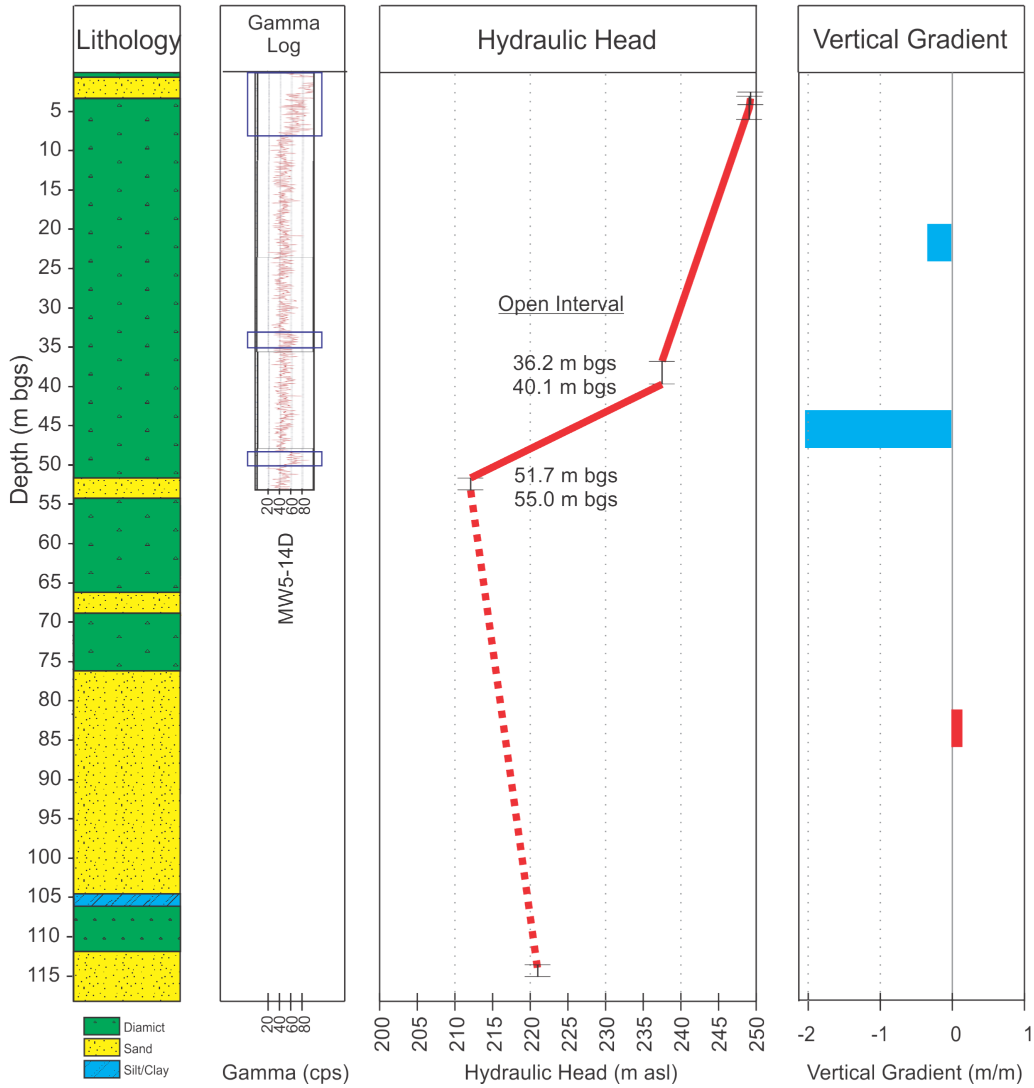

Figure 25: Water levels collected in October of 2015 by Stantec (solid line) in the four shallowest monitoring intervals at the MW5-14 well cluster. The water level of the deepest monitoring interval, MW5-14D(2), was obtained in January of 2015 (dashed line). A more current water level has not been reported. The vertical component of the hydraulic gradient was calculated as the change in hydraulic head (237.86 – 212.28 masl) over the distance between the bottom of the upper well screen to the top of the lower well screen.

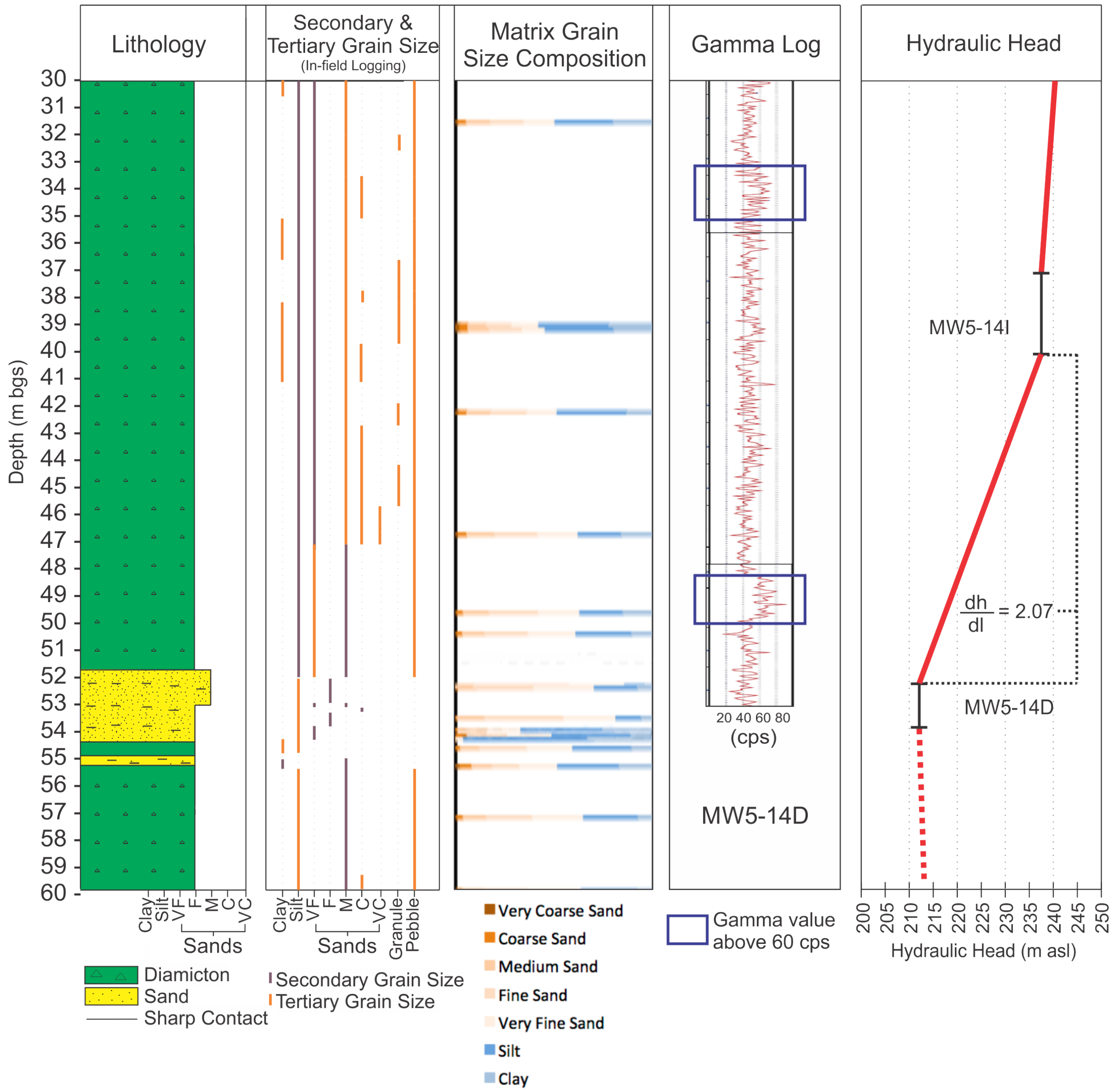

Figure 26: Vertical profiles of lithology, secondary and tertiary grain size characteristics identified during field logging, matrix grain size composition, and gamma across the zone with an identified hydraulic head gradient of 2.07 m/m within the conventional well cluster. A relative increase in gamma is observed in the lower portion of this zone, which may indicate a lower K_v zone across which the hydraulic head differential is occurring.

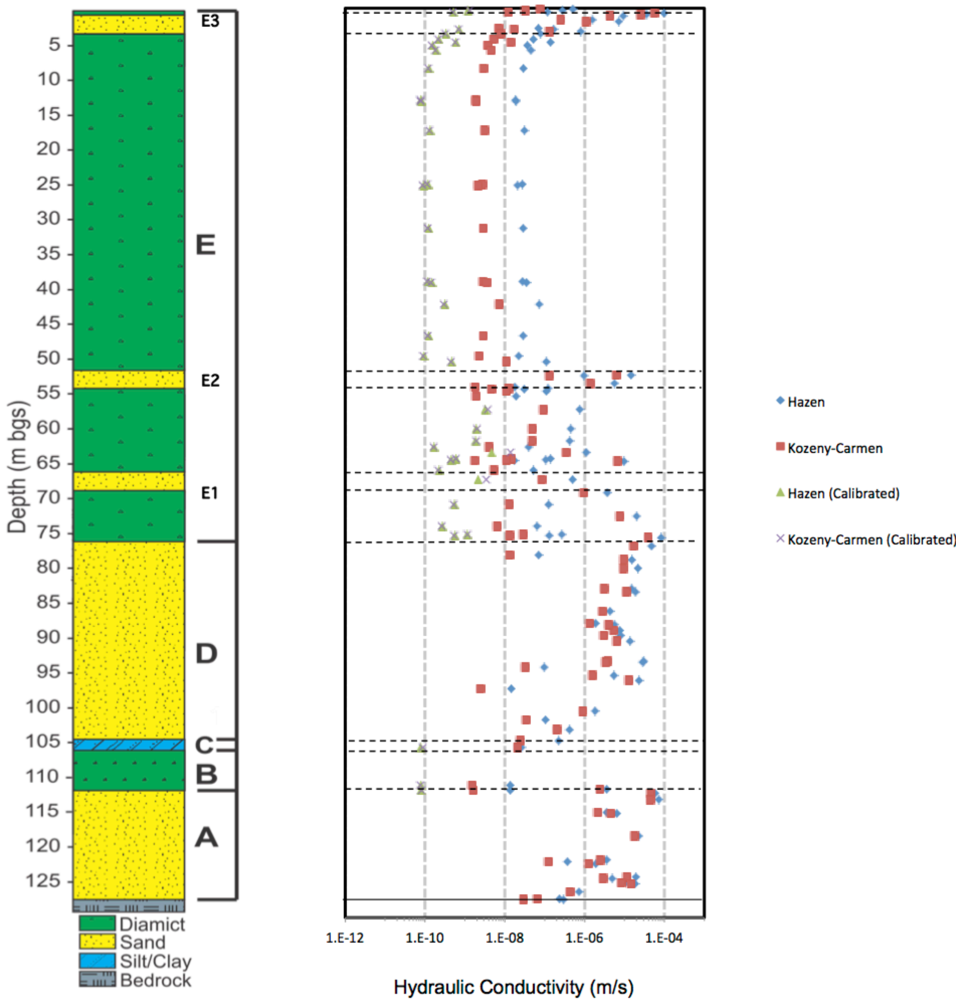

Figure 27: Hydraulic conductivity estimated from grain size using Hazen and Kozeny-Carmen (Batu, 1998; Freeze and Cherry, 1979; Rosas et al., 2014). Un-calibrated and calibrated values are plotted, where available. The calculated K_{sat} of a single sample varies over 2 orders of magnitude between the two empirical grain size methods (Table A4). The calculated values differ more for the samples identified during field logging as diamicton sediments, with the Kozeny-Carmen equation generally producing lower values than the Hazen equation. The two methods agree more strongly for samples identified as sand or silt.

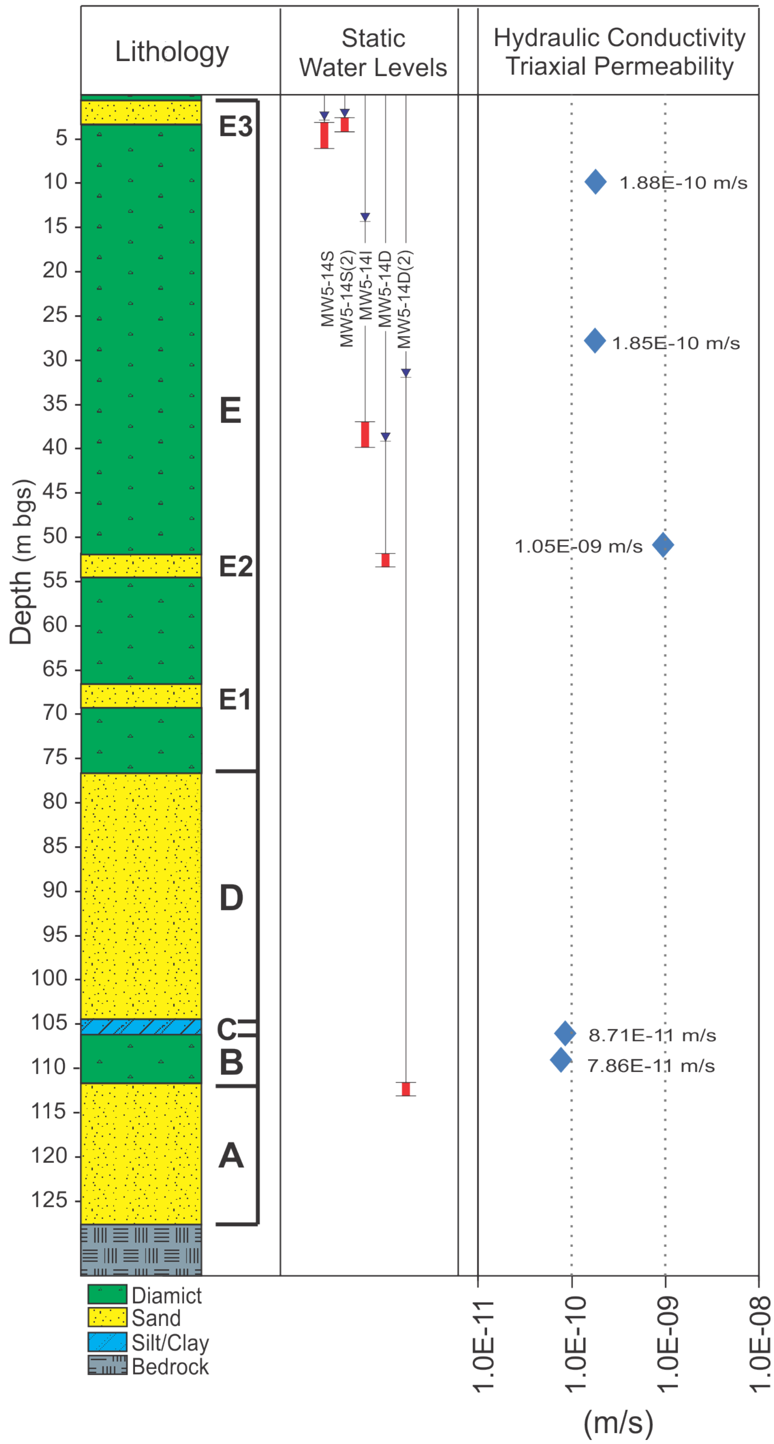

Figure 28: Triaxial permeability results for samples collected in the Clarington borehole.

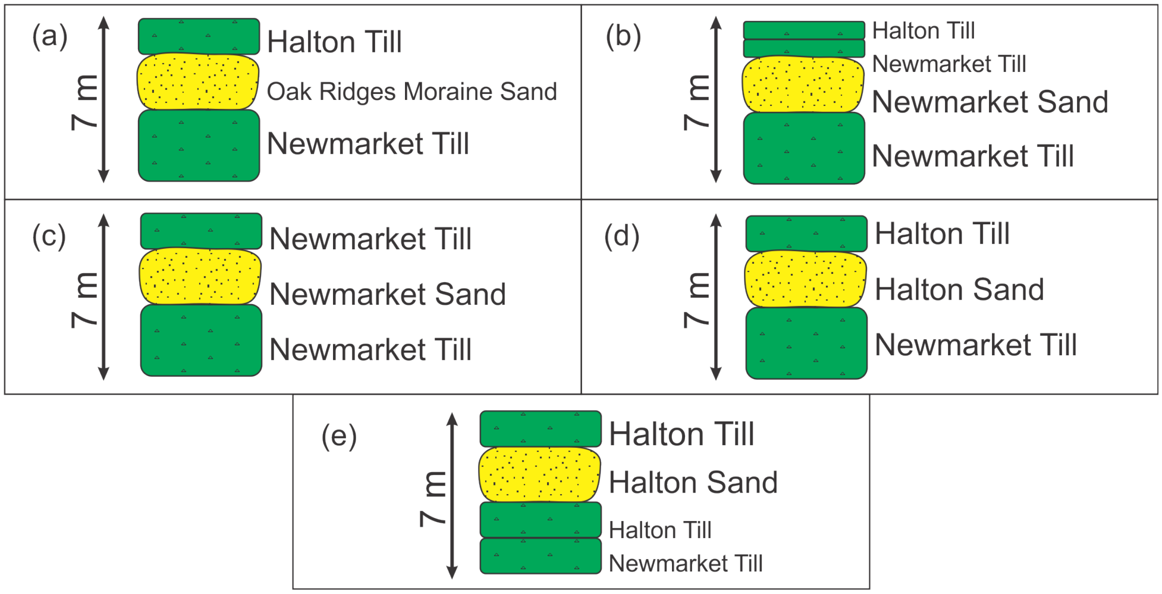

Figure 29: Five conceptual models were hypothesized for the near-surface sediments (Late Wisconsinan) present at the field site: (a) Halton Till at surface with ORM sand and Newmarket Till below; (b) Halton Till directly overlying Newmarket Till with an interbedded sand within the Newmarket Till; (c) Newmarket Till at surface with an interbedded sand; (d) Halton sand separating Halton Till above and Newmarket Till below; or (e) Halton Till containing a sand interbed with Newmarket Till below.

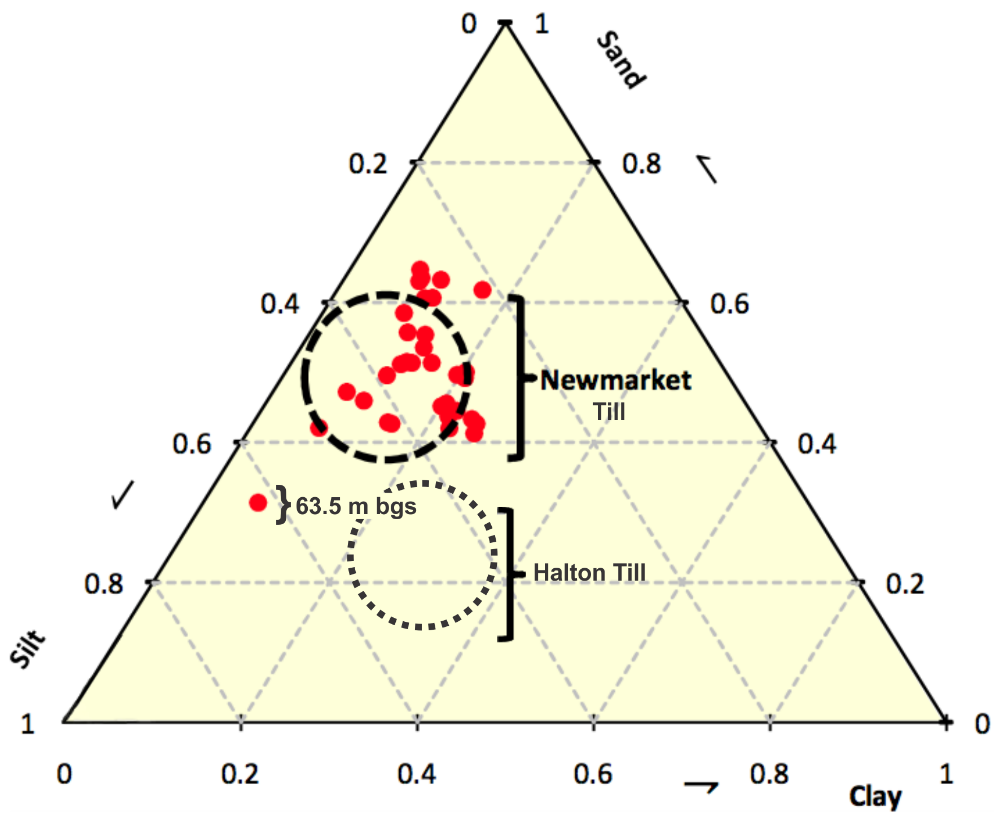

Figure 30: Ternary Diagram of the matrix composition of the diamicton samples from the Clarington borehole. This plot compares the grain size samples from all diamicton samples from MW5-14D and MW5-14D(2) between 0-77 m bgs to the generalized grain size plots of the Newmarket Till (dashed circle) and Halton Till (dotted circle) as drawn by Sharpe and Russell (2016). The dashed circle represents the generalized grain-size plots of the Newmarket Till from Sharpe and Russell (2016) based on >700 sample analyses. The dotted circle represents the generalized grain-size plot of the Halton Till from Sharpe and Russell (2016) based on >275 sample analyses. While the anomalous point falling outside of the generalized Newmarket till composition is more consistent with Halton Till, it is found at 63.5 m bgs and thus cannot be of Halton origin.

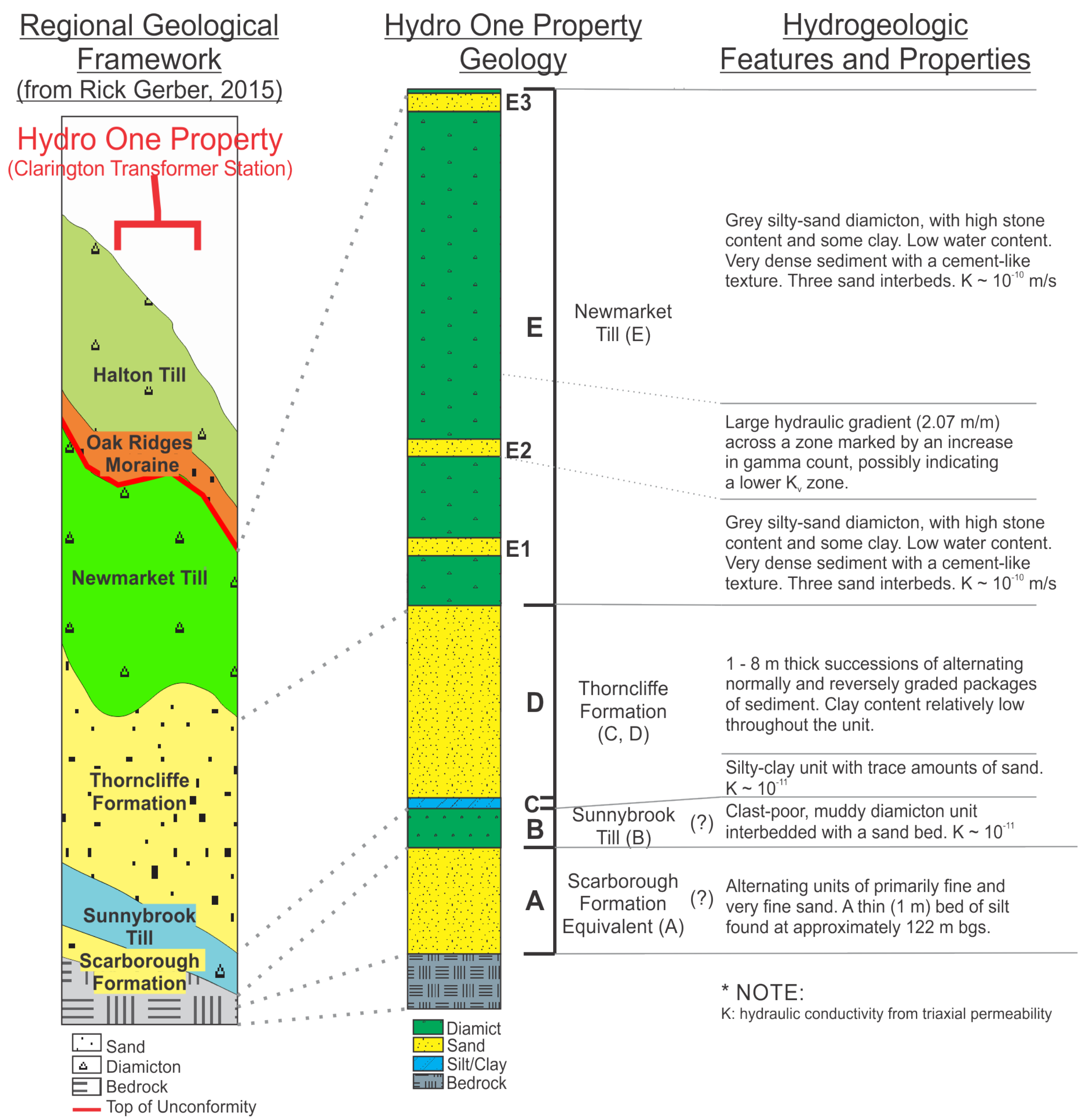

Figure 31: Stratigraphy and hydrogeological features identified in this study at the Clarington Transformer site compared to the regional geological framework interpreted by Dr. Rick Gerber (Figure 5; R. Gerber, written communication, 2015).

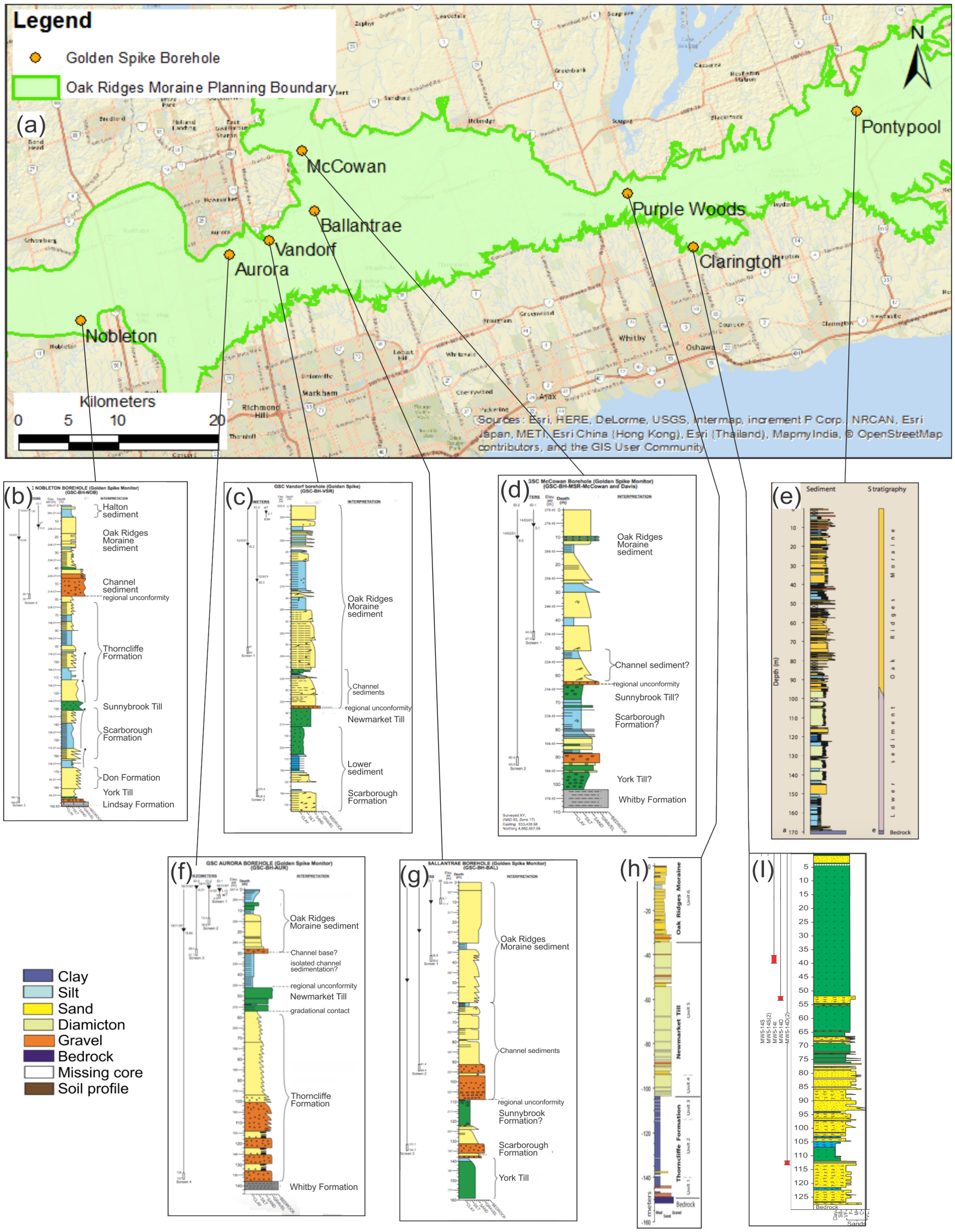

Figure 32: Locations and lithological logs of eight high-quality "Golden Spike" boreholes on the Oak Ridges Moraie,. Halton Till and ORM sediments are absent

from the Clarington borehole (i), which contains a thick sequence of Newmarket Till and Lower sediments. The remaining boreholes contain large percentages of ORM sediment and may or may not contain Newmarket Till and Lower sediments. Logs modified from Knight *et al.,* 2016b (h); Russell *et al.,* 2003b (e); Sharpe *et al.,* 2003 (b, c, d, f, g).

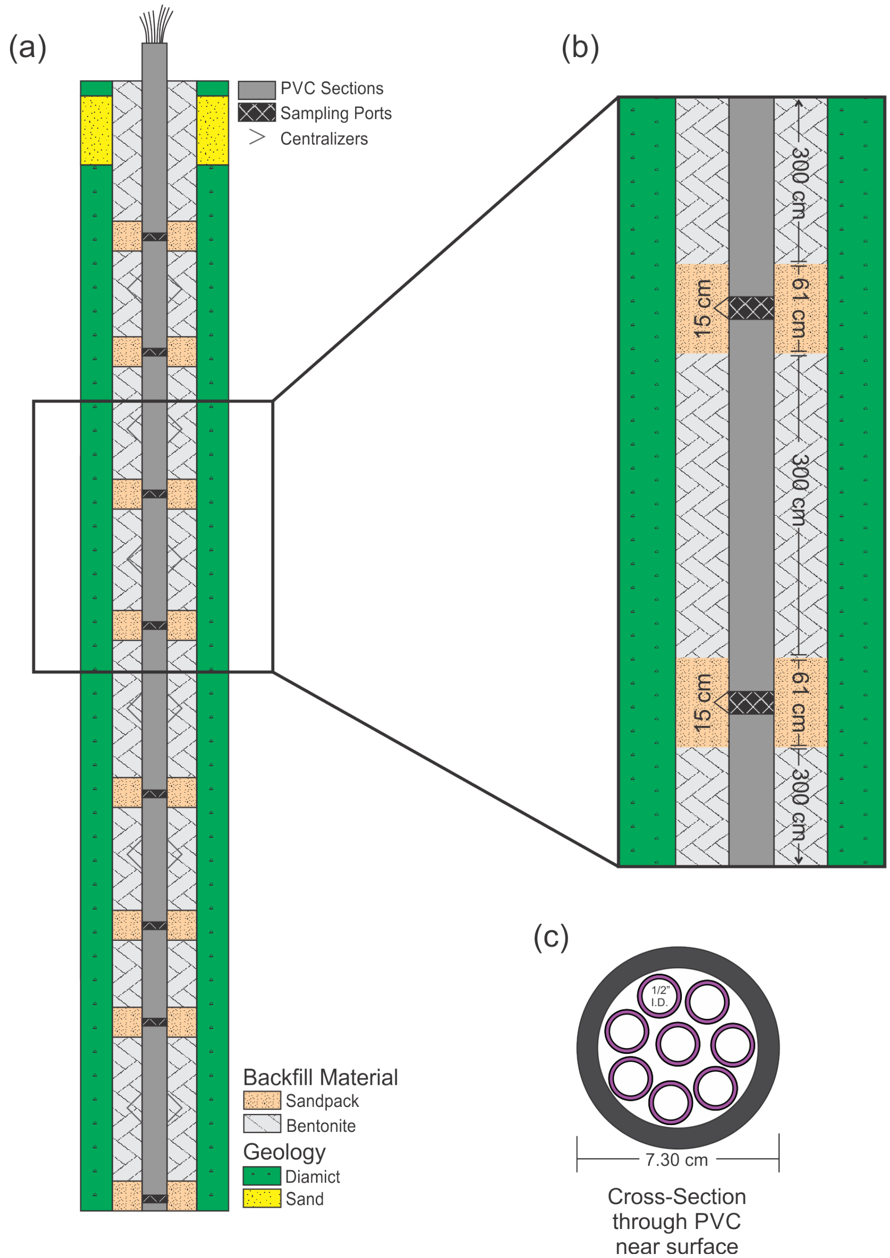

Figure 33: Schematic representation of the preliminary design of the shallow G360 MLS (not to scale). (A) 8 port system with monitoring intervals at different depths to monitor various geologic features (diamict, sand, etc.); (B) sand packs and bentonite seals form monitoring intervals; and (C) cross section through PVC near surface shows a bundle of 8 monitoring tubes inside a 65 mm inner diameter casing.

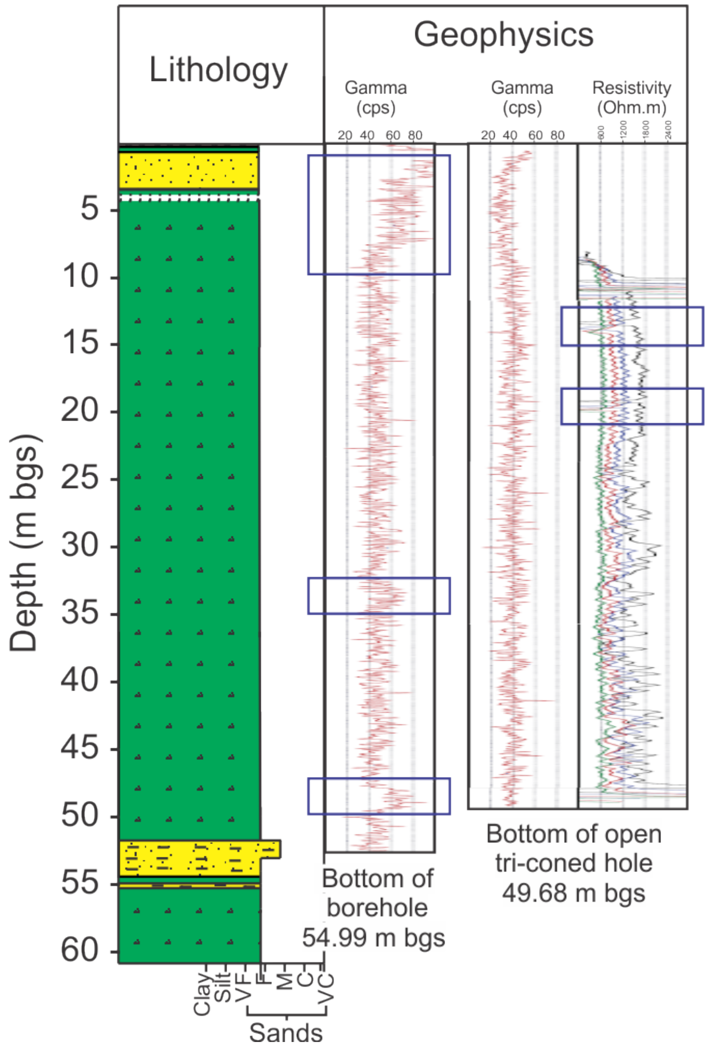

Figure 34: Gamma and electrical resistivity logs for the Clarington borehole, highlighting inflections in the dataset. Geophysical logs extracted from Stantec, 2015.

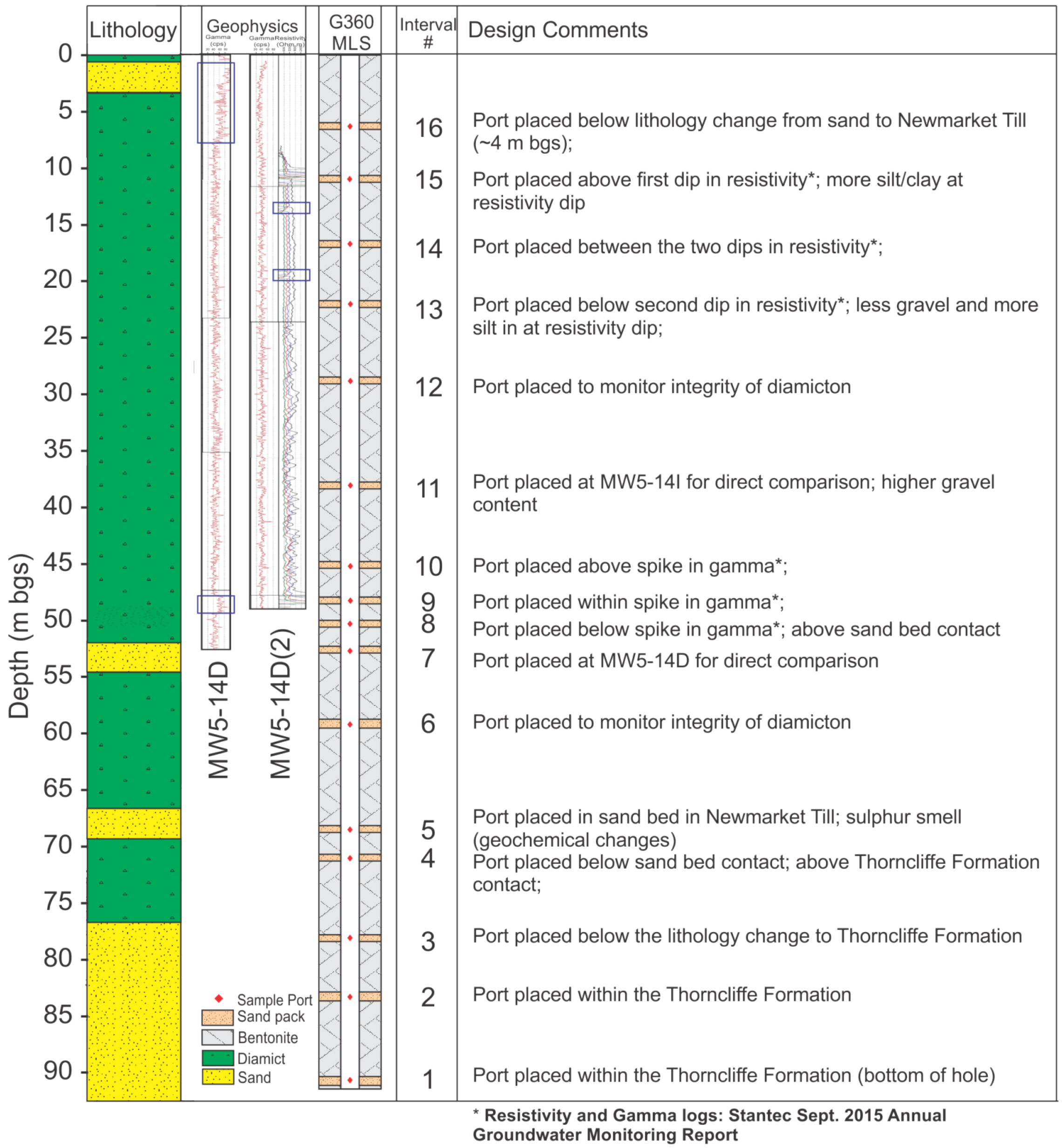

Figure 35: Proposed Multilevel design for the CTS and rationale for the placement of each of the monitoring ports based on geological, hydraulic, and geophysical data collected in the deep Clarington borehole and associated conventional well cluster (Chapter 2). The shallow (ports 9-16) and deep (ports 1-8) G360 MLSs are shown here as one monitoring site.

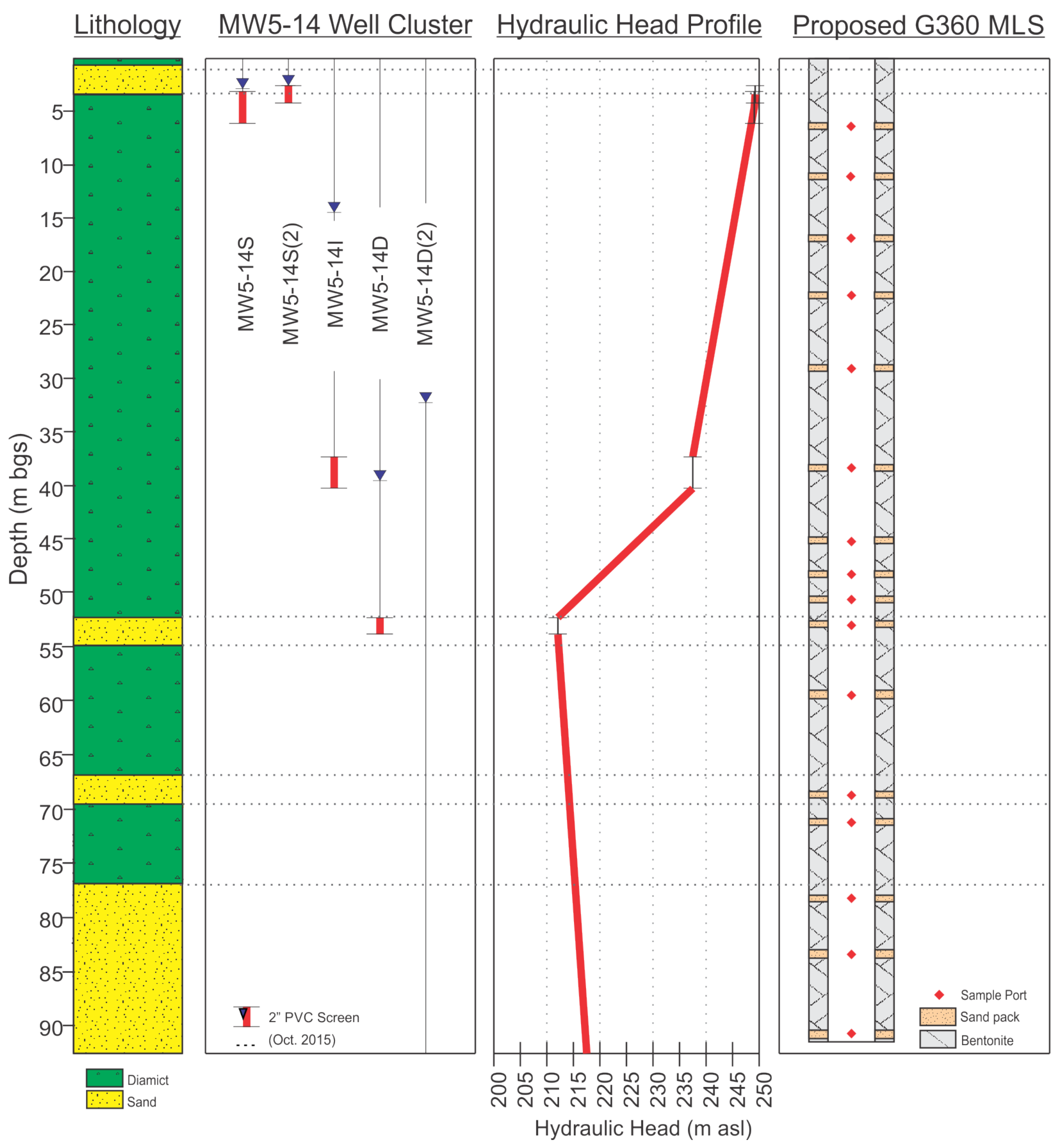

Figure 36: A comparison of the MW5-14 conventional well cluster with 5 monitoring zones to a co-located pair of multilevel systems. The MLSs provide 16 depth-discrete monitoring zones within two boreholes.

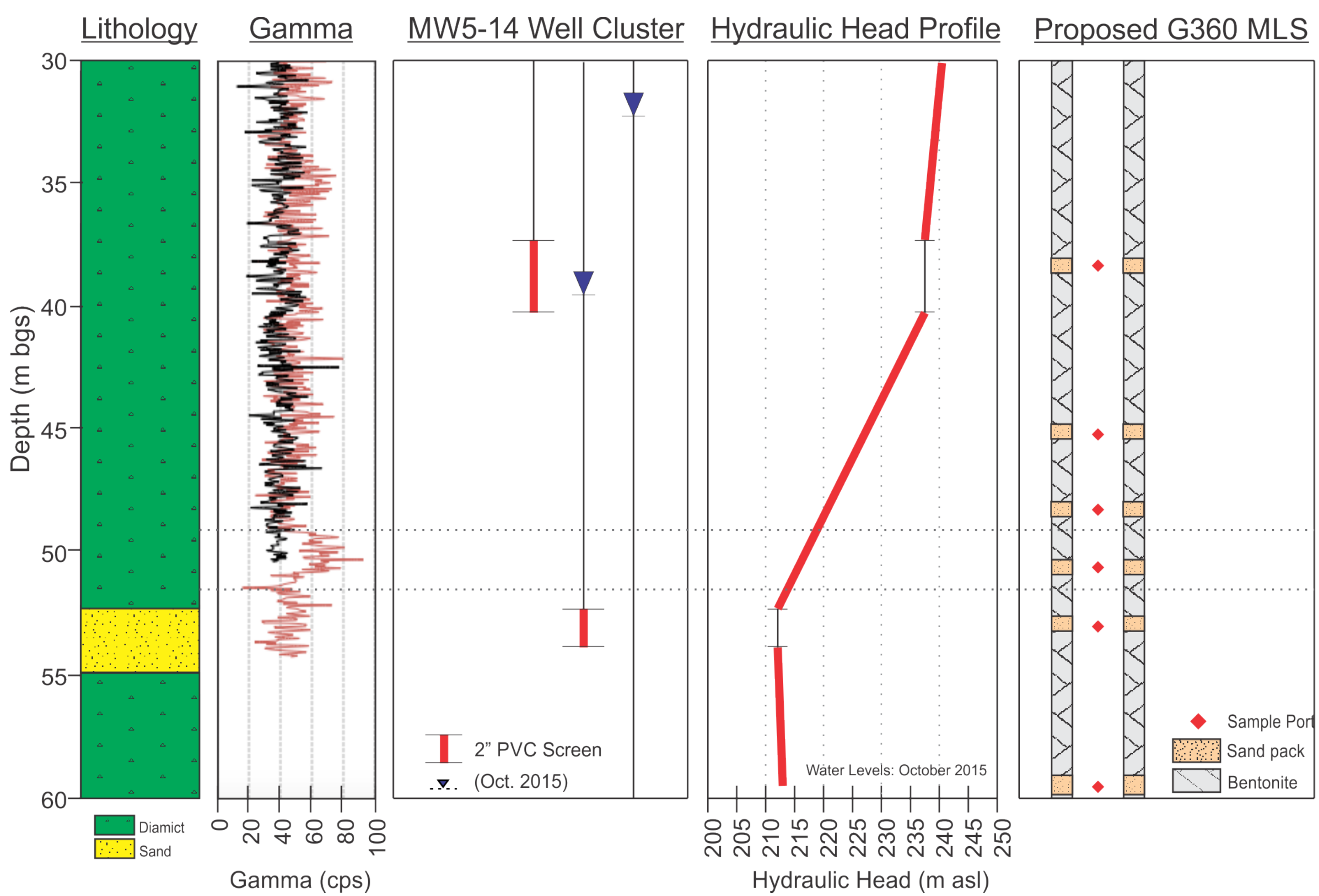

Figure 37: An expanded view of the multilevel system (MLS) ports across the zone with a large hydraulic gradient (2.07 m/m) and an associated gamma spike. Six ports have been placed to observe the drop across this distance.

6.0 References

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Appendix A

Data tables

Table A1: Percent recovery of sediment cores obtained at MW5-14 by mud-rotary drilling methods in November and December of 2014.

Percent Recovery						
Borehole ID	**Run #**	**Top Depth (m bgs)**	**Bottom Depth (m bgs)**	**Top Depth (masl)**	**Bottom Depth (masl)**	**Percent Recovery**
MW5-14D	1	0.00	1.43	252.44	251.01	93.48
MW5-14D	2	1.43	2.29	251.01	250.15	112.30
MW5-14D	3	2.29	2.94	250.15	249.50	100.31
MW5-14D	4	2.94	4.62	249.50	247.82	99.09
MW5-14D	5	4.62	6.25	247.82	246.19	96.82
MW5-14D	6	6.25	7.72	246.19	244.72	105.18
MW5-14D	7	7.72	9.24	244.72	243.20	100.00
MW5-14D	8	9.24	10.77	243.20	241.67	100.00
MW5-14D	9	10.77	12.29	241.67	240.15	100.00
MW5-14D	10	12.29	13.82	240.15	238.62	100.00
MW5-14D	11	13.82	15.34	238.62	237.10	97.50
MW5-14D	12	15.34	16.86	237.10	235.58	97.50
MW5-14D	13	16.86	18.39	235.58	234.05	100.00
MW5-14D	14	18.39	19.91	234.05	232.53	100.00
MW5-14D	15	19.91	21.44	232.53	231.00	99.16
MW5-14D	16	21.44	22.96	231.00	229.48	100.00
MW5-14D	17	22.96	24.48	229.48	227.96	100.00
MW5-14D	18	24.48	26.01	227.96	226.43	96.67
MW5-14D	19	26.01	27.53	226.43	224.91	99.17
MW5-14D	20	27.53	29.06	224.91	223.38	98.33
MW5-14D	21	29.06	30.58	223.38	221.86	101.67
MW5-14D	22	30.58	32.10	221.86	220.34	100.00
MW5-14D	23	32.10	33.63	220.34	218.81	100.00
MW5-14D	24	33.63	35.15	218.81	217.29	101.67
MW5-14D	25	35.15	36.68	217.29	215.76	98.33
MW5-14D	26	36.68	38.20	215.76	214.24	105.00
MW5-14D	27	38.20	39.72	214.24	212.72	95.00
MW5-14D	28	39.72	41.25	212.72	211.19	91.67
MW5-14D	29	41.25	42.77	211.19	209.67	106.67
MW5-14D	30	42.77	44.30	209.67	208.14	103.33
MW5-14D	31	44.30	45.82	208.14	206.62	100.00
MW5-14D	32	45.82	47.37	206.62	205.07	93.50
MW5-14D	33	47.37	48.89	205.07	203.55	108.33

Percent Recovery						
Borehole ID	**Run #**	**Top Depth (m bgs)**	**Bottom Depth (m bgs)**	**Top Depth (masl)**	**Bottom Depth (masl)**	**Percent Recovery**
MW5-14D	34	48.89	50.42	203.55	202.02	88.33
MW5-14D	35	50.42	51.94	202.02	200.50	100.00
MW5-14D	36	51.94	53.46	200.50	198.98	101.67
MW5-14D	37	53.46	54.99	198.98	197.45	97.50
MW5-14D(2)	1	49.78	50.29	202.66	202.15	134.73
MW5-14D(2)	2	50.29	51.82	202.15	200.62	100.00
MW5-14D(2)	3	51.82	53.34	200.62	199.10	97.50
MW5-14D(2)	4	53.34	53.67	199.10	198.77	100.31
MW5-14D(2)	5	53.67	54.86	198.77	197.58	93.54
MW5-14D(2)	6	54.86	56.39	197.58	196.05	94.17
MW5-14D(2)	7	56.39	57.91	196.05	194.53	86.67
MW5-14D(2)	8	57.91	59.44	194.53	193.00	101.67
MW5-14D(2)	9	59.44	60.96	193.00	191.48	100.00
MW5-14D(2)	10	60.96	62.48	191.48	189.96	93.33
MW5-14D(2)	11	62.48	64.01	189.96	188.43	90.83
MW5-14D(2)	12	64.01	65.53	188.43	186.91	88.33
MW5-14D(2)	13	65.53	67.06	186.91	185.38	81.67
MW5-14D(2)	14	67.06	68.58	185.38	183.86	80.83
MW5-14D(2)	15	68.58	70.10	183.86	182.34	95.00
MW5-14D(2)	16	70.10	71.63	182.34	180.81	98.33
MW5-14D(2)	17	71.63	73.15	180.81	179.29	94.17
MW5-14D(2)	18	73.15	74.68	179.29	177.76	93.33
MW5-14D(2)	19	74.68	76.20	177.76	176.24	81.67
MW5-14D(2)	20	76.20	77.72	176.24	174.72	57.50
MW5-14D(2)	21	77.72	79.25	174.72	173.19	80.83
MW5-14D(2)	22	79.25	80.77	173.19	171.67	90.83
MW5-14D(2)	23	80.77	82.30	171.67	170.14	80.00
MW5-14D(2)	24	82.30	83.82	170.14	168.62	100.00
MW5-14D(2)	25	83.82	85.34	168.62	167.10	80.00
MW5-14D(2)	26	85.34	86.87	167.10	165.57	88.33
MW5-14D(2)	27	86.87	88.39	165.57	164.05	91.67
MW5-14D(2)	28	88.39	89.92	164.05	162.52	101.67
MW5-14D(2)	29	89.92	91.44	162.52	161.00	96.67
MW5-14D(2)	30	91.44	92.96	161.00	159.48	97.50

Percent Recovery						
Borehole ID	**Run #**	**Top Depth (m bgs)**	**Bottom Depth (m bgs)**	**Top Depth (masl)**	**Bottom Depth (masl)**	**Percent Recovery**
MW5-14D(2)	31	92.96	94.49	159.48	157.95	91.67
MW5-14D(2)	32	94.49	96.01	157.95	156.43	91.67
MW5-14D(2)	33	96.01	97.54	156.43	154.90	96.67
MW5-14D(2)	34	97.54	99.06	154.90	153.38	98.33
MW5-14D(2)	35	99.06	100.58	153.38	151.86	99.17
MW5-14D(2)	36	100.58	102.11	151.86	150.33	100.00
MW5-14D(2)	37	102.11	103.63	150.33	148.81	91.67
MW5-14D(2)	38	103.63	105.16	148.81	147.28	90.00
MW5-14D(2)	39	105.16	106.68	147.28	145.76	95.00
MW5-14D(2)	40	106.68	108.20	145.76	144.24	98.33
MW5-14D(2)	41	108.20	109.73	144.24	142.71	115.00
MW5-14D(2)	42	109.73	111.25	142.71	141.19	106.67
MW5-14D(2)	43	111.25	112.78	141.19	139.66	74.17
MW5-14D(2)	44	112.78	114.30	139.66	138.14	91.67
MW5-14D(2)	45	114.30	115.82	138.14	136.62	91.67
MW5-14D(2)	46	115.82	117.35	136.62	135.09	97.50
MW5-14D(2)	47	117.35	118.87	135.09	133.57	100.00
MW5-14D(2)	48	118.87	120.40	133.57	132.04	95.00
MW5-14D(2)	49	120.40	121.92	132.04	130.52	107.50
MW5-14D(2)	50	121.92	123.44	130.52	129.00	100.00
MW5-14D(2)	51	123.44	124.97	129.00	127.47	99.17
MW5-14D(2)	52	124.97	126.49	127.47	125.95	96.67
MW5-14D(2)	53	126.49	128.02	125.95	124.42	101.67
MW5-14D(2)	54	128.02	129.54	124.42	122.90	102.50

Table A2: Moisture content by mass for samples obtained in November and December of 2014. Samples were analysed by Stantec in Markham, ON.

Moisture Content Samples						
Sample ID	**Run #**	**Depth (m bgs)**	**Depth (masl)**	**θ (%)**	**n (%)**	**Material Description**
MW5-14D-MC-001	1	1.01	251.43	21.1	36.2	Fine Sand
MW5-14D-MC-002	3	2.67	249.77	10	21.2	Very Fine Sand
MW5-14D-MC-003	4	4.35	248.09	6.8	15.5	Diamicton
MW5-14D-MC-004	5	5.90	246.54	5.6	13.1	Diamicton
MW5-14D-MC-005	6	7.54	244.90	5.7	13.3	Diamicton
MW5-14D-MC-006	7	8.97	243.47	5.9	13.7	Diamicton
MW5-14D-MC-007	8	10.62	241.82	6.8	15.5	Diamicton
MW5-14D-MC-008	9	12.02	240.42	6.5	14.9	Diamicton
MW5-14D-MC-009	10	13.53	238.91	7.4	16.6	Diamicton
MW5-14D-MC-010	11	15.01	237.43	6	13.9	Diamicton
MW5-14D-MC-011	12	16.56	235.88	6.1	14.1	Diamicton
MW5-14D-MC-012	13	18.11	234.33	7.6	17.0	Diamicton
MW5-14D-MC-013	14	19.62	232.82	7.5	16.8	Diamicton
MW5-14D-MC-014	15	20.67	231.77	7	15.8	Diamicton
MW5-14D-MC-015	16	22.69	229.75	6.9	15.7	Diamicton
MW5-14D-MC-016	17	24.20	228.24	4.6	11.0	Diamicton
MW5-14D-MC-017	18	25.64	226.80	5.8	13.5	Diamicton
MW5-14D-MC-018	19	27.29	225.15	6.6	15.1	Diamicton
MW5-14D-MC-019	20	28.72	223.72	6.8	15.5	Diamicton
MW5-14D-MC-020	21	29.91	222.53	6.8	15.5	Diamicton
MW5-14D-MC-021	22	31.71	220.73	6.9	15.7	Diamicton
MW5-14D-MC-022	23	33.29	219.15	7	15.8	Diamicton
MW5-14D-MC-023	24	34.88	217.56	7.2	16.2	Diamicton
MW5-14D-MC-024	25	36.34	216.10	7.3	16.4	Diamicton
MW5-14D-MC-025	26	37.97	214.47	7.3	16.4	Diamicton
MW5-14D-MC-026	27	39.35	213.09	7.7	17.2	Diamicton
MW5-14D-MC-027	28	40.72	211.72	7.2	16.2	Diamicton
MW5-14D-MC-028	29	42.47	209.97	5.4	12.7	Diamicton
MW5-14D-MC-029	30	43.99	208.45	6.4	14.7	Diamicton
MW5-14D-MC-030	31	45.50	206.94	7.2	16.2	Diamicton
MW5-14D-MC-031	32	46.95	205.49	7.4	16.6	Diamicton

Moisture Content Samples						
Sample ID	**Run #**	**Depth (m bgs)**	**Depth (masl)**	**θ (%)**	**n (%)**	**Material Description**
MW5-14D-MC-032	33	48.74	203.70	9.1	19.7	Diamicton
MW5-14D-MC-033	34	49.96	202.48	9.2	19.8	Diamicton
MW5-14D-MC-034	35	51.58	200.86	9.6	20.5	Diamicton
MW5-14D-MC-035	36	53.06	199.38	19	33.8	Medium Sand
MW5-14D-MC-036	37	54.61	197.83	12.7	25.5	Fine Sand
MW5-14D(2)-MC-037	2	51.45	200.99	9.5	20.4	Diamicton
MW5-14D(2)-MC-038	5	54.52	197.92	14.3	27.8	Diamicton
MW5-14D(2)-MC-039	8	59.15	193.29	10.7	22.3	Diamicton
MW5-14D(2)-MC-040	9	60.66	191.78	11	22.8	Diamicton
MW5-14D(2)-MC-041	10	62.07	190.37	10.7	22.3	Diamicton
MW5-14D(2)-MC-042	11	63.55	188.89	20.5	35.5	Diamicton
MW5-14D(2)-MC-043	12	64.88	187.56	20.1	35.1	Very Fine Sand
MW5-14D(2)-MC-044	13	66.46	185.98	15.4	29.3	Diamicton
MW5-14D(2)-MC-045	14	68.03	184.41	18.7	33.5	Fine Sand
MW5-14D(2)-MC-046	15	69.74	182.70	10.3	21.7	Diamicton
MW5-14D(2)-MC-047	16	71.20	181.24	8.1	17.9	Diamicton
MW5-14D(2)-MC-048	17	72.71	179.73	17.4	31.9	Medium Sand
MW5-14D(2)-MC-049	18	74.25	178.19	8.2	18.1	Diamicton
MW5-14D(2)-MC-050	19	75.54	176.90	8.6	18.8	Diamicton
MW5-14D(2)-MC-051	22	80.31	172.13	15.5	29.4	Fine Sand
MW5-14D(2)-MC-052	23	81.66	170.78	14	27.4	Fine Sand
MW5-14D(2)-MC-053	24	83.45	168.99	18.9	33.7	Fine Sand
MW5-14D(2)-MC-054	25	84.73	167.71	15.4	29.3	Fine Sand
MW5-14D(2)-MC-055	26	86.41	166.03	19.6	34.5	Very Fine Sand
MW5-14D(2)-MC-056	28	89.61	162.83	16.5	30.7	Very Fine Sand
MW5-14D(2)-MC-057	29	91.07	161.37	16.5	30.7	Medium Sand
MW5-14D(2)-MC-058	30	92.57	159.87	14.7	28.3	Medium Sand
MW5-14D(2)-MC-059	31	94.09	158.35	17.8	32.4	Silt
MW5-14D(2)-MC-060	32	95.42	157.02	16	30.1	Fine Sand
MW5-14D(2)-MC-061	33	97.17	155.27	19.7	34.7	Silty Clay
MW5-14D(2)-MC-062	34	98.80	153.64	23.8	39.0	Fine Sand
MW5-14D(2)-MC-063	35	100.25	152.19	20.4	35.4	Fine Sand

Moisture Content Samples						
Sample ID	**Run #**	**Depth (m bgs)**	**Depth (masl)**	**θ (%)**	**n (%)**	**Material Description**
MW5-14D(2)-MC-064	36	101.71	150.73	19.2	34.1	Silt
MW5-14D(2)-MC-065	37	103.16	149.28	22.8	38.0	Clayey Silt
MW5-14D(2)-MC-066	38	104.68	147.76	18.6	33.3	Fine Sand
MW5-14D(2)-MC-067	39	106.33	146.11	17.4	31.9	Clay
MW5-14D(2)-MC-068	40	107.82	144.62	10.9	22.7	Diamicton
MW5-14D(2)-MC-069	41	109.47	142.97	9.7	20.7	Diamicton
MW5-14D(2)-MC-070	42	111.01	141.43	7.2	16.2	Diamicton
MW5-14D(2)-MC-071	43	112.12	140.32	21.4	36.5	Medium Sand
MW5-14D(2)-MC-072	44	113.92	138.52	21.6	36.8	Very Fine Sand
MW5-14D(2)-MC-073	45	115.40	137.04	20.8	35.9	Very Fine Sand
MW5-14D(2)-MC-074	46	117.03	135.41	21.9	37.1	Very Fine Sand
MW5-14D(2)-MC-075	47	118.51	133.93	23.9	39.1	Fine Sand
MW5-14D(2)-MC-076	48	119.98	132.46	20.6	35.7	Very Fine Sand
MW5-14D(2)-MC-077	49	121.68	130.76	20.5	35.5	Silt
MW5-14D(2)-MC-078	50	123.08	129.36	21.1	36.2	Fine Sand
MW5-14D(2)-MC-079	51	124.60	127.84	22.6	37.8	Fine Sand
MW5-14D(2)-MC-080	52	126.23	126.21	17.1	31.5	Very Fine Sand
MW5-14D(2)-MC-081	53	127.01	125.43	19	33.8	Very Fine Sand

Θ: Moisture content by mass
n: porosity

Table A3: Water levels reported by Stantec in the 2015 annual groundwater monitoring report. Gradients have been calculated from the reported static water levels.

Water Levels, Hydraulic Gradient						
Well ID	**Top of Well Screen**	**Bottom of Well Screen**	**Jan-16**	**Oct-15**	**Gradient - upward + downward**	
	(m bgs)	**(m bgs)**	**(masl)**	**(masl)**	**(m/m)**	
MW5-14S	3.1	6.1	--	249.72	--	--
MW5-14S(2)	2.48	4.00	--	249.78	S(2) to I	0.36
MW5-14I	37.10	40.1	--	237.86	I TO D	2.07
MW5-14D	52.43	53.95	212.94	212.28	D TO D(2)	-0.14
MW5-14D(2)	112.01	113.54	220.24	--		

-- Not reported
Source: Stantec Consulting Ltd., (2015a)

Table A4: Hydraulic conductivity values calculated with two emprirical grain size methods. Grain size distributions were analyzed by the Geologic Survey of Canada in Ottawa, ON.

Hydraulic Conductivity Calculated from Grain Size							
Grain Size Sample Number	**Material Description**	**d10 (um)**	**d60 (um)**	**Cu**	**n (-)**	**Hazen New (m/s)**	**Kozeny-Carmen (m/s)**
MW5-14D-GS-001	Top Soil	6.427	77	12.0	0.28	5.2E-07	7.5E-08
MW5-14D-GS-002	Diamicton	4.692	79	16.8	0.27	2.8E-07	3.2E-08
MW5-14D-GS-003	Diamicton	3.087	91	29.5	0.26	1.2E-07	1.2E-08
MW5-14D-GS-004	Sand	88.74	280	3.2	0.40	9.8E-05	5.6E-05
MW5-14D-GS-005	Sand	53.16	130	2.4	0.42	3.5E-05	2.5E-05
MW5-14D-GS-006-DUP	Sand	27.32	110	4.0	0.38	9.3E-06	4.2E-06
MW5-14D-GS-007	Pebbly Sand	11.19	120	10.7	0.29	1.6E-06	2.5E-07
MW5-14D-GS-008	Pebbly Sand	23.93	280	11.7	0.28	7.2E-06	1.1E-06
MW5-14D-GS-009	Sand	2.354	100	42.5	0.26	6.9E-08	6.9E-09
MW5-14D-GS-010	Diamicton	3.657	110	30.1	0.26	1.7E-07	1.7E-08
MW5-14D-GS-011	Pebbly Sand	8.042	87	10.8	0.29	8.1E-07	1.3E-07
MW5-14D-GS-012	Diamicton	2.503	98	39.2	0.26	7.8E-08	7.8E-09
MW5-14D-GS-013	Diamicton	2.037	96	47.1	0.26	5.2E-08	5.2E-09
MW5-14D-GS-014	Diamicton	3.335	130	39.0	0.26	1.4E-07	1.4E-08
MW5-14D-GS-015	Diamicton	1.704	81	47.5	0.26	3.6E-08	3.6E-09
MW5-14D-GS-016	Diamicton	1.889	79	41.8	0.26	4.5E-08	4.5E-09
MW5-14D-GS-017	Diamicton	1.534	74	48.2	0.26	2.9E-08	2.9E-09
MW5-14D-GS-018	Diamicton	1.217	66	54.2	0.26	1.9E-08	1.8E-09
MW5-14D-GS-019-DUP	Diamicton	1.23	71	57.7	0.26	1.9E-08	1.9E-09
MW5-14D-GS-020	Diamicton	1.581	93	58.8	0.26	3.1E-08	3.1E-09

Hydraulic Conductivity Calculated from Grain Size							
Grain Size Sample Number	Material Description	d10 (um)	d60 (um)	Cu	n (-)	Hazen New (m/s)	Kozeny-Carmen (m/s)
MW5-14D-GS-021	Diamicton	1.483	80	53.9	0.26	2.7E-08	2.7E-09
MW5-14D-GS-022-DUP	Diamicton	1.3	81	62.3	0.26	2.1E-08	2.1E-09
MW5-14D-GS-023	Diamicton	1.52	100	65.8	0.26	2.9E-08	2.9E-09
MW5-14D-GS-024	Diamicton	1.491	70	46.9	0.26	2.8E-08	2.8E-09
MW5-14D-GS-025-DUP	Diamicton	1.67	90	53.9	0.26	3.5E-08	3.5E-09
MW5-14D-GS-026	Diamicton	2.412	110	45.6	0.26	7.3E-08	7.3E-09
MW5-14D-GS-027	Diamicton	1.519	130	85.6	0.26	2.9E-08	2.9E-09
MW5-14D-GS-028	Diamicton	1.333	130	97.5	0.26	2.2E-08	2.2E-09
MW5-14D-GS-029	Sand	34.43	150	4.4	0.37	1.5E-05	6.2E-06
MW5-14D-GS-030	Sand	21.18	150	7.1	0.32	5.6E-06	1.4E-06
MW5-14D-GS-031	Sand	1.196	46	38.5	0.26	1.8E-08	1.8E-09
MW5-14D-GS-032	Silt/Clay	3.119	87	27.9	0.26	1.2E-07	1.2E-08
MW5-14D-GS-033	Sand	2.956	120	40.6	0.26	1.1E-07	1.1E-08
MW5-14D-GS-034	Sand	1.56	18	11.5	0.28	3.0E-08	4.6E-09
MW5-14D(2)-GS-035	Diamicton	2.952	120	40.7	0.26	1.1E-07	1.1E-08
MW5-14D(2)-GS-036	Sand	8.833	120	13.6	0.28	9.8E-07	1.3E-07
MW5-14D(2)-GS-037	Sand	1.236	94	76.1	0.26	1.9E-08	1.9E-09
MW5-14D(2)-GS-038	Diamicton	7.753	120	15.5	0.27	7.5E-07	9.2E-08
MW5-14D(2)-GS-039	Diamicton	5.997	120	20.0	0.26	4.5E-07	4.9E-08
MW5-14D(2)-GS-040	Diamicton	5.844	110	18.8	0.26	4.3E-07	4.7E-08
MW5-14D(2)-GS-041	Diamicton	1.779	69	38.8	0.26	4.0E-08	4.0E-09
MW5-14D(2)-GS-042	Diamicton	9.327	53	5.7	0.34	1.1E-06	3.4E-07
MW5-14D(2)-GS-043	Diamicton	3.328	76	22.8	0.26	1.4E-07	1.5E-08
MW5-14D(2)-GS-044-DUP	Diamicton	2.92	84	28.8	0.26	1.1E-07	1.1E-08

Hydraulic Conductivity Calculated from Grain Size							
Grain Size Sample Number	Material Description	d10 (um)	d60 (um)	Cu	n (-)	Hazen New (m/s)	Kozeny-Carmen (m/s)
MW5-14D(2)-GS-045	Silt/Clay	1.176	34	28.9	0.26	1.7E-08	1.8E-09
MW5-14D(2)-GS-046	Sand	27.92	73	2.6	0.41	9.7E-06	6.6E-06
MW5-14D(2)-GS-047	Diamicton	2.043	69	33.8	0.26	5.2E-08	5.2E-09
MW5-14D(2)-GS-048	Sand	6.329	65	10.3	0.29	5.0E-07	8.4E-08
MW5-14D(2)-GS-049	Sand	17.23	120	7.0	0.32	3.7E-06	9.3E-07
MW5-14D(2)-GS-050	Diamicton	3.184	100	31.4	0.26	1.3E-07	1.3E-08
MW5-14D(2)-GS-051	Sand	39.91	190	4.8	0.36	2.0E-05	7.6E-06
MW5-14D(2)-GS-052	Diamicton	2.259	100	44.3	0.26	6.4E-08	6.4E-09
MW5-14D(2)-GS-053	Diamicton	4.629	100	21.6	0.26	2.7E-07	2.8E-08
MW5-14D(2)-GS-054	Sand	81.61	320	3.9	0.38	8.3E-05	3.9E-05
MW5-14D(2)-GS-055	Sand	61.65	320	5.2	0.35	4.8E-05	1.6E-05
MW5-14D(2)-GS-056	Silt/Clay	2.386	22	9.2	0.30	7.1E-08	1.3E-08
MW5-14D(2)-GS-057	Sand	34.99	100	2.9	0.40	1.5E-05	9.6E-06
MW5-14D(2)-GS-058	Sand	41.82	180	4.3	0.37	2.2E-05	9.2E-06
MW5-14D(2)-GS-059	Sand	34.51	290	8.4	0.31	1.5E-05	3.0E-06
MW5-14D(2)-GS-060	Sand	38.8	120	3.1	0.40	1.9E-05	1.1E-05
MW5-14D(2)-GS-061-DUP	Diamicton	3.217	93	28.9	0.26	1.3E-07	1.3E-08
MW5-14D(2)-GS-062	Sand	18.59	52	2.8	0.41	4.3E-06	2.7E-06
MW5-14D(2)-GS-063	Sand	24.56	61	2.5	0.42	7.5E-06	5.3E-06
MW5-14D(2)-GS-064	Sand	25.13	120	4.8	0.36	7.9E-06	3.0E-06
MW5-14D(2)-GS-065	Sand	12.19	30	2.5	0.42	1.9E-06	1.3E-06
MW5-14D(2)-GS-066-DUP	Sand	21.16	52	2.5	0.42	5.6E-06	4.0E-06
MW5-14D(2)-GS-067	Sand	33.09	130	3.9	0.38	1.4E-05	6.3E-06
MW5-14D(2)-GS-068	Sand	49.04	720	14.7	0.27	3.0E-05	3.8E-06

Hydraulic Conductivity Calculated from Grain Size							
Grain Size Sample Number	**Material Description**	**d10 (um)**	**d60 (um)**	**Cu**	**n (-)**	**Hazen New (m/s)**	**Kozeny-Carmen (m/s)**
MW5-14D(2)-GS-069-DUP	Sand	47.78	820	17.2	0.27	2.9E-05	3.3E-06
MW5-14D(2)-GS-070	Sand	2.787	15	5.4	0.35	9.7E-08	3.2E-08
MW5-14D(2)-GS-071	Sand	20.93	130	6.2	0.34	5.5E-06	1.6E-06
MW5-14D(2)-GS-072	Sand	42.87	140	3.3	0.39	2.3E-05	1.3E-05
MW5-14D(2)-GS-073	Silt/Clay	1.076	11	10.2	0.29	1.4E-08	2.4E-09
MW5-14D(2)-GS-074	Sand	12.11	45	3.7	0.38	1.8E-06	9.0E-07
MW5-14D(2)-GS-075	Silt/Clay	2.894	16	5.5	0.35	1.0E-07	3.4E-08
MW5-14D(2)-GS-076	Silt/Clay	5.774	22	3.8	0.38	4.2E-07	2.0E-07
MW5-14D(2)-GS-077	Sand	4.218	84	19.9	0.26	2.2E-07	2.4E-08
MW5-14D(2)-GS-078	Silt/Clay	1.446	3.1	2.1	0.43	2.6E-08	2.0E-08
MW5-14D(2)-GS-079	Diamicton	1.043	17	16.3	0.27	1.4E-08	1.6E-09
MW5-14D(2)-GS-080	Diamicton	1.045	20	19.1	0.26	1.4E-08	1.5E-09
MW5-14D(2)-GS-081	Sand	16.82	44	2.6	0.41	3.5E-06	2.4E-06
MW5-14D(2)-GS-082	Sand	68	150	2.2	0.42	5.8E-05	4.4E-05
MW5-14D(2)-GS-083	Sand	75.7	220	2.9	0.40	7.2E-05	4.4E-05
MW5-14D(2)-GS-084	Sand	16.92	52	3.1	0.40	3.6E-06	2.1E-06
MW5-14D(2)-GS-085-DUP	Sand	22.66	57	2.5	0.41	6.4E-06	4.5E-06
MW5-14D(2)-GS-086	Sand	42.32	90	2.1	0.43	2.2E-05	1.8E-05
MW5-14D(2)-GS-087	Sand	16.79	42	2.5	0.41	3.5E-06	2.5E-06
MW5-14D(2)-GS-088	Sand	5.438	29	5.3	0.35	3.7E-07	1.2E-07
MW5-14D(2)-GS-089	Silt/Clay	12.3	33	2.7	0.41	1.9E-06	1.2E-06
MW5-14D(2)-GS-090	Silt/Clay	39.04	120	3.1	0.40	1.9E-05	1.1E-05
MW5-14D(2)-GS-091	Sand	19.78	60	3.0	0.40	4.9E-06	2.9E-06
MW5-14D(2)-GS-092	Sand	31.37	83	2.6	0.41	1.2E-05	8.2E-06

Hydraulic Conductivity Calculated from Grain Size							
Grain Size Sample Number	**Material Description**	**d10 (um)**	**d60 (um)**	**Cu**	**n (-)**	**Hazen New (m/s)**	**Kozeny-Carmen (m/s)**
MW5-14D(2)-GS-093-DUP	Sand	38.17	82	2.1	0.43	1.8E-05	1.4E-05
MW5-14D(2)-GS-094	Silt/Clay	7.65	24	3.1	0.40	7.3E-07	4.2E-07
MW5-14D(2)-GS-095	Silt/Clay	4.336	28	6.5	0.33	2.4E-07	6.4E-08
MW5-14D(2)-GS-096	Sand	4.863	320	65.8	0.26	3.0E-07	2.9E-08

Hazen (New) Method:

$$K\left(\frac{cm}{s}\right) = \beta \cdot C \cdot d_{10}^2$$

Kozeny-Carman Method:

$$K\left(\frac{m}{s}\right) = \frac{g}{v} \cdot 5.56x10^{-3} \cdot \left[\frac{n^3}{(1-n)^2}\right] \cdot d_{10}^2$$

g = acceleration due to gravity = 9.81 m/s^2

n = porosity = estimated from grain size using Istomina (1957) $n = 0.255\,(1 + 0.83^{Cu})$

v = kinematic viscosity = μ/ρ = $1.307x10^{-6}$ m^2/s @ 10°C

d_{10} = effective grain size = finest 10% grain size = caluclated using GRADISTAT

d_{60} = effective grain size = finest 60% grain size = estimated from grain size curves

Table A5: Calibrated values of hydraulic conductivity **for sedimentary units with triaxial permeability samples.**

Calibrated Hydraulic Conductivity Values for Sedimentary Units with Triaxial Permeability Samples							
Grain Size Sample Number	**Material Description**	**d10 (um)**	**d60 (um)**	**Cu**	**n (-)**	**Hazen New (m/s)**	**Kozeny-Carmen (m/s)**
MW5-14D-GS-002	Diamicton	4.692	79	16.8	0.27	1.2E-09	1.3E-09
MW5-14D-GS-003	Diamicton	3.087	91	29.5	0.26	5.1E-10	4.9E-10
MW5-14D-GS-010	Diamicton	3.657	110	30.1	0.26	7.2E-10	6.9E-10
MW5-14D-GS-012	Diamicton	2.503	98	39.2	0.26	3.4E-10	3.2E-10
MW5-14D-GS-013	Diamicton	2.037	96	47.1	0.26	2.2E-10	2.1E-10
MW5-14D-GS-014	Diamicton	3.335	130	39.0	0.26	6.0E-10	5.7E-10
MW5-14D-GS-015	Diamicton	1.704	81	47.5	0.26	1.6E-10	1.5E-10
MW5-14D-GS-016	Diamicton	1.889	79	41.8	0.26	1.9E-10	1.8E-10
MW5-14D-GS-017	Diamicton	1.534	74	48.2	0.26	1.3E-10	1.2E-10
MW5-14D-GS-018	Diamicton	1.217	66	54.2	0.26	8.0E-11	7.5E-11
MW5-14D-GS-019-DUP	Diamicton	1.23	71	57.7	0.26	8.2E-11	7.7E-11
MW5-14D-GS-020	Diamicton	1.581	93	58.8	0.26	1.3E-10	1.3E-10
MW5-14D-GS-021	Diamicton	1.483	80	53.9	0.26	1.2E-10	1.1E-10
MW5-14D-GS-022-DUP	Diamicton	1.3	81	62.3	0.26	9.1E-11	8.6E-11
MW5-14D-GS-023	Diamicton	1.52	100	65.8	0.26	1.2E-10	1.2E-10
MW5-14D-GS-024	Diamicton	1.491	70	46.9	0.26	1.2E-10	1.1E-10
MW5-14D-GS-025-DUP	Diamicton	1.67	90	53.9	0.26	1.5E-10	1.4E-10
MW5-14D-GS-026	Diamicton	2.412	110	45.6	0.26	3.1E-10	3.0E-10
MW5-14D-GS-027	Diamicton	1.519	130	85.6	0.26	1.2E-10	1.2E-10
MW5-14D-GS-028	Diamicton	1.333	130	97.5	0.26	9.6E-11	9.0E-11

Calibrated Hydraulic Conductivity Values for Sedimentary Units with Triaxial Permeability Samples							
Grain Size Sample Number	Material Description	d10 (um)	d60 (um)	Cu	n (-)	Hazen New (m/s)	Kozeny-Carmen (m/s)
MW5-14D(2)-GS-035	Diamicton	2.952	120	40.7	0.26	4.7E-10	4.4E-10
MW5-14D(2)-GS-038	Diamicton	7.753	120	15.5	0.27	3.2E-09	3.7E-09
MW5-14D(2)-GS-039	Diamicton	5.997	120	20.0	0.26	1.9E-09	2.0E-09
MW5-14D(2)-GS-040	Diamicton	5.844	110	18.8	0.26	1.8E-09	1.9E-09
MW5-14D(2)-GS-041	Diamicton	1.779	69	38.8	0.26	1.7E-10	1.6E-10
MW5-14D(2)-GS-042	Diamicton	9.327	53	5.7	0.34	4.7E-09	1.4E-08
MW5-14D(2)-GS-043	Diamicton	3.328	76	22.8	0.26	6.0E-10	5.9E-10
MW5-14D(2)-GS-044-DUP	Diamicton	2.92	84	28.8	0.26	4.6E-10	4.4E-10
MW5-14D(2)-GS-047	Diamicton	2.043	69	33.8	0.26	2.2E-10	2.1E-10
MW5-14D(2)-GS-050	Diamicton	3.184	100	31.4	0.26	2.2E-09	3.4E-09
MW5-14D(2)-GS-052	Diamicton	2.259	100	44.3	0.26	5.5E-10	5.2E-10
MW5-14D(2)-GS-053	Diamicton	4.629	100	21.6	0.26	2.7E-10	2.6E-10
MW5-14D(2)-GS-061-DUP	Diamicton	3.217	93	28.9	0.26	1.2E-09	1.2E-09
MW5-14D(2)-GS-078	Silt/Clay	1.446	3.1	2.1	0.43	7.8E-11	8.8E-11
MW5-14D(2)-GS-079	Diamicton	1.043	17	16.3	0.27	7.9E-11	8.1E-11
MW5-14D(2)-GS-080	Diamicton	1.045	20	19.1	0.26	7.9E-11	7.5E-11

Calibration Factors can be found in Table 6.

g = acceleration due to gravity = 9.81 m/s^2

n = porosity = estimated from grain size using Istomina (1957) $n = 0.255\,(1 + 0.83^{Cu})$

v = kinematic viscosity = μ/ρ = 1.307×10^{-6} m^2/s @ 10°C

d_{10} = effective grain size = finest 10% grain size = caluclated using GRADISTAT

d_{60} = effective grain size = finest 60% grain size = estimated from grain size curves

Table A6: Hydraulic conductivity from triaxial permeability samples.

Triaxial Permeability Samples					
Sample ID	**Run #**	**Top Depth (masl)**	**Bottom Depth (masl)**	**Material Description**	**Hydraulic Conductivity (m/s)**
CLA-MW5-14D-TP-001	8	242.80	242.49	Diamicton	1.88E-10
CLA-MW5-14D-TP-002	20	224.76	224.45	Diamicton	1.85E-10
CLA-MW5-14D(2)-TP-003	1	202.61	202.27	Diamicton	--
CLA-MW5-14D(2)-TP-004	2	201.69	201.39	Diamicton	1.05E-09
CLA-MW5-14D(2)-TP-005	39	146.40	146.13	Clay	8.71E-11
CLA-MW5-14D(2)-TP-006	41	143.41	143.11	Diamicton	7.86E-11

-- Not analyzed

Appendix B

Grain Size Summary Sheets produced with the Gradistat program (Blott and Pye, 2001).

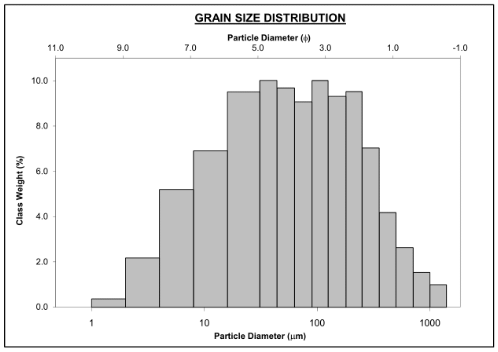
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-001** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	37.50	4.759
MODE 2:	107.5	3.237
MODE 3:	215.0	2.237
D_{10}:	6.427	1.659
MEDIAN or D_{50}:	49.97	4.323
D_{90}:	316.6	7.282
(D_{90} / D_{10}):	49.25	4.388
$(D_{90} - D_{10})$:	310.1	5.622
(D_{75} / D_{25}):	9.083	2.172
$(D_{75} - D_{25})$:	135.4	3.183

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	3.4%
SAND:	44.9%	MEDIUM SAND:	9.2%
MUD:	55.1%	FINE SAND:	15.4%
		V FINE SAND:	15.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	16.1%
COARSE GRAVEL:	0.0%	COARSE SILT:	15.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	11.2%
FINE GRAVEL:	0.0%	FINE SILT:	8.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.5%
V COARSE SAND:	1.3%	CLAY:	0.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	120.6	46.92	4.364	48.15	4.376	Very Coarse Silt
SORTING (σ):	180.3	4.351	2.107	4.498	2.169	Very Poorly Sorted
SKEWNESS (Sk):	3.105	-0.143	0.079	-0.037	0.037	Symmetrical
KURTOSIS (K):	15.14	2.379	2.302	0.879	0.879	Platykurtic



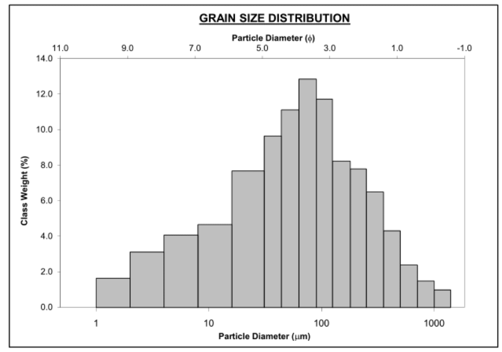
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-002** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	4.692	1.662
MEDIAN or D_{50}:	56.70	4.141
D_{90}:	316.0	7.736
(D_{90} / D_{10}):	67.35	4.654
$(D_{90} - D_{10})$:	311.3	6.074
(D_{75} / D_{25}):	7.738	2.034
$(D_{75} - D_{25})$:	120.4	2.952

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	3.2%
SAND:	47.4%	MEDIUM SAND:	9.0%
MUD:	52.6%	FINE SAND:	13.3%
		V FINE SAND:	20.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	17.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	12.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.7%
FINE GRAVEL:	0.0%	FINE SILT:	6.7%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.1%
V COARSE SAND:	1.4%	CLAY:	3.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	118.9	44.93	4.415	47.51	4.396	Very Coarse Silt
SORTING (σ):	178.4	4.768	2.239	4.991	2.319	Very Poorly Sorted
SKEWNESS (Sk):	3.204	-0.412	0.363	-0.174	0.174	Fine Skewed
KURTOSIS (K):	15.85	2.648	2.629	1.052	1.052	Mesokurtic



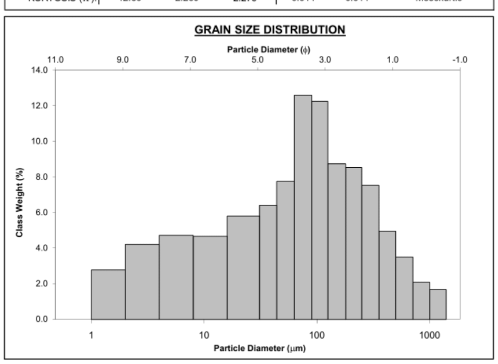
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-003** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	76.50	3.731
MODE 2:	6.000	7.466
MODE 3:		
D_{10}:	3.087	1.403
MEDIAN or D_{50}:	65.51	3.932
D_{90}:	378.1	8.340
(D_{90} / D_{10}):	122.5	5.944
$(D_{90} - D_{10})$:	375.0	6.937
(D_{75} / D_{25}):	13.70	2.467
$(D_{75} - D_{25})$:	155.7	3.776

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	4.6%
SAND:	51.3%	MEDIUM SAND:	10.2%
MUD:	48.7%	FINE SAND:	14.1%
		V FINE SAND:	20.2%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.6%
COARSE GRAVEL:	0.0%	COARSE SILT:	9.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.6%
FINE GRAVEL:	0.0%	FINE SILT:	7.7%
V FINE GRAVEL:	0.0%	V FINE SILT:	6.8%
V COARSE SAND:	2.1%	CLAY:	5.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	137.2	42.91	4.462	45.48	4.459	Very Coarse Silt
SORTING (σ):	207.9	5.897	2.545	6.390	2.676	Very Poorly Sorted
SKEWNESS (Sk):	2.852	-0.391	0.369	-0.257	0.257	Fine Skewed
KURTOSIS (K):	12.50	2.260	2.270	0.914	0.914	Mesokurtic



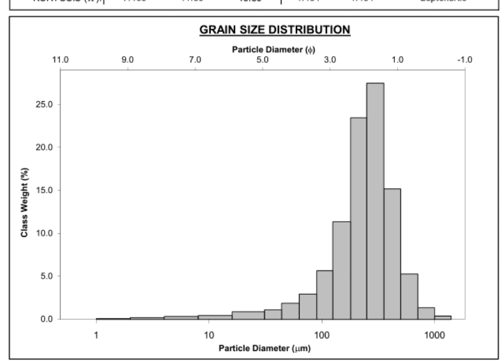
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-004** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sand
SEDIMENT NAME: Moderately Sorted Medium Sand

	μm	φ
MODE 1:	302.5	1.747
MODE 2:		
MODE 3:		
D_{10}:	88.74	1.089
MEDIAN or D_{50}:	250.6	1.996
D_{90}:	470.1	3.494
(D_{90} / D_{10}):	5.298	3.209
$(D_{90} - D_{10})$:	381.4	2.405
(D_{75} / D_{25}):	2.058	1.675
$(D_{75} - D_{25})$:	176.5	1.041

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	6.7%
SAND:	93.0%	MEDIUM SAND:	42.9%
MUD:	7.0%	FINE SAND:	34.3%
		V FINE SAND:	8.5%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	3.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	1.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	0.9%
FINE GRAVEL:	0.0%	FINE SILT:	0.7%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.4%
V COARSE SAND:	0.6%	CLAY:	0.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	273.7	210.1	2.232	235.4	2.087	Fine Sand
SORTING (σ):	164.9	2.433	1.242	1.992	0.994	Moderately Sorted
SKEWNESS (Sk):	1.431	-2.345	2.166	-0.259	0.259	Fine Skewed
KURTOSIS (K):	7.465	11.39	10.30	1.484	1.484	Leptokurtic



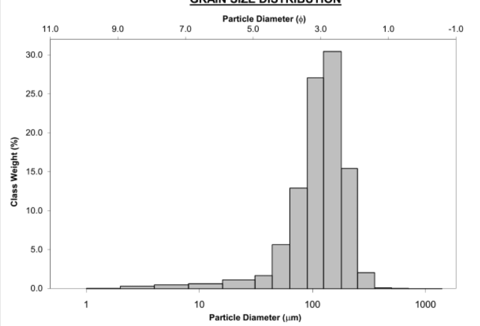
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-005** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	152.5	2.737	GRAVEL:	0.0%	COARSE SAND:	0.1%
MODE 2:			SAND:	87.4%	MEDIUM SAND:	2.2%
MODE 3:			MUD:	12.6%	FINE SAND:	46.3%
D_{10}:	53.16	2.250			V FINE SAND:	38.8%
MEDIAN or D_{50}:	122.8	3.026	V COARSE GRAVEL:	0.0%	V COARSE SILT:	7.3%
D_{90}:	210.3	4.233	COARSE GRAVEL:	0.0%	COARSE SILT:	2.3%
(D_{90} / D_{10}):	3.955	1.882	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.3%
$(D_{90} - D_{10})$:	157.1	1.984	FINE GRAVEL:	0.0%	FINE SILT:	1.0%
(D_{75} / D_{25}):	1.868	1.346	V FINE GRAVEL:	0.0%	V FINE SILT:	0.7%
$(D_{75} - D_{25})$:	76.18	0.902	V COARSE SAND:	0.1%	CLAY:	0.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	129.1	106.9	3.220	115.7	3.111	Very Fine Sand
SORTING (σ):	63.91	2.062	1.034	1.757	0.813	Moderately Sorted
SKEWNESS (Sk):	1.750	-2.401	2.312	-0.281	0.281	Fine Skewed
KURTOSIS (K):	22.53	11.51	11.03	1.378	1.378	Leptokurtic

GRAIN SIZE DISTRIBUTION



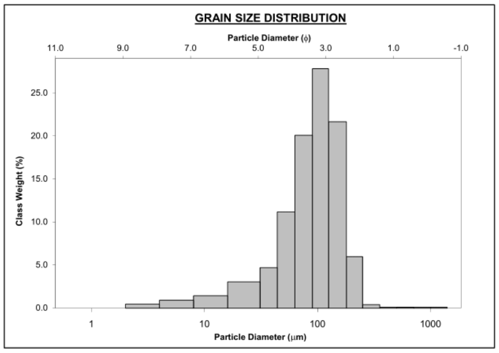
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-006-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	0.2%
MODE 2:			SAND:	73.5%	MEDIUM SAND:	0.5%
MODE 3:			MUD:	26.5%	FINE SAND:	27.3%
D_{10}:	27.32	2.562			V FINE SAND:	45.3%
MEDIAN or D_{50}:	94.13	3.409	V COARSE GRAVEL:	0.0%	V COARSE SILT:	15.3%
D_{90}:	169.3	5.194	COARSE GRAVEL:	0.0%	COARSE SILT:	5.8%
(D_{90} / D_{10}):	6.196	2.027	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.8%
$(D_{90} - D_{10})$:	142.0	2.631	FINE GRAVEL:	0.0%	FINE SILT:	1.7%
(D_{75} / D_{25}):	2.213	1.392	V FINE GRAVEL:	0.0%	V FINE SILT:	0.9%
$(D_{75} - D_{25})$:	72.23	1.146	V COARSE SAND:	0.1%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	101.4	78.25	3.672	86.26	3.535	Very Fine Sand
SORTING (σ):	71.34	2.259	1.172	2.024	1.018	Poorly Sorted
SKEWNESS (Sk):	5.666	-1.553	1.512	-0.328	0.328	Very Fine Skewed
KURTOSIS (K):	75.82	6.454	6.303	1.350	1.350	Leptokurtic

GRAIN SIZE DISTRIBUTION



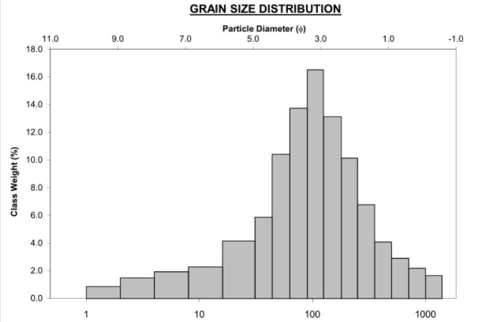
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-007** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.6%
MODE 2:			SAND:	65.8%	MEDIUM SAND:	9.8%
MODE 3:			MUD:	34.2%	FINE SAND:	21.2%
D_{10}:	11.19	1.320			V FINE SAND:	27.1%
MEDIAN or D_{50}:	96.05	3.380	V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.8%
D_{90}:	400.5	6.482	COARSE GRAVEL:	0.0%	COARSE SILT:	7.4%
(D_{90} / D_{10}):	35.80	4.911	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.1%
$(D_{90} - D_{10})$:	389.3	5.162	FINE GRAVEL:	0.0%	FINE SILT:	3.5%
(D_{75} / D_{25}):	4.226	1.863	V FINE GRAVEL:	0.0%	V FINE SILT:	2.7%
$(D_{75} - D_{25})$:	143.6	2.079	V COARSE SAND:	3.0%	CLAY:	1.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	157.2	72.19	3.637	84.18	3.570	Very Fine Sand
SORTING (σ):	206.1	4.305	2.011	4.007	2.003	Very Poorly Sorted
SKEWNESS (Sk):	2.930	-0.911	0.724	-0.186	0.186	Fine Skewed
KURTOSIS (K):	12.96	3.889	3.684	1.443	1.443	Leptokurtic

GRAIN SIZE DISTRIBUTION



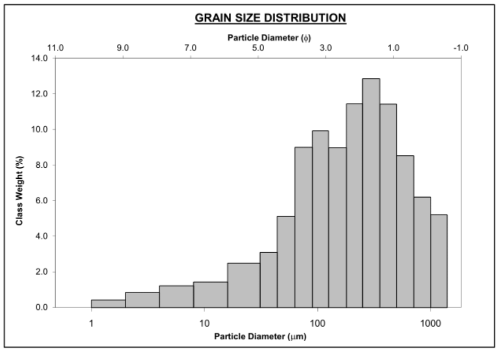
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-008** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Medium Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	302.5	1.747	GRAVEL:	0.0%	COARSE SAND:	13.5%
MODE 2:	107.5	3.237	SAND:	80.6%	MEDIUM SAND:	22.3%
MODE 3:			MUD:	19.4%	FINE SAND:	18.6%
D_{10}:	23.93	0.092			V FINE SAND:	17.2%
MEDIAN or D_{50}:	210.5	2.248	V COARSE GRAVEL:	0.0%	V COARSE SILT:	7.6%
D_{90}:	938.1	5.385	COARSE GRAVEL:	0.0%	COARSE SILT:	4.5%
(D_{90} / D_{10}):	39.20	58.43	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.6%
$(D_{90} - D_{10})$:	914.2	5.293	FINE GRAVEL:	0.0%	FINE SILT:	2.2%
(D_{75} / D_{25}):	5.791	3.263	V FINE GRAVEL:	0.0%	V FINE SILT:	1.5%
$(D_{75} - D_{25})$:	380.8	2.534	V COARSE SAND:	9.0%	CLAY:	0.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	287.7	122.9	2.595	189.9	2.397	Fine Sand
SORTING (σ):	303.9	5.516	2.050	4.122	2.043	Very Poorly Sorted
SKEWNESS (Sk):	1.505	-1.249	0.995	-0.193	0.193	Fine Skewed
KURTOSIS (K):	4.730	4.237	3.947	1.175	1.175	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-009** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Fine Sandy Very Coarse Silt

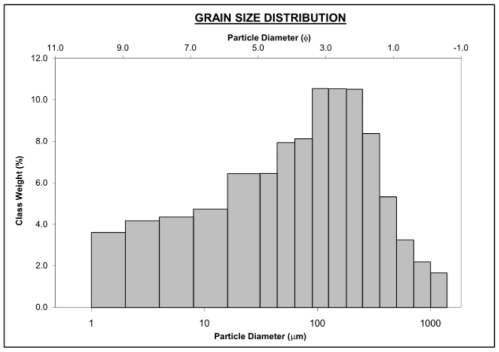
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	2.354	1.380
MEDIAN or D_{50}:	59.59	4.069
D_{90}:	384.3	8.731
(D_{90} / D_{10}):	163.3	6.329
(D_{90} - D_{10}):	382.0	7.351
(D_{75} / D_{25}):	17.52	2.695
(D_{75} - D_{25}):	174.1	4.131

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	4.3%
SAND:	49.1%	MEDIUM SAND:	10.9%
MUD:	50.9%	FINE SAND:	16.7%
		V FINE SAND:	14.7%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.4%
COARSE GRAVEL:	0.0%	COARSE SILT:	10.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.5%
FINE GRAVEL:	0.0%	FINE SILT:	6.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	6.6%
V COARSE SAND:	2.5%	CLAY:	8.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	137.6	39.34	4.552	41.48	4.591	Very Coarse Silt
SORTING (σ):	207.1	6.557	2.697	7.162	2.840	Very Poorly Sorted
SKEWNESS (Sk):	2.798	-0.389	0.377	-0.248	0.248	Fine Skewed
KURTOSIS (K):	12.33	2.128	2.163	0.884	0.884	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-010** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Very Fine Sand

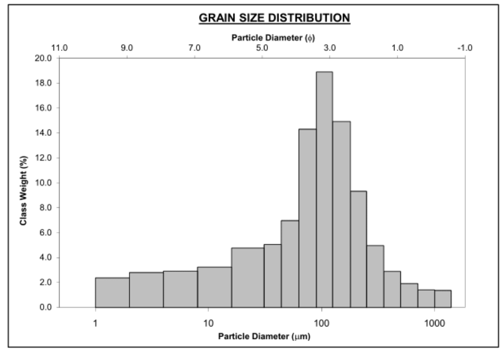
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	3.657	1.796
MEDIAN or D_{50}:	84.95	3.557
D_{90}:	288.0	8.095
(D_{90} / D_{10}):	78.75	4.507
(D_{90} - D_{10}):	284.3	6.299
(D_{75} / D_{25}):	6.948	2.036
(D_{75} - D_{25}):	131.9	2.797

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.9%
SAND:	60.7%	MEDIUM SAND:	6.7%
MUD:	39.3%	FINE SAND:	20.9%
		V FINE SAND:	28.0%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.5%
FINE GRAVEL:	0.0%	FINE SILT:	5.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	4.8%
V COARSE SAND:	2.1%	CLAY:	5.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	128.1	50.39	4.212	52.89	4.241	Very Coarse Silt
SORTING (σ):	180.7	5.229	2.356	5.258	2.395	Very Poorly Sorted
SKEWNESS (Sk):	3.526	-0.795	0.754	-0.409	0.409	Very Fine Skewed
KURTOSIS (K):	18.35	2.927	2.978	1.197	1.197	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-011** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Very Fine Sand

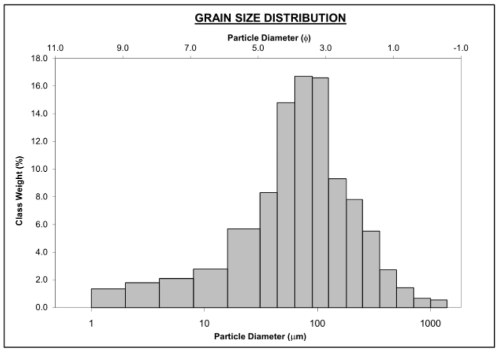
	μm	ϕ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	8.042	1.993
MEDIAN or D_{50}:	69.93	3.838
D_{90}:	251.2	6.958
(D_{90} / D_{10}):	31.23	3.491
(D_{90} - D_{10}):	243.1	4.965
(D_{75} / D_{25}):	3.994	1.670
(D_{75} - D_{25}):	94.87	1.998

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	1.9%
SAND:	54.8%	MEDIUM SAND:	7.3%
MUD:	45.2%	FINE SAND:	15.2%
		V FINE SAND:	29.5%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	20.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	10.0%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.9%
FINE GRAVEL:	0.0%	FINE SILT:	3.7%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.2%
V COARSE SAND:	0.8%	CLAY:	3.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	111.1	55.08	4.148	60.73	4.042	Very Coarse Silt
SORTING (σ):	143.8	3.903	1.950	3.731	1.900	Poorly Sorted
SKEWNESS (Sk):	3.731	-0.870	0.818	-0.245	0.245	Fine Skewed
KURTOSIS (K):	22.65	3.793	3.768	1.411	1.411	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-012** ANALYST & DATE: ,

SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Very Fine Sand

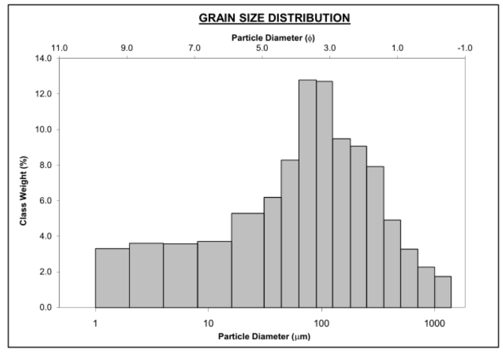
	μm	ϕ
MODE 1:	76.50	3.731
MODE 2:	3.000	8.466
MODE 3:		
D_{10}:	2.503	1.371
MEDIAN or D_{50}:	70.75	3.821
D_{90}:	386.6	8.642
(D_{90} / D_{10}):	154.4	6.303
(D_{90} - D_{10}):	384.1	7.271
(D_{75} / D_{25}):	12.40	2.454
(D_{75} - D_{25}):	162.8	3.632

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	4.6%
SAND:	53.7%	MEDIUM SAND:	10.6%
MUD:	46.3%	FINE SAND:	15.2%
		V FINE SAND:	20.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.1%
FINE GRAVEL:	0.0%	FINE SILT:	5.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.9%
V COARSE SAND:	2.4%	CLAY:	7.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	141.7	43.98	4.406	45.99	4.443	Very Coarse Silt
SORTING (σ):	210.2	6.264	2.627	6.897	2.786	Very Poorly Sorted
SKEWNESS (Sk):	2.828	-0.522	0.507	-0.304	0.304	Very Fine Skewed
KURTOSIS (K):	12.30	2.356	2.397	1.004	1.004	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-013** ANALYST & DATE: ,

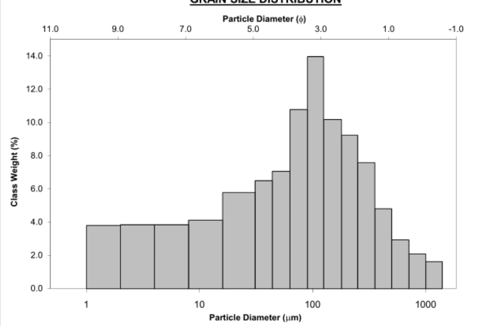
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.0%
MODE 2:			SAND:	51.5%	MEDIUM SAND:	9.9%
MODE 3:			MUD:	48.5%	FINE SAND:	15.6%
D_{10}:	2.037	1.462			V FINE SAND:	19.6%
MEDIAN or D_{50}:	66.53	3.910	V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.8%
D_{90}:	362.9	8.939	COARSE GRAVEL:	0.0%	COARSE SILT:	9.2%
(D_{90} / D_{10}):	178.1	6.112	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.6%
$(D_{90} - D_{10})$:	360.8	7.477	FINE GRAVEL:	0.0%	FINE SILT:	6.1%
(D_{75} / D_{25}):	15.53	2.537	V FINE GRAVEL:	0.0%	V FINE SILT:	6.1%
$(D_{75} - D_{25})$:	157.1	3.957	V COARSE SAND:	2.4%	CLAY:	9.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	133.4	38.74	4.575	40.83	4.614	Very Coarse Silt
SORTING (σ):	202.6	6.609	2.710	7.324	2.873	Very Poorly Sorted
SKEWNESS (Sk):	2.950	-0.460	0.450	-0.321	0.321	Very Fine Skewed
KURTOSIS (K):	13.35	2.193	2.244	0.939	0.939	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-014** ANALYST & DATE: ,

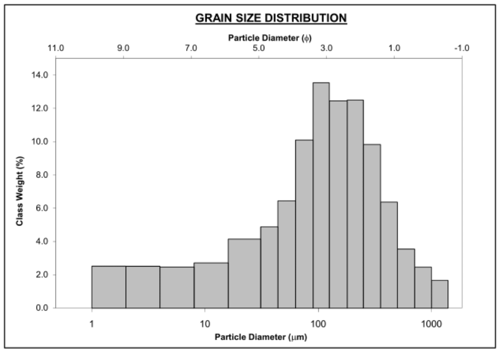
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	5.2%
MODE 2:	215.0	2.237	SAND:	63.3%	MEDIUM SAND:	13.9%
MODE 3:	1.500	9.466	MUD:	36.7%	FINE SAND:	21.4%
D_{10}:	3.335	1.192			V FINE SAND:	20.1%
MEDIAN or D_{50}:	102.2	3.290	V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.7%
D_{90}:	437.8	8.228	COARSE GRAVEL:	0.0%	COARSE SILT:	7.1%
(D_{90} / D_{10}):	131.3	6.905	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.7%
$(D_{90} - D_{10})$:	434.5	7.036	FINE GRAVEL:	0.0%	FINE SILT:	4.2%
(D_{75} / D_{25}):	8.719	2.455	V FINE GRAVEL:	0.0%	V FINE SILT:	4.3%
$(D_{75} - D_{25})$:	199.9	3.124	V COARSE SAND:	2.7%	CLAY:	6.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	167.2	59.99	3.926	65.82	3.925	Very Fine Sand
SORTING (σ):	214.0	6.069	2.550	6.221	2.637	Very Poorly Sorted
SKEWNESS (Sk):	2.506	-0.818	0.805	-0.372	0.372	Very Fine Skewed
KURTOSIS (K):	10.57	2.792	2.876	1.162	1.162	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-015** ANALYST & DATE: ,

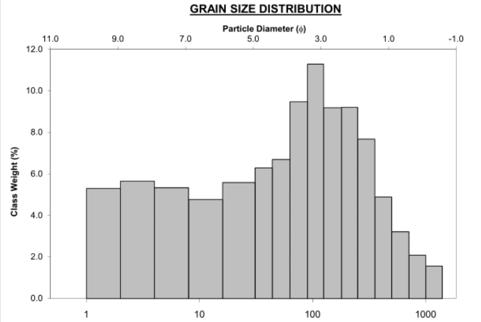
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.1%
MODE 2:	215.0	2.237	SAND:	45.6%	MEDIUM SAND:	9.7%
MODE 3:	3.000	8.466	MUD:	54.4%	FINE SAND:	14.1%
D_{10}:	1.704	1.516			V FINE SAND:	15.8%
MEDIAN or D_{50}:	46.61	4.423	V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.0%
D_{90}:	349.7	9.197	COARSE GRAVEL:	0.0%	COARSE SILT:	8.5%
(D_{90} / D_{10}):	205.2	6.067	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.4%
$(D_{90} - D_{10})$:	348.0	7.681	FINE GRAVEL:	0.0%	FINE SILT:	8.2%
(D_{75} / D_{25}):	27.22	2.794	V FINE GRAVEL:	0.0%	V FINE SILT:	8.7%
$(D_{75} - D_{25})$:	152.7	4.767	V COARSE SAND:	1.9%	CLAY:	11.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	125.3	30.86	4.940	31.72	4.978	Very Coarse Silt
SORTING (σ):	201.5	7.144	2.837	7.913	2.984	Very Poorly Sorted
SKEWNESS (Sk):	2.938	-0.230	0.228	-0.226	0.226	Fine Skewed
KURTOSIS (K):	13.27	1.879	1.904	0.776	0.776	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-016** ANALYST & DATE: ,

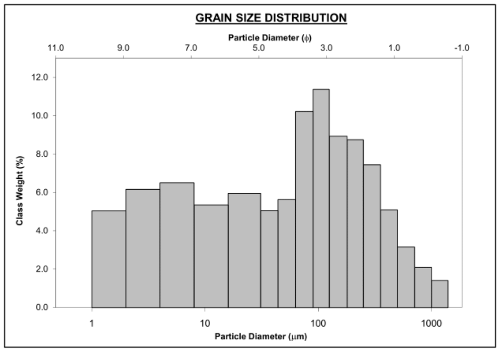
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Fine Silt

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.0%
MODE 2:	6.000	7.466	SAND:	45.2%	MEDIUM SAND:	9.5%
MODE 3:	23.50	5.489	MUD:	54.8%	FINE SAND:	13.4%
D_{10}:	1.889	1.508			V FINE SAND:	16.2%
MEDIAN or D_{50}:	42.23	4.565	V COARSE GRAVEL:	0.0%	V COARSE SILT:	8.1%
D_{90}:	351.7	9.048	COARSE GRAVEL:	0.0%	COARSE SILT:	9.0%
(D_{90} / D_{10}):	186.2	6.002	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	8.2%
$(D_{90} - D_{10})$:	349.8	7.541	FINE GRAVEL:	0.0%	FINE SILT:	9.9%
(D_{75} / D_{25}):	26.92	2.755	V FINE GRAVEL:	0.0%	V FINE SILT:	9.3%
$(D_{75} - D_{25})$:	147.5	4.751	V COARSE SAND:	2.0%	CLAY:	10.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	121.4	29.51	4.985	31.32	4.997	Very Coarse Silt
SORTING (σ):	197.7	7.015	2.812	7.678	2.941	Very Poorly Sorted
SKEWNESS (Sk):	2.949	-0.160	0.155	-0.178	0.178	Fine Skewed
KURTOSIS (K):	13.40	1.846	1.872	0.769	0.769	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-017** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

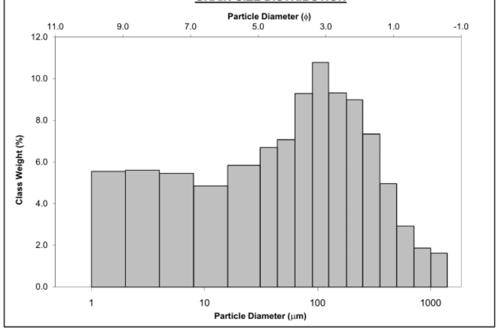
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	3.000	8.466
MODE 3:		
D_{10}:	1.534	1.553
MEDIAN or D_{50}:	41.74	4.582
D_{90}:	340.8	9.348
(D_{90} / D_{10}):	222.1	6.019
$(D_{90} - D_{10})$:	339.2	7.795
(D_{75} / D_{25}):	28.45	2.769
$(D_{75} - D_{25})$:	145.3	4.830

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	3.6%
SAND:	43.8%	MEDIUM SAND:	9.3%
MUD:	56.2%	FINE SAND:	13.8%
		V FINE SAND:	15.0%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.4%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.4%
FINE GRAVEL:	0.0%	FINE SILT:	8.2%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.5%
V COARSE SAND:	2.0%	CLAY:	12.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	120.2	28.59	5.047	29.19	5.098	Coarse Silt
SORTING (σ):	198.3	7.253	2.862	8.094	3.017	Very Poorly Sorted
SKEWNESS (Sk):	3.059	-0.199	0.197	-0.208	0.208	Fine Skewed
KURTOSIS (K):	14.21	1.859	1.887	0.771	0.771	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-018** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

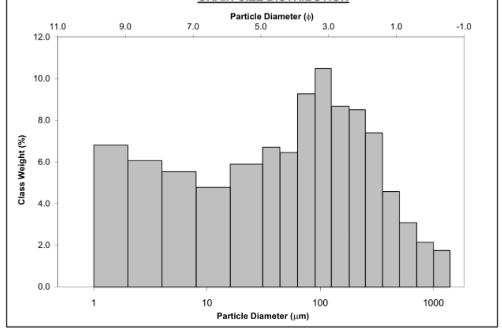
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	1.500	9.466
MODE 3:	37.50	4.759
D_{10}:	1.217	1.563
MEDIAN or D_{50}:	33.33	4.907
D_{90}:	338.4	9.683
(D_{90} / D_{10}):	278.1	6.195
$(D_{90} - D_{10})$:	337.2	8.120
(D_{75} / D_{25}):	37.68	2.850
$(D_{75} - D_{25})$:	137.0	5.236

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	3.8%
SAND:	41.4%	MEDIUM SAND:	8.7%
MUD:	58.6%	FINE SAND:	12.5%
		V FINE SAND:	14.2%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.0%
FINE GRAVEL:	0.0%	FINE SILT:	8.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.8%
V COARSE SAND:	2.2%	CLAY:	16.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	116.0	23.98	5.289	24.30	5.363	Coarse Silt
SORTING (σ):	201.5	7.852	2.984	8.239	3.042	Very Poorly Sorted
SKEWNESS (Sk):	3.095	-0.092	0.096	-0.117	0.117	Fine Skewed
KURTOSIS (K):	14.20	1.755	1.782	0.672	0.672	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-019-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Coarse Silt

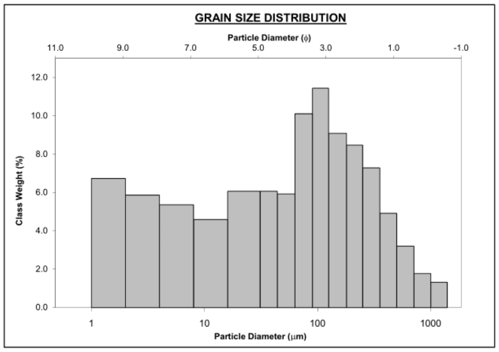
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	1.500	9.466
MODE 3:	37.50	4.759
D_{10}:	1.230	1.598
MEDIAN or D_{50}:	35.05	4.834
D_{90}:	330.3	9.667
(D_{90} / D_{10}):	268.5	6.048
$(D_{90} - D_{10})$:	329.0	8.069
(D_{75} / D_{25}):	36.19	2.823
$(D_{75} - D_{25})$:	135.7	5.178

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	3.7%
SAND:	42.7%	MEDIUM SAND:	8.9%
MUD:	57.3%	FINE SAND:	12.8%
		V FINE SAND:	15.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	8.8%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.7%
FINE GRAVEL:	0.0%	FINE SILT:	7.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.6%
V COARSE SAND:	1.7%	CLAY:	16.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	113.4	24.72	5.263	24.63	5.344	Coarse Silt
SORTING (σ):	190.0	7.725	2.958	8.065	3.012	Very Poorly Sorted
SKEWNESS (Sk):	3.066	-0.139	0.141	-0.149	0.149	Fine Skewed
KURTOSIS (K):	14.48	1.752	1.779	0.670	0.670	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-020** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

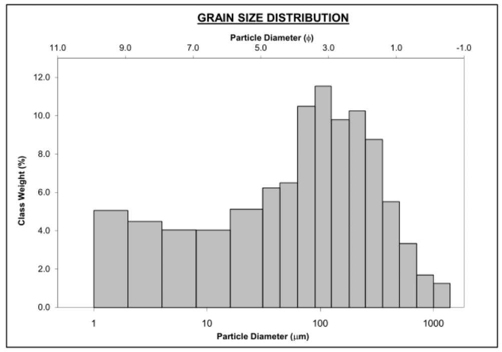
	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	215.0	2.237
MODE 3:	1.500	9.466
D_{10}:	1.581	1.507
MEDIAN or D_{50}:	61.29	4.028
D_{90}:	351.9	9.305
(D_{90} / D_{10}):	222.6	6.175
$(D_{90} - D_{10})$:	350.3	7.798
(D_{75} / D_{25}):	24.79	2.844
$(D_{75} - D_{25})$:	168.3	4.632

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	4.0%
SAND:	49.7%	MEDIUM SAND:	11.3%
MUD:	50.3%	FINE SAND:	15.7%
		V FINE SAND:	17.2%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.0%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.3%
FINE GRAVEL:	0.0%	FINE SILT:	6.4%
V FINE GRAVEL:	0.0%	V FINE SILT:	7.1%
V COARSE SAND:	1.6%	CLAY:	12.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	130.8	35.04	4.775	35.32	4.823	Very Coarse Silt
SORTING (σ):	193.7	7.184	2.841	8.045	3.008	Very Poorly Sorted
SKEWNESS (Sk):	2.793	-0.394	0.394	-0.335	0.335	Very Fine Skewed
KURTOSIS (K):	12.83	1.965	1.992	0.800	0.800	Platykurtic

GRAIN SIZE DISTRIBUTION

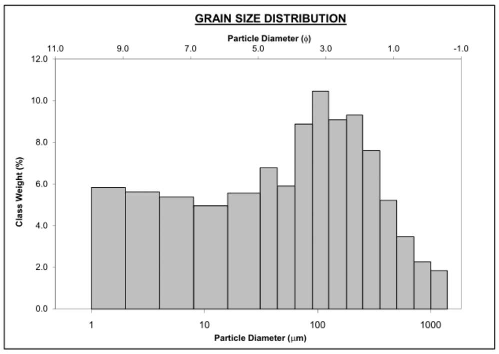


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-021** ANALYST & DATE: ,
SAMPLE TYPE: Polymodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.3%
MODE 2:	215.0	2.237	SAND:	44.6%	MEDIUM SAND:	9.7%
MODE 3:	37.50	4.759	MUD:	55.4%	FINE SAND:	13.8%
D_{10}:	1.483	1.420			V FINE SAND:	14.4%
MEDIAN or D_{50}:	41.37	4.595	V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.5%
D_{90}:	373.8	9.397	COARSE GRAVEL:	0.0%	COARSE SILT:	8.4%
(D_{90} / D_{10}):	252.0	6.619	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.5%
$(D_{90} - D_{10})$:	372.3	7.977	FINE GRAVEL:	0.0%	FINE SILT:	8.1%
(D_{75} / D_{25}):	32.09	2.910	V FINE GRAVEL:	0.0%	V FINE SILT:	8.5%
$(D_{75} - D_{25})$:	157.6	5.004	V COARSE SAND:	2.4%	CLAY:	13.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	127.2	28.66	5.022	29.39	5.089	Coarse Silt
SORTING (σ):	209.5	7.591	2.927	8.523	3.091	Very Poorly Sorted
SKEWNESS (Sk):	2.891	-0.176	0.179	-0.188	0.188	Fine Skewed
KURTOSIS (K):	12.70	1.817	1.846	0.761	0.761	Platykurtic

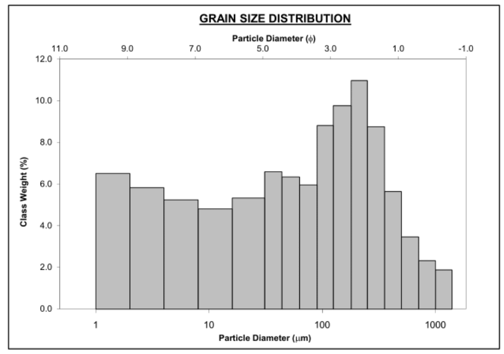


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-022-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	215.0	2.237	GRAVEL:	0.0%	COARSE SAND:	4.3%
MODE 2:	37.50	4.759	SAND:	43.4%	MEDIUM SAND:	10.7%
MODE 3:	1.500	9.466	MUD:	56.6%	FINE SAND:	15.3%
D_{10}:	1.300	1.395			V FINE SAND:	10.8%
MEDIAN or D_{50}:	38.59	4.696	V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.5%
D_{90}:	380.3	9.587	COARSE GRAVEL:	0.0%	COARSE SILT:	7.9%
(D_{90} / D_{10}):	292.5	6.873	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.1%
$(D_{90} - D_{10})$:	379.0	8.192	FINE GRAVEL:	0.0%	FINE SILT:	7.8%
(D_{75} / D_{25}):	43.38	3.200	V FINE GRAVEL:	0.0%	V FINE SILT:	8.6%
$(D_{75} - D_{25})$:	176.1	5.439	V COARSE SAND:	2.4%	CLAY:	15.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	129.8	27.15	5.095	27.51	5.184	Coarse Silt
SORTING (σ):	210.9	8.146	3.032	8.648	3.112	Very Poorly Sorted
SKEWNESS (Sk):	2.801	-0.145	0.154	-0.150	0.150	Fine Skewed
KURTOSIS (K):	12.23	1.718	1.747	0.669	0.669	Very Platykurtic

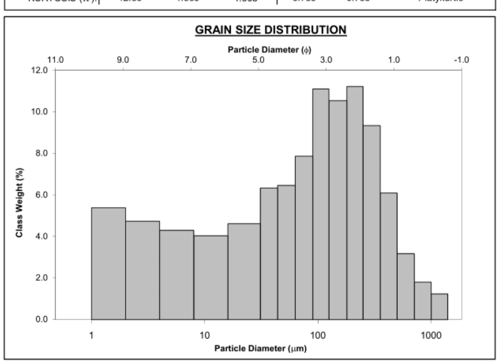


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-023 REPEAT** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	215.0	2.237	GRAVEL:	0.0%	COARSE SAND:	3.9%
MODE 2:	107.5	3.237	SAND:	49.3%	MEDIUM SAND:	12.0%
MODE 3:	1.500	9.466	MUD:	50.7%	FINE SAND:	16.9%
D_{10}:	1.499	1.448			V FINE SAND:	14.6%
MEDIAN or D_{50}:	59.44	4.072	V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.0%
D_{90}:	366.5	9.381	COARSE GRAVEL:	0.0%	COARSE SILT:	7.2%
(D_{90} / D_{10}):	244.4	6.478	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.3%
$(D_{90} - D_{10})$:	365.0	7.933	FINE GRAVEL:	0.0%	FINE SILT:	6.7%
(D_{75} / D_{25}):	30.51	3.043	V FINE GRAVEL:	0.0%	V FINE SILT:	7.4%
$(D_{75} - D_{25})$:	181.5	4.931	V COARSE SAND:	1.9%	CLAY:	13.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	132.8	33.84	4.793	34.48	4.858	Very Coarse Silt
SORTING (σ):	194.5	7.561	2.914	8.352	3.062	Very Poorly Sorted
SKEWNESS (Sk):	2.709	-0.363	0.367	-0.319	0.319	Very Fine Skewed
KURTOSIS (K):	12.36	1.863	1.903	0.755	0.755	Platykurtic

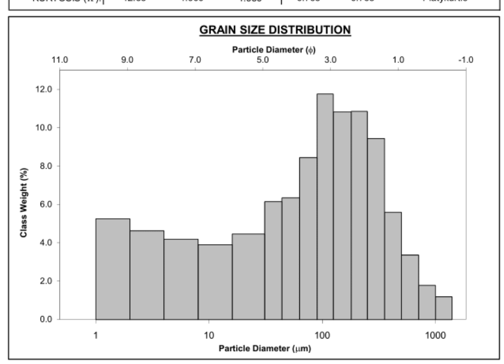


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-023** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	4.1%
MODE 2:	215.0	2.237	SAND:	50.1%	MEDIUM SAND:	11.8%
MODE 3:	1.500	9.466	MUD:	49.9%	FINE SAND:	17.0%
D_{10}:	1.520	1.497			V FINE SAND:	15.7%
MEDIAN or D_{50}:	63.09	3.986	V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.8%
D_{90}:	354.4	9.362	COARSE GRAVEL:	0.0%	COARSE SILT:	7.0%
(D_{90} / D_{10}):	233.2	6.255	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.1%
$(D_{90} - D_{10})$:	352.9	7.866	FINE GRAVEL:	0.0%	FINE SILT:	6.6%
(D_{75} / D_{25}):	28.73	2.983	V FINE GRAVEL:	0.0%	V FINE SILT:	7.3%
$(D_{75} - D_{25})$:	177.5	4.845	V COARSE SAND:	1.6%	CLAY:	13.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	133.5	34.98	4.772	35.25	4.826	Very Coarse Silt
SORTING (σ):	193.6	7.443	2.892	8.266	3.047	Very Poorly Sorted
SKEWNESS (Sk):	2.709	-0.394	0.396	-0.346	0.346	Very Fine Skewed
KURTOSIS (K):	12.35	1.900	1.930	0.768	0.768	Platykurtic



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-024** ANALYST & DATE: ,

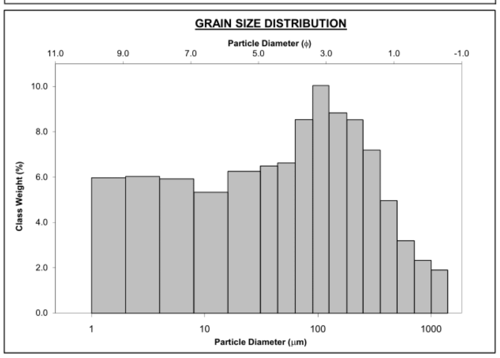
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	3.000	8.466
MODE 3:		
D_{10}:	1.491	1.468
MEDIAN or D_{50}:	35.49	4.816
D_{90}:	361.5	9.390
(D_{90} / D_{10}):	242.5	6.397
$(D_{90} - D_{10})$:	360.0	7.922
(D_{75} / D_{25}):	31.13	2.812
$(D_{75} - D_{25})$:	145.1	4.960

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	4.1%
SAND:	42.1%	MEDIUM SAND:	9.0%
MUD:	57.9%	FINE SAND:	12.8%
		V FINE SAND:	13.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.7%
COARSE GRAVEL:	0.0%	COARSE SILT:	9.2%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.9%
FINE GRAVEL:	0.0%	FINE SILT:	8.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.9%
V COARSE SAND:	2.5%	CLAY:	13.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	121.6	26.56	5.125	27.44	5.188	Coarse Silt
SORTING (σ):	208.6	7.480	2.910	8.437	3.077	Very Poorly Sorted
SKEWNESS (Sk):	2.998	-0.107	0.108	-0.137	0.137	Fine Skewed
KURTOSIS (K):	13.32	1.824	1.851	0.767	0.767	Platykurtic



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-025-DUP** ANALYST & DATE: ,

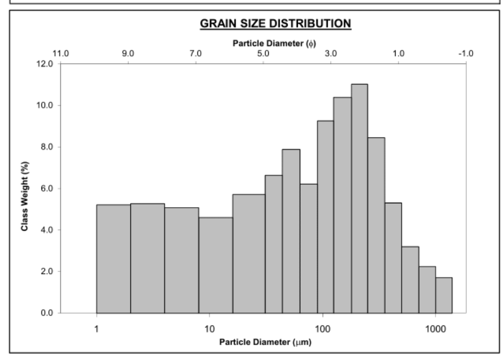
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Fine Sandy Very Coarse Silt

	μm	ϕ
MODE 1:	215.0	2.237
MODE 2:	53.50	4.247
MODE 3:	3.000	8.466
D_{10}:	1.670	1.428
MEDIAN or D_{50}:	47.74	4.389
D_{90}:	371.7	9.226
(D_{90} / D_{10}):	222.6	6.461
$(D_{90} - D_{10})$:	370.0	7.798
(D_{75} / D_{25}):	29.47	2.979
$(D_{75} - D_{25})$:	174.8	4.881

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	4.2%
SAND:	45.3%	MEDIUM SAND:	10.6%
MUD:	54.7%	FINE SAND:	16.4%
		V FINE SAND:	11.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.2%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.7%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.1%
FINE GRAVEL:	0.0%	FINE SILT:	7.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.1%
V COARSE SAND:	2.3%	CLAY:	11.8%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	132.1	32.15	4.856	32.84	4.929	Very Coarse Silt
SORTING (σ):	207.3	7.366	2.878	8.164	3.029	Very Poorly Sorted
SKEWNESS (Sk):	2.822	-0.255	0.256	-0.220	0.220	Fine Skewed
KURTOSIS (K):	12.47	1.867	1.900	0.769	0.769	Platykurtic



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-026 REPEAT** ANALYST & DATE: ,

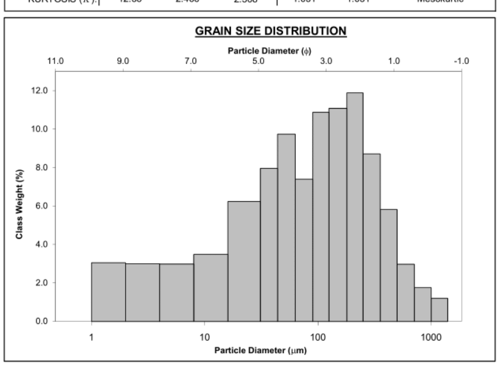
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ
MODE 1:	215.0	2.237
MODE 2:	53.50	4.247
MODE 3:	1.500	9.466
D_{10}:	2.599	1.439
MEDIAN or D_{50}:	68.49	3.868
D_{90}:	368.8	8.588
(D_{90} / D_{10}):	141.9	5.967
$(D_{90} - D_{10})$:	366.2	7.149
(D_{75} / D_{25}):	11.14	2.469
$(D_{75} - D_{25})$:	176.4	3.478

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	3.9%
SAND:	51.7%	MEDIUM SAND:	12.0%
MUD:	48.3%	FINE SAND:	18.9%
		V FINE SAND:	15.0%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.6%
COARSE GRAVEL:	0.0%	COARSE SILT:	10.2%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.7%
FINE GRAVEL:	0.0%	FINE SILT:	4.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.0%
V COARSE SAND:	1.9%	CLAY:	8.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	140.2	46.47	4.338	48.29	4.372	Very Coarse Silt
SORTING (σ):	193.5	6.096	2.587	6.496	2.700	Very Poorly Sorted
SKEWNESS (Sk):	2.734	-0.604	0.589	-0.291	0.291	Fine Skewed
KURTOSIS (K):	12.55	2.466	2.508	1.031	1.031	Mesokurtic



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-026** ANALYST & DATE: ,

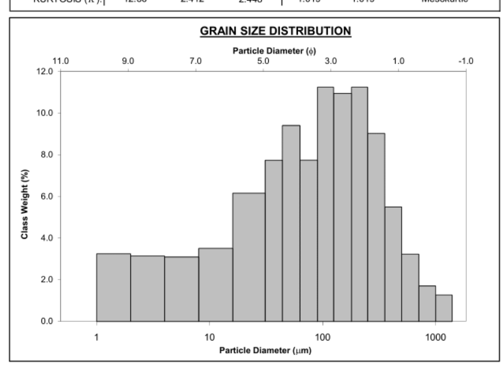
SAMPLE TYPE: Polymodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ
MODE 1:	215.0	2.237
MODE 2:	107.5	3.237
MODE 3:	53.50	4.247
D_{10}:	2.412	1.461
MEDIAN or D_{50}:	67.65	3.886
D_{90}:	363.3	8.696
(D_{90} / D_{10}):	150.6	5.952
$(D_{90} - D_{10})$:	360.9	7.235
(D_{75} / D_{25}):	11.62	2.481
$(D_{75} - D_{25})$:	174.4	3.538

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	4.1%
SAND:	51.5%	MEDIUM SAND:	12.0%
MUD:	48.5%	FINE SAND:	18.2%
		V FINE SAND:	15.5%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.1%
COARSE GRAVEL:	0.0%	COARSE SILT:	10.0%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.7%
FINE GRAVEL:	0.0%	FINE SILT:	5.1%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.2%
V COARSE SAND:	1.8%	CLAY:	8.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	139.9	45.42	4.386	46.37	4.431	Very Coarse Silt
SORTING (σ):	195.1	6.197	2.616	6.705	2.745	Very Poorly Sorted
SKEWNESS (Sk):	2.744	-0.583	0.573	-0.299	0.299	Fine Skewed
KURTOSIS (K):	12.56	2.412	2.448	1.019	1.019	Mesokurtic



SAMPLE STATISTICS

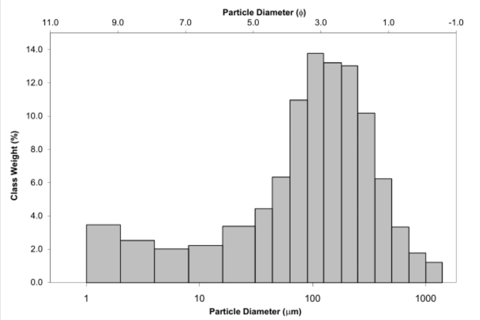
SAMPLE IDENTITY: **CLA-MW5-14D-GS-027** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	1.500	9.466
MODE 3:		
D_{10}:	1.519	1.395
MEDIAN or D_{50}:	96.64	3.371
D_{90}:	380.3	9.363
(D_{90} / D_{10}):	250.4	6.713
$(D_{90} - D_{10})$:	378.8	7.968
(D_{75} / D_{25}):	11.13	2.547
$(D_{75} - D_{25})$:	191.6	3.476

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	4.3%
SAND:	61.9%	MEDIUM SAND:	13.7%
MUD:	38.1%	FINE SAND:	21.9%
		V FINE SAND:	20.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	9.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	5.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.7%
FINE GRAVEL:	0.0%	FINE SILT:	3.4%
V FINE GRAVEL:	0.0%	V FINE SILT:	4.3%
V COARSE SAND:	1.6%	CLAY:	12.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	154.6	50.64	4.242	46.83	4.416	Very Coarse Silt
SORTING (σ):	195.3	7.009	2.794	7.413	2.890	Very Poorly Sorted
SKEWNESS (Sk):	2.569	-0.813	0.819	-0.457	0.457	Very Fine Skewed
KURTOSIS (K):	11.68	2.502	2.558	1.022	1.022	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

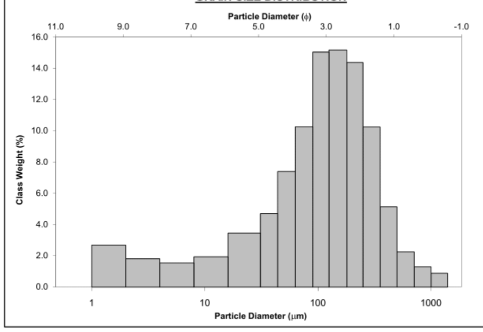
SAMPLE IDENTITY: **CLA-MW5-14D-GS-028** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Muddy Fine Sand

	μm	ϕ
MODE 1:	152.5	2.737
MODE 2:	1.500	9.466
MODE 3:		
D_{10}:	1.333	1.598
MEDIAN or D_{50}:	99.54	3.329
D_{90}:	330.4	9.551
(D_{90} / D_{10}):	247.9	5.979
$(D_{90} - D_{10})$:	329.1	7.954
(D_{75} / D_{25}):	8.194	2.299
$(D_{75} - D_{25})$:	173.9	3.035

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	3.0%
SAND:	62.7%	MEDIUM SAND:	12.9%
MUD:	37.3%	FINE SAND:	24.8%
		V FINE SAND:	20.9%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.2%
COARSE GRAVEL:	0.0%	COARSE SILT:	5.7%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.2%
FINE GRAVEL:	0.0%	FINE SILT:	2.6%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.1%
V COARSE SAND:	1.0%	CLAY:	12.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	145.7	52.56	4.226	48.23	4.374	Very Coarse Silt
SORTING (σ):	174.6	6.625	2.722	6.500	2.700	Very Poorly Sorted
SKEWNESS (Sk):	2.763	-0.963	0.965	-0.493	0.493	Very Fine Skewed
KURTOSIS (K):	14.00	2.804	2.831	1.092	1.092	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

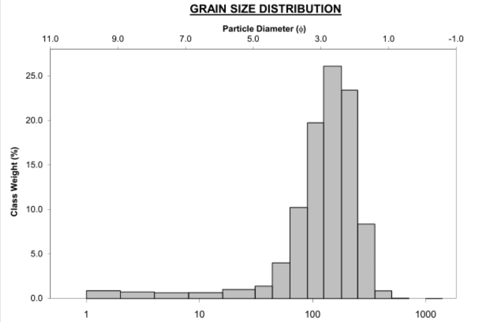
SAMPLE IDENTITY: **CLA-MW5-14D-GS-029** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ
MODE 1:	152.5	2.737
MODE 2:		
MODE 3:		
D_{10}:	34.43	2.021
MEDIAN or D_{50}:	137.4	2.863
D_{90}:	246.4	4.860
(D_{90} / D_{10}):	7.157	2.405
$(D_{90} - D_{10})$:	212.0	2.839
(D_{75} / D_{25}):	2.182	1.478
$(D_{75} - D_{25})$:	106.0	1.126

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	85.1%	MEDIUM SAND:	9.0%
MUD:	14.9%	FINE SAND:	47.8%
		V FINE SAND:	28.3%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	5.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	2.0%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.3%
FINE GRAVEL:	0.0%	FINE SILT:	1.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	1.5%
V COARSE SAND:	0.0%	CLAY:	3.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	145.5	100.4	3.316	126.4	2.984	Fine Sand
SORTING (σ):	83.65	3.326	1.734	2.643	1.402	Poorly Sorted
SKEWNESS (Sk):	0.664	-2.430	2.430	-0.425	0.425	Very Fine Skewed
KURTOSIS (K):	5.821	8.866	8.866	2.299	2.299	Very Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

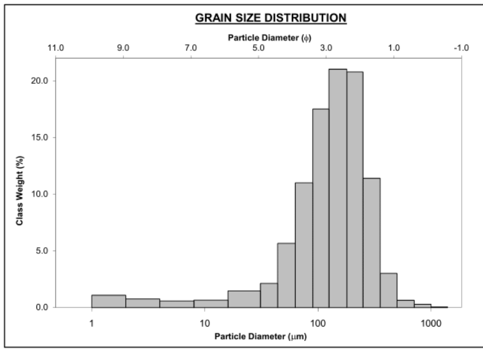
SAMPLE IDENTITY: **CLA-MW5-14D-GS-030** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ
MODE 1:	152.5	2.737
MODE 2:		
MODE 3:		
D_{10}:	21.18	1.776
MEDIAN or D_{50}:	135.0	2.889
D_{90}:	292.0	5.561
(D_{90} / D_{10}):	13.79	3.131
$(D_{90} - D_{10})$:	270.8	3.785
(D_{75} / D_{25}):	2.731	1.642
$(D_{75} - D_{25})$:	132.5	1.449

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.9%
SAND:	81.0%	MEDIUM SAND:	13.8%
MUD:	19.0%	FINE SAND:	39.6%
		V FINE SAND:	26.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	7.4%
COARSE GRAVEL:	0.0%	COARSE SILT:	2.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.3%
FINE GRAVEL:	0.0%	FINE SILT:	1.1%
V FINE GRAVEL:	0.0%	V FINE SILT:	1.5%
V COARSE SAND:	0.2%	CLAY:	5.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	153.8	94.57	3.390	119.4	3.067	Very Fine Sand
SORTING (σ):	113.3	3.889	1.949	3.227	1.690	Poorly Sorted
SKEWNESS (Sk):	1.854	-2.043	2.040	-0.438	0.438	Very Fine Skewed
KURTOSIS (K):	11.82	6.965	7.013	2.104	2.104	Very Leptokurtic

GRAIN SIZE DISTRIBUTION



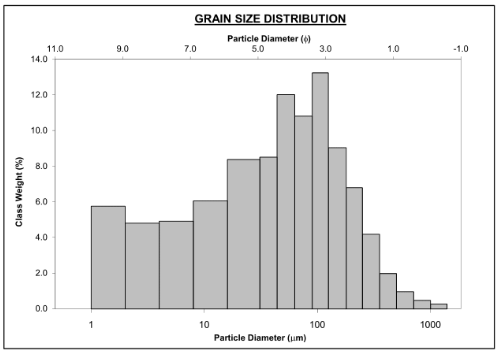
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-031** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	107.5	3.237
MODE 2:	53.50	4.247
MODE 3:	1.500	9.466
D_{10}:	1.196	2.465
MEDIAN or D_{50}:	26.86	5.218
D_{90}:	181.1	9.707
(D_{90} / D_{10}):	151.4	3.938
(D_{90} - D_{10}):	179.9	7.242
(D_{75} / D_{25}):	25.67	2.355
(D_{75} - D_{25}):	87.64	4.682

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	1.0%
SAND:	33.2%	MEDIUM SAND:	4.3%
MUD:	66.8%	FINE SAND:	11.0%
		V FINE SAND:	16.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.2%
COARSE GRAVEL:	0.0%	COARSE SILT:	11.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	8.3%
FINE GRAVEL:	0.0%	FINE SILT:	6.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	6.7%
V COARSE SAND:	0.3%	CLAY:	19.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	69.94	19.10	5.695	17.26	5.856	Coarse Silt
SORTING (σ):	115.3	6.484	2.701	6.359	2.669	Very Poorly Sorted
SKEWNESS (Sk):	4.148	-0.229	0.225	-0.170	0.170	Fine Skewed
KURTOSIS (K):	29.36	1.847	1.862	0.609	0.609	Very Platykurtic



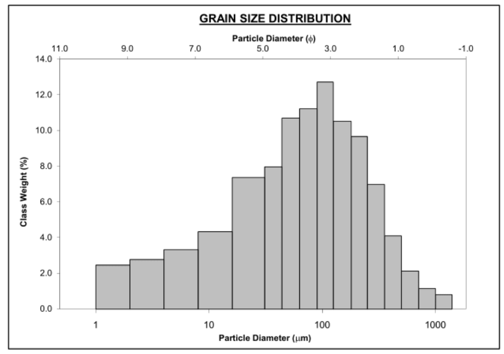
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-032** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	3.119	1.743
MEDIAN or D_{50}:	59.91	4.061
D_{90}:	298.7	8.325
(D_{90} / D_{10}):	95.77	4.776
(D_{90} - D_{10}):	295.6	6.582
(D_{75} / D_{25}):	8.907	2.151
(D_{75} - D_{25}):	132.8	3.155

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	2.7%
SAND:	48.9%	MEDIUM SAND:	9.1%
MUD:	51.1%	FINE SAND:	16.5%
		V FINE SAND:	19.5%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	15.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	11.9%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	7.0%
FINE GRAVEL:	0.0%	FINE SILT:	5.4%
V FINE GRAVEL:	0.0%	V FINE SILT:	4.5%
V COARSE SAND:	1.2%	CLAY:	7.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	117.1	42.53	4.505	45.04	4.473	Very Coarse Silt
SORTING (σ):	166.9	5.368	2.415	5.663	2.502	Very Poorly Sorted
SKEWNESS (Sk):	3.208	-0.592	0.571	-0.277	0.277	Fine Skewed
KURTOSIS (K):	16.83	2.642	2.665	1.080	1.080	Mesokurtic



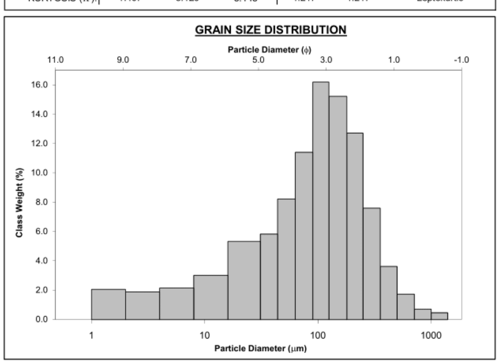
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-033** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	2.956	1.830
MEDIAN or D_{50}:	86.86	3.525
D_{90}:	281.3	8.402
(D_{90} / D_{10}):	95.18	4.592
(D_{90} - D_{10}):	278.4	6.573
(D_{75} / D_{25}):	7.257	2.111
(D_{75} - D_{25}):	144.8	2.859

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	2.1%
SAND:	59.1%	MEDIUM SAND:	9.6%
MUD:	40.9%	FINE SAND:	23.8%
		V FINE SAND:	23.1%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.9%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.1%
FINE GRAVEL:	0.0%	FINE SILT:	3.6%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.2%
V COARSE SAND:	0.5%	CLAY:	8.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	124.6	51.99	4.251	55.91	4.161	Very Coarse Silt
SORTING (σ):	147.4	5.319	2.407	5.419	2.438	Very Poorly Sorted
SKEWNESS (Sk):	2.993	-0.962	0.958	-0.455	0.455	Very Fine Skewed
KURTOSIS (K):	17.07	3.129	3.143	1.217	1.217	Leptokurtic



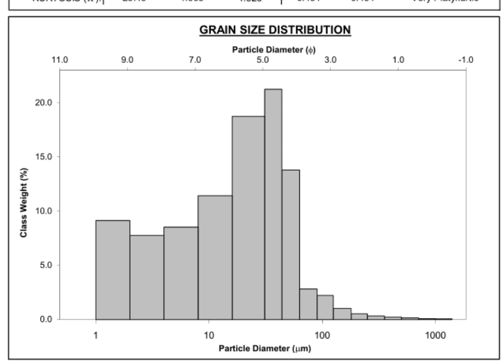
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D-GS-034** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	φ
MODE 1:	37.50	4.759
MODE 2:	1.500	9.466
MODE 3:		
D_{10}:	1.560	4.363
MEDIAN or D_{50}:	11.59	6.431
D_{90}:	48.58	9.324
(D_{90} / D_{10}):	31.14	2.137
(D_{90} - D_{10}):	47.02	4.961
(D_{75} / D_{25}):	15.10	1.775
(D_{75} - D_{25}):	28.14	3.916

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	4.4%	MEDIUM SAND:	0.3%
MUD:	95.6%	FINE SAND:	0.9%
		V FINE SAND:	3.0%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	19.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	20.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	12.6%
FINE GRAVEL:	0.0%	FINE SILT:	9.5%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.7%
V COARSE SAND:	0.1%	CLAY:	24.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	22.78	8.715	6.840	7.903	6.983	Medium Silt
SORTING (σ):	47.28	4.361	2.127	3.991	1.997	Poorly Sorted
SKEWNESS (Sk):	12.43	-0.118	0.112	-0.143	0.143	Fine Skewed
KURTOSIS (K):	237.3	1.908	1.926	0.484	0.484	Very Platykurtic

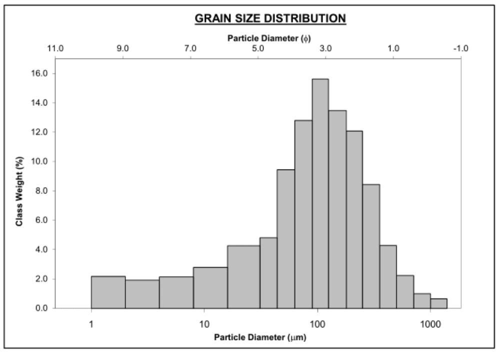


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-035** ANALYST & DATE: cm, mw, 6/28/2015
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	107.5	3.237	GRAVEL: 0.0%	COARSE SAND: 2.8%
MODE 2:			SAND: 60.8%	MEDIUM SAND: 10.9%
MODE 3:			MUD: 39.2%	FINE SAND: 21.9%
D_{10}:	2.952	1.669		V FINE SAND: 24.1%
MEDIAN or D_{50}:	88.14	3.504	V COARSE GRAVEL: 0.0%	V COARSE SILT: 12.2%
D_{90}:	314.4	8.404	COARSE GRAVEL: 0.0%	COARSE SILT: 7.2%
(D_{90} / D_{10}):	106.5	5.034	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 4.7%
$(D_{90} - D_{10})$:	311.4	6.735	FINE GRAVEL: 0.0%	FINE SILT: 3.7%
(D_{75} / D_{25}):	6.848	2.113	V FINE GRAVEL: 0.0%	V FINE SILT: 3.3%
$(D_{75} - D_{25})$:	151.7	2.776	V COARSE SAND: 1.1%	CLAY: 8.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	133.6	53.96	4.161	57.70	4.115	Very Coarse Silt
SORTING (σ):	162.8	5.503	2.444	5.623	2.491	Very Poorly Sorted
SKEWNESS (Sk):	2.914	-0.956	0.945	-0.423	0.423	Very Fine Skewed
KURTOSIS (K):	15.33	3.112	3.161	1.277	1.277	Leptokurtic

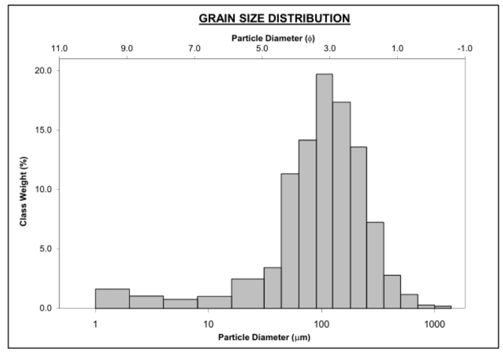


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-036** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	107.5	3.237	GRAVEL: 0.0%	COARSE SAND: 1.4%
MODE 2:			SAND: 70.3%	MEDIUM SAND: 9.3%
MODE 3:			MUD: 29.7%	FINE SAND: 28.6%
D_{10}:	8.833	1.934		V FINE SAND: 30.8%
MEDIAN or D_{50}:	102.2	3.290	V COARSE GRAVEL: 0.0%	V COARSE SILT: 13.7%
D_{90}:	261.7	6.823	COARSE GRAVEL: 0.0%	COARSE SILT: 4.5%
(D_{90} / D_{10}):	29.63	3.528	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 1.9%
$(D_{90} - D_{10})$:	252.8	4.889	FINE GRAVEL: 0.0%	FINE SILT: 1.4%
(D_{75} / D_{25}):	3.205	1.660	V FINE GRAVEL: 0.0%	V FINE SILT: 2.0%
$(D_{75} - D_{25})$:	117.8	1.680	V COARSE SAND: 0.2%	CLAY: 6.3%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	130.3	71.48	3.799	88.31	3.501	Very Fine Sand
SORTING (σ):	121.5	4.245	2.082	3.714	1.893	Poorly Sorted
SKEWNESS (Sk):	2.778	-1.606	1.603	-0.393	0.393	Very Fine Skewed
KURTOSIS (K):	17.66	5.238	5.254	1.919	1.919	Very Leptokurtic

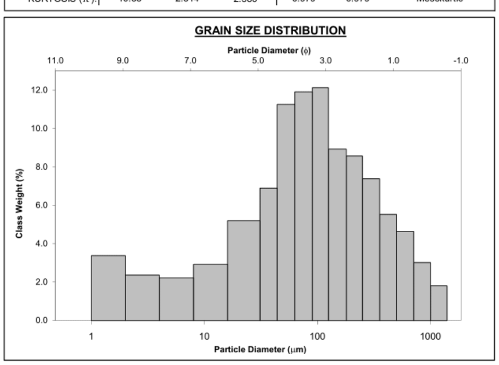


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-037 REPEAT** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	107.5	3.237	GRAVEL: 0.0%	COARSE SAND: 6.1%
MODE 2:	1.500	9.466	SAND: 51.9%	MEDIUM SAND: 10.3%
MODE 3:			MUD: 48.1%	FINE SAND: 14.0%
D_{10}:	1.264	1.167		V FINE SAND: 19.1%
MEDIAN or D_{50}:	67.03	3.899	V COARSE GRAVEL: 0.0%	V COARSE SILT: 14.5%
D_{90}:	445.2	9.628	COARSE GRAVEL: 0.0%	COARSE SILT: 8.2%
(D_{90} / D_{10}):	352.2	8.247	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 4.6%
$(D_{90} - D_{10})$:	444.0	8.460	FINE GRAVEL: 0.0%	FINE SILT: 3.6%
(D_{75} / D_{25}):	12.40	2.481	V FINE GRAVEL: 0.0%	V FINE SILT: 3.8%
$(D_{75} - D_{25})$:	168.0	3.633	V COARSE SAND: 2.4%	CLAY: 13.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	149.0	41.12	4.504	39.56	4.660	Very Coarse Silt
SORTING (σ):	221.9	7.279	2.849	7.756	2.955	Very Poorly Sorted
SKEWNESS (Sk):	2.581	-0.572	0.577	-0.285	0.285	Fine Skewed
KURTOSIS (K):	10.35	2.314	2.380	0.979	0.979	Mesokurtic

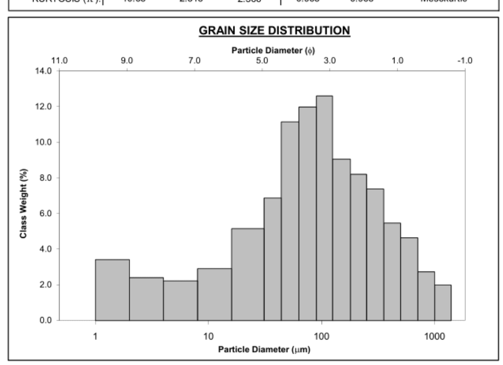


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-037** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	107.5	3.237	GRAVEL: 0.0%	COARSE SAND: 5.9%
MODE 2:	1.500	9.466	SAND: 51.8%	MEDIUM SAND: 10.3%
MODE 3:			MUD: 48.2%	FINE SAND: 13.8%
D_{10}:	1.236	1.201		V FINE SAND: 19.5%
MEDIAN or D_{50}:	66.80	3.904	V COARSE GRAVEL: 0.0%	V COARSE SILT: 14.4%
D_{90}:	435.0	9.661	COARSE GRAVEL: 0.0%	COARSE SILT: 8.1%
(D_{90} / D_{10}):	352.1	8.045	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 4.6%
$(D_{90} - D_{10})$:	433.8	8.460	FINE GRAVEL: 0.0%	FINE SILT: 3.6%
(D_{75} / D_{25}):	12.54	2.462	V FINE GRAVEL: 0.0%	V FINE SILT: 3.9%
$(D_{75} - D_{25})$:	163.3	3.648	V COARSE SAND: 2.3%	CLAY: 13.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	148.5	40.93	4.530	38.65	4.693	Very Coarse Silt
SORTING (σ):	222.8	7.273	2.851	7.761	2.956	Very Poorly Sorted
SKEWNESS (Sk):	2.633	-0.571	0.575	-0.291	0.291	Fine Skewed
KURTOSIS (K):	10.68	2.313	2.366	0.968	0.968	Mesokurtic



SAMPLE STATISTICS

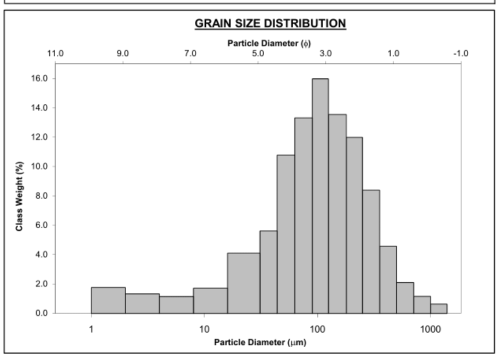
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-038** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	7.753	1.623
MEDIAN or D_{50}:	95.15	3.394
D_{90}:	324.6	7.011
(D_{90} / D_{10}):	41.87	4.319
$(D_{90} - D_{10})$:	316.9	5.388
(D_{75} / D_{25}):	4.310	1.866
$(D_{75} - D_{25})$:	142.3	2.108

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.9%
SAND:	64.8%	MEDIUM SAND:	11.7%
MUD:	35.2%	FINE SAND:	23.0%
		V FINE SAND:	26.1%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.8%
COARSE GRAVEL:	0.0%	COARSE SILT:	7.3%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.1%
FINE GRAVEL:	0.0%	FINE SILT:	2.1%
V FINE GRAVEL:	0.0%	V FINE SILT:	2.4%
V COARSE SAND:	1.0%	CLAY:	5.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	142.7	67.68	3.837	78.86	3.665	Very Fine Sand
SORTING (σ):	164.5	4.597	2.176	4.318	2.110	Very Poorly Sorted
SKEWNESS (Sk):	2.891	-1.182	1.156	-0.331	0.331	Very Fine Skewed
KURTOSIS (K):	14.91	4.129	4.173	1.563	1.563	Very Leptokurtic



SAMPLE STATISTICS

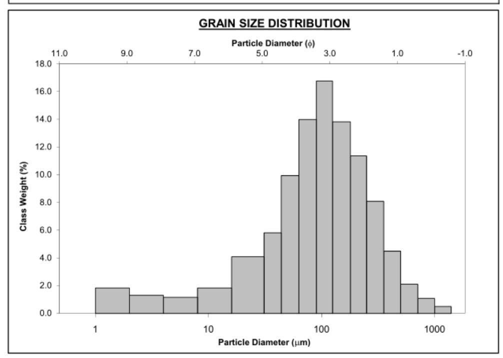
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-039 REPEAT** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	6.617	1.658
MEDIAN or D_{50}:	93.83	3.414
D_{90}:	316.8	7.240
(D_{90} / D_{10}):	47.87	4.365
$(D_{90} - D_{10})$:	310.2	5.581
(D_{75} / D_{25}):	4.353	1.852
$(D_{75} - D_{25})$:	137.0	2.122

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.9%
SAND:	64.9%	MEDIUM SAND:	11.3%
MUD:	35.1%	FINE SAND:	22.6%
		V FINE SAND:	27.3%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.1%
COARSE GRAVEL:	0.0%	COARSE SILT:	7.2%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.3%
FINE GRAVEL:	0.0%	FINE SILT:	2.1%
V FINE GRAVEL:	0.0%	V FINE SILT:	2.4%
V COARSE SAND:	0.8%	CLAY:	6.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	139.0	65.72	3.893	76.23	3.714	Very Fine Sand
SORTING (σ):	158.7	4.650	2.201	4.406	2.140	Very Poorly Sorted
SKEWNESS (Sk):	2.850	-1.188	1.172	-0.348	0.348	Very Fine Skewed
KURTOSIS (K):	14.77	4.082	4.118	1.573	1.573	Very Leptokurtic



SAMPLE STATISTICS

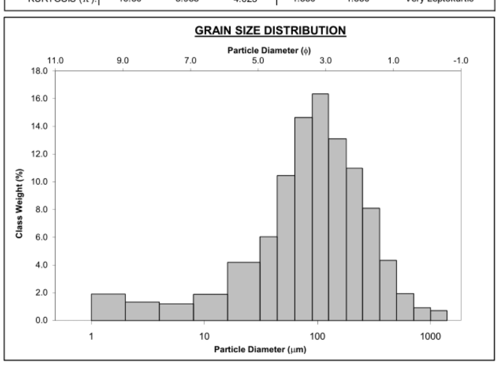
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-039** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	5.997	1.675
MEDIAN or D_{50}:	90.13	3.472
D_{90}:	313.2	7.381
(D_{90} / D_{10}):	52.22	4.407
$(D_{90} - D_{10})$:	307.2	5.707
(D_{75} / D_{25}):	4.473	1.858
$(D_{75} - D_{25})$:	135.6	2.161

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.6%
SAND:	63.7%	MEDIUM SAND:	11.1%
MUD:	36.3%	FINE SAND:	21.6%
		V FINE SAND:	27.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.8%
COARSE GRAVEL:	0.0%	COARSE SILT:	7.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.3%
FINE GRAVEL:	0.0%	FINE SILT:	2.2%
V FINE GRAVEL:	0.0%	V FINE SILT:	2.4%
V COARSE SAND:	1.0%	CLAY:	6.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	137.0	63.59	3.940	73.92	3.758	Very Fine Sand
SORTING (σ):	162.1	4.699	2.216	4.456	2.156	Very Poorly Sorted
SKEWNESS (Sk):	3.068	-1.152	1.134	-0.337	0.337	Very Fine Skewed
KURTOSIS (K):	16.50	3.988	4.025	1.550	1.550	Very Leptokurtic



SAMPLE STATISTICS

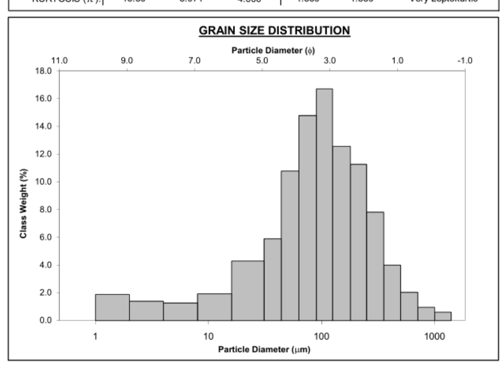
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-040** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	5.844	1.708
MEDIAN or D_{50}:	88.67	3.495
D_{90}:	306.1	7.419
(D_{90} / D_{10}):	52.38	4.343
$(D_{90} - D_{10})$:	300.2	5.711
(D_{75} / D_{25}):	4.490	1.854
$(D_{75} - D_{25})$:	133.9	2.167

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.7%
SAND:	63.2%	MEDIUM SAND:	10.6%
MUD:	36.8%	FINE SAND:	21.3%
		V FINE SAND:	27.9%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	7.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.4%
FINE GRAVEL:	0.0%	FINE SILT:	2.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	2.5%
V COARSE SAND:	0.8%	CLAY:	6.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	134.7	62.78	3.965	72.50	3.786	Very Fine Sand
SORTING (σ):	158.8	4.663	2.208	4.438	2.150	Very Poorly Sorted
SKEWNESS (Sk):	3.039	-1.143	1.129	-0.338	0.338	Very Fine Skewed
KURTOSIS (K):	16.30	3.971	4.000	1.539	1.539	Very Leptokurtic



SAMPLE STATISTICS

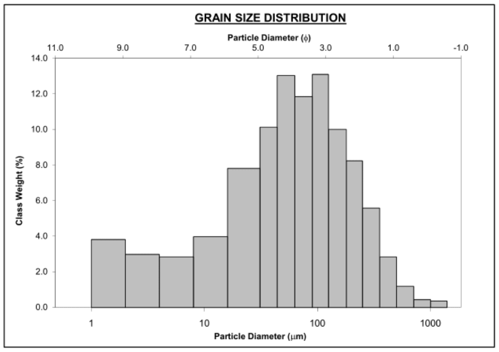
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-041** ANALYST & DATE: ,

SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	1.3%
MODE 2:	53.50	4.247	SAND:	42.9%	MEDIUM SAND:	6.7%
MODE 3:	1.500	9.466	MUD:	57.1%	FINE SAND:	14.6%
D_{10}:	1.779	2.113			V FINE SAND:	19.8%
MEDIAN or D_{50}:	49.28	4.343	V COARSE GRAVEL:	0.0%	V COARSE SILT:	18.4%
D_{90}:	231.2	9.135	COARSE GRAVEL:	0.0%	COARSE SILT:	12.3%
(D_{90} / D_{10}):	130.0	4.323	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.3%
$(D_{90} - D_{10})$:	229.4	7.022	FINE GRAVEL:	0.0%	FINE SILT:	4.5%
(D_{75} / D_{25}):	8.765	2.013	V FINE GRAVEL:	0.0%	V FINE SILT:	4.8%
$(D_{75} - D_{25})$:	103.9	3.132	V COARSE SAND:	0.5%	CLAY:	10.8%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	92.38	33.63	4.874	32.63	4.937	Very Coarse Silt
SORTING (σ):	129.8	5.493	2.457	6.089	2.606	Very Poorly Sorted
SKEWNESS (Sk):	3.593	-0.623	0.615	-0.338	0.338	Very Fine Skewed
KURTOSIS (K):	22.99	2.517	2.535	1.093	1.093	Mesokurtic



SAMPLE STATISTICS

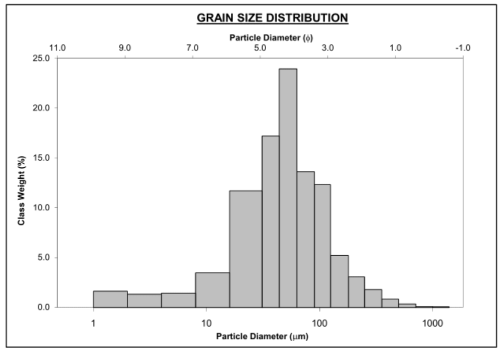
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-042** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	0.4%
MODE 2:			SAND:	31.8%	MEDIUM SAND:	2.2%
MODE 3:			MUD:	68.2%	FINE SAND:	7.1%
D_{10}:	9.327	3.008			V FINE SAND:	22.0%
MEDIAN or D_{50}:	45.67	4.453	V COARSE GRAVEL:	0.0%	V COARSE SILT:	34.5%
D_{90}:	124.3	6.744	COARSE GRAVEL:	0.0%	COARSE SILT:	19.3%
(D_{90} / D_{10}):	13.33	2.242	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.7%
$(D_{90} - D_{10})$:	115.0	3.736	FINE GRAVEL:	0.0%	FINE SILT:	2.4%
(D_{75} / D_{25}):	3.304	1.465	V FINE GRAVEL:	0.0%	V FINE SILT:	2.3%
$(D_{75} - D_{25})$:	53.31	1.724	V COARSE SAND:	0.1%	CLAY:	3.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	64.85	37.86	4.716	42.75	4.548	Very Coarse Silt
SORTING (σ):	78.72	3.187	1.671	2.976	1.574	Poorly Sorted
SKEWNESS (Sk):	5.249	-1.012	0.987	-0.224	0.224	Fine Skewed
KURTOSIS (K):	50.89	4.700	4.707	1.451	1.451	Leptokurtic



SAMPLE STATISTICS

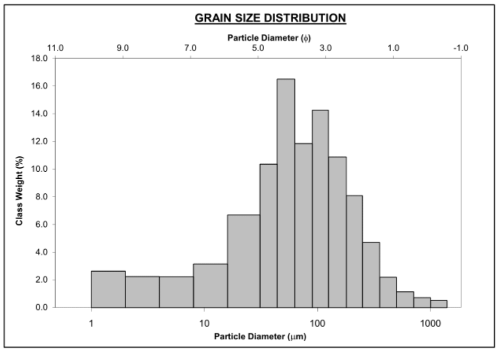
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-043** ANALYST & DATE: ,

SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	1.6%
MODE 2:	107.5	3.237	SAND:	46.3%	MEDIUM SAND:	5.8%
MODE 3:	1.500	9.466	MUD:	53.7%	FINE SAND:	16.1%
D_{10}:	3.328	2.134			V FINE SAND:	22.0%
MEDIAN or D_{50}:	56.94	4.135	V COARSE GRAVEL:	0.0%	V COARSE SILT:	22.7%
D_{90}:	227.8	8.231	COARSE GRAVEL:	0.0%	COARSE SILT:	11.1%
(D_{90} / D_{10}):	68.44	3.857	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.3%
$(D_{90} - D_{10})$:	224.5	6.097	FINE GRAVEL:	0.0%	FINE SILT:	3.8%
(D_{75} / D_{25}):	5.656	1.825	V FINE GRAVEL:	0.0%	V FINE SILT:	3.8%
$(D_{75} - D_{25})$:	100.8	2.500	V COARSE SAND:	0.7%	CLAY:	7.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	99.57	42.50	4.526	45.05	4.472	Very Coarse Silt
SORTING (σ):	138.2	4.701	2.227	4.716	2.238	Very Poorly Sorted
SKEWNESS (Sk):	3.972	-0.813	0.791	-0.299	0.299	Fine Skewed
KURTOSIS (K):	25.43	3.189	3.213	1.289	1.289	Leptokurtic



SAMPLE STATISTICS

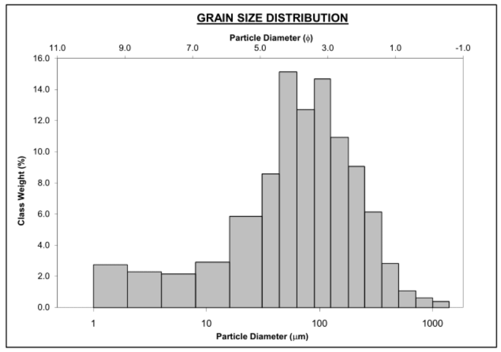
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-044-DUP** ANALYST & DATE: ,

SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud

SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	1.5%
MODE 2:	107.5	3.237	SAND:	49.9%	MEDIUM SAND:	7.6%
MODE 3:	1.500	9.466	MUD:	50.1%	FINE SAND:	17.0%
D_{10}:	2.920	2.017			V FINE SAND:	23.1%
MEDIAN or D_{50}:	62.26	4.005	V COARSE GRAVEL:	0.0%	V COARSE SILT:	20.1%
D_{90}:	247.1	8.420	COARSE GRAVEL:	0.0%	COARSE SILT:	9.8%
(D_{90} / D_{10}):	84.63	4.174	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.9%
$(D_{90} - D_{10})$:	244.1	6.403	FINE GRAVEL:	0.0%	FINE SILT:	3.7%
(D_{75} / D_{25}):	6.037	1.893	V FINE GRAVEL:	0.0%	V FINE SILT:	3.9%
$(D_{75} - D_{25})$:	111.3	2.594	V COARSE SAND:	0.7%	CLAY:	7.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	104.8	44.17	4.468	46.65	4.422	Very Coarse Silt
SORTING (σ):	135.3	4.948	2.300	5.024	2.329	Very Poorly Sorted
SKEWNESS (Sk):	3.511	-0.860	0.842	-0.334	0.334	Very Fine Skewed
KURTOSIS (K):	21.88	3.095	3.123	1.270	1.270	Leptokurtic



SAMPLE STATISTICS

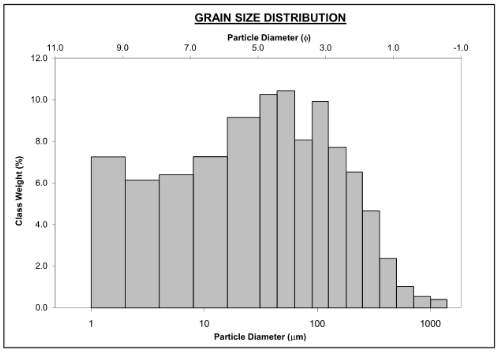
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-045** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ
MODE 1:	53.50	4.247
MODE 2:	107.5	3.237
MODE 3:	1.500	9.466
D_{10}:	1.176	2.404
MEDIAN or D_{50}:	21.12	5.565
D_{90}:	189.0	9.731
(D_{90} / D_{10}):	160.7	4.049
$(D_{90} - D_{10})$:	187.8	7.328
(D_{75} / D_{25}):	21.38	2.201
$(D_{75} - D_{25})$:	74.37	4.419

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	1.1%
SAND:	28.6%	MEDIUM SAND:	4.9%
MUD:	71.4%	FINE SAND:	9.9%
		V FINE SAND:	12.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	12.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	10.0%
FINE GRAVEL:	0.0%	FINE SILT:	8.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	8.5%
V COARSE SAND:	0.4%	CLAY:	17.3%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	68.34	17.74	5.804	16.84	5.892	Coarse Silt
SORTING (σ):	123.8	6.152	2.625	6.382	2.674	Very Poorly Sorted
SKEWNESS (Sk):	4.274	-0.053	0.048	-0.076	0.076	Symmetrical
KURTOSIS (K):	29.44	1.919	1.931	0.695	0.695	Platykurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

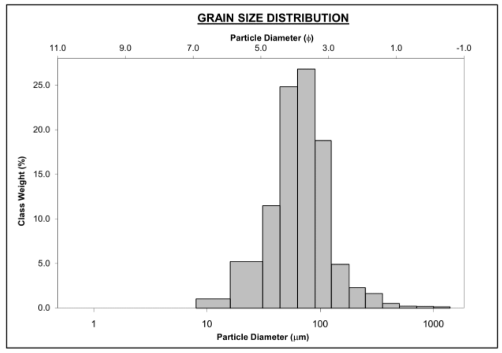
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-046** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	27.92	3.007
MEDIAN or D_{50}:	65.60	3.930
D_{90}:	124.4	5.162
(D_{90} / D_{10}):	4.456	1.717
$(D_{90} - D_{10})$:	96.51	2.156
(D_{75} / D_{25}):	2.040	1.300
$(D_{75} - D_{25})$:	47.44	1.029

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.4%
SAND:	53.5%	MEDIUM SAND:	2.1%
MUD:	46.5%	FINE SAND:	7.0%
		V FINE SAND:	43.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	34.7%
COARSE GRAVEL:	0.0%	COARSE SILT:	9.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.9%
FINE GRAVEL:	0.0%	FINE SILT:	0.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.2%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	81.74	63.73	3.962	63.81	3.970	Very Fine Sand
SORTING (σ):	80.85	1.932	0.940	1.852	0.889	Moderately Sorted
SKEWNESS (Sk):	6.896	-0.093	-0.202	-0.083	0.083	Symmetrical
KURTOSIS (K):	75.67	5.753	4.694	1.265	1.265	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

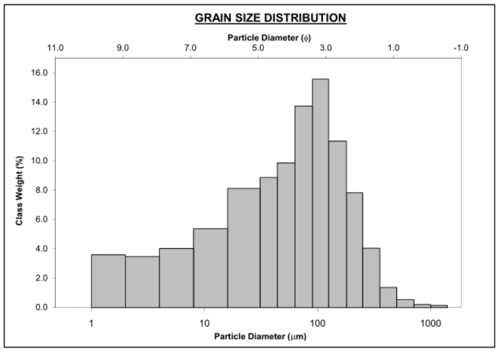
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-047** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	1.500	9.466
MODE 3:		
D_{10}:	2.043	2.400
MEDIAN or D_{50}:	45.70	4.452
D_{90}:	189.4	8.935
(D_{90} / D_{10}):	92.72	3.722
$(D_{90} - D_{10})$:	187.4	6.535
(D_{75} / D_{25}):	10.30	2.053
$(D_{75} - D_{25})$:	98.58	3.365

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.6%
SAND:	43.0%	MEDIUM SAND:	4.3%
MUD:	57.0%	FINE SAND:	15.1%
		V FINE SAND:	22.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.7%
COARSE GRAVEL:	0.0%	COARSE SILT:	12.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	8.3%
FINE GRAVEL:	0.0%	FINE SILT:	6.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.4%
V COARSE SAND:	0.2%	CLAY:	9.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	78.73	30.75	5.013	30.80	5.021	Coarse Silt
SORTING (σ):	101.9	5.144	2.363	5.501	2.460	Very Poorly Sorted
SKEWNESS (Sk):	3.656	-0.598	0.592	-0.353	0.353	Very Fine Skewed
KURTOSIS (K):	27.87	2.401	2.412	0.955	0.955	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

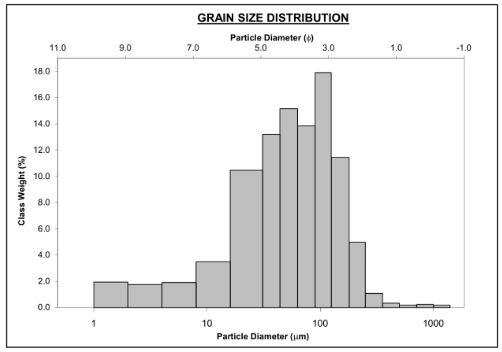
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-048** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	53.50	4.247
MODE 3:		
D_{10}:	6.329	2.690
MEDIAN or D_{50}:	50.70	4.302
D_{90}:	154.9	7.304
(D_{90} / D_{10}):	24.48	2.715
$(D_{90} - D_{10})$:	148.6	4.613
(D_{75} / D_{25}):	4.605	1.667
$(D_{75} - D_{25})$:	79.33	2.203

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.4%
SAND:	42.3%	MEDIUM SAND:	1.2%
MUD:	57.7%	FINE SAND:	14.0%
		V FINE SAND:	26.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	23.7%
COARSE GRAVEL:	0.0%	COARSE SILT:	17.2%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.8%
FINE GRAVEL:	0.0%	FINE SILT:	3.2%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.0%
V COARSE SAND:	0.3%	CLAY:	4.8%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	73.05	39.69	4.639	44.90	4.477	Very Coarse Silt
SORTING (σ):	86.46	3.649	1.865	3.426	1.776	Poorly Sorted
SKEWNESS (Sk):	5.788	-1.014	0.983	-0.290	0.290	Fine Skewed
KURTOSIS (K):	61.86	3.908	3.922	1.222	1.222	Leptokurtic

GRAIN SIZE DISTRIBUTION

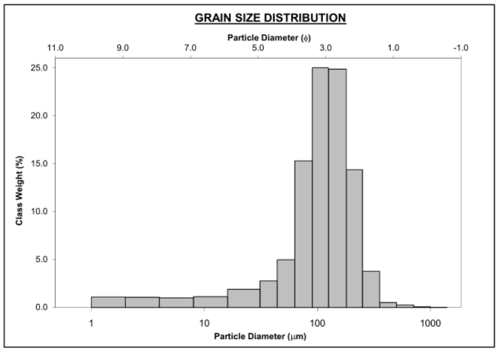


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-049** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	0.3%
MODE 2:			SAND:	79.5%	MEDIUM SAND:	4.1%
MODE 3:			MUD:	20.5%	FINE SAND:	37.6%
D_{10}:	17.23	2.203			V FINE SAND:	37.4%
MEDIAN or D_{50}:	111.3	3.167	V COARSE GRAVEL:	0.0%	V COARSE SILT:	7.4%
D_{90}:	217.1	5.859	COARSE GRAVEL:	0.0%	COARSE SILT:	3.6%
(D_{90} / D_{10}):	12.60	2.659	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.1%
$(D_{90} - D_{10})$:	199.9	3.655	FINE GRAVEL:	0.0%	FINE SILT:	1.9%
(D_{75} / D_{25}):	2.297	1.455	V FINE GRAVEL:	0.0%	V FINE SILT:	2.0%
$(D_{75} - D_{25})$:	90.81	1.200	V COARSE SAND:	0.0%	CLAY:	3.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	121.4	80.48	3.635	97.70	3.355	Very Fine Sand
SORTING (σ):	81.55	3.365	1.750	2.743	1.456	Poorly Sorted
SKEWNESS (Sk):	1.980	-2.044	2.044	-0.453	0.453	Very Fine Skewed
KURTOSIS (K):	16.54	7.030	7.030	2.126	2.126	Very Leptokurtic

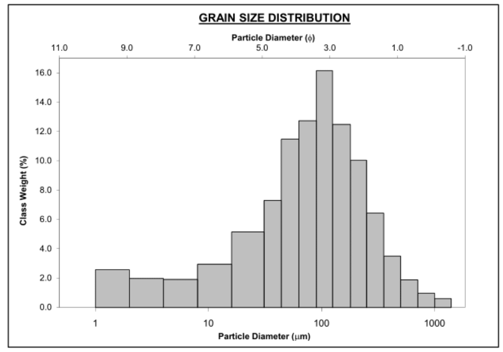


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-050** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	2.5%
MODE 2:	1.500	9.466	SAND:	55.9%	MEDIUM SAND:	8.5%
MODE 3:			MUD:	44.1%	FINE SAND:	19.4%
D_{10}:	3.184	1.815			V FINE SAND:	24.5%
MEDIAN or D_{50}:	75.48	3.728	V COARSE GRAVEL:	0.0%	V COARSE SILT:	16.1%
D_{90}:	284.2	8.295	COARSE GRAVEL:	0.0%	COARSE SILT:	8.7%
(D_{90} / D_{10}):	89.27	4.570	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.0%
$(D_{90} - D_{10})$:	281.0	6.480	FINE GRAVEL:	0.0%	FINE SILT:	3.3%
(D_{75} / D_{25}):	6.214	1.976	V FINE GRAVEL:	0.0%	V FINE SILT:	3.4%
$(D_{75} - D_{25})$:	129.1	2.636	V COARSE SAND:	1.0%	CLAY:	7.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	120.6	49.66	4.278	54.32	4.202	Very Coarse Silt
SORTING (σ):	155.8	5.154	2.350	5.159	2.367	Very Poorly Sorted
SKEWNESS (Sk):	3.257	-0.900	0.879	-0.364	0.364	Very Fine Skewed
KURTOSIS (K):	17.95	3.162	3.208	1.296	1.296	Leptokurtic

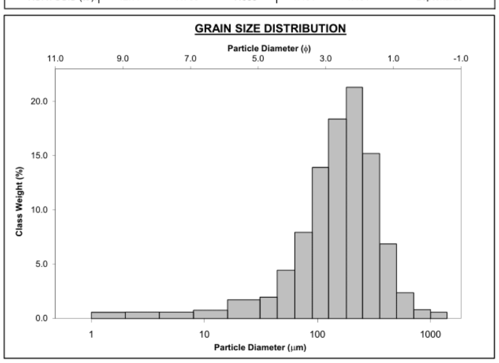


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-051** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	215.0	2.237	GRAVEL:	0.0%	COARSE SAND:	3.2%
MODE 2:			SAND:	85.1%	MEDIUM SAND:	21.6%
MODE 3:			MUD:	14.9%	FINE SAND:	38.5%
D_{10}:	39.91	1.445			V FINE SAND:	20.9%
MEDIAN or D_{50}:	164.3	2.605	V COARSE GRAVEL:	0.0%	V COARSE SILT:	6.3%
D_{90}:	367.2	4.647	COARSE GRAVEL:	0.0%	COARSE SILT:	3.3%
(D_{90} / D_{10}):	9.201	3.215	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.5%
$(D_{90} - D_{10})$:	327.3	3.202	FINE GRAVEL:	0.0%	FINE SILT:	1.2%
(D_{75} / D_{25}):	2.680	1.719	V FINE GRAVEL:	0.0%	V FINE SILT:	1.2%
$(D_{75} - D_{25})$:	159.1	1.422	V COARSE SAND:	0.9%	CLAY:	1.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	196.4	129.0	2.921	150.2	2.735	Fine Sand
SORTING (σ):	158.8	3.164	1.621	2.534	1.341	Poorly Sorted
SKEWNESS (Sk):	2.358	-1.906	1.829	-0.288	0.288	Fine Skewed
KURTOSIS (K):	12.77	7.788	7.633	1.481	1.481	Leptokurtic

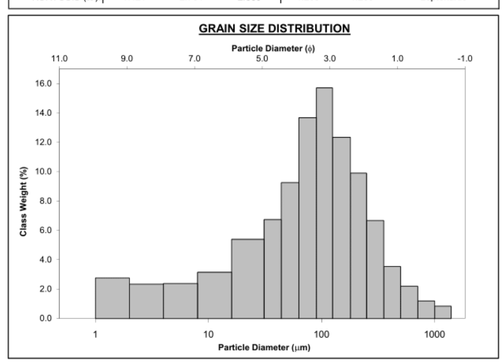


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-052** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	2.8%
MODE 2:	1.500	9.466	SAND:	55.5%	MEDIUM SAND:	8.5%
MODE 3:			MUD:	44.5%	FINE SAND:	18.6%
D_{10}:	2.259	1.754			V FINE SAND:	24.2%
MEDIAN or D_{50}:	74.21	3.752	V COARSE GRAVEL:	0.0%	V COARSE SILT:	13.3%
D_{90}:	296.4	8.790	COARSE GRAVEL:	0.0%	COARSE SILT:	8.9%
(D_{90} / D_{10}):	131.2	5.010	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.2%
$(D_{90} - D_{10})$:	294.1	7.036	FINE GRAVEL:	0.0%	FINE SILT:	4.0%
(D_{75} / D_{25}):	7.932	2.110	V FINE GRAVEL:	0.0%	V FINE SILT:	3.9%
$(D_{75} - D_{25})$:	135.2	2.988	V COARSE SAND:	1.4%	CLAY:	9.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	122.3	45.06	4.405	47.19	4.405	Very Coarse Silt
SORTING (σ):	167.3	5.726	2.503	6.041	2.595	Very Poorly Sorted
SKEWNESS (Sk):	3.257	-0.785	0.770	-0.395	0.395	Very Fine Skewed
KURTOSIS (K):	17.21	2.784	2.839	1.203	1.203	Leptokurtic



SAMPLE STATISTICS

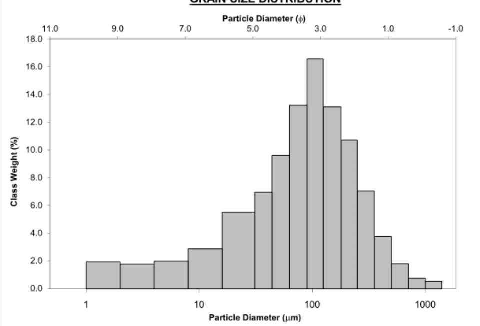
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-053** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	107.5	3.237
MODE 2:		
MODE 3:		
D_{10}:	4.629	1.809
MEDIAN or D_{50}:	81.36	3.620
D_{90}:	285.3	7.755
(D_{90} / D_{10}):	61.64	4.286
(D_{90} - D_{10}):	280.7	5.946
(D_{75} / D_{25}):	5.893	1.968
(D_{75} - D_{25}):	132.8	2.559

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	2.2%
SAND:	58.6%	MEDIUM SAND:	9.4%
MUD:	41.4%	FINE SAND:	20.7%
		V FINE SAND:	25.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	14.4%
COARSE GRAVEL:	0.0%	COARSE SILT:	9.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.9%
FINE GRAVEL:	0.0%	FINE SILT:	3.4%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.1%
V COARSE SAND:	0.7%	CLAY:	6.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	123.8	54.90	4.163	60.71	4.042	Very Coarse Silt
SORTING (σ):	150.9	4.780	2.248	4.725	2.240	Very Poorly Sorted
SKEWNESS (Sk):	3.138	-0.963	0.949	-0.366	0.366	Very Fine Skewed
KURTOSIS (K):	17.65	3.420	3.437	1.282	1.282	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

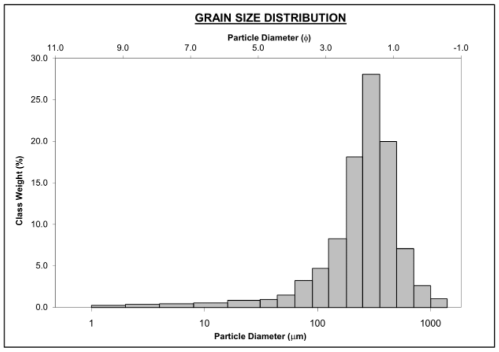
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-054** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Sand
SEDIMENT NAME: Poorly Sorted Medium Sand

	μm	φ
MODE 1:	302.5	1.747
MODE 2:		
MODE 3:		
D_{10}:	81.61	0.925
MEDIAN or D_{50}:	279.2	1.841
D_{90}:	526.6	3.615
(D_{90} / D_{10}):	6.453	3.907
(D_{90} - D_{10}):	445.0	2.690
(D_{75} / D_{25}):	2.137	1.811
(D_{75} - D_{25}):	208.6	1.096

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	9.7%
SAND:	92.4%	MEDIUM SAND:	47.8%
MUD:	7.6%	FINE SAND:	25.7%
		V FINE SAND:	7.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	2.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	1.7%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.1%
FINE GRAVEL:	0.0%	FINE SILT:	0.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.8%
V COARSE SAND:	1.3%	CLAY:	0.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	305.8	220.4	2.150	254.3	1.975	Medium Sand
SORTING (σ):	196.3	2.859	1.456	2.203	1.139	Poorly Sorted
SKEWNESS (Sk):	1.430	-2.456	2.343	-0.327	0.327	Very Fine Skewed
KURTOSIS (K):	6.875	10.91	10.45	1.679	1.679	Very Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

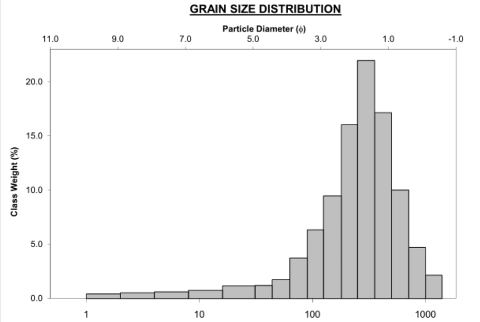
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-055** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Medium Sand

	μm	φ
MODE 1:	302.5	1.747
MODE 2:		
MODE 3:		
D_{10}:	61.65	0.608
MEDIAN or D_{50}:	274.6	1.865
D_{90}:	656.2	4.020
(D_{90} / D_{10}):	10.64	6.615
(D_{90} - D_{10}):	594.6	3.412
(D_{75} / D_{25}):	2.816	2.224
(D_{75} - D_{25}):	276.8	1.494

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	14.4%
SAND:	89.9%	MEDIUM SAND:	38.1%
MUD:	10.1%	FINE SAND:	24.5%
		V FINE SAND:	9.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	2.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	2.3%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.5%
FINE GRAVEL:	0.0%	FINE SILT:	1.2%
V FINE GRAVEL:	0.0%	V FINE SILT:	1.1%
V COARSE SAND:	3.2%	CLAY:	1.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	317.0	195.9	2.232	245.4	2.027	Fine Sand
SORTING (σ):	241.4	3.749	1.730	2.765	1.467	Poorly Sorted
SKEWNESS (Sk):	1.355	-2.095	1.960	-0.311	0.311	Very Fine Skewed
KURTOSIS (K):	5.349	8.024	7.897	1.577	1.577	Very Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

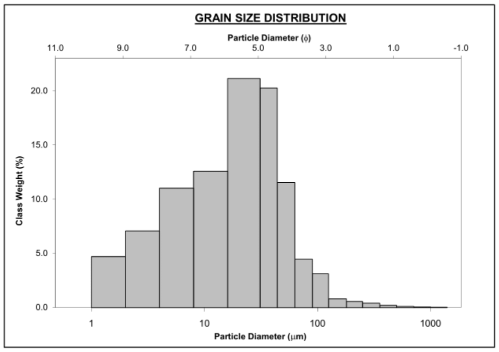
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-056** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	φ
MODE 1:	23.50	5.489
MODE 2:		
MODE 3:		
D_{10}:	2.386	4.236
MEDIAN or D_{50}:	17.27	5.856
D_{90}:	53.05	8.711
(D_{90} / D_{10}):	22.23	2.056
(D_{90} - D_{10}):	50.67	4.475
(D_{75} / D_{25}):	5.474	1.497
(D_{75} - D_{25}):	26.81	2.453

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	6.5%	MEDIUM SAND:	0.4%
MUD:	93.5%	FINE SAND:	0.9%
		V FINE SAND:	5.0%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	20.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	26.7%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	16.1%
FINE GRAVEL:	0.0%	FINE SILT:	14.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	9.0%
V COARSE SAND:	0.0%	CLAY:	7.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	26.72	13.84	6.173	13.96	6.163	Medium Silt
SORTING (σ):	44.93	3.246	1.700	3.302	1.723	Poorly Sorted
SKEWNESS (Sk):	11.11	-0.291	0.283	-0.262	0.262	Fine Skewed
KURTOSIS (K):	207.5	2.726	2.748	0.945	0.945	Mesokurtic

GRAIN SIZE DISTRIBUTION



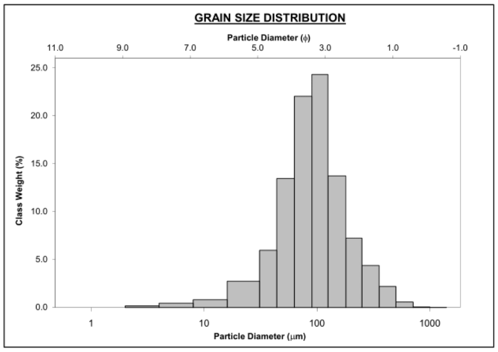
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-057** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	0.6%
MODE 2:			SAND:	72.8%	MEDIUM SAND:	6.5%
MODE 3:			MUD:	27.2%	FINE SAND:	20.8%
D_{10}:	34.99	2.204			V FINE SAND:	44.9%
MEDIAN or D_{50}:	90.55	3.465	V COARSE GRAVEL:	0.0%	V COARSE SILT:	19.1%
D_{90}:	217.1	4.837	COARSE GRAVEL:	0.0%	COARSE SILT:	5.3%
(D_{90} / D_{10}):	6.205	2.195	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.6%
$(D_{90} - D_{10})$:	182.1	2.633	FINE GRAVEL:	0.0%	FINE SILT:	0.9%
(D_{75} / D_{25}):	2.283	1.412	V FINE GRAVEL:	0.0%	V FINE SILT:	0.3%
$(D_{75} - D_{25})$:	75.78	1.191	V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS Arithmetic μm	Geometric μm	Logarithmic ϕ	FOLK & WARD METHOD Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	114.4	86.27	3.535	89.52	3.482	Very Fine Sand
SORTING (σ):	91.39	2.168	1.117	2.063	1.045	Poorly Sorted
SKEWNESS (Sk):	2.660	-0.727	0.727	-0.064	0.064	Symmetrical
KURTOSIS (K):	14.92	5.123	5.123	1.311	1.311	Leptokurtic

GRAIN SIZE DISTRIBUTION



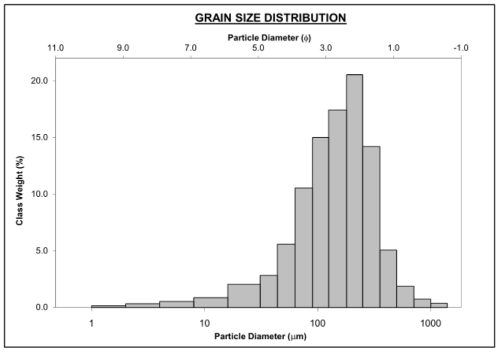
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-058** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	215.0	2.237	GRAVEL:	0.0%	COARSE SAND:	2.6%
MODE 2:			SAND:	84.0%	MEDIUM SAND:	19.0%
MODE 3:			MUD:	16.0%	FINE SAND:	37.1%
D_{10}:	41.82	1.565			V FINE SAND:	24.8%
MEDIAN or D_{50}:	150.8	2.729	V COARSE GRAVEL:	0.0%	V COARSE SILT:	8.3%
D_{90}:	337.9	4.580	COARSE GRAVEL:	0.0%	COARSE SILT:	4.0%
(D_{90} / D_{10}):	8.080	2.926	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.7%
$(D_{90} - D_{10})$:	296.1	3.014	FINE GRAVEL:	0.0%	FINE SILT:	1.0%
(D_{75} / D_{25}):	2.804	1.718	V FINE GRAVEL:	0.0%	V FINE SILT:	0.7%
$(D_{75} - D_{25})$:	153.1	1.488	V COARSE SAND:	0.5%	CLAY:	0.3%

	METHOD OF MOMENTS Arithmetic μm	Geometric μm	Logarithmic ϕ	FOLK & WARD METHOD Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	182.7	127.8	2.956	140.1	2.835	Fine Sand
SORTING (σ):	146.4	2.646	1.385	2.347	1.231	Poorly Sorted
SKEWNESS (Sk):	2.437	-1.438	1.347	-0.228	0.228	Fine Skewed
KURTOSIS (K):	13.68	6.599	6.204	1.230	1.230	Leptokurtic

GRAIN SIZE DISTRIBUTION



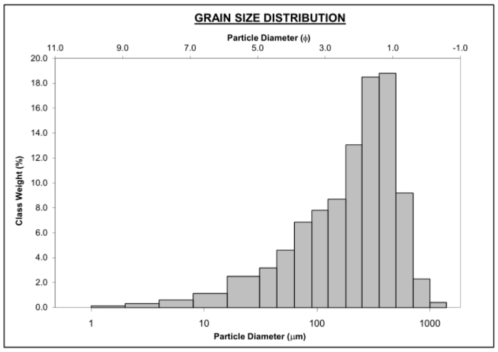
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-059** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Medium Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	427.5	1.247	GRAVEL:	0.0%	COARSE SAND:	11.3%
MODE 2:			SAND:	83.3%	MEDIUM SAND:	36.3%
MODE 3:			MUD:	16.7%	FINE SAND:	21.0%
D_{10}:	34.51	0.901			V FINE SAND:	14.2%
MEDIAN or D_{50}:	237.4	2.074	V COARSE GRAVEL:	0.0%	V COARSE SILT:	7.6%
D_{90}:	535.7	4.857	COARSE GRAVEL:	0.0%	COARSE SILT:	4.8%
(D_{90} / D_{10}):	15.52	5.393	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.2%
$(D_{90} - D_{10})$:	501.2	3.956	FINE GRAVEL:	0.0%	FINE SILT:	1.2%
(D_{75} / D_{25}):	4.078	2.490	V FINE GRAVEL:	0.0%	V FINE SILT:	0.6%
$(D_{75} - D_{25})$:	293.9	2.028	V COARSE SAND:	0.5%	CLAY:	0.3%

	METHOD OF MOMENTS Arithmetic μm	Geometric μm	Logarithmic ϕ	FOLK & WARD METHOD Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	268.8	170.8	2.540	186.4	2.423	Fine Sand
SORTING (σ):	204.4	3.160	1.645	2.891	1.531	Poorly Sorted
SKEWNESS (Sk):	1.007	-1.306	1.265	-0.398	0.398	Very Fine Skewed
KURTOSIS (K):	4.375	4.872	4.676	1.054	1.054	Mesokurtic

GRAIN SIZE DISTRIBUTION



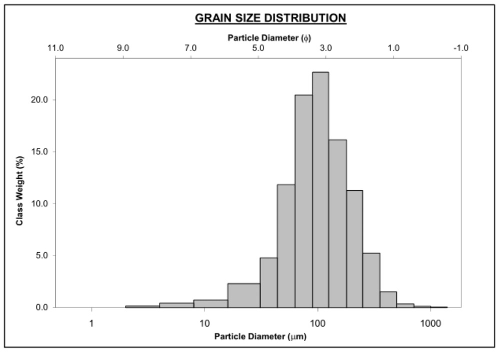
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-060** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	0.5%
MODE 2:			SAND:	76.5%	MEDIUM SAND:	6.7%
MODE 3:			MUD:	23.5%	FINE SAND:	27.2%
D_{10}:	38.80	2.124			V FINE SAND:	42.1%
MEDIAN or D_{50}:	98.13	3.349	V COARSE GRAVEL:	0.0%	V COARSE SILT:	16.4%
D_{90}:	229.4	4.688	COARSE GRAVEL:	0.0%	COARSE SILT:	4.5%
(D_{90} / D_{10}):	5.912	2.207	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.4%
$(D_{90} - D_{10})$:	190.6	2.564	FINE GRAVEL:	0.0%	FINE SILT:	0.8%
(D_{75} / D_{25}):	2.387	1.465	V FINE GRAVEL:	0.0%	V FINE SILT:	0.3%
$(D_{75} - D_{25})$:	89.30	1.255	V COARSE SAND:	0.1%	CLAY:	0.0%

	METHOD OF MOMENTS Arithmetic μm	Geometric μm	Logarithmic ϕ	FOLK & WARD METHOD Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	122.1	93.46	3.419	97.71	3.355	Very Fine Sand
SORTING (σ):	91.98	2.151	1.105	2.050	1.036	Poorly Sorted
SKEWNESS (Sk):	2.898	-0.878	0.878	-0.076	0.076	Symmetrical
KURTOSIS (K):	21.22	5.331	5.331	1.194	1.194	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

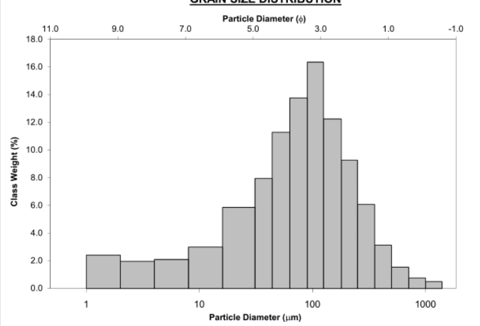
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-061-DUP** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	2.0%
MODE 2:			SAND:	54.3%	MEDIUM SAND:	7.8%
MODE 3:			MUD:	45.7%	FINE SAND:	18.4%
D_{10}:	3.217	1.947			V FINE SAND:	25.4%
MEDIAN or D_{50}:	71.14	3.813	V COARSE GRAVEL:	0.0%	V COARSE SILT:	16.4%
D_{90}:	259.4	8.280	COARSE GRAVEL:	0.0%	COARSE SILT:	9.8%
(D_{90} / D_{10}):	80.63	4.253	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.0%
$(D_{90} - D_{10})$:	256.2	6.333	FINE GRAVEL:	0.0%	FINE SILT:	3.5%
(D_{75} / D_{25}):	6.152	1.933	V FINE GRAVEL:	0.0%	V FINE SILT:	3.4%
$(D_{75} - D_{25})$:	119.4	2.621	V COARSE SAND:	0.7%	CLAY:	7.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	112.6	47.43	4.366	51.34	4.284	Very Coarse Silt
SORTING (σ):	145.0	5.001	2.314	5.021	2.328	Very Poorly Sorted
SKEWNESS (Sk):	3.409	-0.897	0.881	-0.372	0.372	Very Fine Skewed
KURTOSIS (K):	20.03	3.189	3.217	1.282	1.282	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

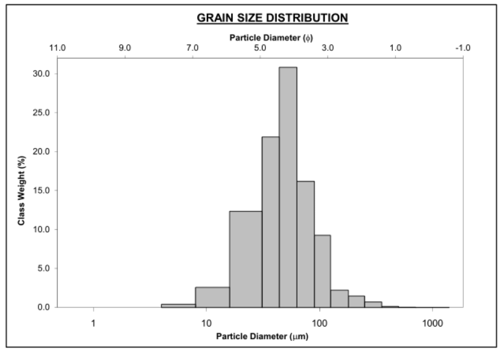
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-062** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	27.1%	MEDIUM SAND:	0.8%
MODE 3:			MUD:	72.9%	FINE SAND:	3.3%
D_{10}:	18.59	3.360			V FINE SAND:	23.0%
MEDIAN or D_{50}:	46.63	4.423	V COARSE GRAVEL:	0.0%	V COARSE SILT:	46.4%
D_{90}:	97.36	5.750	COARSE GRAVEL:	0.0%	COARSE SILT:	21.3%
(D_{90} / D_{10}):	5.238	1.711	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.4%
$(D_{90} - D_{10})$:	78.78	2.389	FINE GRAVEL:	0.0%	FINE SILT:	0.7%
(D_{75} / D_{25}):	2.177	1.285	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	35.33	1.123	V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	55.96	44.25	4.497	44.04	4.505	Very Coarse Silt
SORTING (σ):	45.10	1.920	0.941	1.885	0.915	Moderately Sorted
SKEWNESS (Sk):	5.368	-0.076	0.057	-0.107	0.107	Fine Skewed
KURTOSIS (K):	74.70	3.768	3.732	1.088	1.088	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

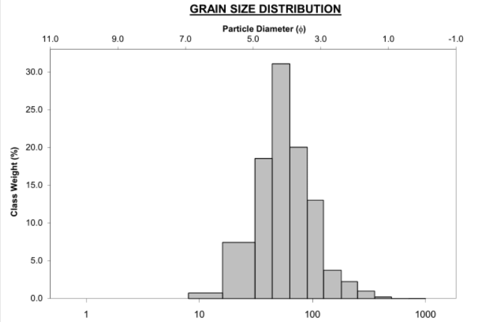
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-063** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	38.4%	MEDIUM SAND:	1.2%
MODE 3:			MUD:	61.6%	FINE SAND:	5.7%
D_{10}:	24.56	3.127			V FINE SAND:	31.5%
MEDIAN or D_{50}:	54.42	4.200	V COARSE GRAVEL:	0.0%	V COARSE SILT:	46.5%
D_{90}:	114.5	5.348	COARSE GRAVEL:	0.0%	COARSE SILT:	13.7%
(D_{90} / D_{10}):	4.660	1.710	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.3%
$(D_{90} - D_{10})$:	89.90	2.220	FINE GRAVEL:	0.0%	FINE SILT:	0.0%
(D_{75} / D_{25}):	2.092	1.292	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	41.62	1.065	V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	67.16	54.83	4.189	55.09	4.182	Very Coarse Silt
SORTING (σ):	49.28	1.812	0.857	1.804	0.851	Moderately Sorted
SKEWNESS (Sk):	3.770	0.169	-0.169	0.010	-0.010	Symmetrical
KURTOSIS (K):	32.12	3.543	3.543	1.146	1.146	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

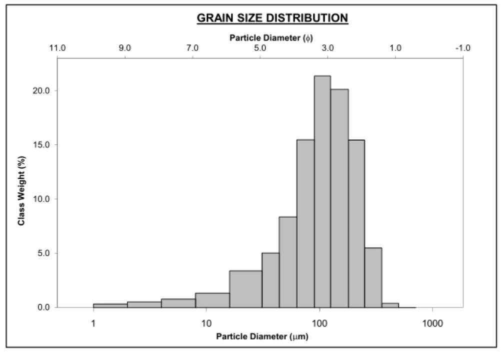
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-064** ANALYST & DATE: ,

SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	75.0%	MEDIUM SAND:	5.7%
MODE 3:			MUD:	25.0%	FINE SAND:	34.4%
D_{10}:	25.13	2.144			V FINE SAND:	34.9%
MEDIAN or D_{50}:	105.7	3.241	V COARSE GRAVEL:	0.0%	V COARSE SILT:	12.9%
D_{90}:	226.3	5.314	COARSE GRAVEL:	0.0%	COARSE SILT:	6.4%
(D_{90} / D_{10}):	9.006	2.479	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.5%
$(D_{90} - D_{10})$:	201.2	3.171	FINE GRAVEL:	0.0%	FINE SILT:	1.5%
(D_{75} / D_{25}):	2.623	1.533	V FINE GRAVEL:	0.0%	V FINE SILT:	1.0%
$(D_{75} - D_{25})$:	101.4	1.391	V COARSE SAND:	0.0%	CLAY:	0.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	119.8	87.03	3.522	95.11	3.394	Very Fine Sand
SORTING (σ):	77.31	2.578	1.366	2.327	1.219	Poorly Sorted
SKEWNESS (Sk):	0.812	-1.583	1.583	-0.299	0.299	Fine Skewed
KURTOSIS (K):	3.631	6.314	6.314	1.276	1.276	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-065** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

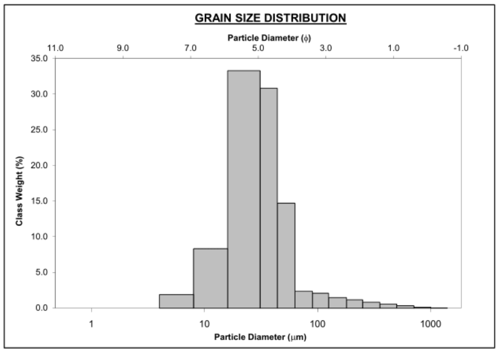
	μm	φ
MODE 1:	23.50	5.489
MODE 2:		
MODE 3:		
D_{10}:	12.19	4.152
MEDIAN or D_{50}:	26.73	5.226
D_{90}:	56.24	6.358
(D_{90} / D_{10}):	4.614	1.531
$(D_{90} - D_{10})$:	44.05	2.206
(D_{75} / D_{25}):	2.104	1.229
$(D_{75} - D_{25})$:	20.51	1.073

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.4%
SAND:	6.8%	MEDIUM SAND:	1.0%
MUD:	93.2%	FINE SAND:	1.9%
		V FINE SAND:	3.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	32.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	46.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	11.6%
FINE GRAVEL:	0.0%	FINE SILT:	2.6%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	39.32	27.56	5.180	27.20	5.200	Coarse Silt
SORTING (σ):	61.42	1.980	0.986	1.823	0.867	Moderately Sorted
SKEWNESS (Sk):	8.577	0.975	-1.001	0.047	-0.047	Symmetrical
KURTOSIS (K):	104.3	6.648	6.661	1.238	1.238	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-066-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

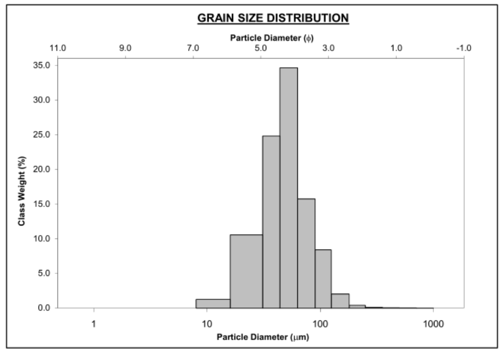
	μm	φ
MODE 1:	53.50	4.247
MODE 2:		
MODE 3:		
D_{10}:	21.16	3.483
MEDIAN or D_{50}:	47.45	4.397
D_{90}:	89.44	5.562
(D_{90} / D_{10}):	4.226	1.597
$(D_{90} - D_{10})$:	68.28	2.079
(D_{75} / D_{25}):	1.884	1.228
$(D_{75} - D_{25})$:	29.35	0.913

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	25.1%	MEDIUM SAND:	0.2%
MUD:	74.9%	FINE SAND:	2.3%
		V FINE SAND:	22.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	53.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	18.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.2%
FINE GRAVEL:	0.0%	FINE SILT:	0.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	54.14	45.80	4.449	45.86	4.446	Very Coarse Silt
SORTING (σ):	35.60	1.715	0.778	1.731	0.792	Moderately Sorted
SKEWNESS (Sk):	6.163	0.003	-0.003	-0.083	0.083	Symmetrical
KURTOSIS (K):	96.78	3.600	3.600	1.194	1.194	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-067** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

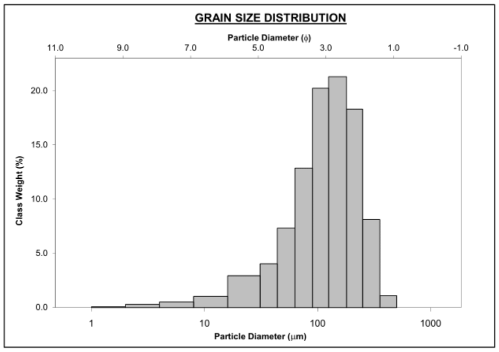
	μm	φ
MODE 1:	152.5	2.737
MODE 2:		
MODE 3:		
D_{10}:	33.09	2.026
MEDIAN or D_{50}:	120.3	3.056
D_{90}:	245.6	4.917
(D_{90} / D_{10}):	7.421	2.427
$(D_{90} - D_{10})$:	212.5	2.892
(D_{75} / D_{25}):	2.581	1.559
$(D_{75} - D_{25})$:	112.4	1.368

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.0%
SAND:	79.5%	MEDIUM SAND:	9.1%
MUD:	20.5%	FINE SAND:	38.7%
		V FINE SAND:	31.7%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.1%
COARSE GRAVEL:	0.0%	COARSE SILT:	5.6%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.0%
FINE GRAVEL:	0.0%	FINE SILT:	1.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.6%
V COARSE SAND:	0.0%	CLAY:	0.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	135.4	102.3	3.289	109.8	3.188	Very Fine Sand
SORTING (σ):	83.95	2.359	1.238	2.200	1.138	Poorly Sorted
SKEWNESS (Sk):	0.783	-1.447	1.447	-0.266	0.266	Fine Skewed
KURTOSIS (K):	3.503	6.004	6.004	1.202	1.202	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-068** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Coarse Sand

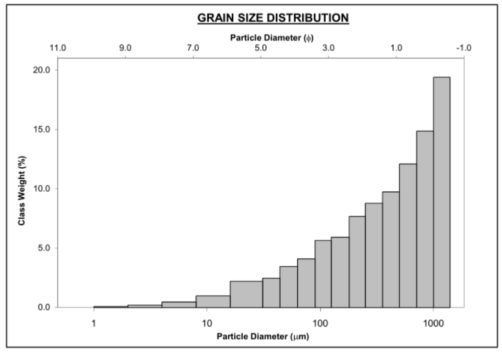
	μm	φ
MODE 1:	1200.0	-0.243
MODE 2:		
MODE 3:		
D_{10}:	49.04	-0.564
MEDIAN or D_{50}:	521.8	0.938
D_{90}:	1478.8	4.350
(D_{90} / D_{10}):	30.15	-7.707
$(D_{90} - D_{10})$:	1429.7	4.914
(D_{75} / D_{25}):	6.302	-32.552
$(D_{75} - D_{25})$:	888.8	2.656

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	23.6%
SAND:	87.9%	MEDIUM SAND:	16.2%
MUD:	12.1%	FINE SAND:	11.9%
		V FINE SAND:	8.5%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	5.2%
COARSE GRAVEL:	0.0%	COARSE SILT:	3.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.7%
FINE GRAVEL:	0.0%	FINE SILT:	0.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.4%
V COARSE SAND:	27.7%	CLAY:	0.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	466.5	156.4	1.563	391.5	1.353	Medium Sand
SORTING (σ):	425.8	8.888	1.885	3.522	1.816	Poorly Sorted
SKEWNESS (Sk):	0.570	-1.297	1.260	-0.461	0.461	Very Fine Skewed
KURTOSIS (K):	1.917	3.577	4.180	0.880	0.880	Platykurtic

GRAIN SIZE DISTRIBUTION



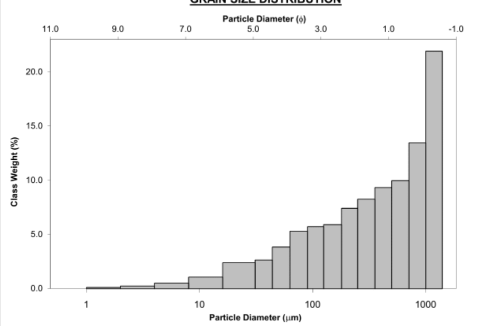
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-069-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Coarse Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	1200.0	-0.243	GRAVEL:	0.0%	COARSE SAND:	19.3%
MODE 2:			SAND:	87.5%	MEDIUM SAND:	14.5%
MODE 3:			MUD:	12.5%	FINE SAND:	10.9%
D_{10}:	47.78	-0.942			V FINE SAND:	9.0%
MEDIAN or D_{50}:	570.4	0.810	V COARSE GRAVEL:	0.0%	V COARSE SILT:	5.4%
D_{90}:	1920.6	4.388	COARSE GRAVEL:	0.0%	COARSE SILT:	3.9%
(D_{90} / D_{10}):	40.20	-4.660	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.7%
$(D_{90} - D_{10})$:	1872.9	5.329	FINE GRAVEL:	0.0%	FINE SILT:	0.8%
(D_{75} / D_{25}):	7.393	-10.743	V FINE GRAVEL:	0.0%	V FINE SILT:	0.4%
$(D_{75} - D_{25})$:	1025.4	2.886	V COARSE SAND:	33.9%	CLAY:	0.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	439.5	111.9	1.530	403.6	1.309	Medium Sand
SORTING (σ):	440.9	11.43	1.938	3.671	1.876	Poorly Sorted
SKEWNESS (Sk):	0.664	-0.993	1.248	-0.515	0.515	Very Fine Skewed
KURTOSIS (K):	1.943	2.616	4.043	0.806	0.806	Platykurtic

GRAIN SIZE DISTRIBUTION



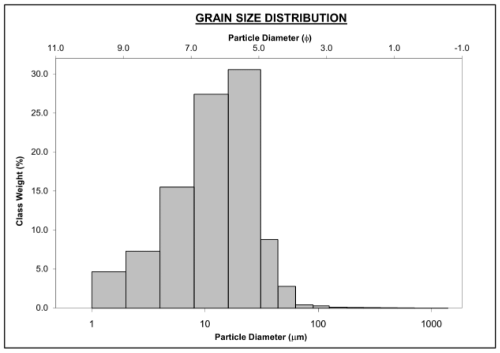
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-070** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	23.50	5.489	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	0.7%	MEDIUM SAND:	0.1%
MODE 3:			MUD:	99.3%	FINE SAND:	0.1%
D_{10}:	2.787	5.099			V FINE SAND:	0.4%
MEDIAN or D_{50}:	12.39	6.335	V COARSE GRAVEL:	0.0%	V COARSE SILT:	6.3%
D_{90}:	29.18	8.487	COARSE GRAVEL:	0.0%	COARSE SILT:	33.0%
(D_{90} / D_{10}):	10.47	1.664	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	29.5%
$(D_{90} - D_{10})$:	26.39	3.388	FINE GRAVEL:	0.0%	FINE SILT:	16.6%
(D_{75} / D_{25}):	3.429	1.320	V FINE GRAVEL:	0.0%	V FINE SILT:	7.9%
$(D_{75} - D_{25})$:	15.14	1.778	V COARSE SAND:	0.0%	CLAY:	6.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	16.25	10.79	6.533	11.12	6.490	Medium Silt
SORTING (σ):	23.22	2.461	1.301	2.482	1.312	Poorly Sorted
SKEWNESS (Sk):	24.94	-0.568	0.546	-0.241	0.241	Fine Skewed
KURTOSIS (K):	994.9	3.356	3.434	1.015	1.015	Mesokurtic

GRAIN SIZE DISTRIBUTION



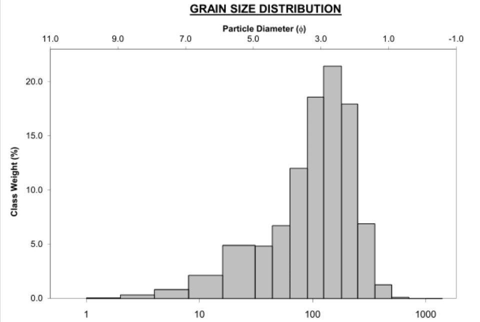
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-071** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	152.5	2.737	GRAVEL:	0.0%	COARSE SAND:	0.1%
MODE 2:	23.50	5.489	SAND:	73.7%	MEDIUM SAND:	7.8%
MODE 3:			MUD:	26.3%	FINE SAND:	37.3%
D_{10}:	20.93	2.061			V FINE SAND:	28.4%
MEDIAN or D_{50}:	113.8	3.135	V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.9%
D_{90}:	239.6	5.579	COARSE GRAVEL:	0.0%	COARSE SILT:	9.1%
(D_{90} / D_{10}):	11.45	2.707	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	4.0%
$(D_{90} - D_{10})$:	218.7	3.517	FINE GRAVEL:	0.0%	FINE SILT:	1.5%
(D_{75} / D_{25}):	3.039	1.642	V FINE GRAVEL:	0.0%	V FINE SILT:	0.6%
$(D_{75} - D_{25})$:	118.7	1.604	V COARSE SAND:	0.0%	CLAY:	0.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	127.8	89.81	3.477	92.49	3.435	Very Fine Sand
SORTING (σ):	89.39	2.626	1.393	2.568	1.360	Poorly Sorted
SKEWNESS (Sk):	1.334	-1.141	1.141	-0.367	0.367	Very Fine Skewed
KURTOSIS (K):	9.405	4.192	4.192	1.160	1.160	Leptokurtic

GRAIN SIZE DISTRIBUTION



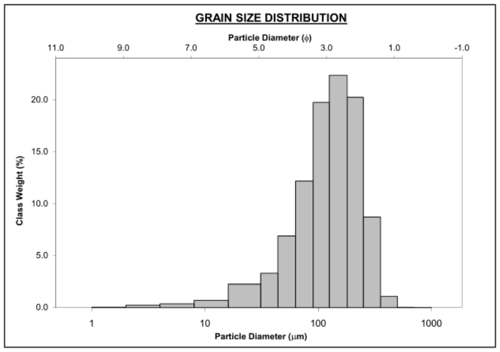
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-072** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Fine Sand

	μm	ϕ	GRAIN SIZE DISTRIBUTION			
MODE 1:	152.5	2.737	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	82.9%	MEDIUM SAND:	9.8%
MODE 3:			MUD:	17.1%	FINE SAND:	42.1%
D_{10}:	42.87	2.005			V FINE SAND:	31.0%
MEDIAN or D_{50}:	128.8	2.956	V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.1%
D_{90}:	249.2	4.544	COARSE GRAVEL:	0.0%	COARSE SILT:	4.4%
(D_{90} / D_{10}):	5.813	2.267	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.4%
$(D_{90} - D_{10})$:	206.3	2.539	FINE GRAVEL:	0.0%	FINE SILT:	0.7%
(D_{75} / D_{25}):	2.439	1.540	V FINE GRAVEL:	0.0%	V FINE SILT:	0.5%
$(D_{75} - D_{25})$:	113.3	1.287	V COARSE SAND:	0.0%	CLAY:	0.1%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	142.7	111.4	3.164	119.5	3.065	Very Fine Sand
SORTING (σ):	83.68	2.221	1.148	2.066	1.047	Poorly Sorted
SKEWNESS (Sk):	0.802	-1.549	1.524	-0.252	0.252	Fine Skewed
KURTOSIS (K):	4.074	6.850	6.718	1.187	1.187	Leptokurtic

GRAIN SIZE DISTRIBUTION



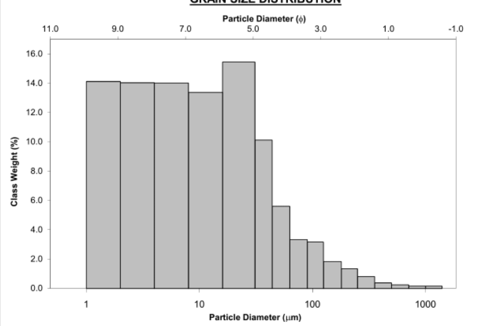
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-073** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	23.50	5.489	GRAVEL: 0.0%	COARSE SAND: 0.2%
MODE 2:	1.500	9.466	SAND: 6.4%	MEDIUM SAND: 0.7%
MODE 3:			MUD: 93.6%	FINE SAND: 1.8%
D_{10}:	1.076	4.554		V FINE SAND: 3.6%
MEDIAN or D_{50}:	6.575	7.249	V COARSE GRAVEL: 0.0%	V COARSE SILT: 8.5%
D_{90}:	42.56	9.860	COARSE GRAVEL: 0.0%	COARSE SILT: 16.7%
(D_{90} / D_{10}):	39.55	2.165	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 14.6%
$(D_{90} - D_{10})$:	41.49	5.306	FINE GRAVEL: 0.0%	FINE SILT: 15.3%
(D_{75} / D_{25}):	9.724	1.586	V FINE GRAVEL: 0.0%	V FINE SILT: 15.3%
$(D_{75} - D_{25})$:	18.46	3.282	V COARSE SAND: 0.1%	CLAY: 23.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	22.23	7.112	7.129	6.513	7.262	Fine Silt
SORTING (σ):	62.35	4.053	2.025	3.838	1.940	Poorly Sorted
SKEWNESS (Sk):	10.52	0.436	-0.451	0.148	-0.148	Coarse Skewed
KURTOSIS (K):	157.3	2.607	2.659	0.692	0.692	Platykurtic

GRAIN SIZE DISTRIBUTION



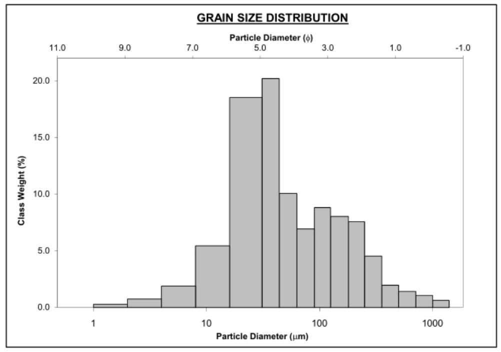
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-074** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	37.50	4.759	GRAVEL: 0.0%	COARSE SAND: 2.0%
MODE 2:	107.5	3.237	SAND: 33.3%	MEDIUM SAND: 5.3%
MODE 3:			MUD: 66.7%	FINE SAND: 12.6%
D_{10}:	12.11	2.159		V FINE SAND: 12.7%
MEDIAN or D_{50}:	36.75	4.766	V COARSE GRAVEL: 0.0%	V COARSE SILT: 24.3%
D_{90}:	223.9	6.367	COARSE GRAVEL: 0.0%	COARSE SILT: 29.2%
(D_{90} / D_{10}):	18.48	2.949	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 8.6%
$(D_{90} - D_{10})$:	211.8	4.208	FINE GRAVEL: 0.0%	FINE SILT: 3.0%
(D_{75} / D_{25}):	4.842	1.688	V FINE GRAVEL: 0.0%	V FINE SILT: 1.2%
$(D_{75} - D_{25})$:	80.24	2.276	V COARSE SAND: 0.8%	CLAY: 0.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	91.24	43.69	4.489	46.40	4.430	Very Coarse Silt
SORTING (σ):	146.7	3.201	1.670	3.078	1.622	Poorly Sorted
SKEWNESS (Sk):	4.107	0.196	-0.301	0.250	-0.250	Coarse Skewed
KURTOSIS (K):	24.75	3.298	3.173	0.964	0.964	Mesokurtic

GRAIN SIZE DISTRIBUTION



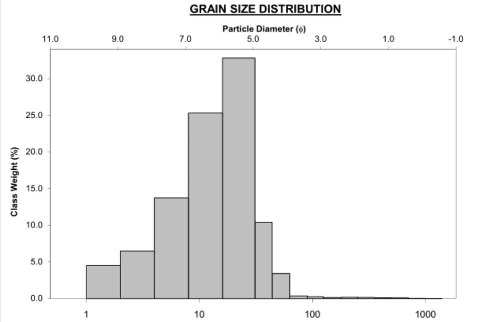
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-075** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	23.50	5.489	GRAVEL: 0.0%	COARSE SAND: 0.1%
MODE 2:			SAND: 0.9%	MEDIUM SAND: 0.2%
MODE 3:			MUD: 99.1%	FINE SAND: 0.2%
D_{10}:	2.894	5.049		V FINE SAND: 0.4%
MEDIAN or D_{50}:	13.57	6.203	V COARSE GRAVEL: 0.0%	V COARSE SILT: 7.6%
D_{90}:	30.20	8.433	COARSE GRAVEL: 0.0%	COARSE SILT: 35.8%
(D_{90} / D_{10}):	10.43	1.670	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 27.6%
$(D_{90} - D_{10})$:	27.30	3.383	FINE GRAVEL: 0.0%	FINE SILT: 14.9%
(D_{75} / D_{25}):	3.340	1.319	V FINE GRAVEL: 0.0%	V FINE SILT: 7.1%
$(D_{75} - D_{25})$:	15.90	1.740	V COARSE SAND: 0.0%	CLAY: 6.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	17.98	11.53	6.438	11.81	6.403	Medium Silt
SORTING (σ):	31.02	2.513	1.330	2.507	1.326	Poorly Sorted
SKEWNESS (Sk):	19.37	-0.541	0.536	-0.282	0.282	Fine Skewed
KURTOSIS (K):	534.8	3.703	3.719	1.060	1.060	Mesokurtic

GRAIN SIZE DISTRIBUTION



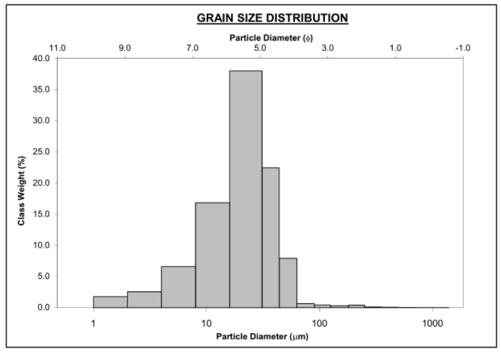
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-076** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION	
MODE 1:	23.50	5.489	GRAVEL: 0.0%	COARSE SAND: 0.0%
MODE 2:			SAND: 1.4%	MEDIUM SAND: 0.1%
MODE 3:			MUD: 98.6%	FINE SAND: 0.4%
D_{10}:	5.774	4.637		V FINE SAND: 0.8%
MEDIAN or D_{50}:	20.04	5.641	V COARSE GRAVEL: 0.0%	V COARSE SILT: 18.7%
D_{90}:	40.19	7.436	COARSE GRAVEL: 0.0%	COARSE SILT: 45.9%
(D_{90} / D_{10}):	6.960	1.604	MEDIUM GRAVEL: 0.0%	MEDIUM SILT: 20.4%
$(D_{90} - D_{10})$:	34.41	2.799	FINE GRAVEL: 0.0%	FINE SILT: 8.0%
(D_{75} / D_{25}):	2.500	1.259	V FINE GRAVEL: 0.0%	V FINE SILT: 3.1%
$(D_{75} - D_{25})$:	17.38	1.322	V COARSE SAND: 0.0%	CLAY: 2.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	23.77	17.33	5.851	18.13	5.786	Coarse Silt
SORTING (σ):	24.89	2.221	1.151	2.113	1.080	Poorly Sorted
SKEWNESS (Sk):	14.06	-0.908	0.904	-0.274	0.274	Fine Skewed
KURTOSIS (K):	394.0	4.994	5.003	1.181	1.181	Leptokurtic

GRAIN SIZE DISTRIBUTION



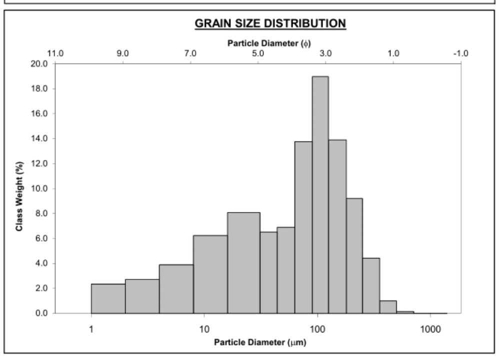
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-077** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Coarse Silty Very Fine Sand

	μm	ϕ
MODE 1:	107.5	3.237
MODE 2:	23.50	5.489
MODE 3:		
D_{10}:	4.218	2.356
MEDIAN or D_{50}:	63.05	3.987
D_{90}:	195.3	7.889
(D_{90} / D_{10}):	46.29	3.348
$(D_{90} - D_{10})$:	191.1	5.533
(D_{75} / D_{25}):	8.184	1.997
$(D_{75} - D_{25})$:	106.7	3.033

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	50.2%	MEDIUM SAND:	4.5%
MUD:	49.8%	FINE SAND:	19.1%
		V FINE SAND:	26.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	11.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	13.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	10.1%
FINE GRAVEL:	0.0%	FINE SILT:	6.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	4.4%
V COARSE SAND:	0.0%	CLAY:	4.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	83.70	39.35	4.668	43.16	4.534	Very Coarse Silt
SORTING (σ):	85.04	4.348	2.120	4.370	2.128	Very Poorly Sorted
SKEWNESS (Sk):	1.711	-0.715	0.715	-0.409	0.409	Very Fine Skewed
KURTOSIS (K):	8.335	2.638	2.638	0.940	0.940	Mesokurtic



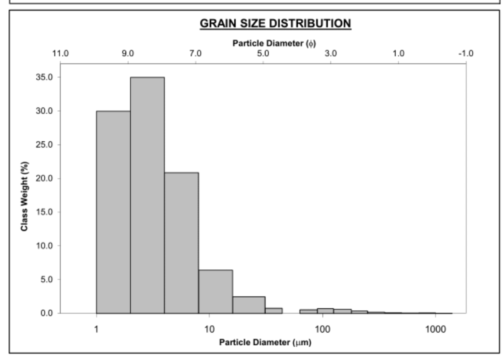
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-078** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Mud

	μm	ϕ
MODE 1:	3.000	8.466
MODE 2:		
MODE 3:		
D_{10}:	1.446	6.995
MEDIAN or D_{50}:	2.465	8.664
D_{90}:	7.839	9.434
(D_{90} / D_{10}):	5.422	1.349
$(D_{90} - D_{10})$:	6.393	2.439
(D_{75} / D_{25}):	3.356	1.224
$(D_{75} - D_{25})$:	3.154	1.747

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	1.2%	MEDIUM SAND:	0.1%
MUD:	98.8%	FINE SAND:	0.4%
		V FINE SAND:	0.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	0.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	2.3%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.2%
FINE GRAVEL:	0.0%	FINE SILT:	19.1%
V FINE GRAVEL:	0.0%	V FINE SILT:	31.2%
V COARSE SAND:	0.0%	CLAY:	39.6%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	6.372	2.773	8.493	2.541	8.620	Very Fine Silt
SORTING (σ):	31.30	2.436	1.289	2.033	1.024	Poorly Sorted
SKEWNESS (Sk):	22.19	1.553	-1.582	0.505	-0.505	Very Coarse Skewed
KURTOSIS (K):	652.5	7.542	7.753	0.593	0.593	Very Platykurtic



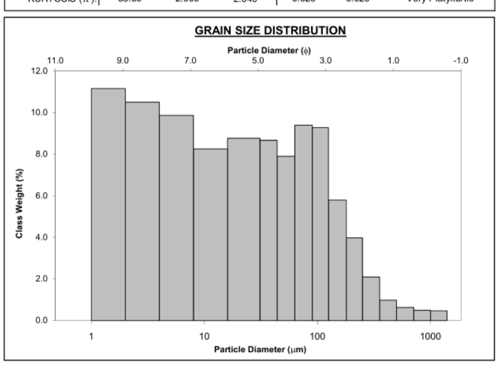
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-079** ANALYST & DATE: ,
SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Fine Silt

	μm	ϕ
MODE 1:	1.500	9.466
MODE 2:	76.50	3.731
MODE 3:	23.50	5.489
D_{10}:	1.043	3.068
MEDIAN or D_{50}:	9.017	6.793
D_{90}:	119.3	9.904
(D_{90} / D_{10}):	114.3	3.229
$(D_{90} - D_{10})$:	118.2	6.837
(D_{75} / D_{25}):	20.82	1.988
$(D_{75} - D_{25})$:	44.13	4.380

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.7%
SAND:	20.8%	MEDIUM SAND:	1.9%
MUD:	79.2%	FINE SAND:	6.1%
		V FINE SAND:	11.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	10.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	10.3%
FINE GRAVEL:	0.0%	FINE SILT:	12.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	13.0%
V COARSE SAND:	0.5%	CLAY:	22.5%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	46.06	10.66	6.532	10.19	6.617	Medium Silt
SORTING (σ):	105.9	5.725	2.529	5.595	2.484	Very Poorly Sorted
SKEWNESS (Sk):	6.208	0.310	-0.322	0.204	-0.204	Coarse Skewed
KURTOSIS (K):	55.33	2.006	2.040	0.626	0.626	Very Platykurtic



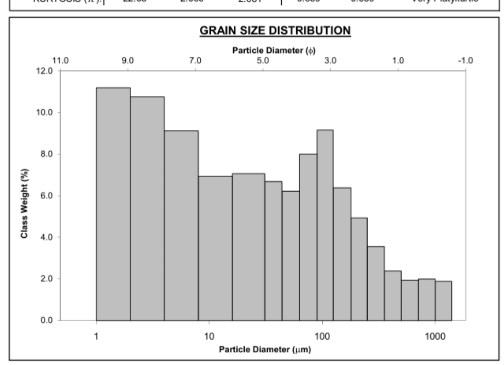
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-080** ANALYST & DATE: ,
SAMPLE TYPE: Polymodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Fine Silt

	μm	ϕ
MODE 1:	1.500	9.466
MODE 2:	107.5	3.237
MODE 3:	23.50	5.489
D_{10}:	1.045	2.245
MEDIAN or D_{50}:	9.234	6.759
D_{90}:	210.9	9.902
(D_{90} / D_{10}):	201.8	4.410
$(D_{90} - D_{10})$:	209.9	7.657
(D_{75} / D_{25}):	31.37	2.288
$(D_{75} - D_{25})$:	66.66	4.971

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	2.5%
SAND:	26.4%	MEDIUM SAND:	3.7%
MUD:	73.6%	FINE SAND:	7.2%
		V FINE SAND:	10.7%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	8.1%
COARSE GRAVEL:	0.0%	COARSE SILT:	8.9%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	8.8%
FINE GRAVEL:	0.0%	FINE SILT:	11.5%
V FINE GRAVEL:	0.0%	V FINE SILT:	13.6%
V COARSE SAND:	2.3%	CLAY:	22.7%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic ϕ	Geometric μm	Logarithmic ϕ	Description
MEAN ($\bar{x}$):	75.94	12.03	6.268	11.66	6.422	Medium Silt
SORTING (σ):	181.0	7.071	2.873	7.071	2.822	Very Poorly Sorted
SKEWNESS (Sk):	4.195	0.435	-0.439	0.288	-0.288	Coarse Skewed
KURTOSIS (K):	22.63	2.060	2.081	0.659	0.659	Very Platykurtic



SAMPLE STATISTICS

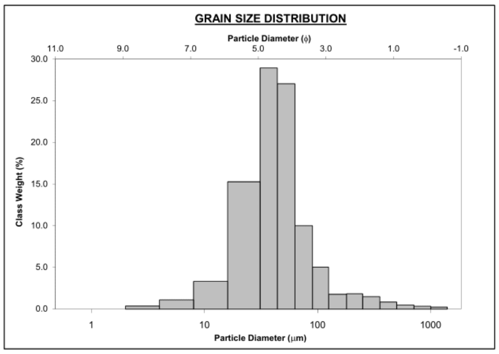
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-081** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	37.50	4.759
MODE 2:		
MODE 3:		
D_{10}:	16.82	3.454
MEDIAN or D_{50}:	39.58	4.659
D_{90}:	91.27	5.894
(D_{90} / D_{10}):	5.428	1.707
$(D_{90} - D_{10})$:	74.46	2.440
(D_{75} / D_{25}):	2.282	1.289
$(D_{75} - D_{25})$:	32.25	1.190

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.7%
SAND:	19.4%	MEDIUM SAND:	2.0%
MUD:	80.6%	FINE SAND:	3.1%
		V FINE SAND:	13.3%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	47.3%
COARSE GRAVEL:	0.0%	COARSE SILT:	25.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	5.5%
FINE GRAVEL:	0.0%	FINE SILT:	1.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.6%
V COARSE SAND:	0.4%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	59.52	39.23	4.657	38.13	4.713	Very Coarse Silt
SORTING (σ):	93.36	2.232	1.154	2.073	1.052	Poorly Sorted
SKEWNESS (Sk):	7.043	0.293	-0.503	-0.022	0.022	Symmetrical
KURTOSIS (K):	67.65	5.850	5.645	1.343	1.343	Leptokurtic



SAMPLE STATISTICS

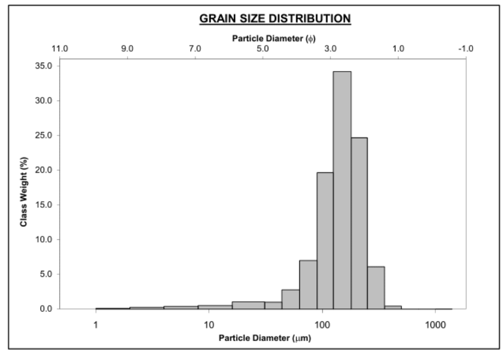
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-082** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sand
SEDIMENT NAME: Moderately Sorted Fine Sand

	μm	φ
MODE 1:	152.5	2.737
MODE 2:		
MODE 3:		
D_{10}:	68.00	2.069
MEDIAN or D_{50}:	146.8	2.768
D_{90}:	238.4	3.878
(D_{90} / D_{10}):	3.506	1.875
$(D_{90} - D_{10})$:	170.4	1.810
(D_{75} / D_{25}):	1.817	1.363
$(D_{75} - D_{25})$:	86.75	0.861

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.0%
SAND:	91.6%	MEDIUM SAND:	6.6%
MUD:	8.4%	FINE SAND:	59.2%
		V FINE SAND:	25.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	3.8%
COARSE GRAVEL:	0.0%	COARSE SILT:	2.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.0%
FINE GRAVEL:	0.0%	FINE SILT:	0.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.5%
V COARSE SAND:	0.0%	CLAY:	0.2%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	153.7	128.9	2.956	142.8	2.808	Fine Sand
SORTING (σ):	71.24	2.035	1.025	1.697	0.763	Moderately Sorted
SKEWNESS (Sk):	1.354	-2.689	2.689	-0.239	0.239	Fine Skewed
KURTOSIS (K):	17.51	13.42	13.42	1.396	1.396	Leptokurtic



SAMPLE STATISTICS

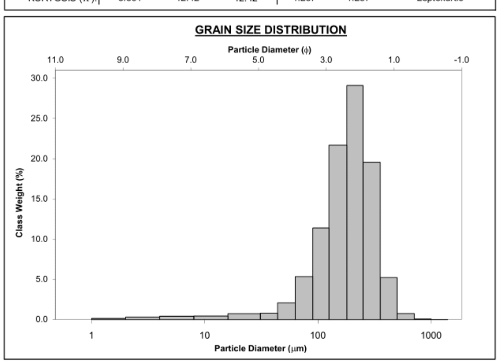
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-083** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sand
SEDIMENT NAME: Moderately Sorted Fine Sand

	μm	φ
MODE 1:	215.0	2.237
MODE 2:		
MODE 3:		
D_{10}:	75.70	1.594
MEDIAN or D_{50}:	187.9	2.412
D_{90}:	331.2	3.724
(D_{90} / D_{10}):	4.375	2.336
$(D_{90} - D_{10})$:	255.5	2.129
(D_{75} / D_{25}):	1.986	1.501
$(D_{75} - D_{25})$:	126.1	0.990

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.9%
SAND:	92.9%	MEDIUM SAND:	25.1%
MUD:	7.1%	FINE SAND:	50.6%
		V FINE SAND:	16.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	2.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	1.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	0.9%
FINE GRAVEL:	0.0%	FINE SILT:	0.9%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.6%
V COARSE SAND:	0.0%	CLAY:	0.3%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	200.1	160.7	2.637	177.3	2.496	Fine Sand
SORTING (σ):	105.0	2.239	1.163	1.823	0.866	Moderately Sorted
SKEWNESS (Sk):	0.939	-2.537	2.537	-0.251	0.251	Fine Skewed
KURTOSIS (K):	5.891	12.42	12.42	1.287	1.287	Leptokurtic



SAMPLE STATISTICS

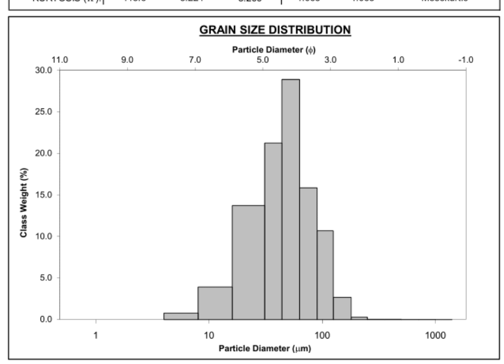
SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-084** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	53.50	4.247
MODE 2:		
MODE 3:		
D_{10}:	16.92	3.394
MEDIAN or D_{50}:	44.67	4.485
D_{90}:	95.11	5.885
(D_{90} / D_{10}):	5.620	1.734
$(D_{90} - D_{10})$:	78.18	2.491
(D_{75} / D_{25}):	2.419	1.321
$(D_{75} - D_{25})$:	37.37	1.274

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.0%
SAND:	26.0%	MEDIUM SAND:	0.1%
MUD:	74.0%	FINE SAND:	2.7%
		V FINE SAND:	23.2%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	43.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	23.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.5%
FINE GRAVEL:	0.0%	FINE SILT:	1.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	51.53	40.97	4.608	41.66	4.585	Very Coarse Silt
SORTING (σ):	35.86	1.958	0.969	1.997	0.998	Moderately Sorted
SKEWNESS (Sk):	5.307	-0.379	0.363	-0.163	0.163	Fine Skewed
KURTOSIS (K):	113.6	3.224	3.200	1.063	1.063	Mesokurtic



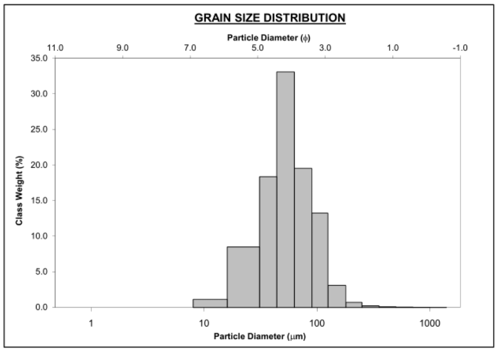
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-085-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	53.50	4.247
MODE 2:		
MODE 3:		
D_{10}:	22.66	3.241
MEDIAN or D_{50}:	52.66	4.247
D_{90}:	105.8	5.464
(D_{90} / D_{10}):	4.668	1.686
(D_{90} - D_{10}):	83.12	2.223
(D_{75} / D_{25}):	2.064	1.280
(D_{75} - D_{25}):	38.79	1.046

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	34.9%	MEDIUM SAND:	0.3%
MUD:	65.1%	FINE SAND:	3.7%
		V FINE SAND:	30.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	47.6%
COARSE GRAVEL:	0.0%	COARSE SILT:	15.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	2.1%
FINE GRAVEL:	0.0%	FINE SILT:	0.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	61.67	51.31	4.283	51.83	4.270	Very Coarse Silt
SORTING (σ):	44.44	1.775	0.826	1.760	0.816	Moderately Sorted
SKEWNESS (Sk):	7.784	-0.112	0.055	-0.081	0.081	Symmetrical
KURTOSIS (K):	145.0	3.892	3.711	1.076	1.076	Mesokurtic



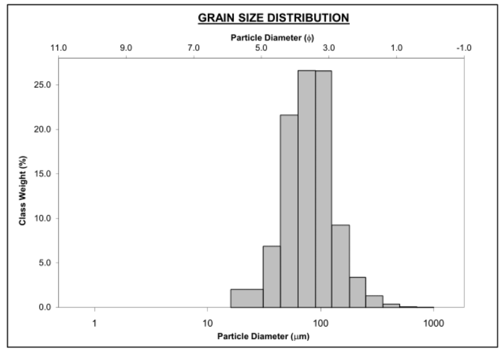
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-086** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	42.32	2.743
MEDIAN or D_{50}:	78.70	3.668
D_{90}:	149.4	4.563
(D_{90} / D_{10}):	3.530	1.663
(D_{90} - D_{10}):	107.1	1.820
(D_{75} / D_{25}):	1.973	1.307
(D_{75} - D_{25}):	53.88	0.981

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	67.5%	MEDIUM SAND:	1.7%
MUD:	32.5%	FINE SAND:	12.9%
		V FINE SAND:	52.7%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	28.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	4.0%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	0.0%
FINE GRAVEL:	0.0%	FINE SILT:	0.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	91.37	78.19	3.677	77.37	3.692	Very Fine Sand
SORTING (σ):	56.55	1.685	0.753	1.639	0.713	Moderately Sorted
SKEWNESS (Sk):	3.520	0.072	-0.072	-0.039	0.039	Symmetrical
KURTOSIS (K):	29.03	3.751	3.751	1.029	1.029	Mesokurtic



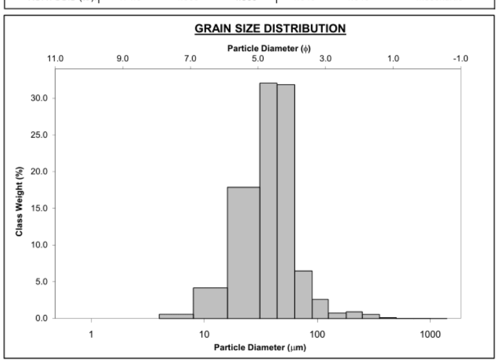
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-087** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ
MODE 1:	37.50	4.759
MODE 2:		
MODE 3:		
D_{10}:	16.79	3.995
MEDIAN or D_{50}:	37.12	4.752
D_{90}:	62.71	5.896
(D_{90} / D_{10}):	3.735	1.476
(D_{90} - D_{10}):	45.92	1.901
(D_{75} / D_{25}):	2.159	1.259
(D_{75} - D_{25}):	27.64	1.110

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	10.3%	MEDIUM SAND:	0.6%
MUD:	89.7%	FINE SAND:	1.4%
		V FINE SAND:	8.2%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	52.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	29.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	6.7%
FINE GRAVEL:	0.0%	FINE SILT:	1.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	43.74	35.17	4.829	34.64	4.851	Very Coarse Silt
SORTING (σ):	40.10	1.818	0.863	1.772	0.826	Moderately Sorted
SKEWNESS (Sk):	9.363	0.127	-0.136	-0.172	0.172	Fine Skewed
KURTOSIS (K):	174.9	4.806	4.800	1.046	1.046	Mesokurtic



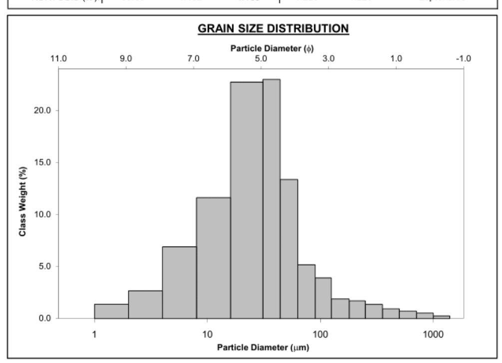
SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-088** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Coarse Silt

	μm	φ
MODE 1:	37.50	4.759
MODE 2:		
MODE 3:		
D_{10}:	5.438	3.759
MEDIAN or D_{50}:	23.77	5.395
D_{90}:	73.88	7.523
(D_{90} / D_{10}):	13.59	2.001
(D_{90} - D_{10}):	68.44	3.764
(D_{75} / D_{25}):	3.391	1.382
(D_{75} - D_{25}):	28.72	1.762

GRAIN SIZE DISTRIBUTION			
GRAVEL:	0.0%	COARSE SAND:	0.9%
SAND:	11.9%	MEDIUM SAND:	1.6%
MUD:	88.1%	FINE SAND:	2.5%
		V FINE SAND:	6.6%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	25.5%
COARSE GRAVEL:	0.0%	COARSE SILT:	31.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	16.1%
FINE GRAVEL:	0.0%	FINE SILT:	9.5%
V FINE GRAVEL:	0.0%	V FINE SILT:	3.7%
V COARSE SAND:	0.3%	CLAY:	1.9%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	45.68	22.50	5.466	21.88	5.514	Coarse Silt
SORTING (σ):	96.34	2.949	1.563	2.783	1.476	Poorly Sorted
SKEWNESS (Sk):	6.959	0.153	-0.188	-0.089	0.089	Symmetrical
KURTOSIS (K):	63.56	4.132	4.165	1.226	1.226	Leptokurtic

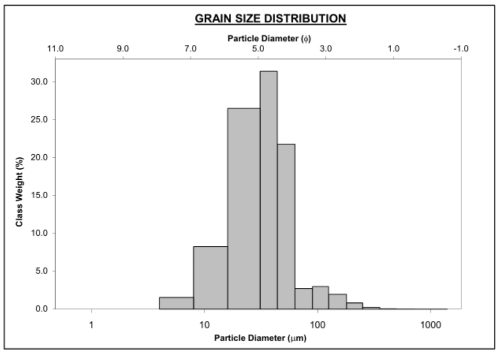


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-089** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	37.50	4.759	GRAVEL:	0.0%	COARSE SAND:	0.0%
MODE 2:			SAND:	7.0%	MEDIUM SAND:	0.2%
MODE 3:			MUD:	93.0%	FINE SAND:	2.1%
D_{10}:	12.30	4.093			V FINE SAND:	4.6%
MEDIAN or D_{50}:	29.60	5.078	V COARSE GRAVEL:	0.0%	V COARSE SILT:	39.8%
D_{90}:	58.62	6.345	COARSE GRAVEL:	0.0%	COARSE SILT:	38.9%
(D_{90} / D_{10}):	4.765	1.550	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	12.0%
$(D_{90} - D_{10})$:	46.32	2.253	FINE GRAVEL:	0.0%	FINE SILT:	2.2%
(D_{75} / D_{25}):	2.249	1.258	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	23.92	1.169	V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	36.89	28.84	5.116	29.24	5.096	Coarse Silt
SORTING (σ):	32.26	1.892	0.920	1.855	0.892	Moderately Sorted
SKEWNESS (Sk):	6.534	0.192	-0.197	-0.046	0.046	Symmetrical
KURTOSIS (K):	115.3	4.024	4.026	1.104	1.104	Mesokurtic

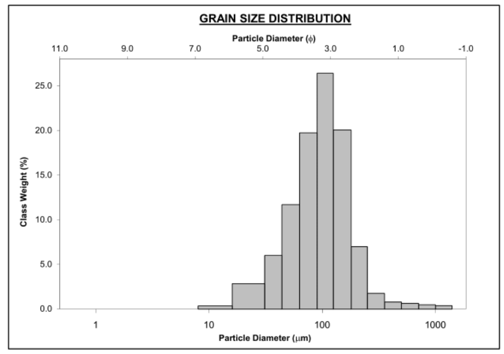


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-090** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	107.5	3.237	GRAVEL:	0.0%	COARSE SAND:	1.1%
MODE 2:			SAND:	76.3%	MEDIUM SAND:	2.5%
MODE 3:			MUD:	23.7%	FINE SAND:	27.3%
D_{10}:	39.04	2.420			V FINE SAND:	44.8%
MEDIAN or D_{50}:	97.61	3.357	V COARSE GRAVEL:	0.0%	V COARSE SILT:	17.5%
D_{90}:	186.9	4.679	COARSE GRAVEL:	0.0%	COARSE SILT:	5.5%
(D_{90} / D_{10}):	4.786	1.933	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	0.7%
$(D_{90} - D_{10})$:	147.8	2.259	FINE GRAVEL:	0.0%	FINE SILT:	0.0%
(D_{75} / D_{25}):	2.182	1.397	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	75.89	1.126	V COARSE SAND:	0.6%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	118.4	91.49	3.430	92.61	3.433	Very Fine Sand
SORTING (σ):	111.8	2.009	0.976	1.877	0.908	Moderately Sorted
SKEWNESS (Sk):	5.444	-0.552	-0.013	-0.153	0.153	Fine Skewed
KURTOSIS (K):	44.44	7.192	4.500	1.145	1.145	Leptokurtic

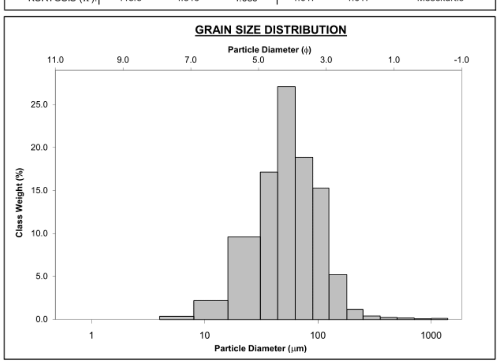


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-091 REPEAT** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	0.3%
MODE 2:			SAND:	38.3%	MEDIUM SAND:	0.6%
MODE 3:			MUD:	61.7%	FINE SAND:	6.0%
D_{10}:	19.75	3.106			V FINE SAND:	31.2%
MEDIAN or D_{50}:	52.93	4.240	V COARSE GRAVEL:	0.0%	V COARSE SILT:	40.1%
D_{90}:	116.2	5.662	COARSE GRAVEL:	0.0%	COARSE SILT:	17.1%
(D_{90} / D_{10}):	5.882	1.823	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.9%
$(D_{90} - D_{10})$:	96.41	2.556	FINE GRAVEL:	0.0%	FINE SILT:	0.7%
(D_{75} / D_{25}):	2.423	1.353	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	47.91	1.277	V COARSE SAND:	0.2%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	66.82	50.90	4.292	51.00	4.293	Very Coarse Silt
SORTING (σ):	69.34	2.017	1.009	1.971	0.979	Moderately Sorted
SKEWNESS (Sk):	8.640	-0.140	0.044	-0.080	0.080	Symmetrical
KURTOSIS (K):	118.8	4.316	4.080	1.017	1.017	Mesokurtic

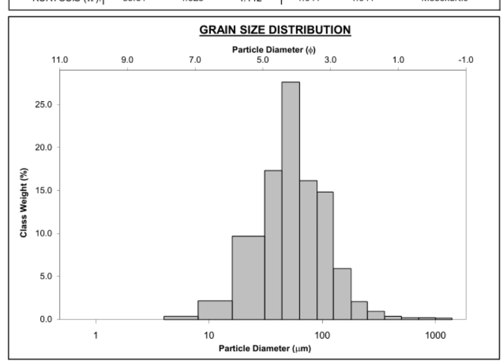


SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-091** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Very Coarse Silt

	μm	φ	GRAIN SIZE DISTRIBUTION			
MODE 1:	53.50	4.247	GRAVEL:	0.0%	COARSE SAND:	0.4%
MODE 2:			SAND:	37.6%	MEDIUM SAND:	1.2%
MODE 3:			MUD:	62.4%	FINE SAND:	7.4%
D_{10}:	19.78	3.026			V FINE SAND:	28.3%
MEDIAN or D_{50}:	52.59	4.249	V COARSE GRAVEL:	0.0%	V COARSE SILT:	40.7%
D_{90}:	122.8	5.660	COARSE GRAVEL:	0.0%	COARSE SILT:	17.2%
(D_{90} / D_{10}):	6.207	1.870	MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	3.9%
$(D_{90} - D_{10})$:	103.0	2.634	FINE GRAVEL:	0.0%	FINE SILT:	0.7%
(D_{75} / D_{25}):	2.493	1.369	V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
$(D_{75} - D_{25})$:	50.19	1.318	V COARSE SAND:	0.2%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	70.77	51.87	4.260	51.76	4.272	Very Coarse Silt
SORTING (σ):	80.42	2.096	1.061	2.034	1.024	Poorly Sorted
SKEWNESS (Sk):	7.441	-0.010	-0.163	-0.023	0.023	Symmetrical
KURTOSIS (K):	85.51	4.528	4.112	1.041	1.041	Mesokurtic



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-092** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

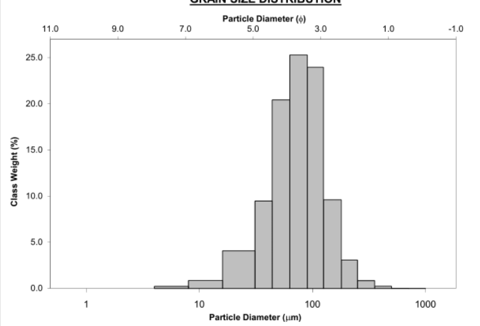
	μm	φ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	31.37	2.801
MEDIAN or D_{50}:	73.32	3.770
D_{90}:	143.4	4.995
(D_{90} / D_{10}):	4.573	1.783
(D_{90} - D_{10}):	112.1	2.193
(D_{75} / D_{25}):	2.154	1.341
(D_{75} - D_{25}):	56.52	1.107

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.0%
SAND:	61.1%	MEDIUM SAND:	1.1%
MUD:	38.9%	FINE SAND:	12.6%
		V FINE SAND:	47.4%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	29.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	7.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	1.7%
FINE GRAVEL:	0.0%	FINE SILT:	0.5%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.0%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	83.83	69.03	3.857	70.38	3.829	Very Fine Sand
SORTING (σ):	51.51	1.877	0.908	1.828	0.870	Moderately Sorted
SKEWNESS (Sk):	2.290	-0.651	0.651	-0.152	0.152	Fine Skewed
KURTOSIS (K):	15.72	4.228	4.228	1.138	1.138	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-093-DUP** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Moderately Well Sorted TEXTURAL GROUP: Muddy Sand
SEDIMENT NAME: Very Coarse Silty Very Fine Sand

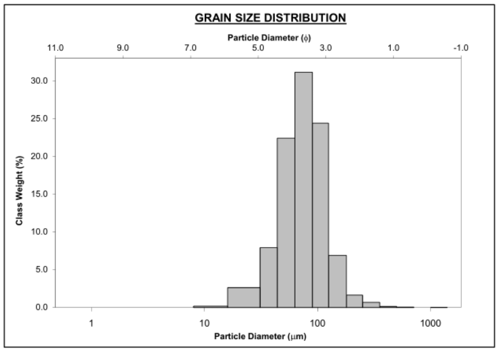
	μm	φ
MODE 1:	76.50	3.731
MODE 2:		
MODE 3:		
D_{10}:	38.17	3.007
MEDIAN or D_{50}:	73.78	3.761
D_{90}:	124.4	4.711
(D_{90} / D_{10}):	3.259	1.567
(D_{90} - D_{10}):	86.22	1.704
(D_{75} / D_{25}):	1.891	1.277
(D_{75} - D_{25}):	47.22	0.920

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.1%
SAND:	64.5%	MEDIUM SAND:	0.8%
MUD:	35.5%	FINE SAND:	8.7%
		V FINE SAND:	54.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	30.0%
COARSE GRAVEL:	0.0%	COARSE SILT:	5.1%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	0.4%
FINE GRAVEL:	0.0%	FINE SILT:	0.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	0.0%
V COARSE SAND:	0.1%	CLAY:	0.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	82.63	71.66	3.799	72.87	3.778	Very Fine Sand
SORTING (σ):	48.32	1.666	0.730	1.618	0.694	Moderately Well Sorted
SKEWNESS (Sk):	5.559	-0.468	0.181	-0.063	0.063	Symmetrical
KURTOSIS (K):	90.79	6.096	4.476	1.077	1.077	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-094** ANALYST & DATE: ,
SAMPLE TYPE: Unimodal, Poorly Sorted TEXTURAL GROUP: Mud
SEDIMENT NAME: Coarse Silt

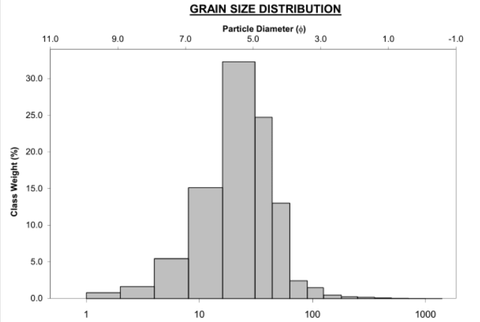
	μm	φ
MODE 1:	23.50	5.489
MODE 2:		
MODE 3:		
D_{10}:	7.650	4.374
MEDIAN or D_{50}:	21.97	5.508
D_{90}:	48.23	7.030
(D_{90} / D_{10}):	6.305	1.607
(D_{90} - D_{10}):	40.58	2.657
(D_{75} / D_{25}):	2.539	1.275
(D_{75} - D_{25}):	20.37	1.344

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	0.0%
SAND:	3.6%	MEDIUM SAND:	0.2%
MUD:	96.4%	FINE SAND:	0.5%
		V FINE SAND:	2.8%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	24.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	41.8%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	19.6%
FINE GRAVEL:	0.0%	FINE SILT:	7.0%
V FINE GRAVEL:	0.0%	V FINE SILT:	2.1%
V COARSE SAND:	0.0%	CLAY:	1.0%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	27.65	20.22	5.628	20.53	5.606	Coarse Silt
SORTING (σ):	28.93	2.156	1.108	2.098	1.069	Poorly Sorted
SKEWNESS (Sk):	11.32	-0.545	0.542	-0.179	0.179	Fine Skewed
KURTOSIS (K):	258.6	4.609	4.615	1.110	1.110	Leptokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-095** ANALYST & DATE: ,
SAMPLE TYPE: Bimodal, Very Poorly Sorted TEXTURAL GROUP: Sandy Mud
SEDIMENT NAME: Very Fine Sandy Coarse Silt

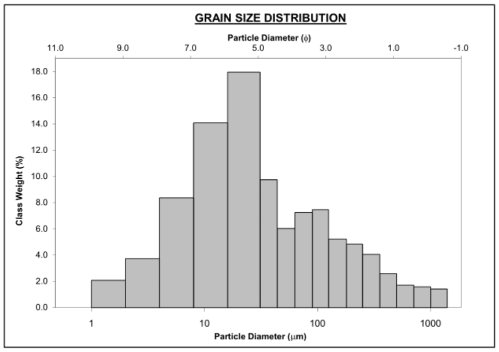
	μm	φ
MODE 1:	23.50	5.489
MODE 2:	107.5	3.237
MODE 3:		
D_{10}:	4.336	2.187
MEDIAN or D_{50}:	21.43	5.544
D_{90}:	219.6	7.850
(D_{90} / D_{10}):	50.66	3.590
(D_{90} - D_{10}):	215.3	5.663
(D_{75} / D_{25}):	6.976	1.716
(D_{75} - D_{25}):	56.77	2.802

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	2.3%
SAND:	25.8%	MEDIUM SAND:	4.6%
MUD:	74.2%	FINE SAND:	7.0%
		V FINE SAND:	10.1%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	10.8%
COARSE GRAVEL:	0.0%	COARSE SILT:	24.4%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	19.1%
FINE GRAVEL:	0.0%	FINE SILT:	11.3%
V FINE GRAVEL:	0.0%	V FINE SILT:	5.1%
V COARSE SAND:	1.9%	CLAY:	3.4%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	79.41	23.94	5.292	25.37	5.301	Coarse Silt
SORTING (σ):	170.6	4.403	2.154	4.603	2.202	Very Poorly Sorted
SKEWNESS (Sk):	4.257	0.327	-0.425	0.164	-0.164	Coarse Skewed
KURTOSIS (K):	23.84	2.925	2.931	1.088	1.088	Mesokurtic

GRAIN SIZE DISTRIBUTION



SAMPLE STATISTICS

SAMPLE IDENTITY: **CLA-MW5-14D(2)-GS-096** ANALYST & DATE: ,

SAMPLE TYPE: Trimodal, Very Poorly Sorted TEXTURAL GROUP: Muddy Sand

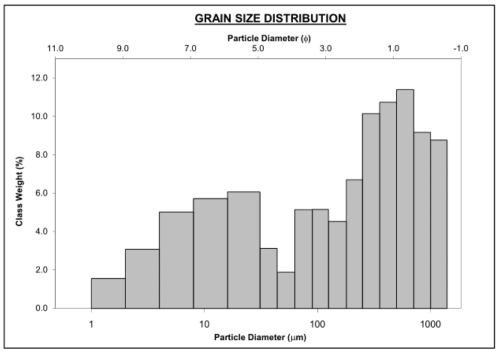
SEDIMENT NAME: Coarse Silty Medium Sand

	μm	φ
MODE 1:	605.0	0.747
MODE 2:	23.50	5.489
MODE 3:	107.5	3.237
D_{10}:	4.863	-0.185
MEDIAN or D_{50}:	183.6	2.445
D_{90}:	1136.9	7.684
(D_{90} / D_{10}):	233.8	-41.507
$(D_{90} - D_{10})$:	1132.1	7.869
(D_{75} / D_{25}):	35.47	7.533
$(D_{75} - D_{25})$:	562.8	5.149

GRAIN SIZE DISTRIBUTION

GRAVEL:	0.0%	COARSE SAND:	16.3%
SAND:	62.1%	MEDIUM SAND:	16.5%
MUD:	37.9%	FINE SAND:	8.8%
		V FINE SAND:	8.1%
V COARSE GRAVEL:	0.0%	V COARSE SILT:	3.9%
COARSE GRAVEL:	0.0%	COARSE SILT:	9.5%
MEDIUM GRAVEL:	0.0%	MEDIUM SILT:	9.0%
FINE GRAVEL:	0.0%	FINE SILT:	7.8%
V FINE GRAVEL:	0.0%	V FINE SILT:	4.8%
V COARSE SAND:	12.6%	CLAY:	2.8%

	METHOD OF MOMENTS			FOLK & WARD METHOD		
	Arithmetic μm	Geometric μm	Logarithmic φ	Geometric μm	Logarithmic φ	Description
MEAN ($\bar{x}$):	286.6	64.98	3.361	108.5	3.205	Very Fine Sand
SORTING (σ):	356.2	9.076	2.928	8.166	3.030	Very Poorly Sorted
SKEWNESS (Sk):	1.277	-0.413	0.483	-0.351	0.351	Very Fine Skewed
KURTOSIS (K):	3.589	1.879	1.912	0.712	0.712	Platykurtic



Appendix C

Downhole geophysics (gamma, electrical resistivity) data.

MW5-14D											
2 Inch Well Log											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
0.57	20	3.62	52	6.67	55.5556	9.72	38	12.77	66	15.82	48
0.62	24.7619	3.67	75.5556	6.72	62	9.77	37.7778	12.82	31.1111	15.87	58
0.67	34.2857	3.72	58	6.77	64	9.82	48	12.87	64	15.92	60
0.72	43.3333	3.77	55.5556	6.82	77.7778	9.87	53.3333	12.92	51.1111	15.97	42
0.77	50.9091	3.82	72	6.87	82	9.92	36	12.97	34	16.02	55.5556
0.82	64	3.87	60	6.92	62.2222	9.97	44	13.02	51.1111	16.07	64
0.87	56	3.92	80	6.97	62	10.02	35.5556	13.07	48	16.12	44
0.92	75.5556	3.97	102	7.02	71.1111	10.07	66	13.12	37.7778	16.17	37.7778
0.97	76	4.02	93.3333	7.07	60	10.12	50	13.17	56	16.22	40
1.02	75.5556	4.07	68	7.12	46	10.17	22.2222	13.22	31.1111	16.27	48.8889
1.07	78	4.12	64	7.17	66.6667	10.22	44	13.27	52	16.32	42
1.12	100	4.17	48.8889	7.22	68	10.27	40	13.32	56	16.37	48.8889
1.17	60	4.22	54	7.27	72	10.32	44	13.37	57.7778	16.42	28
1.22	86	4.27	86.6667	7.32	68.8889	10.37	46.6667	13.42	60	16.47	48.8889
1.27	116	4.32	56	7.37	70	10.42	40	13.47	48	16.52	42
1.32	137.778	4.37	71.1111	7.42	94	10.47	42.2222	13.52	51.1111	16.57	46.6667
1.37	136	4.42	80	7.47	55.5556	10.52	54	13.57	30	16.62	42
1.42	132	4.47	82.2222	7.52	70	10.57	53.3333	13.62	51.1111	16.67	38
1.47	114	4.52	66	7.57	73.3333	10.62	44.4444	13.67	50	16.72	53.3333
1.52	113.333	4.57	77.7778	7.62	76	10.67	50	13.72	53.3333	16.77	44
1.57	130	4.62	80	7.67	52	10.72	38	13.77	40	16.82	40
1.62	136	4.67	73.3333	7.72	46.6667	10.77	22.2222	13.82	46.6667	16.87	44.4444
1.67	120	4.72	72	7.77	74	10.82	38	13.87	48	16.92	46
1.72	106	4.77	86	7.82	48.8889	10.87	38	13.92	42.2222	16.97	57.7778
1.77	116	4.82	62.2222	7.87	64.4444	10.92	53.3333	13.97	44	17.02	64
1.82	144.444	4.87	78	7.92	56	10.97	44	14.02	31.1111	17.07	48
1.87	106	4.92	46.6667	7.97	97.7778	11.02	35.5556	14.07	58	17.12	48.8889
1.92	115.556	4.97	84	8.02	66	11.07	42	14.12	56	17.17	38
1.97	98	5.02	42	8.07	55.5556	11.12	54	14.17	57.7778	17.22	75.5556
2.02	80	5.07	86.6667	8.12	92	11.17	66.6667	14.22	32	17.27	38
2.07	97.7778	5.12	38	8.17	82	11.22	46.6667	14.27	28	17.32	53.3333
2.12	116	5.17	82.2222	8.22	62.2222	11.27	46	14.32	46.6667	17.37	38
2.17	90	5.22	84	8.27	48	11.32	31.1111	14.37	48	17.42	57.7778
2.22	124.444	5.27	66.6667	8.32	68	11.37	48	14.42	60	17.47	26
2.27	100	5.32	60	8.37	73.3333	11.42	33.3333	14.47	52	17.52	31.1111
2.32	92	5.37	50	8.42	38	11.47	50	14.52	36	17.57	42
2.37	78	5.42	88.8889	8.47	37.7778	11.52	37.7778	14.57	28.8889	17.62	52
2.42	117.778	5.47	56	8.52	56	11.57	44	14.62	50	17.67	44.4444
2.47	92	5.52	62.2222	8.57	60	11.62	40	14.67	35.5556	17.72	54
2.52	92	5.57	64	8.62	42.2222	11.67	28.8889	14.72	26.6667	17.77	52
2.57	91.1111	5.62	64	8.67	68.8889	11.72	48	14.77	54	17.82	42.2222
2.62	76	5.67	66.6667	8.72	50	11.77	50	14.82	56	17.87	58
2.67	72	5.72	72	8.77	48.8889	11.82	46.6667	14.87	33.3333	17.92	46
2.72	82.2222	5.77	52	8.82	56	11.87	42	14.92	38	17.97	51.1111
2.77	84	5.82	71.1111	8.87	33.3333	11.92	46.6667	14.97	53.3333	18.02	52
2.82	93.3333	5.87	66	8.92	38	11.97	50	15.02	32	18.07	46.6667
2.87	84	5.92	91.1111	8.97	40	12.02	46.6667	15.07	30	18.12	46
2.92	112	5.97	50	9.02	44	12.07	50	15.12	55.5556	18.17	46.6667
2.97	102.222	6.02	82.2222	9.07	54	12.12	64.4444	15.17	68	18.22	42
3.02	104	6.07	76	9.12	46.6667	12.17	46	15.22	30	18.27	53.3333
3.07	88	6.12	42.2222	9.17	42	12.22	48.8889	15.27	53.3333	18.32	46
3.12	111.111	6.17	82	9.22	48	12.27	52	15.32	42	18.37	35.5556
3.17	106	6.22	84.4444	9.27	40	12.32	28.8889	15.37	60	18.42	58
3.22	84	6.27	84	9.32	58	12.37	60	15.42	34	18.47	44
3.27	95.5556	6.32	82.2222	9.37	48.8889	12.42	46.6667	15.47	51.1111	18.52	42.2222
3.32	84	6.37	68	9.42	36	12.47	66	15.52	62	18.57	36
3.37	68	6.42	73.3333	9.47	33.3333	12.52	38	15.57	62.2222	18.62	56
3.42	75.5556	6.47	64	9.52	62	12.57	51.1111	15.62	52	18.67	42.2222
3.47	50	6.52	50	9.57	35.5556	12.62	54	15.67	66.6667	18.72	56
3.52	55.5556	6.57	57.7778	9.62	46	12.67	56	15.72	58	18.77	33.3333
3.57	71.1111	6.62	74	9.67	62.2222	12.72	46.6667	15.77	55.5556	18.82	44

MW5-14D											
2 Inch Well Log											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
18.87	48	21.92	53.3333	24.97	46.6667	28.02	58	31.07	34	34.12	56
18.92	42.2222	21.97	54	25.02	58	28.07	64.4444	31.12	52	34.17	54
18.97	28	22.02	52	25.07	24.4444	28.12	42	31.17	52	34.22	31.1111
19.02	31.1111	22.07	30	25.12	50	28.17	54	31.22	44	34.27	44
19.07	40	22.12	57.7778	25.17	64	28.22	48	31.27	56	34.32	64
19.12	42	22.17	48	25.22	44.4444	28.27	35.5556	31.32	42	34.37	30
19.17	48	22.22	46.6667	25.27	46	28.32	40	31.37	37.7778	34.42	70
19.22	33.3333	22.27	40	25.32	38	28.37	62	31.42	50	34.47	60
19.27	38	22.32	46.6667	25.37	48.8889	28.42	46	31.47	52	34.52	54
19.32	42	22.37	46	25.42	46	28.47	31.1111	31.52	60	34.57	58
19.37	35.5556	22.42	33.3333	25.47	40	28.52	46	31.57	66.6667	34.62	36
19.42	34	22.47	54	25.52	33.3333	28.57	40	31.62	44	34.67	74
19.47	42	22.52	34	25.57	54	28.62	50	31.67	44	34.72	68
19.52	44.4444	22.57	44.4444	25.62	52	28.67	54	31.72	34	34.77	46
19.57	50	22.62	54	25.67	40	28.72	36	31.77	55.5556	34.82	60
19.62	35.5556	22.67	44.4444	25.72	51.1111	28.77	52	31.82	46	34.87	66
19.67	32	22.72	46	25.77	60	28.82	55.5556	31.87	54	34.92	62
19.72	57.7778	22.77	70	25.82	40	28.87	52	31.92	34	34.97	71.1111
19.77	38	22.82	36	25.87	64	28.92	58	31.97	48	35.02	62
19.82	48.8889	22.87	55.5556	25.92	37.7778	28.97	48	32.02	42	35.07	64
19.87	38	22.92	46	25.97	40	29.02	46	32.07	44	35.12	40
19.92	55.5556	22.97	55.5556	26.02	50	29.07	46.6667	32.12	53.3333	35.17	40
19.97	38	23.02	54	26.07	66	29.12	40	32.17	52	35.22	72
20.02	44	23.07	48	26.12	36	29.17	50	32.22	42	35.27	42
20.07	28.8889	23.12	55.5556	26.17	56	29.22	57.7778	32.27	50	35.32	70
20.12	44	23.17	52	26.22	42.2222	29.27	58	32.32	40	35.37	46
20.17	44	23.22	40	26.27	48	29.32	30	32.37	54	35.42	64.4444
20.22	42.2222	23.27	58	26.32	40	29.37	44	32.42	55.5556	35.47	46
20.27	54	23.32	57.7778	26.37	64	29.42	46	32.47	42	35.52	50
20.32	56	23.37	52	26.42	56	29.47	50	32.52	50	35.57	62
20.37	26.6667	23.42	40	26.47	38	29.52	37.7778	32.57	46.6667	35.62	68
20.42	44	23.47	44	26.52	55.5556	29.57	48	32.62	40	35.67	37.7778
20.47	46.6667	23.52	48	26.57	36	29.62	42	32.67	48	35.72	58
20.52	36	23.57	68.8889	26.62	48	29.67	26	32.72	50	35.77	56
20.57	28.8889	23.62	42	26.67	26.6667	29.72	50	32.77	42	35.82	38
20.62	48	23.67	44	26.72	44	29.77	52	32.82	46	35.87	60
20.67	53.3333	23.72	17.7778	26.77	48	29.82	50	32.87	34	35.92	48
20.72	58	23.77	62	26.82	56	29.87	60	32.92	55.5556	35.97	40
20.77	36	23.82	36	26.87	52	29.92	66	32.97	42	36.02	37.7778
20.82	37.7778	23.87	55.5556	26.92	54	29.97	68	33.02	40	36.07	36
20.87	38	23.92	30	26.97	42.2222	30.02	68.8889	33.07	26	36.12	52
20.92	60	23.97	51.1111	27.02	44	30.07	38	33.12	28	36.17	30
20.97	40	24.02	42	27.07	38	30.12	42	33.17	42.2222	36.22	46
21.02	40	24.07	51.1111	27.12	48	30.17	44	33.22	38	36.27	62
21.07	55.5556	24.12	64	27.17	36	30.22	42.2222	33.27	40	36.32	30
21.12	44	24.17	53.3333	27.22	40	30.27	48	33.32	46	36.37	35.5556
21.17	50	24.22	38	27.27	32	30.32	60	33.37	33.3333	36.42	46
21.22	44.4444	24.27	52	27.32	33.3333	30.37	40	33.42	30	36.47	62
21.27	52	24.32	48.8889	27.37	42	30.42	50	33.47	40	36.52	36
21.32	50	24.37	44	27.42	32	30.47	44	33.52	46	36.57	60
21.37	51.1111	24.42	32	27.47	37.7778	30.52	36	33.57	46.6667	36.62	28
21.42	36	24.47	40	27.52	42	30.57	58	33.62	42	36.67	44
21.47	55.5556	24.52	28	27.57	34	30.62	51.1111	33.67	50	36.72	48
21.52	46	24.57	46	27.62	52	30.67	44	33.72	44	36.77	44.4444
21.57	57.7778	24.62	48.8889	27.67	46.6667	30.72	68	33.77	38	36.82	66
21.62	82	24.67	54	27.72	46	30.77	35.5556	33.82	46	36.87	46
21.67	48.8889	24.72	40	27.77	32	30.82	48	33.87	60	36.92	38
21.72	40	24.77	64.4444	27.82	54	30.87	72	33.92	32	36.97	46
21.77	60	24.82	56	27.87	60	30.92	70	33.97	52	37.02	53.3333
21.82	42	24.87	60	27.92	34	30.97	42.2222	34.02	44	37.07	42
21.87	40	24.92	48	27.97	38	31.02	64	34.07	60	37.12	70

MW5-14D											
2 Inch Well Log											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
37.17	60	40.22	64	43.27	55.5556	46.32	34	49.37	76	52.42	52
37.22	48	40.27	50	43.32	54	46.37	50	49.42	62	52.47	44
37.27	46	40.32	50	43.37	58	46.42	40	49.47	60	52.52	50
37.32	44	40.37	36	43.42	44.4444	46.47	40	49.52	58	52.57	57.7778
37.37	37.7778	40.42	40	43.47	42	46.52	44	49.57	66	52.62	38
37.42	38	40.47	30	43.52	48	46.57	44	49.62	54	52.67	50
37.47	56	40.52	66	43.57	60	46.62	32	49.67	60	52.72	50
37.52	44.4444	40.57	48	43.62	30	46.67	35.5556	49.72	66	52.77	28
37.57	50	40.62	44	43.67	38	46.72	32	49.77	80	52.82	28.8889
37.62	38	40.67	52	43.72	35.5556	46.77	50	49.82	74	52.87	50
37.67	46	40.72	35.5556	43.77	52	46.82	33.3333	49.87	62	52.92	56
37.72	32	40.77	54	43.82	34	46.87	30	49.92	52	52.97	56
37.77	46.6667	40.82	38	43.87	40	46.92	40	49.97	76	53.02	36.3636
37.82	40	40.87	50	43.92	58	46.97	50	50.02	64.4444	53.07	42
37.87	44	40.92	28.8889	43.97	66	47.02	40	50.07	66	53.12	58.1818
37.92	58	40.97	30	44.02	44	47.07	50	50.12	70	53.17	49.0909
37.97	52	41.02	48	44.07	48.8889	47.12	40	50.17	54	53.22	32.7273
38.02	44	41.07	54	44.12	48	47.17	42	50.22	55.5556	53.27	38.1818
38.07	48	41.12	52	44.17	46	47.22	40	50.27	92	53.32	47.2727
38.12	51.1111	41.17	37.7778	44.22	46.6667	47.27	36	50.32	66	53.37	43.6364
38.17	24	41.22	44	44.27	56	47.32	42	50.37	70	53.42	36.6667
38.22	64	41.27	58	44.32	58	47.37	38	50.42	66	53.47	51.6667
38.27	46	41.32	56	44.37	64	47.42	52	50.47	58	53.52	38.1818
38.32	48.8889	41.37	50	44.42	40	47.47	44	50.52	68	53.57	38.3333
38.37	48	41.42	32	44.47	73.3333	47.52	57.7778	50.57	62	53.62	23.3333
38.42	50	41.47	32	44.52	52	47.57	48	50.62	77.7778	53.67	36.6667
38.47	37.7778	41.52	35.5556	44.57	48	47.62	40	50.67	54	53.72	31.6667
38.52	46	41.57	34	44.62	54	47.67	24.4444	50.72	70	53.77	56.9231
38.57	58	41.62	50	44.67	48	47.72	58	50.77	64	53.82	45.7143
38.62	62	41.67	44.4444	44.72	64	47.77	44	50.82	48	53.87	30.6667
38.67	44	41.72	40	44.77	46	47.82	48	50.87	51.1111	53.92	34.1176
38.72	52	41.77	34	44.82	50	47.87	36	50.92	34	53.97	43.3333
38.77	44	41.82	54	44.87	40	47.92	34	50.97	54	54.02	55.7895
38.82	51.1111	41.87	44.4444	44.92	56	47.97	42	51.02	48	54.07	49.5652
38.87	52	41.92	44	44.97	38	48.02	44	51.07	48.8889	54.12	39.3548
38.92	40	41.97	48	45.02	51.1111	48.07	48.8889	51.12	50	54.17	50
38.97	48	42.02	38	45.07	64	48.12	40	51.17	50	54.22	46.3857
39.02	38	42.07	64	45.12	56	48.17	46	51.22	46		
39.07	57.7778	42.12	78	45.17	42	48.22	40	51.27	42		
39.12	46	42.17	36	45.22	44.4444	48.27	38	51.32	40		
39.17	58	42.22	48.8889	45.27	42	48.32	33.3333	51.37	34		
39.22	46.6667	42.27	52	45.32	48	48.37	36	51.42	16		
39.27	44	42.32	50	45.37	42	48.42	42	51.47	46.6667		
39.32	48	42.37	42	45.42	40	48.47	34	51.52	34		
39.37	38	42.42	50	45.47	42	48.52	33.3333	51.57	52		
39.42	40	42.47	46.6667	45.52	30	48.57	38	51.62	38		
39.47	40	42.52	54	45.57	50	48.62	48	51.67	40		
39.52	42	42.57	44	45.62	57.7778	48.67	46	51.72	51.1111		
39.57	38	42.62	35.5556	45.67	50	48.72	38	51.77	58		
39.62	46	42.67	60	45.72	62	48.77	38	51.82	44		
39.67	56	42.72	44	45.77	52	48.82	40	51.87	42		
39.72	58	42.77	36	45.82	38	48.87	48	51.92	40		
39.77	31.1111	42.82	54	45.87	57.7778	48.92	55.5556	51.97	38		
39.82	46	42.87	38	45.92	32	48.97	32	52.02	50		
39.87	60	42.92	38	45.97	34	49.02	46	52.07	42		
39.92	50	42.97	57.7778	46.02	62.2222	49.07	42	52.12	72		
39.97	55.5556	43.02	30	46.07	44	49.12	44	52.17	46		
40.02	52	43.07	44	46.12	52	49.17	55.5556	52.22	44		
40.07	66	43.12	54	46.17	52	49.22	62	52.27	50		
40.12	60	43.17	34	46.22	28	49.27	58	52.32	52		
40.17	52	43.22	34	46.27	54	49.32	68.8889	52.37	55.5556		

MW5-14D(2)											
6 Inch Well Logs											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
1.06	52.069	4.11	30.7692	7.16	26.1538	10.21	42.8571	13.26	32.3077	16.31	47.6923
1.11	54.9153	4.16	35.3846	7.21	26.1538	10.26	53.8462	13.31	40	16.36	43.0769
1.16	50.6122	4.21	32.8571	7.26	20	10.31	40	13.36	30.7692	16.41	52.3077
1.21	55.5556	4.26	27.6923	7.31	27.6923	10.36	49.2308	13.41	55.3846	16.46	35
1.26	56.7568	4.31	33.8462	7.36	29.2308	10.41	38.4615	13.46	45.7143	16.51	53.8462
1.31	53.5714	4.36	36.9231	7.41	38.5714	10.46	38.4615	13.51	44.6154	16.56	46.1538
1.36	49.2308	4.41	27.6923	7.46	32.3077	10.51	32.8571	13.56	50.7692	16.61	40
1.41	46.1538	4.46	29.2308	7.51	30.7692	10.56	55.3846	13.61	46.1538	16.66	33.8462
1.46	50.7692	4.51	30.7692	7.56	32.3077	10.61	38.4615	13.66	38.5714	16.71	46.1538
1.51	43.8095	4.56	23.0769	7.61	27.6923	10.66	45.7143	13.71	33.8462	16.76	51.4286
1.56	32.2222	4.61	29.2308	7.66	29.2308	10.71	36.9231	13.76	43.0769	16.81	52.3077
1.61	57.8947	4.66	27.6923	7.71	40	10.76	28.5714	13.81	43.0769	16.86	33.8462
1.66	45.5556	4.71	21.4286	7.76	32.3077	10.81	38.4615	13.86	35.3846	16.91	46.1538
1.71	49.4737	4.76	27.6923	7.81	27.6923	10.86	33.8462	13.91	41.5385	16.96	24.6154
1.76	54.4444	4.81	35.3846	7.86	32.3077	10.91	41.4286	13.96	50	17.01	33.8462
1.81	31.5789	4.86	30.7692	7.91	26.1538	10.96	49.2308	14.01	32.3077	17.06	41.4286
1.86	43.3333	4.91	42.8571	7.96	35.3846	11.01	38.5714	14.06	35.3846	17.11	32.3077
1.91	46.6667	4.96	26.1538	8.01	38.5714	11.06	30.7692	14.11	40	17.16	30.7692
1.96	42.1053	5.01	35.3846	8.06	38.4615	11.11	33.8462	14.16	41.5385	17.21	30.7692
2.01	34.4444	5.06	23.0769	8.11	26.1538	11.16	32.3077	14.21	44.2857	17.26	43.0769
2.06	40	5.11	32.3077	8.16	20	11.21	29.2308	14.26	35.3846	17.31	44.6154
2.11	34.4444	5.16	21.5385	8.21	35.3846	11.26	45.7143	14.31	51.4286	17.36	38.4615
2.16	37.8947	5.21	41.5385	8.26	32.3077	11.31	33.8462	14.36	44.6154	17.41	38.4615
2.21	43.5294	5.26	20	8.31	31.4286	11.36	50.7692	14.41	42.8571	17.46	35.3846
2.26	37.6471	5.31	40	8.36	30.7692	11.41	38.4615	14.46	41.5385	17.51	35.3846
2.31	37.7778	5.36	24.6154	8.41	18.4615	11.46	24.2857	14.51	41.5385	17.56	32.3077
2.36	47.0588	5.41	32.8571	8.46	25.7143	11.51	30.7692	14.56	38.5714	17.61	44.2857
2.41	32.2222	5.46	40	8.51	44.6154	11.56	35.3846	14.61	46.1538	17.66	50.7692
2.46	37.6471	5.51	29.2308	8.56	41.5385	11.61	40	14.66	36.9231	17.71	24.6154
2.51	30.6667	5.56	32.3077	8.61	41.5385	11.66	55.3846	14.71	30	17.76	44.6154
2.56	47.1429	5.61	33.8462	8.66	30.7692	11.71	35.7143	14.76	43.0769	17.81	33.8462
2.61	40	5.66	32.8571	8.71	36.9231	11.76	38.4615	14.81	16.9231	17.86	29.2308
2.66	30.7692	5.71	18.4615	8.76	26.1538	11.81	43.0769	14.86	41.4286	17.91	44.6154
2.71	32.3077	5.76	27.6923	8.81	31.4286	11.86	35.7143	14.91	41.5385	17.96	33.8462
2.76	33.8462	5.81	18.4615	8.86	40	11.91	32.3077	14.96	38.5714	18.01	47.1429
2.81	36.9231	5.86	37.1429	8.91	30.7692	11.96	50.7692	15.01	47.6923	18.06	38.3333
2.86	35.3846	5.91	29.2308	8.96	40	12.01	41.5385	15.06	35.7143	18.11	27.6923
2.91	33.8462	5.96	21.5385	9.01	38.5714	12.06	35.7143	15.11	41.5385	18.16	27.6923
2.96	24.6154	6.01	33.8462	9.06	30.7692	12.11	38.4615	15.16	37.1429	18.21	30.7692
3.01	28.5714	6.06	29.2308	9.11	29.2308	12.16	49.2308	15.21	49.2308	18.26	35.7143
3.06	21.5385	6.11	29.2308	9.16	35.7143	12.21	33.8462	15.26	37.1429	18.31	32.3077
3.11	30.7692	6.16	40	9.21	35.3846	12.26	25.7143	15.31	41.5385	18.36	32.3077
3.16	29.2308	6.21	24.6154	9.26	24.6154	12.31	33.8462	15.36	48.5714	18.41	41.5385
3.21	37.1429	6.26	24.6154	9.31	41.4286	12.36	33.8462	15.41	30.7692	18.46	46.1538
3.26	30.7692	6.31	27.6923	9.36	33.8462	12.41	40	15.46	36.9231	18.51	50
3.31	33.8462	6.36	26.1538	9.41	44.6154	12.46	26.1538	15.51	41.4286	18.56	55.3846
3.36	27.6923	6.41	28.5714	9.46	40	12.51	42.8571	15.56	36.9231	18.61	40
3.41	33.8462	6.46	27.6923	9.51	38.5714	12.56	32.3077	15.61	49.2308	18.66	30.7692
3.46	23.0769	6.51	33.8462	9.56	44.6154	12.61	55.3846	15.66	30	18.71	35.3846
3.51	29.2308	6.56	44.6154	9.61	29.2308	12.66	38.5714	15.71	60	18.76	30.7692
3.56	30.7692	6.61	41.4286	9.66	33.8462	12.71	32.3077	15.76	35.7143	18.81	40
3.61	41.5385	6.66	38.4615	9.71	27.1429	12.76	47.1429	15.81	58.4615	18.86	32.8571
3.66	36.9231	6.71	32.3077	9.76	21.5385	12.81	35.3846	15.86	44.2857	18.91	29.2308
3.71	33.8462	6.76	35.3846	9.81	49.2308	12.86	32.3077	15.91	47.1429	18.96	32.3077
3.76	30	6.81	44.6154	9.86	32.8571	12.91	51.4286	15.96	52.3077	19.01	32.3077
3.81	33.8462	6.86	30.7692	9.91	47.6923	12.96	44.6154	16.01	38.5714	19.06	40
3.86	40	6.91	35.3846	9.96	55.7143	13.01	38.4615	16.06	44.6154	19.11	41.5385
3.91	43.0769	6.96	29.2308	10.01	43.0769	13.06	47.6923	16.11	46.1538	19.16	46.1538
3.96	38.5714	7.01	38.3333	10.06	45.7143	13.11	45.7143	16.16	46.1538	19.21	41.5385
4.01	27.6923	7.06	33.8462	10.11	30.7692	13.16	44.6154	16.21	47.6923	19.26	27.6923
4.06	30.7692	7.11	30.7692	10.16	40	13.21	53.8462	16.26	30.7692	19.31	28.5714

MW5-14D(2)											
6 Inch Well Logs											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
19.36	33.8462	22.41	36.9231	25.46	35.3846	28.51	40	31.56	29.2308	34.61	33.8462
19.41	29.2308	22.46	55.3846	25.51	32.3077	28.56	46.1538	31.61	32.8571	34.66	42.8571
19.46	26.1538	22.51	53.8462	25.56	18.4615	28.61	33.8462	31.66	44.6154	34.71	52.3077
19.51	47.6923	22.56	46.1538	25.61	38.4615	28.66	35.7143	31.71	32.3077	34.76	41.4286
19.56	41.4286	22.61	41.5385	25.66	30.7692	28.71	36.9231	31.76	43.0769	34.81	47.6923
19.61	33.8462	22.66	44.2857	25.71	40	28.76	43.0769	31.81	40	34.86	21.5385
19.66	56.9231	22.71	43.0769	25.76	41.5385	28.81	36.9231	31.86	40	34.91	40
19.71	40	22.76	36.9231	25.81	50.7692	28.86	37.1429	31.91	34.2857	34.96	36.9231
19.76	38.4615	22.81	38.5714	25.86	51.4286	28.91	16.9231	31.96	50.7692	35.01	38.4615
19.81	46.1538	22.86	36.9231	25.91	43.0769	28.96	49.2308	32.01	35.7143	35.06	21.5385
19.86	47.6923	22.91	36.9231	25.96	41.5385	29.01	32.8571	32.06	40	35.11	25.7143
19.91	36.9231	22.96	47.6923	26.01	50.7692	29.06	44.6154	32.11	56.9231	35.16	53.8462
19.96	35.3846	23.01	43.0769	26.06	24.6154	29.11	32.8571	32.16	40	35.21	43.0769
20.01	63.0769	23.06	33.8462	26.11	43.0769	29.16	60	32.21	47.6923	35.26	27.1429
20.06	24.2857	23.11	41.5385	26.16	40	29.21	36.9231	32.26	42.8571	35.31	29.2308
20.11	30.7692	23.16	20	26.21	36.9231	29.26	36.9231	32.31	40	35.36	45.7143
20.16	41.5385	23.21	29.2308	26.26	47.6923	29.31	44.2857	32.36	44.6154	35.41	43.0769
20.21	35.7143	23.26	38.4615	26.31	41.5385	29.36	26.1538	32.41	32.8571	35.46	34.2857
20.26	44.6154	23.31	30.7692	26.36	35.3846	29.41	34.2857	32.46	36.9231	35.51	40
20.31	33.8462	23.36	32.8571	26.41	37.1429	29.46	47.6923	32.51	24.6154	35.56	41.4286
20.36	38.4615	23.41	60	26.46	46.1538	29.51	34.2857	32.56	48.5714	35.61	35.3846
20.41	38.4615	23.46	33.8462	26.51	33.8462	29.56	29.2308	32.61	44.6154	35.66	42.8571
20.46	33.8462	23.51	40	26.56	32.3077	29.61	50	32.66	49.2308	35.71	38.4615
20.51	41.5385	23.56	47.6923	26.61	40	29.66	63.0769	32.71	35.7143	35.76	33.8462
20.56	35.7143	23.61	36.9231	26.66	44.6154	29.71	41.4286	32.76	53.8462	35.81	41.4286
20.61	25	23.66	44.2857	26.71	33.8462	29.76	27.6923	32.81	30	35.86	41.5385
20.66	35.3846	23.71	40	26.76	38.4615	29.81	41.4286	32.86	33.8462	35.91	44.6154
20.71	61.5385	23.76	50.7692	26.81	32.3077	29.86	27.6923	32.91	17.1429	35.96	44.6154
20.76	50.7692	23.81	50.7692	26.86	52.3077	29.91	43.0769	32.96	38.4615	36.01	41.4286
20.81	42.8571	23.86	43.0769	26.91	35.7143	29.96	38.5714	33.01	45.7143	36.06	36.9231
20.86	44.6154	23.91	41.5385	26.96	70.7692	30.01	33.8462	33.06	40	36.11	35.3846
20.91	53.8462	23.96	47.1429	27.01	49.2308	30.06	38.4615	33.11	50	36.16	41.4286
20.96	47.6923	24.01	30.7692	27.06	44.6154	30.11	38.5714	33.16	32.3077	36.21	36.9231
21.01	35.3846	24.06	35.3846	27.11	44.6154	30.16	33.8462	33.21	40	36.26	31.4286
21.06	44.2857	24.11	40	27.16	31.4286	30.21	45.7143	33.26	30	36.31	36.9231
21.11	47.6923	24.16	26.1538	27.21	43.0769	30.26	33.8462	33.31	26.1538	36.36	38.5714
21.16	46.1538	24.21	50.7692	27.26	44.6154	30.31	47.1429	33.36	30.7692	36.41	33.8462
21.21	27.6923	24.26	49.2308	27.31	49.2308	30.36	33.8462	33.41	45.7143	36.46	32.8571
21.26	41.5385	24.31	44.6154	27.36	41.5385	30.41	43.0769	33.46	43.0769	36.51	33.8462
21.31	38.4615	24.36	30.7692	27.41	26.1538	30.46	34.2857	33.51	55.3846	36.56	32.3077
21.36	41.4286	24.41	34.2857	27.46	43.0769	30.51	24.6154	33.56	48.5714	36.61	18.5714
21.41	43.0769	24.46	38.4615	27.51	41.5385	30.56	27.1429	33.61	35.3846	36.66	33.8462
21.46	58.4615	24.51	47.6923	27.56	32.3077	30.61	49.2308	33.66	38.5714	36.71	46.1538
21.51	35.3846	24.56	32.8571	27.61	53.8462	30.66	38.5714	33.71	41.5385	36.76	36.9231
21.56	55.3846	24.61	33.8462	27.66	42.8571	30.71	43.0769	33.76	40	36.81	38.5714
21.61	38.4615	24.66	40	27.71	38.4615	30.76	43.0769	33.81	52.3077	36.86	50.7692
21.66	49.2308	24.71	27.6923	27.76	49.2308	30.81	57.1429	33.86	44.2857	36.91	51.4286
21.71	35.3846	24.76	30.7692	27.81	24.6154	30.86	36.9231	33.91	38.4615	36.96	44.6154
21.76	46.1538	24.81	32.3077	27.86	27.6923	30.91	30.7692	33.96	53.8462	37.01	44.6154
21.81	17.1429	24.86	35.3846	27.91	57.1429	30.96	41.4286	34.01	32.8571	37.06	51.4286
21.86	38.4615	24.91	46.1538	27.96	44.6154	31.01	26.1538	34.06	38.4615	37.11	33.8462
21.91	27.6923	24.96	46.1538	28.01	29.2308	31.06	12.3077	34.11	38.4615	37.16	31.4286
21.96	41.5385	25.01	30.7692	28.06	40	31.11	34.2857	34.16	52.8571	37.21	29.2308
22.01	43.0769	25.06	16.9231	28.11	38.5714	31.16	44.6154	34.21	36.9231	37.26	31.4286
22.06	30.7692	25.11	29.2308	28.16	32.3077	31.21	38.5714	34.26	41.5385	37.31	32.3077
22.11	35.3846	25.16	45.7143	28.21	41.5385	31.26	38.4615	34.31	52.8571	37.36	31.4286
22.16	48.5714	25.21	23.0769	28.26	47.6923	31.31	38.5714	34.36	41.5385	37.41	47.6923
22.21	43.0769	25.26	40	28.31	29.2308	31.36	35.7143	34.41	44.2857	37.46	49.2308
22.26	47.6923	25.31	32.3077	28.36	38.4615	31.41	38.4615	34.46	33.8462	37.51	29.2308
22.31	38.4615	25.36	30	28.41	46.1538	31.46	43.0769	34.51	44.6154	37.56	27.1429
22.36	43.0769	25.41	29.2308	28.46	43.0769	31.51	24.2857	34.56	54.2857	37.61	46.1538

MW5-14D(2)											
6 Inch Well Logs											
Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps	Depth m	Gamma cps
37.66	46.1538	39.81	47.6923	41.96	30.7692	44.11	43.0769	46.26	55.3846	48.41	37.037
37.71	51.4286	39.86	42.8571	42.01	27.1429	44.16	45.7143	46.31	38.5714	48.46	35.5556
37.76	40	39.91	50.7692	42.06	41.5385	44.21	47.6923	46.36	32.3077	48.51	45.7143
37.81	44.6154	39.96	50.7692	42.11	38.5714	44.26	35.3846	46.41	27.1429	48.56	34.8148
37.86	35.7143	40.01	44.2857	42.16	32.3077	44.31	35.3846	46.46	55.3846	48.61	36.2963
37.91	43.0769	40.06	36.9231	42.21	42.8571	44.36	35.7143	46.51	41.5385	48.66	30
37.96	44.2857	40.11	43.0769	42.26	40	44.41	20	46.56	65.7143	48.71	40.7143
38.01	38.4615	40.16	47.1429	42.31	41.5385	44.46	30.7692	46.61	38.4615	48.76	35.8824
38.06	32.8571	40.21	33.8462	42.36	45.7143	44.51	40	46.66	32.3077	48.81	31.1111
38.11	38.4615	40.26	43.0769	42.41	26.1538	44.56	27.6923	46.71	30	48.86	31.6667
38.16	21.5385	40.31	32.8571	42.46	76.9231	44.61	48.5714	46.76	32.3077	48.91	30.5556
38.21	42.8571	40.36	41.5385	42.51	35.7143	44.66	40	46.81	40	48.96	37.7778
38.26	32.3077	40.41	30	42.56	47.6923	44.71	29.2308	46.86	41.5385	49.01	32.7778
38.31	36.9231	40.46	30.7692	42.61	40	44.76	35.7143	46.91	38.5714	49.06	48.3333
38.36	30.7692	40.51	34.2857	42.66	27.6923	44.81	30.7692	46.96	35.3846	49.11	37.7778
38.41	37.1429	40.56	36.9231	42.71	28.5714	44.86	41.4286	47.01	32.3077	49.16	30.5556
38.46	40	40.61	32.8571	42.76	26.1538	44.91	36.9231	47.06	34.2857	49.21	39.3548
38.51	43.0769	40.66	38.4615	42.81	44.2857	44.96	35.3846	47.11	38.4615	49.26	37.9412
38.56	35.7143	40.71	29.2308	42.86	36.9231	45.01	43.0769	47.16	30	49.31	39.7101
38.61	41.5385	40.76	41.4286	42.91	36.9231	45.06	34.2857	47.21	35.3846	49.36	36.2667
38.66	41.4286	40.81	26.1538	42.96	42.8571	45.11	41.5385	47.26	30	49.41	43.3846
38.71	32.3077	40.86	38.4615	43.01	47.6923	45.16	44.6154	47.31	40	49.46	43.5484
38.76	18.4615	40.91	43.0769	43.06	38.5714	45.21	45.7143	47.36	52.3077	49.51	37.4194
38.81	28.5714	40.96	31.4286	43.11	30.7692	45.26	38.4615	47.41	41.4286	49.56	37.7465
38.86	47.6923	41.01	35.3846	43.16	38.5714	45.31	50.7692	47.46	35.3846	49.61	37.6471
38.91	27.1429	41.06	29.2308	43.21	30.7692	45.36	50	47.51	50.7692	49.66	38.8235
38.96	24.6154	41.11	44.2857	43.26	41.5385	45.41	47.6923	47.56	32.3077	49.71	33.6585
39.01	45.7143	41.16	36.9231	43.31	50	45.46	38.5714	47.61	44.2857	49.76	34.8936
39.06	40	41.21	31.4286	43.36	32.3077	45.51	47.6923	47.66	47.6923	49.81	35.4545
39.11	35.3846	41.26	49.2308	43.41	35.3846	45.56	38.4615	47.71	41.5385	49.86	35.122
39.16	38.4615	41.31	48.5714	43.46	38.4615	45.61	35.7143	47.76	32.8571	49.91	31.5
39.21	37.1429	41.36	27.6923	43.51	49.2308	45.66	35.3846	47.81	36.9231	49.96	38.0488
39.26	24.6154	41.41	31.4286	43.56	44.2857	45.71	40	47.86	33.8462	50.01	43.9024
39.31	35.3846	41.46	24.6154	43.61	46.1538	45.76	44.6154	47.91	31.4286	50.06	35.7143
39.36	42.8571	41.51	43.0769	43.66	57.1429	45.81	47.6923	47.96	27.6923	50.11	42.7811
39.41	52.3077	41.56	41.4286	43.71	40	45.86	33.8462	48.01	56.3636	50.16	37.4359
39.46	21.5385	41.61	32.3077	43.76	47.1429	45.91	38.5714	48.06	38.1818	50.21	43.1579
39.51	51.4286	41.66	26.1538	43.81	38.4615	45.96	46.1538	48.11	41.1111	50.26	34.2105
39.56	44.6154	41.71	40	43.86	40	46.01	35.3846	48.16	20.9524	50.31	37.9487
39.61	55.7143	41.76	27.6923	43.91	37.1429	46.06	33.8462	48.21	33.8462	50.36	34.8718
39.66	46.1538	41.81	52.3077	43.96	47.6923	46.11	41.4286	48.26	43.5714		
39.71	40	41.86	32.8571	44.01	37.1429	46.16	38.4615	48.31	35.5556		
39.76	53.8462	41.91	40	44.06	46.1538	46.21	31.4286	48.36	46.6667		

MW5-14D(2) 6 Inch Well Logs													
Depth m	R8 Ohm-m	Depth m	R8 Ohm-m	Depth m	R8 Ohm-m	Depth m	R8 Ohm-m	Depth m	R8 Ohm-m	Depth m	R8 Ohm-m	Depth m	R8 Ohm-m
9.41	264.458	15.51	606.956	21.61	693.11	27.71	558.461	33.81	525.794	39.91	578.254	46.01	791.198
9.51	390.369	15.61	639.089	21.71	575.188	27.81	525.471	33.91	527.395	40.01	529.691	46.11	736.724
9.61	458.54	15.71	582.476	21.81	547.115	27.91	575.039	34.01	501.435	40.11	447.037	46.21	674.126
9.71	401.084	15.81	559.88	21.91	625.048	28.01	601.591	34.11	459.341	40.21	497.165	46.31	658.164
9.81	395.272	15.91	625.732	22.01	636.667	28.11	521.164	34.21	461.14	40.31	672.724	46.41	608.112
9.91	507.82	16.01	656.275	22.11	550.773	28.21	499.706	34.31	540.757	40.41	689.577	46.51	523.627
10.01	552.918	16.11	588.956	22.21	541.78	28.31	574.387	34.41	586.446	40.51	556.031	46.61	481.253
10.11	458.413	16.21	564.53	22.31	644.519	28.41	594.101	34.51	554.643	40.61	592.044	46.71	643.515
10.21	443.607	16.31	613.933	22.41	698.231	28.51	550.438	34.61	547.54	40.71	711.697	46.81	773.156
10.31	528.523	16.41	636.908	22.51	596.218	28.61	553.318	34.71	581.428	40.81	653.204	46.91	571.889
10.41	561.579	16.51	582.894	22.61	565.937	28.71	586.954	34.81	591.519	40.91	514.937	47.01	564.307
10.51	478.905	16.61	574.842	22.71	634.446	28.81	609.322	34.91	490.639	41.01	557.316	47.11	805.201
10.61	460.713	16.71	660.347	22.81	642.166	28.91	605.979	35.01	453.794	41.11	716.672	47.21	889.707
10.71	541.171	16.81	712.217	22.91	572.14	29.01	612.587	35.11	577.13	41.21	765.597	47.31	638.154
10.81	574.78	16.91	639.467	23.01	543.717	29.11	659.425	35.21	707.307	41.31	646.47	47.41	452.346
10.91	508.495	17.01	607.642	23.11	594.126	29.21	695.135	35.31	639.88	41.41	572.202	47.51	526.428
11.01	493.975	17.11	669.574	23.21	617.519	29.31	612.349	35.41	542.481	41.51	589.546	47.61	675.622
11.11	559.664	17.21	684.286	23.31	535.122	29.41	564.182	35.51	554.857	41.61	626.235	47.71	551.284
11.21	612.155	17.31	619.696	23.41	497.241	29.51	670.395	35.61	611.024	41.71	593.718	47.81	548.586
11.31	565.451	17.41	614.636	23.51	528.985	29.61	732.456	35.71	535.547	41.81	565.377	47.91	619.752
11.41	736.569	17.51	671.643	23.61	543.356	29.71	591.22	35.81	496.408	41.91	664.869	48.01	584.773
11.51	2409.74	17.61	690.18	23.71	503.214	29.81	484.479	35.91	579.915	42.01	768.9	48.11	565.493
11.61	-126.42	17.71	617.752	23.81	508.18	29.91	491.156	36.01	631.389	42.11	668.367	48.21	642.489
11.71	127.214	17.81	586.938	23.91	565.058	30.01	544.971	36.11	545.386	42.21	588.855	48.31	736.308
11.81	1198.15	17.91	660.776	24.01	572.126	30.11	517.716	36.21	461.19	42.31	657.566	48.41	731.272
11.91	2461.67	18.01	711.288	24.11	523.165	30.21	504.297	36.31	491.431	42.41	691.819	48.51	632.372
12.01	9355.07	18.11	648.185	24.21	500.634	30.31	573.188	36.41	547.299	42.51	544.295	48.61	545.076
12.11	16105.5	18.21	629.733	24.31	551.511	30.41	617.07	36.51	481.63	42.61	455.602	48.71	571.878
12.21	33896.5	18.31	699.874	24.41	597.024	30.51	557.578	36.61	455.81	42.71	548.923	48.81	536.487
12.31	-999	18.41	727.877	24.51	524.581	30.61	499.404	36.71	494.246	42.81	679.895	48.91	441.436
12.41	599.232	18.51	649.872	24.61	501.83	30.71	542.984	36.81	503.436	42.91	581.588	49.01	539.987
12.51	532.695	18.61	612.014	24.71	571.25	30.81	642.362	36.91	428.651	43.01	501.902	49.11	753.07
12.61	513.265	18.71	659.474	24.81	579.461	30.91	577.853	37.01	388.807	43.11	508.74	49.21	711.848
12.71	576.185	18.81	689.211	24.91	500.157	31.01	527.21	37.11	465.455	43.21	545.202	49.31	637.568
12.81	602.041	18.91	616.107	25.01	481.934	31.11	590.474	37.21	554.893	43.31	557.752	49.41	781.541
12.91	535.732	19.01	595.453	25.11	543.896	31.21	584.992	37.31	522.277	43.41	601.119	49.51	1336.29
13.01	514.891	19.11	670.637	25.21	581.986	31.31	503.964	37.41	530.126	43.51	656.671	49.61	1869.74
13.11	577.186	19.21	688.701	25.31	505.242	31.41	512.925	37.51	627.069	43.61	584.637	49.71	6003.99
13.21	614.946	19.31	628.764	25.41	486.496	31.51	648.941	37.61	622.651	43.71	486.326	49.81	-2423.9
13.31	559.782	19.41	622.175	25.51	588.32	31.61	744.788	37.71	466.902	43.81	522.535	49.91	-954.14
13.41	543.105	19.51	686.429	25.61	628.136	31.71	660.645	37.81	368.852	43.91	721.427	50.01	-658.03
13.51	614.743	19.61	710.86	25.71	486.922	31.81	627.406	37.91	423.016	44.01	843.514	50.11	1107.89
13.61	645.681	19.71	631.029	25.81	399.268	31.91	675.301	38.01	562.055	44.11	763.236		
13.71	575.959	19.81	614.996	25.91	503.068	32.01	677.296	38.11	576.759	44.21	752.048		
13.81	563.645	19.91	697.049	26.01	611.621	32.11	633.066	38.21	548.024	44.31	858.696		
13.91	644.602	20.01	719.075	26.11	505.645	32.21	629.679	38.31	557.218	44.41	962.574		
14.01	681.615	20.11	626.713	26.21	438.82	32.31	698.063	38.41	544.351	44.51	821.432		
14.11	603.888	20.21	605.071	26.31	483.78	32.41	710.149	38.51	508.713	44.61	724.364		
14.21	581.593	20.31	699.874	26.41	535.595	32.51	565.96	38.61	541.248	44.71	734.411		
14.31	654.989	20.41	725.441	26.51	504.673	32.61	527.462	38.71	602.479	44.81	704.109		
14.41	697.156	20.51	611.177	26.61	488.887	32.71	657.971	38.81	535.057	44.91	684.261		
14.51	601.805	20.61	574.437	26.71	580.109	32.81	740.761	38.91	423.89	45.01	740.697		
14.61	535.7	20.71	-999	26.81	681.05	32.91	617.602	39.01	403.495	45.11	821.396		
14.71	391.473	20.81	685.283	26.91	611.358	33.01	515.336	39.11	496.72	45.21	714.197		
14.81	238.766	20.91	618.731	27.01	561.841	33.11	554.505	39.21	631.695	45.31	537.008		
14.91	404.494	21.01	588.888	27.11	627.319	33.21	669.288	39.31	604.835	45.41	475.985		
15.01	563.596	21.11	661.1	27.21	650.383	33.31	657.456	39.41	592.645	45.51	503.317		
15.11	622.866	21.21	673.247	27.31	551.22	33.41	621.029	39.51	625.671	45.61	519.333		
15.21	646.759	21.31	569.795	27.41	493.248	33.51	659.209	39.61	558.606	45.71	531.97		
15.31	565.004	21.41	555.309	27.51	559.04	33.61	639.591	39.71	464.947	45.81	595.566		
15.41	545.225	21.51	665.538	27.61	625.901	33.71	551.161	39.81	491.47	45.91	686.51		

MW5-14D(2)											
6 Inch Well Logs											
Depth m	R16 Ohm-m	Depth m	R16 Ohm-m	Depth m	R16 Ohm-m	Depth m	R16 Ohm-m	Depth m	R16 Ohm-m	Depth m	R16 Ohm-m
9.31	201.492	16.11	820.643	22.91	822.683	29.71	696.383	36.51	659.891	43.31	896.437
9.41	349.278	16.21	886.905	23.01	888.127	29.81	677.319	36.61	704.019	43.41	946.828
9.51	460.713	16.31	917.989	23.11	925.218	29.91	758.13	36.71	712.077	43.51	796.19
9.61	445.256	16.41	839.667	23.21	808.588	30.01	743.578	36.81	596.231	43.61	664.207
9.71	465.225	16.51	824.576	23.31	744.983	30.11	727.334	36.91	524.118	43.71	750.091
9.81	635.807	16.61	934.55	23.41	763.293	30.21	820.585	37.01	632.855	43.81	1085.69
9.91	698.307	16.71	1009.15	23.51	771.007	30.31	895.645	37.11	790.532	43.91	1290.6
10.01	590.682	16.81	909.464	23.61	730.443	30.41	821.694	37.21	766.131	44.01	1191.3
10.11	589.179	16.91	868.32	23.71	751.609	30.51	721.264	37.31	792.457	44.11	1188.33
10.21	707.392	17.01	952.464	23.81	819.282	30.61	771.078	37.41	942.195	44.21	1342.41
10.31	746.633	17.11	975.741	23.91	815.81	30.71	945.729	37.51	927.445	44.31	1525.06
10.41	640.967	17.21	907.009	24.01	761.962	30.81	864.903	37.61	664.403	44.41	1321.6
10.51	617.182	17.31	916.961	24.11	730.607	30.91	776.095	37.71	471.505	44.51	1150.19
10.61	732.291	17.41	1002.36	24.21	794.341	31.01	852.906	37.81	533.805	44.61	1115.53
10.71	780.514	17.51	1017.56	24.31	866.613	31.11	833.587	37.91	788.997	44.71	1045.3
10.81	687.964	17.61	909.678	24.41	770.623	31.21	726.434	38.01	868.358	44.81	1066.86
10.91	668.32	17.71	852.585	24.51	742.531	31.31	757.931	38.11	831.666	44.91	1191.24
11.01	766.719	17.81	946.572	24.61	823.181	31.41	980.668	38.21	816.319	45.01	1288.05
11.11	843.414	17.91	1036.72	24.71	825.358	31.51	1148.91	38.31	765.727	45.11	1066.53
11.21	778.829	18.01	959.087	24.81	728.826	31.61	1026.6	38.41	729.727	45.21	791.472
11.31	1010.68	18.11	925.433	24.91	695.249	31.71	967.213	38.51	801.642	45.31	685.756
11.41	3291.63	18.21	1018.18	25.01	768.329	31.81	1016.05	38.61	872.038	45.41	690.712
11.51	-142.09	18.31	1064.31	25.11	829.303	31.91	1011.17	38.71	728.119	45.51	703.159
11.61	205.773	18.41	953.399	25.21	720.22	32.01	975.238	38.81	568.272	45.61	781.809
11.71	1736.4	18.51	890.036	25.31	695.244	32.11	976.275	38.91	545.595	45.71	917.952
11.81	3512.33	18.61	945.851	25.41	857.208	32.21	1056.02	39.01	684.779	45.81	1031.37
11.91	12528.8	18.71	987.869	25.51	923.541	32.31	1066.32	39.11	925.76	45.91	1203.74
12.01	21364.8	18.81	888.902	25.61	691.941	32.41	837.843	39.21	928.352	46.01	1173.13
12.11	44931.2	18.91	864.974	25.71	527.104	32.51	770.43	39.31	913.586	46.11	1070.83
12.21	-999	19.01	964.354	25.81	691.975	32.61	975.938	39.41	921.364	46.21	985.109
12.31	846.831	19.11	982.075	25.91	890.625	32.71	1115.69	39.51	773.625	46.31	874.637
12.41	749.857	19.21	901.694	26.01	729.455	32.81	934.028	39.61	637.908	46.41	776.828
12.51	722.909	19.31	901.018	26.11	616.252	32.91	756.763	39.71	696.768	46.51	698.486
12.61	808.287	19.41	987.062	26.21	668.93	33.01	799.52	39.81	821.407	46.61	940.938
12.71	847.945	19.51	1015.82	26.31	747.537	33.11	1001.26	39.91	715.967	46.71	1172.99
12.81	755.664	19.61	917.182	26.41	727.242	33.21	1011.62	40.01	609.11	46.81	858.719
12.91	726.267	19.71	904.884	26.51	706.268	33.31	947.838	40.11	713.515	46.91	854.274
13.01	811.289	19.81	1021.66	26.61	836.675	33.41	972.917	40.21	1002.11	47.01	1248.98
13.11	858.405	19.91	1056.6	26.71	1013.86	33.51	928.334	40.31	1027.61	47.11	1406.31
13.21	784.253	20.01	923.965	26.81	918.471	33.61	808.495	40.41	822.286	47.21	1007.8
13.31	755.859	20.11	895.611	26.91	835.511	33.71	773.912	40.51	902.595	47.31	652.565
13.41	848.546	20.21	1040.63	27.01	929.592	33.81	731.646	40.61	1094.43	47.41	721.899
13.51	898.521	20.31	1066.13	27.11	964.173	33.91	664.375	40.71	972.261	47.51	984.767
13.61	802.627	20.41	896.394	27.21	817.036	34.01	629.534	40.81	749	47.61	823.02
13.71	782.091	20.51	853.702	27.31	712.765	34.11	641.119	40.91	835.072	47.71	835.551
13.81	895.786	20.61	-999	27.41	801.794	34.21	748.099	41.01	1101.1	47.81	913.531
13.91	955.102	20.71	1005.65	27.51	915.023	34.31	829.713	41.11	1187.41	47.91	824.292
14.01	848.052	20.81	928.097	27.61	815.855	34.41	816.769	41.21	996.071	48.01	857.679
14.11	821.073	20.91	883.331	27.71	765.457	34.51	816.265	41.31	855.508	48.11	1024.8
14.21	927.062	21.01	981.573	27.81	820.02	34.61	850.82	41.41	840.669	48.21	1142.96
14.31	991.137	21.11	997.403	27.91	846.763	34.71	858.028	41.51	892.079	48.31	1125.88
14.41	845.881	21.21	842.463	28.01	736.85	34.81	703.312	41.61	880.76	48.41	995.875
14.51	731.556	21.31	825.435	28.11	711.087	34.91	643.981	41.71	849.401	48.51	835.333
14.61	430.041	21.41	992.632	28.21	818.221	35.01	845.374	41.81	1006.51	48.61	834.902
14.71	80.8725	21.51	1032.15	28.31	852.359	35.11	1071.41	41.91	1188.8	48.71	755.96
14.81	444.045	21.61	857.753	28.41	812.243	35.21	983.254	42.01	1034.15	48.81	631.795
14.91	816.18	21.71	815.412	28.51	829.977	35.31	807.455	42.11	884.665	48.91	824.797
15.01	884.913	21.81	928.41	28.61	856.912	35.41	799.318	42.21	977.864	49.01	1146.07
15.11	922.427	21.91	936.338	28.71	880.132	35.51	903.718	42.31	1040.41	49.11	1044.64
15.21	816.739	22.01	807.436	28.81	910.391	35.61	793.958	42.41	800.538	49.21	983.323
15.31	783.76	22.11	799.435	28.91	935.82	35.71	727.337	42.51	630.703	49.31	1255.92
15.41	866.793	22.21	950.252	29.01	993.738	35.81	855.918	42.61	753.992	49.41	2158.74
15.51	911.795	22.31	1040.29	29.11	1040	35.91	945.999	42.71	982.195	49.51	3022.48
15.61	827.041	22.41	895.25	29.21	917.1	36.01	818.079	42.81	857.174	49.61	9658.59
15.71	802.675	22.51	844.92	29.31	841.767	36.11	666.358	42.91	714.082	49.71	-3851.8
15.81	900.892	22.61	932.036	29.41	1010.3	36.21	693.069	43.01	675.686	49.81	-1384.9
15.91	935.72	22.71	944.298	29.51	1113.07	36.31	781.548	43.11	727.631	49.91	-812.32
16.01	851.233	22.81	863.782	29.61	886.361	36.41	693.1	43.21	803.661	50.01	1162.01

MW5-14D(2)											
6 Inch Well Logs											
Depth m	R32 Ohm-m	Depth m	R32 Ohm-m	Depth m	R32 Ohm-m	Depth m	R32 Ohm-m	Depth m	R32 Ohm-m	Depth m	R32 Ohm-m
9.1	96.9681	15.9	1083.97	22.7	1113.2	29.5	888.065	36.3	807.333	43.1	1148.07
9.2	-93.997	16	1157.85	22.8	1173.96	29.6	810.011	36.4	852.395	43.2	1186.08
9.3	-8.6927	16.1	1169.59	22.9	1248.83	29.7	899.885	36.5	957.048	43.3	922.288
9.4	335.709	16.2	1084.26	23	1126.57	29.8	909.954	36.6	852.01	43.4	757.967
9.5	256.211	16.3	1067.05	23.1	1019.96	29.9	903.793	36.7	696.255	43.5	962.476
9.6	454.148	16.4	1198.48	23.2	994.532	30	1014.02	36.8	719.617	43.6	1478.37
9.7	540.252	16.5	1306.09	23.3	972.886	30.1	1154.25	36.9	934.957	43.7	1705.75
9.8	512.317	16.6	1167.15	23.4	960.431	30.2	1098.65	37	1005.31	43.8	1493.91
9.9	590.04	16.7	1092.67	23.5	1012.81	30.3	936.936	37.1	1018.35	43.9	1455.52
10	757.92	16.8	1187.53	23.6	1075.57	30.4	947.7	37.2	1157.58	44	1602.01
10.1	779.793	16.9	1207	23.7	1075.39	30.5	1154.09	37.3	1151.69	44.1	1887.49
10.2	690.133	17	1124.84	23.8	1030.84	30.6	1089.1	37.4	834.6	44.2	1699.61
10.3	678.031	17.1	1153.01	23.9	970.31	30.7	1003.57	37.5	517.176	44.3	1422.17
10.4	832.88	17.2	1229.98	24	1027.91	30.8	1084.59	37.6	587.186	44.4	1303.95
10.5	898.227	17.3	1230.09	24.1	1106.73	30.9	1066.31	37.7	1036.09	44.5	1244.14
10.6	807.609	17.4	1161.11	24.2	999.953	31	992.491	37.8	1199.51	44.6	1333.57
10.7	803.618	17.5	1125.41	24.3	965.468	31.1	1058.46	37.9	1172.21	44.7	1533.66
10.8	922.523	17.6	1231.35	24.4	1057.49	31.2	1348.68	38	1115.44	44.8	1693.47
10.9	1013.46	17.7	1338.83	24.5	1068.05	31.3	1560.83	38.1	945.395	44.9	1392.42
11	949.531	17.8	1238.9	24.6	957.495	31.4	1394.48	38.2	836.424	45	952.925
11.1	1243.44	17.9	1201.97	24.7	923.487	31.5	1308.85	38.3	917.889	45.1	809.596
11.2	4134.2	18	1325.27	24.8	1002.87	31.6	1346.47	38.4	965.47	45.2	860.446
11.3	-215.75	18.1	1367.94	24.9	1060.83	31.7	1362.01	38.5	738.048	45.3	916.115
11.4	224.272	18.2	1221.72	25	907.078	31.8	1357.5	38.6	582.155	45.4	1077.54
11.5	2052.66	18.3	1146.04	25.1	877.789	31.9	1366.42	38.7	588.576	45.5	1253.06
11.6	3893.72	18.4	1212.06	25.2	1086.67	32	1455.96	38.8	767.566	45.6	1288.67
11.7	5974.26	18.5	1282.35	25.3	1149.63	32.1	1458.77	38.9	1151.21	45.7	1424.62
11.8	8038.44	18.6	1172.83	25.4	789.875	32.2	1166.14	39	1242.49	45.8	1482.83
11.9	16147.9	18.7	1135.39	25.5	534.546	32.3	1064.64	39.1	1167.97	45.9	1394.19
12	-999	18.8	1245.04	25.6	800.802	32.4	1283.41	39.2	1015.64	46	1164.61
12.1	1060.1	18.9	1255.68	25.7	1118.2	32.5	1423.58	39.3	764.758	46.1	1070.45
12.2	952.17	19	1164.38	25.8	916.424	32.6	1237.11	39.4	670.454	46.2	1087.73
12.3	918.998	19.1	1154.43	25.9	777.239	32.7	1028.92	39.5	826.523	46.3	889.817
12.4	1026.14	19.2	1243.58	26	842.135	32.8	1056.44	39.6	1027.78	46.4	1053.42
12.5	1072.65	19.3	1278.27	26.1	982.447	32.9	1306.55	39.7	889.756	46.5	1449.52
12.6	968.077	19.4	1155.8	26.2	997.438	33	1316.83	39.8	751.592	46.6	1117.22
12.7	934.933	19.5	1131.56	26.3	961.802	33.1	1203.88	39.9	858.337	46.7	1025.3
12.8	1038.33	19.6	1275.04	26.4	1116.94	33.2	1205.02	40	1181.29	46.8	1430.83
12.9	1102.91	19.7	1338.57	26.5	1347.77	33.3	1165.87	40.1	1180.85	46.9	1726.8
13	1005	19.8	1185.33	26.6	1231.33	33.4	1031.21	40.2	958.706	47	1338.06
13.1	964.124	19.9	1164.83	26.7	1128.21	33.5	985.304	40.3	1147.77	47.1	837.953
13.2	1077.31	20	1346.7	26.8	1242.22	33.6	854.604	40.4	1456.08	47.2	835.665
13.3	1121.06	20.1	1362.75	26.9	1290.99	33.7	727.449	40.5	1306.41	47.3	1206.23
13.4	993.994	20.2	1170.5	27	1099.64	33.8	745.742	40.6	965.622	47.4	1116.46
13.5	961.882	20.3	1131.2	27.1	917.174	33.9	747.674	40.7	1058.72	47.5	1225.53
13.6	1098.55	20.4	-999	27.2	1013.32	34	870.004	40.8	1465.29	47.6	1319.99
13.7	1168.63	20.5	1291.01	27.3	1182.96	34.1	1008.9	40.9	1591.13	47.7	1054.1
13.8	1039.1	20.6	1199.03	27.4	1063.03	34.2	1004.82	41	1253.88	47.8	1040.18
13.9	1011.94	20.7	1149.95	27.5	1004.55	34.3	1006.12	41.1	992.501	47.9	1267.28
14	1138.67	20.8	1293.98	27.6	1033.23	34.4	1061.96	41.2	896.714	48	1421.65
14.1	1225.27	20.9	1322.6	27.7	1028.21	34.5	1100.7	41.3	1025.56	48.1	1515.01
14.2	1043.38	21	1108.79	27.8	933.097	34.6	891.733	41.4	1140.69	48.2	1340.8
14.3	871.965	21.1	1068.99	27.9	908.316	34.7	819.129	41.5	1103.15	48.3	1101.96
14.4	304.211	21.2	1267.1	28	987.578	34.8	1139.02	41.6	1323.6	48.4	1203.53
14.5	-231.55	21.3	1313.26	28.1	1036.22	34.9	1456.41	41.7	1567.25	48.5	1118.7
14.6	442.247	21.4	1108.31	28.2	1057.4	35	1342.89	41.8	1296.52	48.6	920.615
14.7	1029.21	21.5	1088.09	28.3	1060.53	35.1	1114.5	41.9	1042.25	48.7	1174.64
14.8	1117.73	21.6	1250.1	28.4	1045.06	35.2	1055.95	42	1166.65	48.8	1464.43
14.9	1176.89	21.7	1254.14	28.5	1102.28	35.3	1190	42.1	1385.78	48.9	1299.6
15	1060.08	21.8	1109.77	28.6	1185.4	35.4	1038.32	42.2	1128.35	49	1363.56
15.1	1033.06	21.9	1092.38	28.7	1252.64	35.5	905.535	42.3	813.454	49.1	1746.65
15.2	1142.68	22	1262.18	28.8	1345.43	35.6	1133.99	42.4	831.67	49.2	2947.23
15.3	1200.11	22.1	1374.74	28.9	1387.03	35.7	1296.41	42.5	1091.2	49.3	4141.56
15.4	1092.14	22.2	1195.21	29	1205.71	35.8	1109.45	42.6	1037.83	49.4	13793.7
15.5	1048.19	22.3	1137.19	29.1	1104.93	35.9	903.091	42.7	940.747	49.5	-5923.2
15.6	1162.8	22.4	1219.29	29.2	1304.19	36	871.403	42.8	841.644	49.6	-2186.2
15.7	1232.1	22.5	1207.45	29.3	1437.25	36.1	951.027	42.9	876.702	49.7	-1277.6
15.8	1128.44	22.6	1148.92	29.4	1162.76	36.2	866.376	43	1040.66	49.8	1661.83

MW5-14D(2)											
6 Inch Well Logs											
Depth m	R64 Ohm-m	Depth m	R64 Ohm-m	Depth m	R64 Ohm-m	Depth m	R64 Ohm-m	Depth m	R64 Ohm-m	Depth m	R64 Ohm-m
8.7	201.912	15.5	1583.12	22.3	1652.92	29.1	1237.58	35.9	1163.8	42.7	1557.41
8.8	291.236	15.6	1597.24	22.4	1633.34	29.2	983.301	36	1143.52	42.8	1457.4
8.9	228.183	15.7	1617.01	22.5	1793.14	29.3	1082.59	36.1	1374.33	42.9	1007.22
9	228.37	15.8	1566.88	22.6	1719.39	29.4	1228.3	36.2	1352.1	43	890.282
9.1	210.278	15.9	1524.29	22.7	1535.65	29.5	1239.69	36.3	1064.08	43.1	1266.3
9.2	185.272	16	1635.46	22.8	1381.29	29.6	1282.8	36.4	865.582	43.2	1944.61
9.3	444.427	16.1	1805.29	22.9	1331.54	29.7	1523.23	36.5	1187.97	43.3	2197.98
9.4	32.1614	16.2	1695.77	23	1419.49	29.8	1608.54	36.6	1491.15	43.4	1916.71
9.5	353.594	16.3	1579.51	23.1	1519.21	29.9	1362.09	36.7	1498.84	43.5	1789.03
9.6	-39.917	16.4	1635.27	23.2	1534.61	30	1214.15	36.8	1555.47	43.6	1777.85
9.7	125.687	16.5	1616.73	23.3	1555.87	30.1	1461.24	36.9	1527.24	43.7	2249.34
9.8	768.432	16.6	1565.2	23.4	1585.9	30.2	1507.95	37	1184.55	43.8	2230.56
9.9	468.971	16.7	1606.04	23.5	1470.5	30.3	1396.08	37.1	639.402	43.9	1751.84
10	677.972	16.8	1541.82	23.6	1470.35	30.4	1384.95	37.2	615.891	44	1350.52
10.1	814.449	16.9	1447.45	23.7	1560.23	30.5	1380.5	37.3	1408.32	44.1	1320.75
10.2	855.748	17	1506.71	23.8	1467.43	30.6	1476.02	37.4	1825.94	44.2	1688.58
10.3	880.348	17.1	1527.92	23.9	1435.77	30.7	1606.64	37.5	1822.66	44.3	2015.29
10.4	1086.01	17.2	1582.52	24	1498.11	30.8	1915.72	37.6	1622.63	44.4	2118.95
10.5	1210.14	17.3	1727.34	24.1	1502.11	30.9	2227.68	37.7	1242.17	44.5	1669.63
10.6	1208.25	17.4	1725.04	24.2	1423.49	31	2091.24	37.8	1104.59	44.6	1146.41
10.7	1604.07	17.5	1714.42	24.3	1378.65	31.1	1938.09	37.9	1209.44	44.7	967.977
10.8	5215.49	17.6	1830.28	24.4	1399.17	31.2	1870.5	38	1128.17	44.8	976.71
10.9	-380.83	17.7	1868.89	24.5	1464.96	31.3	1910	38.1	706.055	44.9	1096.43
11	132.283	17.8	1743.14	24.6	1312.09	31.4	2032.52	38.2	626.117	45	1502.01
11.1	2160.11	17.9	1645.65	24.7	1267.34	31.5	2048.73	38.3	701.73	45.1	1759.55
11.2	4195.03	18	1662.8	24.8	1493.04	31.6	2063.22	38.4	879.992	45.2	1518.22
11.3	5720.85	18.1	1791.95	24.9	1542.61	31.7	2054.05	38.5	1499.19	45.3	1565.45
11.4	7215.77	18.2	1719.81	25	1004.05	31.8	1741.35	38.6	1825.76	45.4	1949.27
11.5	13941.4	18.3	1640.41	25.1	570.008	31.9	1571.34	38.7	1658.5	45.5	1892.94
11.6	-999	18.4	1698.15	25.2	961.476	32	1730.98	38.8	1152.24	45.6	1245.28
11.7	1458.55	18.5	1691.58	25.3	1487.48	32.1	1920.64	38.9	703.799	45.7	1143.88
11.8	1347.05	18.6	1657.14	25.4	1273.32	32.2	1844.71	39	759.259	45.8	1558.82
11.9	1302.14	18.7	1650.81	25.5	1097.05	32.3	1536.35	39.1	1089.59	45.9	1176.4
12	1404.83	18.8	1664.77	25.6	1116.87	32.4	1437.35	39.2	1334.28	46	1059.37
12.1	1463.77	18.9	1700.65	25.7	1348.39	32.5	1780.5	39.3	1143.15	46.1	1723.18
12.2	1371.29	19	1615.79	25.8	1496.62	32.6	1872.07	39.4	1051.25	46.2	1512.5
12.3	1337.81	19.1	1564.58	25.9	1439.6	32.7	1678.73	39.5	1169.18	46.3	1285.75
12.4	1449.52	19.2	1668.85	26	1551.76	32.8	1536.74	39.6	1479.03	46.4	1578.38
12.5	1544.71	19.3	1760.47	26.1	1883.36	32.9	1484.57	39.7	1427.04	46.5	2102.89
12.6	1460.93	19.4	1645.01	26.2	1829.77	33	1427.97	39.8	1244.72	46.6	1856.29
12.7	1399.95	19.5	1630.85	26.3	1685.07	33.1	1361.06	39.9	1588.17	46.7	1088.84
12.8	1500.58	19.6	1791.52	26.4	1747.38	33.2	982.134	40	2021.75	46.8	828.425
12.9	1556.22	19.7	1810.92	26.5	1779.59	33.3	733.231	40.1	1830.8	46.9	1352.37
13	1432.47	19.8	1638.14	26.6	1578.11	33.4	947.047	40.2	1353.43	47	1552.71
13.1	1376.3	19.9	1560.7	26.7	1270	33.5	957.65	40.3	1458.67	47.1	1841.97
13.2	1504.58	20	-999	26.8	1287.3	33.6	1005.45	40.4	2011.05	47.2	1845.17
13.3	1594.12	20.1	1667.59	26.9	1541.98	33.7	1262.49	40.5	2180.31	47.3	1280.13
13.4	1457.53	20.2	1644.32	27	1484.43	33.8	1379.01	40.6	1712.36	47.4	1322.93
13.5	1417.07	20.3	1624.38	27.1	1436.79	33.9	1375.27	40.7	1255.77	47.5	1646.93
13.6	1523.1	20.4	1738.41	27.2	1350.98	34	1377.64	40.8	903.72	47.6	1722.03
13.7	1636.32	20.5	1764.16	27.3	1268.52	34.1	1431.13	40.9	1186.29	47.7	1976.84
13.8	1426.26	20.6	1565.8	27.4	1308	34.2	1206.08	41	1618.47	47.8	1878.54
13.9	1146.52	20.7	1501.19	27.5	1285.53	34.3	1115.91	41.1	1564.36	47.9	1498.96
14	26.9981	20.8	1665.39	27.6	1212.03	34.4	1540.88	41.2	1831.46	48	1607.04
14.1	-943.99	20.9	1722.05	27.7	1277.48	34.5	2008.62	41.3	2183.46	48.1	1509.38
14.2	374.831	21	1555.93	27.8	1476.47	34.6	1961.25	41.4	1804.5	48.2	1325.95
14.3	1448.99	21.1	1551.48	27.9	1474.16	34.7	1632.37	41.5	1369.39	48.3	1701.86
14.4	1505.76	21.2	1687.83	28	1308.89	34.8	1399.82	41.6	1413.77	48.4	1777.29
14.5	1589.33	21.3	1682.32	28.1	1401.65	34.9	1629.04	41.7	1884.54	48.5	1511.69
14.6	1506.21	21.4	1590.21	28.2	1659.57	35	1525.19	41.8	1704.02	48.6	1953.38
14.7	1481.43	21.5	1555.19	28.3	1799.76	35.1	1265.11	41.9	1125.83	48.7	2537.28
14.8	1584.1	21.6	1685.15	28.4	1882.68	35.2	1538.17	42	854.973	48.8	4032.51
14.9	1677.35	21.7	1874.26	28.5	1935.14	35.3	1820.4	42.1	1184.48	48.9	5702.31
15	1585.47	21.8	1738.35	28.6	1755.4	35.4	1650.17	42.2	1366.87	49	20717.3
15.1	1523.36	21.9	1661.94	28.7	1579.44	35.5	1352.44	42.3	1312.27	49.1	-9426.9
15.2	1638.73	22	1692.03	28.8	1721.48	35.6	1130.8	42.4	982.906	49.2	-3588.1
15.3	1740.72	22.1	1666.06	28.9	1904.16	35.7	1217.66	42.5	987.201	49.3	-1879.6
15.4	1658.13	22.2	1714.56	29	1647.17	35.8	1257.64	42.6	1422.44	49.4	1867.97