Infrastructure Engineering Solutions

3031 W. Grand Blvd. • Suite 228 • Detroit, Michigan 48202

REPORT ON GEOTECHNICAL EVALUATION

GROUND UPHEAVAL INCIDENT
INTERSECTION OF FORT AND DEARBORN STREETS
DETROIT, MICHIGAN

Owner:

CITY OF
DETROIT

City of Detroit

Performed under contract with:

HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Hubbell, Roth, and Clark, Inc.
535 Griswold St Ste 1650,
Detroit, Michigan 48226

December 13, 2021
2019086E-005

Somat Engineering, INCORPORATED

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INCORPORATED

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Mr. Oladayo Akinyemi, P.E.
Deputy Director, Department of Public Works
City of Detroit
City Engineering Division
2 Woodward Avenue, Suite 611
Detroit, Michigan 48226

RE: Report on Geotechnical Evaluation
Ground Upheaval Incident
Intersection Of Fort and Dearborn Streets
Detroit, Michigan

Dear Mr. Akinyemi:

We have completed the geotechnical evaluation for the ground upheaval incident at the intersection of Fort and Dearborn Streets in Detroit, Michigan. This report presents the results of our observations, and geotechnical analysis.

The soil samples collected during our field investigation will be retained in our laboratory for 1 year from the date of the final geotechnical report, at which time these samples will be discarded unless otherwise directed by you.

It was a pleasure working with you on this project. If you have any questions regarding this report, please do not hesitate to contact us.

Sincerely,
Somat Engineering, Inc.

JD Hoksbergen, P.E.
Senior Project Engineer

JONATHAN D. ZAREMSKI
No. 49269

Jonathan Zaremski
Dec 13 2021 2:54 PM
Jonathan D. Zaremski, P.E.
Geotechnical Services Manager

JDH/JDZ/aer

cc: Richard Doherty - City of Detroit, Department of Public Works
Kevin Surhigh - HRC

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EXECUTIVE SUMMARY

A general summary of the report conclusions and recommendations is provided below:

1. Unexpected and significant ground movement that resulted in two major heave areas and damage to existing buildings, pavement, and utility structures occurred at the southeast corner of the intersection Fort Street and Dearborn Street in Detroit, Michigan during the evening of Saturday, September 11, 2021.
2. Based on video footage from security cameras, the majority of the ground movement happened between about 7:00pm and 7:35pm on September 11, 2021.
3. From observations collected during our initial site visit on September 13, 2021, and our knowledge of the subsurface characteristics of this area of Detroit, we suspected that the primary cause of the ground movement was related to the presence of a nearby stockpile of metallic scrap and soft ground conditions. This report primarily addresses the geotechnical aspects of site investigation and analysis that were performed post-incident to determine the most likely cause of the ground upheaval.
4. Central to the two major heave areas is the corner of a property owned by Fort Iron and Metal. Since the mid-1980s, this corner of the parcel near Fort Street and Dearborn Street has been used for scrap storage. At the time of the incident on September 11, 2021, a large stockpile of mill scale was situated in this exact area of the parcel. The post-incident topographic survey indicated that the peak elevation of the stockpile was almost 610 feet, or about 25 feet above surrounding street grades. Based on the video camera footage, it appears that the top elevation of the stockpile was lowered during the failure event, indicating that the top of the mill scale pile was likely situated at a maximum elevation greater than 610 feet. Based on a sample of mill scale collected from the stockpile and our laboratory testing, the mill scale has a unit weight of about 230 pcf. This value is in the range of about two times the unit weight of most soils.
5. In the 100-day period before the incident, 15.8 inches of rainfall was recorded at the Detroit/Pontiac weather station. This is about 150% of the normal rainfall received during this timeframe.
6. Somat performed two soil borings between September 15 and September 18, 2021. Soil samples were collected for numerous laboratory tests, and in-situ vane shear tests were performed to determine the shear strength of the clay soils encountered in the borings. Additionally, an inclinometer was installed in one of the boreholes to measure lateral subsurface displacement in the soils.
7. The results of our field investigation and laboratory testing indicated a subsurface profile typical for this area of Detroit, including zones of very soft to soft clay soils encountered between about 20 to 55 feet below existing grades, or within elevation range 565 to 535 feet.

8. Section 5 of this report provides a hypothesis and rationale for the most likely causes of the incident. We have considered several reasonable, but wide-ranging possibilities including mine subsidence, artesian groundwater, methane gas, utility rupture, seismic activity, excessive rainfall, soil shear failure, and time-dependent consolidation settlement of the clay soils underlying the site.
9. Ultimately, it is our professional engineering opinion that the weight of the stockpiled mill scale material exceeded the shear strength capacity of the underlying clay soils to cause the heaved areas and disruption to the existing structures adjacent to the Fort Iron site. Other factors such as consolidation settlement may have contributed to the incident and/or to the timing of the incident, but the primary cause of the soil failure was the load imposed by the mill scale stockpile.

The summary presented above is general in nature and should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned therein. Details of our findings are discussed in the following sections and in the appendices of this report.

REPORT PREPARED BY:	REPORT REVIEWED BY:
JD Hoksbergen, P.E. Senior Project Engineer	Corey R. Hostetter, P.E., LEED AP Senior Project Engineer
Jonathan D. Zaremski, P.E. Geotechnical Services Manager	Richard O. Anderson, P.E. Principal Engineer

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1.0 INTRODUCTION

1.1 GENERAL

Upon authorization from the City of Detroit (City), Somat Engineering, Inc. (Somat) has completed a geotechnical evaluation of the ground upheaval incident in Southwest Detroit, near the intersection of Dearborn Street and Fort Street. This report concludes the as-needed emergency scope of work, generally outlined in our proposal dated September 15, 2021.

The following sections of this report provide our understanding of the site characteristics, ground movement, historical background, the results of the geotechnical investigations, and our hypothesis for the cause of the movement. The closing of this report attempts to explain "Why did it happen?".

1.2 PROJECT INFORMATION

In the evening of September 11, 2021, the ground in the vicinity of the southeast corner of Dearborn Street and Fort Street began to move. The result of this movement was a large heaved area on the south side of Dearborn Street and another heaved area behind the former Stash facility, structural damage of the buildings at 10015 and 10023 W. Fort Street, and the subsidence of the stockpiled material within the west side of the Fort Iron and Metal yard on Dearborn Street. The heave of the streets, parking lot, and sidewalks, estimated to be as high as about 7 feet, resulted in several utilities being impacted and/or damaged.

1.2.1 Common Terms and Stakeholders

Throughout this report, several terms and stakeholders will be called out. For clarity, we offer this glossary of terms and names:

- Fort Iron – Fort Iron and Metal scrap recycling facility is located at 9607 Dearborn Street in Detroit
- Mill Scale – Mill scale is a type of iron oxide that is formed on the surface of the steel during the hot-rolling process, and is considered to be a scrap material. The material has value in the ferrous recycled material market and was being stockpiled by Fort Iron on their yard.

- Stash Building – Formerly the Stash Detroit Medical Marijuana Dispensary, located at 10015 W. Fort Street in Detroit, was a two-story building with a basement built in 1907.
- Rayco Building – The Rayco Plating facility, located at 10023 W. Fort Street, immediately adjacent to the south of the Stash building.
- Heaved Areas (Dearborn Heave, Stash Heave) – the results of the ground movement incident included the heaved surface of Dearborn Street and the heaved surface in the rear of the Stash building. These areas are referred to as either the Dearborn Heave or the Stash Heave
- Incident – the collective circumstances and events around September 11, 2021 that resulted in the two major heave areas and structural damage to the Stash and Rayco buildings, as well as other structures, including pavement and utilities.
- GLWA - Great Lakes Water Authority; owns and maintains a 16-inch diameter watermain in Fort Street and Dearborn Street.
- DWSD - Detroit Water and Sewerage Department; owns and maintains a 15-inch diameter storm sewer in Dearborn Street.
- DTE - DTE Energy; owns and maintains a 24-inch diameter high pressure gas line in Fort Street and Dearborn Street and a 6-inch diameter gas line in Fort Street.
- City - City of Detroit; maintains Dearborn Street
- MDOT - Michigan Department of Transportation; maintains Fort Street
- EGLE – Michigan Department of Environment, Great Lakes, and Energy
- SME – Geotechnical consultant for DTE gas operations
- Exponent - Geotechnical consultant for DTE
- FK Engineering – Geotechnical consultant for GLWA
- TEC – Testing Engineers and Consultants, geotechnical consultant for Fort Iron
- G2 – G2 Consulting, geotechnical consultant for Fort Iron
- NOAA – National Oceanic and Atmospheric Administration, referenced for rainfall data

1.3 TIMELINE OF EVENTS

The following timeline of the incident at the southeast corner of Fort Street and Dearborn Street has been compiled from historical documents, site visits, and shared project information:

- Up until the mid-1980’s, there were several structures situated on the Fort Iron parcel (DTE/Wayne State Aerial Photo Library)
- Since the mid-1980s, this area of the Fort Iron parcel near the corner of Fort Street and Dearborn Street has been used for metallic scrap storage (Google Earth Images)

- Since at least 2018, the area of the parcel adjacent to the Heaved Areas has been used for the storage of Mill Scale (MDEQ inspection report and Google Earth Images). However, historic stockpile dimensions, including heights, are unknown.
- Street level photographs from November 2020 show the stockpiled height of the Mill Scale to be about 15 feet high above street grades, based on the known height of 10 feet for the existing fence. (Google Earth Images)
- Street level photographs from August 2021 show the stockpiled Mill Scale significantly larger in height, about 25 to 30 feet above street level grades.
- In late August 2021, residents and people in the area reported the smell of natural gas near this intersection and DTE was requested to investigate. (Conversations with stakeholders)
- September 10, 2021: reports of water leaking into basement of Stash building
- Events of September 11, 2021, from security video files:
    - 6:50pm, DTE vehicle on site, parked on Dearborn Sidewalk (ch08_20210911185043.mp4)
    - 6:50pm, visual of stockpile heights in excess of 25 feet (ch02_20210911185043.mp4)
    - 7:06pm; traffic on Dearborn starts showing bumps in pavement (ch08_20210911190618.mp4)
    - 7:08pm – 7:32pm, stockpile in background can be seen dropping (ch2 various files)
    - 7:17pm, movement in Rayco north wall (ch02_20210911191630.mp4)
    - 7:24pm, brick façade on south Stash wall collapses (ch02_20210911191630.mp4)
    - 7:32pm, heave in Dearborn grows rapidly (ch08_20210911193246.mp4)
    - 7:32pm, cracks in pavement can be seen widening, and rear parking lot of Stash business starts heaving (ch01_20210911193142.mp4)
    - 7:33pm, brick façade of north wall of Stash collapses (ch08_20210911193246.mp4)
    - 7:34pm, significant settling of stockpile (ch08_20210911193407.mp4)
    - 7:35pm, movement appears to have stopped in rear parking lot of Stash (ch01_20210911193527.mp4)
- The afternoon of September 13, 2021: Somat is engaged by the City during a site visit, to lead investigative effort, coordination of various design consultants, and restoration efforts, DTE completes bypass of 6-inch gas line in the evening.
- September 14, 2021: Stash building demolished, Somat commences our investigation with GPR scanning, surveying of site begins.
- September 15, 2021: DTE 24-inch-high pressure gas main shut down out of caution, Mill Scale stock pile lowered by about 5 to 10 feet in height, Somat boring Somat_B-01 started.

- September 16, 2021: day-over-day comparative survey readings indicate minimal movement, Somat boring Somat_B-01completed with inclinometer installed, allowed to visit the Fort Iron yard and take photographs: observed fissure around edge of mill scale stock pile.
- September 17, 2021: Somat boring Somat_B-02 started
- September 18, 2021: Meeting at Fort Iron site, sample of mill scale obtained, Somat boring Somat_B-02 completed
- September 19, 2021: TEC Boring TEC_B-1 started
- September 20, 2021: EGLE notifies City of potential contamination from Rayco Building site and other area sites, TEC Boring TEC_B-1 completed
- September 21, 2021: Fort Iron resumes removal of Mill Scale from the corner of the site
- September 28, 2021: DTE consultant begins test pit and soil boring program
- September 30, 2021: DTE consultant completes test pit and soil boring program with one boring, stacked piezometers, and two test pits, excavation of Dearborn Heave starts at east end.
- October 5, 2021: excavation of Dearborn Heave completed
- October 8, 2021: repair of GLWA water main completed, removal of Stash building debris starts
- October 20, 2021, G2/TEC investigation completed
- November 2, 2021: removal of Stash building debris completed

2.0 SITE CONDITIONS

As noted above, the current use of the Fort Iron site appears to begin in the mid to late 1980s. However, this area of Detroit was historically an industrial area, with the old Carbon Works nearby and a gateway to the Ford Rouge Factory. However, the area currently carries heavy truck traffic along Fort Street and Fort Iron hauling traffic on Dearborn Street.

The main section of the Fort Iron site is generally bounded by Dearborn Street to the north, railroad tracks to the south and east, and by the Stash and Rayco parcels to the west. To the north of Dearborn Street, there is an auto repair shop, a Fort Iron dumpster storage yard, and some residential streets. In the overall area, there are many empty parcels, some other residential streets, a few commercial and industrial properties, and a cemetery. Woodmere Cemetery is located at the north quadrant of the Fort Street and Dearborn Street intersection. The intersection of Fort Street and the Rouge River is located about 1,800 feet to the west of the intersection. An overall site proximity map is located in Figure 1.

2.1 TOPOGRAPHIC INFORMATION

Based on the topographic information obtained at the onset of this investigation, the road surface grades of Dearborn Street and Fort Street near the intersection range from 585 to 586 feet. At the time of the topographic survey, the Dearborn heave reached an elevation of about 592 feet, was about 180 feet long along Dearborn Street and about 55 feet wide. Based on visual estimates, the Stash Heave reached a similar height.

The topographic survey of the mill scale stock pile, post-incident, indicated a peak elevation of almost 610 feet, or about 25 feet above surrounding street grades and consistent with estimates from videos and photographs.

In total, about 1.1 acres (48,500 square feet) of plan area was impacted by the incident. The plan area of the incident is depicted in the aerial image shown below.

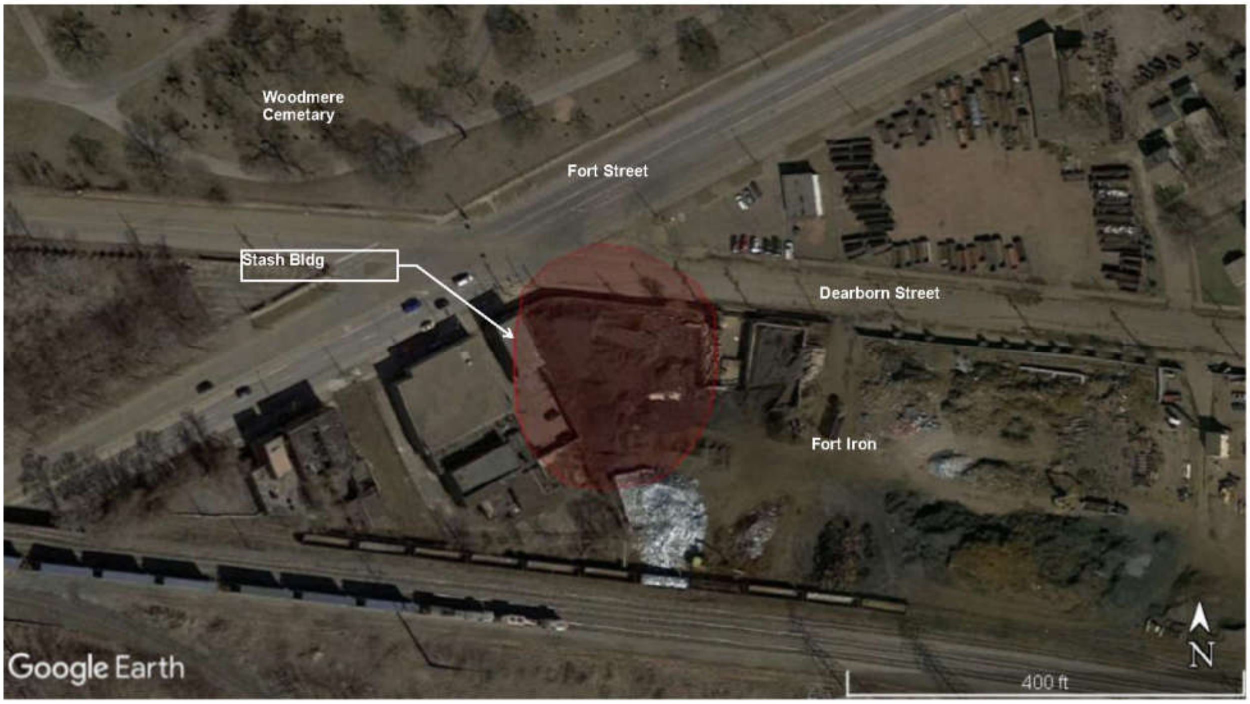


Exhibit 1 - Site Aerial Image

2.2 REGIONAL GEOLOGY

The local geology of southeastern Wayne County is predominantly a result of the glacial activity, resulting in lacustrine deposits, primarily clays and silts but some areas of sands and gravels. These deposits likely originated from the recession of the glaciers during the Wisconsin stage of glaciation.

2.2.1 Salt Mining and Solution Mining Activities

During the Paleozoic Era, beginning 600 million years ago and ending about 230 million years ago, seawater invaded the Michigan basin at least six times. As the seas receded and evaporated, rock and mineral deposits such as halite (rock salt), gypsum (calcium sulfate with water), liquid brines, petroleum, lime, clay, sandstone, and coal were left behind. Since the early decades of the 20th century, Michigan has been ranked first in the United States in the production of calcium chloride (salt). This mineral is found in the sedimentary rocks of the Michigan Basin. Salt is obtained from beds of rock salt over 1,100 feet below the surface in the Detroit area and from natural and artificial brines of dissolved salt that are pumped to the surface in Midland, Manistee, Muskegon, Wayne, and St. Clair counties. Brine is water saturated with common salt.

In the Detroit area, the salt mining consisted of conventional tunnel excavation techniques and the solution mining method. In the conventional tunnel excavation technique (or dry mining), which is the more common in Detroit area, the salt is mined directly in solid form in large underground caverns, much like one would mine coal or iron ore. Underneath the southwestern Detroit area, it is estimated that rock salt mines total over 100 tunneled miles. In the solution mining method, fresh water is injected through a pipe into deep shafts that end in the salt beds, and salty water (brine) is drawn upward and evaporated, to recrystallize the salt. Or, salty brine found in shallow wells can simply be pumped to the surface and evaporated there, to make salt.

At the Detroit salt mine (Morton Salt), which has a mine shaft near the existing M-85 Bascule bridge (southwest of Oakwood Blvd. and Fort St. intersection), active mining occurs about 1,200 feet below the surface and employs the room and pillar method to extract the salt. The salt is extracted by carving out rooms that measure 50 to 60 feet wide and about 25 feet high. At regular intervals are 60-foot by

80-foot pillars of salt that support the roofs. These galleries are generally "undercut" using machines that bite out channels at the floor and dynamite blasting operations that crumble down the walls of salt. As a result of these salt mining operations, large spans of unsupported roofs are sometimes formed, which in turn cause sagging, downward flexure, and local separation of rock units. This may result in local roof collapse and eventual surface subsidence. In addition, the dynamite blasting may cause significant vibrations which propagate through the rock and soil layers on top of the mine and eventually to structures at the ground surface. Also, salt mining near the top of the salt layers may expose overlying already weak or weakened rocks due to the dynamite blasting, which increases the risk of roof collapses.

As part of nearby geotechnical investigations, we conducted a document review of the available information regarding the effects of the salt mining operations on the rock and soil layers above the salt mine galleries and on the surface structures within the southwestern area of Detroit. Review of published documents indicates that sinkholes, ground subsidence, and damage to surface properties were reported in local news media since the 1950's and were attributed to the salt mining operations underneath the southwestern Detroit area. According to published literature, sinkhole and ground subsidence were reported on Zug Island, the Downriver area, and Grosse Ile as a "consequence" of the salt mining operations. In addition, damage to surface structures (foundation settlement and vibrations) attributed to the salt mining operations were also reported in some areas of southwest Detroit.

The above information regarding the Salt Mining and Solution Mining Activities was adapted and compiled from different references, which are identified below:

- Salt Institute Website.
- Detroit Free Press Archives.
- Detroit News Archives.
- Detroit Sunday Times Archives.

2.3 LOCAL PRECIPITATION AND HYDROLOGY

Based on the USGS water level gauge at Fort Wayne (Monitoring location 04165710), the average elevation of the water surface in the Detroit River on September 11, 2021 was 575 feet for the day.

Based on the rainfall data collected at the NOAA Detroit/Pontiac City airport station, we reviewed daily rainfall totals for the 100 days preceding the event, starting June 1. The cumulative total for this period in 2021 was about 15.8 inches. In reviewing the cumulative total of rain over the same period of 2020, slightly more rainfall was recorded at 16.9 inches. These two years followed 2019 and 2018, which recorded much less rain over that period, at 10.3 and 11 inches respectively. For perspective, according to NOAA the average monthly rainfall in Detroit over the months June, July, and August ranges from about 3.25 to 3.5 inches per month (10 inches total over the three-month period).

Month	Cumulative Totals (inches)				
	2021	2020	2019	2018	Average
June	5.16	2.4	2.86	3.66	3.26
July	4.95	5.02	2.63	4.24	3.51
August	5.17	5.99	3.14	1.2	3.26

The rainfall data for these periods are contained in Appendix G.

As noted, the precipitation in 2021 and 2020 was higher than average. However, due to the well-drained condition of the mill scale stockpile, it is our opinion the rainfall did not appreciably increase the unit weight of the mill scale, as shown later in the results of the laboratory testing of this material.

3.0 FIELD INVESTIGATIONS AND MONITORING

Beginning on September 13, 2021, along with other emergency response personnel already being on site, several geotechnical consultants were engaged by various parties to begin investigating the incident and planning for restoration. Through these consultants, three (3) separate field investigations were performed, generally consisting of drilling of soil borings and performing test pits. In addition, several historical boring logs were provided to the consultant team by Somat and MDOT. In total, fifteen (15) soil borings, either current or historical, were available for this report. A compilation of the boring locations is included as part of a site diagram included in Figure 2.

As stated in the timeline, Somat performed GPR scanning on September 14, 2021. The scanning was performed as part of early site reconnaissance and, in general, revealed voids under the pavement that had heaved along Dearborn Street. However, due to the thickness of the pavement, groundwater in the soil, and other material in the pavement section (railroad tracks and ties), the results were inconclusive other than providing for concern to place equipment onto the top of the heaved area.

3.1 SOMAT ENGINEERING INVESTIGATION

3.1.1 Soil Borings, Sampling, and In-Situ Testing

As first on the site, Somat originally proposed a field exploration consisting of drilling a total of five soil borings, with depths varying from about 60 feet below grade to the top of bedrock (estimated to be at 85 to 90 feet below grade). Two soil borings were proposed in the heaved areas, but were not drilled due to safety concerns. At the time the drill rig and crew were on-site, the height of the mill scale stockpile had not been lowered enough to allow for the removal of debris and earthwork to level off a safe area for a working platform. A third boring was proposed within the Fort Iron & Metal property, but Somat was not permitted by the Fort Iron owner to drill the boring.

Only two soil borings were drilled. Somat_B01 and Somat_B02 were completed between September 15 and September 18, 2021. In general, each boring was performed in an area deemed safe to work, but close enough to represent each of the heaved areas. Soil boring Somat_B01 was drilled behind the Stash building, and extended to a depth of 84.5 feet below grade (elevation 500.2 feet). Soil boring Somat_B02 was drilled in the south sidewalk of Dearborn Street, just east of the intersection with Fort Street and extended to 85 feet below grade (elevation 501.8 feet). The surveyed location information is provided in Table 1 at the end of this report.

Using an ATV mounted drill rig, the two borings were advanced using 3¼ inch inside diameter, hollow stem augers to a depth of about 10 feet, after which wash rotary techniques were used to complete the boring.

Soil samples were recovered in the soil borings using split-spoon sampling procedures in accordance with ASTM Standard D1586. The sampling intervals were atypical, but in general, the samples were obtained at 2½ -foot intervals for the first 10 to 15 feet of drilling, then on a more continuous basis through 40 to 50 feet, where a notable increase in shear strength of the lean clay soils was observed. The split-spoon samples were sealed in glass jars in the field to protect the soil and maintain the soil's natural moisture content. Shelby tube samples were obtained to supplement the split-spoon samples.

The thin-walled (3-inch diameter) Shelby tube samples were obtained in accordance with ASTM D1587. Shelby tubes are hydraulically pushed into the soil at the base of the borehole and allowed to sit in the ground for about 10 minutes, after which a ¼ turn by hand is applied to the drill rods to break the soil column at the bottom of the tube. Shelby tube samples are sealed immediately at both ends with about one inch of hot liquid wax and then sealed with plastic end-caps and duct tape. All tubes were identified with information on boring number, sample number, sample depth and recovery. The tubes were stored in a vertical position to minimize sample disturbance during transportation.

In addition to the split spoon and Shelby tube samples, field vane shear tests were performed at selected depths, where suitably soft to medium clay layers were encountered. The tests were performed using an Acker vane shear test kit with a calibrated torque head, in accordance with ASTM D2573. These tests were performed primarily to determine the in-place shear strength of the clay soils. The test generally consists of pushing a four-bladed vane into the undisturbed soil and rotating it from the surface to determine the torsional force required to cause a cylindrical surface to be sheared by the vane. This torsional force is then converted to a unit shearing resistance of the cylindrical surface.

The vane was rotated at a rate of approximately 5 degrees per minute and torque readings were obtained at 5-degree intervals. Following determination of the maximum shear strength, the vane was rotated quickly to shear off the soil column and a remolded strength test was performed following a 5-minute waiting period. The undisturbed shear strength was compared to the remolded shear strength to determine the sensitivity of the clay. The results of these field vane shear tests are presented on the boring logs and as detailed reports in Appendix B-1.

In addition to the soil boring sampling, a 5-gallon bucket of the Mill Scale was obtained from Fort Iron. The material was sampled from the surface of several locations around the perimeter of the stockpile. The sample was transported to our laboratory for further testing.

All soil samples were transported to Somat's laboratory for further analysis and testing. Subsequently, selected samples were sent to an outside laboratory for further testing. The soil samples collected for this investigation will be retained in our laboratory for a period of 1 year from the date of the final report, after which they will be discarded unless we are notified otherwise.

Whenever possible, groundwater level observations were made during the drilling operations and are shown on the individual Logs of Test Borings. During drilling, the depth at which free water was observed, where drill cuttings became saturated or where saturated samples were collected, was indicated as the groundwater level during drilling. In granular, pervious soils, the indicated water levels are considered relatively reliable when solid or hollow-stem augers are used for drilling. However, in cohesive soils, groundwater observations are not necessarily indicative of the static water table due to the low permeability rates of the soils, and due to the sealing off of natural paths of groundwater flow during drilling operations.

It should be noted that seasonal variations and recent precipitation conditions may influence the level of the groundwater table significantly. Groundwater observation wells are generally used if precise groundwater table information is needed, however the installation of groundwater monitoring wells was not included in the scope of the investigation.

3.1.2 Gas Monitoring

During drilling of the soil borings, the atmosphere within the breathing zone was being monitored continuously throughout the drilling of the borings. Gas monitoring was performed using a four-gas detection meter. The meter simultaneously measures the Lower Explosive Limit (LEL) of combustible gases, oxygen, carbon monoxide, and hydrogen sulfide. These gases are virtually undetectable by visual and olfactory methods (hydrogen sulfide has a distinct odor, but the gas can paralyze the sense of smell).

3.1.3 Photoionization Detector Screening

Photoionization detector (PID) screening was performed in conjunction with the geotechnical investigation for the top 25 feet of both Somat borings. Each retrieved soil sample was examined for evidence of discoloration, unusual odors, or non-aqueous phase liquids. These observations (if any) were recorded on the field logs of the soil borings.

Each retrieved soil sample in the top 25 feet was field-screened for total volatile organic compounds (VOCs) using a Mini-Rae 3000® PID equipped with a 10.6 eV UV lamp. The PID is a portable vapor and gas instrument that detects a variety of organic compounds with a detection range of approximately 0.1 to 10,000 parts per million (ppm). The PID reading can indicate if VOCs are present, but does not identify which type or the specific concentration. The PID was calibrated prior to screening using a 100-ppm isobutylene standard. Each soil sample was placed in a re-sealable, plastic sample collection jar, allowing for headspace expansion as the sample was allowed to warm. Once expansion occurred the bag was opened, the tip of the PID was inserted and the result was recorded.

3.1.4 Instrumentation

At the completion of boring Somat_B1, a 3-inch diameter inclinometer casing was installed to a depth of about 57 feet below grade (approximate elevation 578 feet). This was the maximum depth to which the tip of the casing could be pushed due to the squeezing-in of the borehole excavation upon drilling completion. Because we were interested in quickly obtaining readings in the installed casing, the annular space between the excavation sides and the plastic casing was not backfilled using traditional grout methods, which require cure time. The sand was used as backfill material so inclinometer monitoring could occur immediately. The intent of installing the inclinometer was to detect on-going lateral displacement of the subsurface soil profile. Daily readings using a manual probe were obtained from September 16 through October 6, 2021. Graphical representation of the inclinometer readings is included in Appendix B-2.

3.1.5 Laboratory Testing

All soil samples were classified in accordance with the Unified Soil Classification System (USCS). Representative soil samples were subjected to laboratory tests consisting of moisture content determinations, unit weight determinations, hand penetrometer tests, Torvane tests, unconfined compressive strength tests, Atterberg Limits tests, and grain size/hydrometer analyses. Select Shelby tube samples were subjected to other geotechnical lab tests, including one-dimensional consolidation tests.

In addition to performing unit weight testing on the soil samples, unit weight determinations were also performed on the bulk sample of Mill Scale. The results of that testing are presented in Appendix C-5.

A summary table and results of the laboratory tests are presented in Appendices C. All laboratory tests were performed in accordance with their applicable ASTM procedures.

Moisture Content Determination Tests

All samples were sealed in the field to retain the natural moisture content of the soil specimen. Moisture content determination tests were performed on cohesive samples in accordance with ASTM

D2216. Results of the moisture content determination tests are included in Appendix A-1 on the respective logs of test borings. The moisture content of the Mill Scale was determined by allowing the sample to air dry over several days.

Unconfined Compressive Strength Tests

Standard test methods for unconfined compressive strength of cohesive soil were performed in accordance with ASTM D2166 on selected cohesive samples from the soil borings. The unconfined compression test consists of axially loading a small cylindrical soil sample at a slow rate of strain, until failure occurs. Failure is defined as the maximum stress level in the soil sample or the stress level at 15 percent strain, whichever is less. The results of these tests are shown on the respective logs of test borings in Appendix A-1. The results of the unconfined compressive strength tests are represented graphically in Appendix A-1.

Estimation of unconfined compressive strength on remaining cohesive samples was obtained by performing either a hand penetrometer test or a Torvane test. In the hand penetrometer test, the shear strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small, calibrated spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square foot. In the Torvane test, the shear strength of a cohesive soil sample is estimated by measuring the resistance of the sample in shear when twisting a small, calibrated spring-loaded vane pressed into the sample. The results of these tests are shown on the respective logs of test borings in Appendix A-1.

Unit Weight Determination Tests

Unit weight determination tests were performed in accordance with ASTM D2166 on selected cohesive samples from the soil borings. The results of these tests are shown on the respective logs of test borings in Appendix A-1.

In addition to determining unit weights of the soil samples, testing to estimate the unit weight of the Mill Scale sample was performed. To estimate the range of possible unit weights for the material stockpiled at Fort Iron, three test methods were followed. First, the material was loosely placed into the Proctor mold, to approximate newly stockpiled material. Second, the material was compacted in the Proctor mold following ASTM D698 procedures (Standard Proctor Test). Lastly, the material was compacted in the Proctor mold following ASTM D1557 procedures (Modified Proctor Test). As a follow up to this testing, we compacted the material into a mold following ASTM D1557 procedures and then soaked the sample for 24 hours.

Atterberg Limits Tests

Standard test methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils known as Atterberg Limits were performed on selected soil samples. The Atterberg Limits tests were performed in accordance with ASTM D4318 on selected cohesive samples from the soil borings. Fine-grained soils are tested to determine the Liquid Limit (LL) and Plastic Limits (PL), which are moisture contents that define boundaries between material consistency states. The LL and PL values define the water content boundaries between non-plastic, plastic, and viscous fluid states. The plasticity index (PI) defines the complete range of plastic state. The LL and PI are shown on the respective logs of test borings in Appendix A-1. Graphical results of the Atterberg Limits are included in Appendix C-2.

Grain Size Analyses

Grain size/hydrometer analyses were performed in accordance with ASTM D422 (2007) and D6913 on selected soil samples to evaluate the gradation of the soil represented by the sample. The distribution of particle sizes larger than 75 micrometers (retained on the No. 200 sieve) is determined by sieving, while the distribution of particle sizes smaller than 75 micrometers is determined by a sedimentation process using a hydrometer. Graphical results of the grain size/hydrometer analyses are included in Appendix C-3.

One-Dimensional Consolidation Tests

One-dimensional consolidation tests were performed on select Shelby tube samples from cohesive soils. The tests were performed in accordance with ASTM D2435, Method B. These results are included in Appendix C-4.

3.2 EXPONENT INVESTIGATION

On September 28, the DTE contractor saw cut the pavement and excavated a test trench in Fort Street, just in front of the Stash building. The purpose of the test pit was to locate the 24-inch diameter high pressure gas line to evaluate the condition of the utility. A second test pit was performed on the north side of Dearborn just east of Fort Street, again to attempt to locate the 24-inch diameter high pressure gas line.

3.3 SME INVESTIGATION

SME mobilized a drill rig to the site on September 29, 2021 and drilled one boring, DTE-1, to a depth of 70 feet. The boring was sampled in a similar fashion to the Somat borings. An attempt to install inclinometer casing within this boring failed because the augers failed at a joint. In a separate borehole adjacent to boring SME_B1, performed the next day, two vibrating wire piezometers were installed at depths of 16 and 31 feet. The log and piezometer data for this investigation was shared and included in this report in Appendix A-2.

3.4 TEC INVESTIGATION

TEC initially mobilized to drill one boring, TEC_B1, on September 26, 2021 in the Fort Iron yard, just east of the Mill Scale stockpile. The boring was completed on September 27, 2021, when bedrock was encountered about 87 feet below grades. The boring was sampled in a similar fashion to the Somat borings. On a second mobilization, and under the direction of G2, three borings (G2_B1 thru G2_B3) were started on October 7, 2021 and completed on October 20, 2021. At this time, the results of these test borings are not available. In addition, the naming nomenclature presented here was determined by Somat for the purposes of cataloging the boring locations for this report. The boring logs that will be produced by G2 may include a different naming convention. Somat, through the City, has made a request to have this information shared. As of this date, we have not received any formal information regarding these borings.

3.5 HISTORIC SOIL BORING INFORMATION

Along with the current investigation, several older soil boring logs were located in the area and provided for this report. These include:

- Somat boring in Fort Street in front of 10047 Fort Street from 2021
- MDOT Signal borings at the Fort Street and Dearborn Street Intersection from 2020
- Stoll, Evans, and Associates borings from Koenig Coal from 1979
- SME borings in the vicinity of 10059/10047 Fort Street from 2020

These boring logs are contained in Appendix F.

3.6 SURVEYING

On September 14th, 2021, Hubbell, Roth & Clark, Inc. (HRC) was requested to provide survey support for the incident. On this date, HRC set survey control points throughout the site so that a 3-D Laser Scan and UAS (Unmanned Aerial System / Drone) flight could be completed and tied to each other to provide control for future surveying activities. A horizontal survey control network was established by installing ½” Iron Rebar with survey caps as well as Mag-Nails in pavement. All control points were measured by either robotic total station or by GNSS (GPS) on NAD83 datum with State Plane Coordinates (SPC) South Zone 2113; Real-Time Network solution (RTN) from the Michigan Department of Transportation (MDOT) – Michigan Spatial Reference Network (MSRN) / MDOT CORS. Each GNSS point was measured multiple times and an averaged coordinate value was held. Benchmark and survey control point heights (elevations) were established by running digital level loops from a published National Geodetic Survey (NGS) benchmark PID: NE1004.

After control was established, HRC surveyors completed a 3-D Laser scan from approximately the intersection of Dearborn Street and Gerisch Street; through the intersection of Dearborn Street and W. Fort Street.; along the southwesterly side of the building located at 10023 W. Fort Street and behind the affected building located at 10015 W. Fort Street. The laser scan data was imported into registration software. The laser scanner captures HDR images as well as LiDAR data. Each scan was stitched together onto the survey control network. A point cloud file was generated. This file was referenced into CAD where data was extracted to generate a record topographic survey drawing. This point cloud data set serves as a time stamp of existing conditions which can be referenced at any time and serves as a basis for the project.

A UAS flight was also completed on this date which captures many photo images. The images were stitched together to create two deliverables which included a single photomosaic image and a 3-D point cloud. The image can be used as a time stamp of existing site conditions captured from a bird's eye view. It was also used as background imagery for the CAD drawing and to supplement stockpile elevations on the Fort Iron property where the laser scanner was not able to capture data due to obstructions.

On September 15th, HRC surveyors established additional control on Dearborn Street where the road was uplifted. These points consisted of Mag-Nails set in pavement and in the curbs, and surround the effected roadway to allow for continuous monitoring for any movement in the X, Y and Z directions. These points were established by robotic total station. On this date, HRC also completed a laser scan for record. HRC completed two sets of monitoring: one in the morning and one in the evening.

HRC also completed work on the dates listed below. Note that no survey was performed on days of inclement weather or days with construction traffic that may have disturbed the surveying activities.

September 16th, 2021 • Monitoring Survey in the Morning • Monitoring Survey in the Afternoon	September 23rd, 2021 • Monitoring Survey
September 17th, 2021 • Monitoring Survey • Laser Scan • UAS Flight	September 27th, 2021 • Monitoring Survey
September 18th, 2021 • Monitoring Survey	September 28th, 2021 • UAS Flight
September 19th, 2021 • Monitoring Survey	September 29th, 2021 • Monitoring Survey
September 21st, 2021 • Monitoring Survey	October 5th, 2021 • Monitoring Survey

In addition to this current survey, HRC was able to download historical LiDAR data to compare to current data. The information contained in the 2017 LiDAR survey is included in Figure 5.

4.0 INVESTIGATION RESULTS

4.1 SOIL STRATIFICATION

Soil conditions encountered at the Somat boring locations have been evaluated and are presented in the form of Logs of Test Borings. The Logs of Test Borings presented in Appendix A-1 include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the test borings. In addition to the observed subsoil stratigraphy, the Logs of Test Borings present information relating to sample data, standard penetration test results, groundwater conditions observed in the boring, personnel involved, and other pertinent data. For information, and to aid in understanding the data as presented on the boring logs, general notes defining nomenclature used in soil descriptions are presented immediately following the logs in Appendix A-2. It should be noted that the Logs of Test Borings included with this report have been prepared on the basis of laboratory classifications and testing as well as field logs of the soils encountered.

A generalized description of the soils encountered in the soil borings, beginning at the existing ground surface and proceeding downward, is provided below:

> **Pavement:** Boring Somat_B1 was drilled through asphalt parking lot pavement, about 8 inches thick. Boring Somat_B2 was drilled through the Portland cement concrete sidewalk, about 4.5 inches thick.
>
> **Fill Soils:** Fill soils consisting of sand, silty sand and sandy silt, or a mixture of these soils were encountered below the pavement in both borings. The fill soils extended to depths ranging between 8 to 8.5 feet below existing grades (elevation 579 to 576 feet). The apparent density of the granular fill soil was medium dense to very loose.
>
> **Sandy Silt:** Natural loose sandy silt was encountered below the fill in boring Somat_B02, extending to a depth of 13.5 feet (elevation 573 feet).
>
> **Medium to Stiff Clay:** Natural lean gray clay soils were encountered below the fill in boring Somat_B01 and below the silt in boring Somat_B02. This upper clay soil layer extended to depths ranging from 20 to 25 feet below existing grade (elevation 565 to 562 feet). The

consistency of the native clay was generally stiff to medium. The moisture contents of the clay samples ranged between 27 and 34%.

Soft to Very Soft Clay: Soft to very soft lean gray clay soils were encountered below the medium to stiff clay soil layer in both borings. These clay soils extended to depths ranging from 45 to 55 feet below existing grade (elevation 542 to 530 feet). The consistency of the native clay was generally soft to very soft, and the moisture content ranged between 19 and 50%.

Within this stratum, very soft clay soils having unconfined compressive strengths measured to be between 120 and 280 psf, were present in both borings from depths of 23 to 30 feet, at an elevation range of 562 to 555 feet. The extremely soft clay layer was the thickest in boring Somat_B1.

While drilling both borings, the driller reported significant “squeezing in” of the borehole within this layer.

Medium Clay: Gray lean clay was encountered below the soft to very soft clay soils in both borings, extending to the termination depth of the borings. The consistency of the clay was soft to medium, and the moisture content ranged between 23 and 40%.

A layer of high plasticity (“fat”) clay was encountered between 45 and 47 feet (elevation 542 to 540 feet) in boring Somat_B2.

A layer of clayey fine sand was encountered at the bottom of boring Somat_B1, from 80 to 84.5 feet (elevation 505 to 500 feet).

Boring Somat_B1 was terminated on assumed bedrock, at a depth 84.5 feet (elevation 500 feet)

No reportable gas levels were detected in either boring with the gas meter. No reportable VOC readings were detected in either boring with the PID meter.

Please refer to the boring logs for the soil conditions at the specific boring locations. It is emphasized that the stratification lines shown on the Logs of Test Borings are approximate indications of change from one soil type to another at the location of the boreholes. The actual transition from one stratum to the next may be gradual and may vary within the area represented by the test boring.

4.2 AREA SOIL INFORMATION AND OBSERVATIONS

Based on the shared historical information and the other Somat boring-03-02 (previously drilled for a separate project), the soil conditions encountered in these borings were similar to the conditions encountered in the recent borings.

The Somat boring B-03-02 encountered the soft gray lean clay from elevation 568 to 548 feet, with shear strengths of about 160 psf reported based on testing.

The MDOT signal pole borings encountered the soft clay soils starting at about elevation 575 feet and groundwater at about 5 to 8 feet during drilling and 10 to 18 feet upon completion of drilling.

4.3 GROUNDWATER LEVEL OBSERVATIONS

Groundwater was encountered during drilling in both soil borings at depths of 3.5 and 6 feet below existing grades (elevations 581 feet±). Groundwater was not measured upon completion of drilling due to wash rotary techniques. The specific groundwater observations made during our field investigation are presented in the individual boring logs in Appendix A-1.

Based on the available information, the groundwater encountered in the borings is situated in the granular fill material. It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation, and percolation in the area, as well as the surface water level of the Detroit River and any other nearby water bodies that may affect the groundwater flow pattern. The groundwater information is only accurate for the time and date the readings were taken for this field investigation.

Further, upon observing various stages of the restoration construction, several areas of wet silt soils were observed in excavations, some of which turned into a flowing silt condition, “bubbling” up to the surface. These conditions could be attributed to residual excess pore water pressure in the soils from the movement of the subsurface soils.

Based on our experience with similar cohesive soils in the area, we estimate groundwater permeability rates of about 10^{-7} to 10^{-8} meters per second. These permeability rates for this type of clay in Michigan are well documented, and accepted by the Michigan EGLE. It is our opinion, laboratory testing of the clay is not necessary for the purposes of the causal report.

4.4 SENSITIVITY OF CLAY SOILS

Sensitivity of the soils is an indication of the reduction in shear strength of the soil when it is subjected to disturbance such as remolding (i.e., during a shear failure event). It is defined as the ratio of the undrained shear strength of undisturbed soil to the undrained shear strength of the remodeled soil at the same in-situ water content.

As described previously in the report, the in-situ vane shear tests were performed for an undisturbed condition and a remolded condition. While we believe that some of the in-situ clays were already disturbed by the ground movement incident, we used the comparison of the undrained shear strength of the "undisturbed" soil versus the undrained shear strength of the remolded soil as a guide to the sensitivity values of the clays. Of the eleven (11) vane shear tests performed by Somat, the average sensitivity of the clay was about 2.5. Historically, in our experience, this sensitivity value ranges from about 2 to 4 for clay soils similar to those encountered on this site.

Based on the classification of sensitivity proposed by Bowles (1996), soils having a ratio equal to between 4 and 8 are "sensitive", with lower ratios being "insensitive" and higher ratios being "extra sensitive".

4.5 SUMMARY OF OTHER INVESTIGATIONS AND FIELD OBSERVATIONS

At this time, only the results of the SME investigation were made available to include in this report. Thus far, the TEC/G2 investigation has not been made available for this report, but piezometer readings are summarized in Appendix A-2, and our observations of their drilling operations are summarized in Appendix A-3. In addition, the following observations were noted by Somat personnel who were on site during these investigations.

- The SME boring (SME_B1) encountered similar squeezing soils in the range of 30 to 50 feet below grade.
- The second Exponent test pit, performed on Dearborn near the turning island in the pavement, encountered silty sand and silt material surrounding several known and unknown utilities. The excavation was switched to a soft dig (water lancing and vacuum truck) to attempt to expose the 24-inch diameter high pressure gas line. However, the excavation sidewalls were unable to be maintained and it was abandoned without reaching the gas line.
- The TEC boring (TEC_B1) also encountered similar squeezing soils in the range of 30 to 50 feet below grade. That boring encountered bedrock at an elevation of about 502 feet. The boring was drilled just east of the Mill Scale pile, and encountered fill to an elevation of about elevation 576 feet.
- Two fissures or cracks were noted in the mill scale pile, one on the south side and one on the north side.
- The first G2 boring (G2_B1) encountered mill scale to a depth of about 14 feet, or elevation 576 feet. Below the mill scale, dense sand, gravel, and asphalt millings were encountered below the mill scale, to a depth of 23 feet, or approximately elevation 567 feet. This dense material is consistent with a “platform” described by the Fort Iron foreman that was reportedly constructed to support the stockpile. The other G2 borings encountered similar soft soils below the fill and sand/silt soils, but no evidence of similar “platform” materials. The presence of a “platform” is only based on the material encountered in G2_B1 and conversations with Fort Iron staff. No other evidence or information was available as to the location, size or thickness of this layer.
- Excavation of the heave area in Dearborn revealed several broken utilities, which may be contributing to the groundwater observed in the granular fill.
- Also, during the excavation of the heave area, several pockets of silt and silty fine sand were encountered.
- The test pit in Fort Street extended to a depth of about 6 feet, exposing the 24-inch gas pipe. Observations of the sidewalls in the excavation indicated some movement and a slight shear zone within 5 feet of the east Fort Street curb line.

- In the SME DTE-1 boring, a stacked piezometer was installed adjacent to the boring. Based on the readings shared on October 25, 2021, the groundwater level measured in the piezometer installed to 16 feet was about grade level. The piezometer installed at a depth of 31 feet in the lean clay measured piezometric groundwater pressure at about 15 feet above grade, thus indicating excess pore water pressure consistent with a shear failure of the soil.
- The laboratory testing data for the SME DTE-1 boring was reviewed by Somat on November 5, 2021. In general, multiple tests/types of tests were performed to determine shear strengths and the results are similar to the Somat test results. In addition, of the consolidation tests performed, one predicted slightly less settlement and the other predicted up to 50% more settlement than our original estimate based on our consolidation testing.

4.6 MILL SCALE TESTING

Unit weight tests were run on the Mill Scale sample, as described in section 3.1.3. The results of these tests are as follows:

Compactive Effort	Unit Weight
Loosely Placed	147 pcf
ASTM D698	217 pcf
ASTM D1557	227 pcf
ASTM D1557 (dry)	223 pcf
ASTM D1557 (soaked, 24 hrs.)	236 pcf
ASTM D1557 (drained, 1 hr.)	234 pcf

The moisture content on the air-dried sample was about 3.8%. Our preliminary modeling did not indicate the angle of friction for the mill scale was a critical value, and therefore no additional testing was performed. Based on the angle of repose observed in the field, we conservatively estimated the phi angle to be about 38 degrees and about 1 psi of apparent cohesion to account for chemical cementing of particles.

Please note the minor change in unit weight of mill scale material soaked for 24 hours, and after being drained for one hour. The likelihood of the impact of rainfall on the unit weight of the mill scale, and consequently on the observed failure, is discussed in Section 5.5

4.7 INSTRUMENTATION INFORMATION

At the time of this report, the only instrumentation data available are from the inclinometer installed in Somat_B01, and the SME piezometric data described above. The orientation of the inclinometer casing is generally pointing the primary (A axis) axis towards the former peak of the stockpile (post-incident) at a bearing of about 30 degrees east of north. Since the initial baseline readings on September 16, there are two zones of movement observed:

- The upper granular fill zone (elevation range 584 to 572 feet) has shown a maximum movement of about ¼-inch towards the northwest (60 degrees west of north), with the peak movement about elevation 578 feet.
- While very minor, there does appear to be some rotational movement between 33 and 38 feet below grade, between elevation 549 and 544 feet.

4.8 SOIL PROFILES WITH DEFINED STRENGTH PARAMETERS

In general, two geotechnically related conditions needed to be considered for the analysis performed to support this report. The recent borings performed on and around the failure zone, while heavily sampled and tested, must be considered as a “disturbed” state. That is, the clay sample tests on the disturbed zones of soil represent the post-movement condition and, most likely, a lower strength state. The analysis needed for this report required the clay conditions in the “pre-movement” strength state. We utilized the data provided in the historical borings to evaluate the changes that may have occurred in strength and develop a “pre” soil profile. Based on these assumptions, the following generalized soil profiles were developed for each boring location.

Keep in mind that the shear strengths of sands (granular) and clays (cohesive) are modeled using a cohesion value and an internal friction angle (phi). A pure sand has zero cohesion and a phi angle that is not dependent on whether the condition is short-term (undrained) or long-term (drained). A purely clay soil has cohesion only, unless it is in a long-term condition, then it will have cohesion and an internal friction angle contributing to strength. For the purposes of our analysis, an undrained/total stress condition was considered due to the cyclical loading and unloading of the stockpile.

Generalized Soil Profile for Boring Somat B-01				
Elevation	Material	Total Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)
585 – 578 ft	Mixed Clay and Sand Fill	120	0	32
578 – 576 ft	Sandy Silt	115	0	25
576 – 574 ft	Stiff Clay	125	1200	0
574 – 570 ft	Medium Clay	125	900	0
570 – 563 ft	Medium Clay	120	750	0
563 – 556 ft	Soft Clay	120	350	0
556 – 530 ft	Soft Clay	120	400	0
530 – 507 ft	Medium Clay	125	500	0
507 -500 ft	Clayey Sand	120	200	32
500 ft	Apparent Bedrock			

Groundwater Level @ 581 Ft

Generalized Soil Profile for Boring Somat B-02				
Elevation	Material	Total Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)
587 – 578 ft	Mixed Clay and Sand Fill	120	0	32
578 – 573 ft	Sandy Silt	115	144	27
573 – 570 ft	Medium to Stiff Clay	125	850	0
570 – 562 ft	Medium Clay	125	625	0
562 – 559 ft	Soft Clay	120	300	0
559 – 542 ft	Soft Clay	125	350	0
542 – 524 ft	Medium Clay	125	500	0
524 – 502 ft	Soft Clay	130	450	0

Groundwater Level @ 583 Ft

The Mill Scale was modeled with a total unit weight of 230 pcf and a phi angle of 38 degrees. This assumed friction angle was based on our experience and judgement considering the granular, angular nature of the mill scale. The unit weight of the mill scale has a much more profound effect on the failure than the angle of internal friction. The unit weight was confirmed by an independent test performed by one of the other consultants engaged on this investigation.

4.9 OTHER INFORMATION REVIEWED

Along with the geotechnical and survey information noted in the previous sections, aerial historical photographs from Nearmap were compiled to show the historical site usage, presented in Figure 4. In addition, screen shots form security videos were captured and presented in Figure 3 to exhibit changes in the site on the day of the failure.

5.0 CAUSES OF INCIDENT CONSIDERED

The purpose of this report is to provide a hypothesis and rationale for the most likely cause of the incident. To reach that goal, we have considered reasonable, wide-ranging possibilities that may have caused the incident and whether there is merit to those possibilities, eventually narrowing down to our proposed hypothesis. The plausible causes presented in the following text are based on our knowledge and experience with the soil and subsurface conditions in the general area of southwest Detroit, available historical information, the observed site conditions, and the post-incident investigations performed. If other conditions are discovered or determined to be relevant at a later date, we reserve the ability to revisit these conclusions.

5.1 MINE SUBSIDENCE

As noted in section 2.2.1, there is a history of salt mining in this area of Detroit, specifically the Morton Salt facility just west of this area. Based on the literature review conducted and our experience with numerous geotechnical investigations carried out in the southwest Detroit area, we believe there is a general phenomenon of subsidence of the soil that has been occurring during the last decades. However, no clear indication can be drawn to attribute the formation of the sinkholes, the ground subsidence, and the damage to the surface structures **only** to the salt mining operations. We believe the recorded occurrences are the results of a combination of simultaneous causes: consolidation and settlement of soft ground, general lowering of groundwater table, industrial plant operations, and probably salt mining activities. Based on this background, along with the observed **upward** movement of the roadway and Stash building, it is unlikely that the incident was due to any salt mine subsidence or salt mine operations.

5.2 ARTESIAN WATER OR METHANE GAS

This area of Detroit, nearby to the Rouge and Detroit Rivers, is known to have artesian ground water conditions, along with naturally occurring gases; hydrogen sulfide and methane gas. Methane has been responsible for a number of injuries and deaths resulting from fires and explosions. It is believed the methane is a product of either or both degassing of the sedimentary rock underlying the area, or the decomposition of organic substances buried within the glacial soils. Hydrogen sulfide is a highly toxic gas that is usually encountered in deeper excavations (approaching the glacial till or bedrock formations), or during piling operations. Artesian groundwater in this area, near the rivers, has been measured up to 15 feet above the ground surface.

As noted, these conditions are typically found near the interface with the glacial till and bedrock. It would be very unusual for these conditions to reach the surface without a man-made conduit in which to travel. Further, if either artesian groundwater or naturally occurring gasses had made their way to the surface to create the heave, those conditions would have continued to be present at the time of the site visits and the daylighting of either the gasses or the artesian groundwater would have been plainly visible or detectable. No artesian groundwater or gasses were noted during any of our site visits. There were gases visibly emanating from the heaved area, but those were likely from the broken utility lines. And as noted, groundwater was observed, but it appeared to be the natural groundwater table or from broken utility lines.

The readings on the lower piezometer installed by SME for DTE indicate an elevated pore water pressure equivalent to a head of about 15 feet above grade. Three readings were obtained between September 30, and October 12, 2021, and showed decreasing pressure with time. This may represent the decrease in the excess pore water pressure within the subsurface clay as a result of the shearing of the soil and the unloading the stockpile. However, we cannot comment on the validity of the instrument installation or baseline procedures performed by others.

5.3 UTILITY BREAK OR EXPLOSION

Based on the available information, there are several utilities located in the Dearborn right of way: DTE gas lines, DWSD sewers, GLWA water mains and AT&T duct banks. At the time of the engagement on this project, almost all of these lines were either damaged or shifted due to the heave in Dearborn. To our knowledge, there are no utilities located within the Stash building parcel, other than the service leads to the building. In addition to these noted movements, there were reports of a gas leak in the area for several weeks prior to the incident. The surveillance videos show several DTE personnel on site at the time of the incident, reportedly investigating the reported leak.

The evidence does not point to a possible gas line leak and explosion, as the result would leave more of a crater than a heave. It is possible that a massive rupture of the 16-inch water main could have heaved the soil up, but there would have been more washout of the sand and silt within the utility trenches, than lifting of the entire area.

Further, upon investigating the GLWA watermain, only a 4-foot-long crack was observed in the pipe. The crack is shown in the photo below.

Exhibit 2 - Repair of Watermain

In addition, further east along Dearborn, two (2) abandoned water leads were located, connected to the 16-inch diameter main, extending likely to the former residences on the south side of Dearborn. These lines were observed to be leaking.

There is certainly the possibility of a sewer collapse, but that, again, would leave more of a sinkhole than a heave, as material fills in the void created by the collapse.

So, while either of these, utility break or explosion, may be feasible, neither would explain the heave at the Stash building, which occurred simultaneously to the heave in Dearborn, based on the security footage. Therefore, we believe the broken or shifted utilities are a result of the heave.

However, it should be noted that, prior to the failure incident, utilities within a range of about 50 feet of the existing stockpile, may have experienced lateral deflection and/or settlement as a result of consolidation settlement and lateral squeeze of the very soft clay under the mill scale stockpile. If there were leaks prior to the incident, we do not believe those would have been a direct cause of the movement.

5.4 SEISMIC EFFECTS

As noted, the ground water level is situated only a few feet below the ground surface. In addition, the in-situ vane shear testing indicated an average sensitivity of the clays of 2.5, meaning the clays lose 60% of their strength when disturbed. Considering both of these factors, ground vibrations could impact the strength of the site clays.

However, based on the USGS, no seismic activity has been recorded since 2020, when a magnitude 3.2 earthquake event, located 2 km SSE of Detroit Beach on August 21, 2020, occurred at 6:55 pm local time.

Fort Street carries heavy truck traffic, and the operations of Fort Iron introduces truck traffic onto Dearborn Street. The movement of these heavy trucks would induce ground vibrations to the site. However, considering the frequency of these vibrations and the presence of the groundwater and soft clay which would dampen these vibrations, it is not likely that the vibrations could reach the critical and sensitive soft clay layers.

5.5 EXCESSIVE RAINFALL

As noted in section 2.3, City Airport in Detroit recorded over 10 inches of rain in the 60-day period prior to the incident, which is almost 50% over the normal amount. While the site is located several miles from City Airport, it can be assumed that the Fort Iron site received a similarly large amount of rainfall over that period. This amount of rain would do two things to the site: elevate the ground water table and saturate the mill scale stockpile, thus increasing the unit weight.

The long-term ground water level in this area is influenced by the water level in the Rouge and Detroit Rivers, which was recorded at 575 feet, or about 10 feet below grade, based on the NOAA water level gauge at Fort Wayne. The observed groundwater level in the soil borings performed in September 2021 was about 581 feet, slightly higher than the MDOT borings performed in July of 2020. Therefore, the groundwater level in this area was already within 10 feet of the ground surface. Our preliminary soil stability models analyzed groundwater at both the level encountered in the borings and at grade, which did not yield a significant difference in the results.

More likely, the impact of this amount of rain was to slightly increase the unit weight of the mill scale. As noted in section 4.4, after soaking the material, the unit weight determined by ASTM D-1557 increased by 13 pcf from 223 pcf to 236 pcf. This additional weight equates to about a 5% increase in stockpile unit weight. Our laboratory testing also indicated that after the soaked mill scale was allowed to drain for 1 hour, the unit weight decreased from 236 pcf to 234 pcf. This indicates that the additional weight of the stockpile may increase during but rapidly decrease after the individual rain events. Another way to look at this is that if 6 inches of rain had fallen and been totally contained within the limits of the mill scale stockpile and not permitted to drain, the 6 inches of water would have resulted in an increase of 32.1 pounds of water per square foot (psf) of the area of the pile. With a 20-foot-high pile of mill scale, the weight of the mill scale would have been 4600 psf of pile area. (20 feet times 230 pcf = 4,600 psf). Therefore, the maximum percentage increase in the contact pressure under a 20-foot-high pile would be 32.1psf/4,600 psf, or about 0.7%, which is a trivial increase. Because the mill scale drains so fast, this hypothetical increase in contact pressure under the stockpile could never be achieved.

The increase in unit weight may have had a very slight impact on the stability of the stockpile as noted in the following sections. So, while the additional rainfall may have had a contributing effect on the incident, it cannot be pointed to as the primary or even a significant factor in the stockpile failure.

Another theory considered was that the additional rainfall saturated the native clay soils to the point where additional unit weight or a softening of the soils, due to an increase in moisture content, resulted in a failure. Based on our professional experience and knowledge of the type of clay mineral (illite) typically encountered within the clay matrix portion of the soils in this area, we do not believe this was a contributing factor. The natural clay encountered in all of the borings has a very low permeability and it would take decades for water from precipitation or leaking utilities to affect the moisture content of the clay to the depth where the very soft clay was encountered. Additionally, the moisture contents of the soil samples obtained during the drilling of the 1979 historical borings and the 2019 borings are similar or higher than the moisture contents determined for the samples obtained during our recent investigation. A graphical summary of these conditions is presented in Appendix D. Further, areas of wet silt soils were observed in excavations, some of which turned into a flowing silt condition, "bubbling" up to the surface. These can be attributed to residual excess pore water pressure in the soils from the movement of the subsurface soils.

5.6 SOIL FAILURE MECHANISMS

Based on the evidence from observations at the site, the soil and groundwater conditions, our engineering analyses, and what we know of the timeline of the events, the incident appears to be a result of a soil shear strength failure. Soil strength failures can be attributed to inadequate bearing capacity, slope instability, and lateral squeeze (deformation). Two of these mechanisms were analyzed and summarized below. Lateral squeeze was dismissed from our consideration based on the physical appearance of the failure.

Additionally, we performed calculations to estimate the amount of consolidation settlement that could have occurred at the site based on the available data relative to the mill scale stockpile dimensions over the past several years.

Initially, as part of the emergency response, a preliminary subsurface soil profile and global stability model were set up to aid in determining/justifying the steps to stabilize the site and preserve public safety. This modeling and analysis were submitted to the City on September 21 and 29, 2021. The shear strength parameters used for the clays considered the disturbed condition of the site, as seen in the borings, post-movement. For the purposes of evaluating the site in a pre-movement condition, the soil shear strength parameters were adjusted based on the available data and observations.

5.6.1 Bearing Capacity Failure

A bearing capacity failure occurs when the shear stresses in the soil due to loading exceed the shear strength of the soil, and is generally classified either as a general shear failure, a local shear failure, or a punching shear failure. In a general shear failure, the load bearing area subsides, and the subsurface soil ruptures and pushes the soil up along the sides of the load.

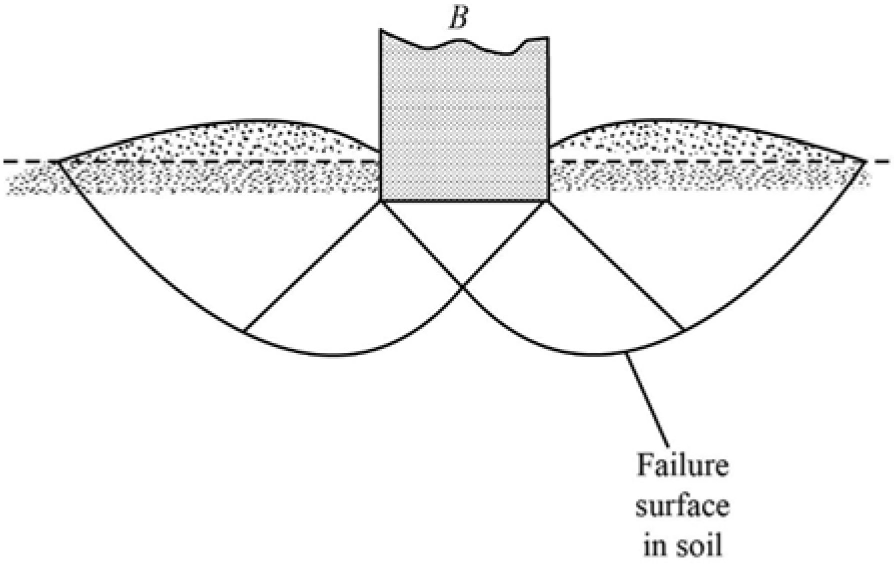


Exhibit 3 - Typical Bearing Capacity Failure Surface

The movement expected with this type of failure would be the dropping/downward movement of the load (mill scale) and a heaving/bulging of the soils adjacent to the load (roadway and parking lot). In addition, surface features within the heaved areas would tip or lean from vertical.
Based on the observations in the field, the areas on Dearborn Street and behind Stash certainly heaved. The video footage shows the mill scale stockpile dropping. And, the utility poles and fencing immediately adjacent to the stockpile tipped inward toward the stockpile.

Exhibit 4 - Aerial Photo of Overall Movement

In addition, the longitudinal cracks observed around the perimeter of the stockpile are indicators of this type of failure. The typical cracking observed at the site is shown in the two photos presented below, taken by Somat on September 14 and October 2, 2021.

Exhibit 5 - Surface Cracking around Stockpile

As we noted, the exact height of the stockpile at the time of the incident is not known. Based on the topographic information obtained on September 17, 2021, the maximum elevation of the post-incident stockpile was 610 feet. However, from video footage, we also know that a portion of the stockpile was placed to some elevation above 610 feet. This maximum height is unknown. In our analyses, we conservatively assumed that the maximum height of the stockpile was 24 feet above the surrounding roadway and site grades (approximate elevation of about 586 feet), and that the stockpile was formed with a flat top and conical ends/sides. (Reference the topographic map provided as Figure 5, for the plan dimensions of the embankment area used in our analysis). Using this geometry, the observed conditions in the soil borings, and a mill scale unit weight of 230 pcf, we have developed the subsurface profile for the bearing capacity analysis as noted in section 4.6.

Because the borings were performed post-incident, engineering judgement was required to assign strength parameters to the clay layers for the purpose of modeling a pre-failure condition. Once disturbed to the point of failure, clay soils exhibit a residual shear strength that is a fraction of their peak shear strength. (It should be noted that based on our preliminary analysis, using the actual post-failure values of the shear strengths of the soil samples from our investigation, bearing capacity and slope stability models resulted in unstable conditions, or factors of safety less than 1.)

Of particular interest is the granular fill material encountered below the apparent base of the mill scale in boring G2-B1performed within the footprint of the stockpile, as described in Appendix A-3. We assume that this may be evidence of a platform that may have been constructed to help support the stockpile. However, we do not know the lateral limits of this material.

We performed bearing capacity analyses of the underlying soils (below elevation 586 feet) using various methods and compared the results to the loading of the mill scale stockpile to determine a plausible range of factors of safety against bearing capacity failure. An estimated maximum stockpile loading of 5,520 psf (at the ground surface) was used to estimate the factors of safety. A description of each model is provided below:

> Case 1: Bearing capacity analysis using well-known Terzaghi equation, assuming stockpile dimensions of 90’ x 90’ bearing on a platform constructed of compacted granular fill below the base of the entire plan area of the stockpile.
>
> Case 2: Same as “Case 1” above, but with the stockpile and platform bearing on clay soil with an averaged cohesion value of c = 500 psf.
>
> Case 3: Stockpile bearing on a two-layered system (strong clay layer with average cohesion value of c = 880 psf from about elevation 575 feet to elevation 562 feet overlying a weaker clay layer with average cohesion value of c = 350 psf).

Based on the bearing capacity analyses described above, we have estimated factors of safety against bearing failure as follows:

Case 1: Estimated ultimate bearing capacity = 58,500 psf, F.S: = 10
Case 2: Estimated ultimate bearing capacity = 3,710 psf, F.S. = 0.67
Case 3: Maximum* estimated ultimate bearing capacity = 4,500 psf, F.S. = 0.82

**Based on minimum stockpile size of 24 ft. x 24 ft., F.S. decreases with increased size.*

A factor of safety greater than 1 indicates the capacity of the subgrade soil is adequate to support the load from the stockpile. A factor of safety less than 1 indicates the weight of the stockpile exceeds the bearing capacity of the soil.

Typically, depending on the variability of a site, loads placed on soils (foundations, embankment, stockpiles, etc.) are designed to have a factor of safety against bearing capacity failure of at least 1.5 and typically 3.0.

Based on our simplified analyses and assumptions, the results seem to indicate that the presence of the granular fill material acting as a platform provided some strength to the subgrade which increased bearing capacity. However, at some point, with increased loading, the integrity of this platform was compromised, and shear failure occurred.

Additionally, the dual heaved areas seem to represent this type of failure.

5.6.2 Slope Failure

Similar to a bearing failure, slope stability failures occur with a shearing of the soil along a failure surface. Slope stability refers to geometries where a slope can withstand its own weight and other forces without exhibiting movement. When the weight or forces exceed the resistance provided by the soil, movement occurs. These failure surfaces are typically circular, rotating around a point with the driving (upslope) loads being resisted by the shear strength along the circular arc and any other loads on the toe of the slope. The results of these slope failures are similar to the bearing failures: the dropping of the load (mill scale), a heaving/bulging of the soils adjacent to the load (roadway), and the tipping of surface features from vertical.

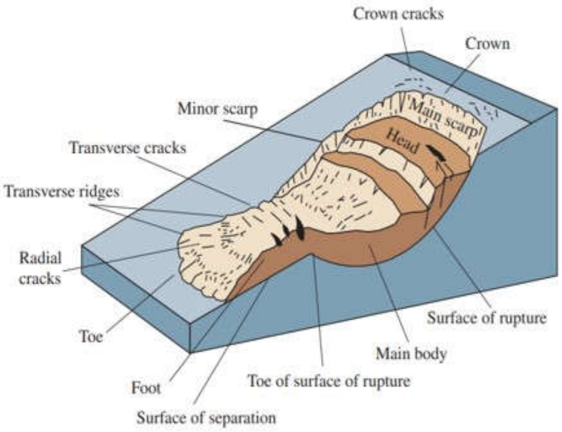


Exhibit 6 - Typical Slope Failure

Exhibit 7 - Photo of Scarp

In order to evaluate the factor of safety against global stability failure, the slope stability analyses were performed using the “SLIDE” computer program by Rocscience of Toronto, Ontario, Canada. The SLIDE program evaluates the safety factor of circular or non-circular failure surfaces in soil or rock slopes. This program analyzes the stability of slip surfaces using vertical slice limit equilibrium methods, including the Janbu Simplified, Bishop Simplified, and Spencer methods. The Janbu Simplified method makes some simplifying assumptions and satisfies only some of the equilibrium conditions. The Spencer method is considered more rigorous (and comparatively more accurate) than the other two methods, since it accounts for a satisfaction of three conditions of equilibrium (force equilibrium in the horizontal and vertical directions and the moment equilibrium condition).

Our analysis took into consideration the following basic global stability parameters; location and shape of the potential failure surface, internal friction angle and/or cohesion of the various soils, density of the various soils, and location of the estimated groundwater surface, utilizing the design soil profiles for soil borings Somat_B1 and Somat_B2 noted in section 4.6.

The results of these analyses indicate that for the given stockpile footprint and height and the assumed soil strength parameters, the Fort Iron stockpile site may have had a factor of safety close to 1 or slightly below (0.82 to 0.96). The graphical results of these analyses are available in Appendix E.

Typically, failures of this type occur in a single direction. For the site to have heaved in the two areas of Dearborn Street and Stash, two separate slope failures would have had to occur.

5.6.3 Consolidation Settlement

As noted, the underlying natural clays are soft and highly compressible. Consolidation settlement is the process where soil changes volume as a response to change in applied pressure. An increase in applied pressure on the soils results in water within the soil voids also increasing in pressure (pore pressure). This increase in pressure is slowly released as water is expelled from the soil, and as a result of the loss of water, the volume of the soil decreases. This process takes time and the rate of consolidation is dependent on the hydraulic conductivity of the soil (rate at which water will flow through the soils), as well as the distance to any drainage pathways within, above, or below the compressible layers. Therefore, it is likely that the subsurface soils in the area under the mill scale stockpile have been consolidating for years concurrent with the addition of the mill scale to the stockpile.

Based on the consolidation testing performed, and our experience with modeling clay soils in the Detroit area, we calculated that a maximum of about 36 inches of consolidation settlement could occur from the placement of a 24-foot-high mill scale stockpile load having approximate footprint dimensions of 170 feet by 170 feet. Unfortunately, we do not have detailed survey data from before the incident that would have recorded the progression of the stockpile dimensions across the site in time, along with settlement of the surrounding area. To reach a maximum settlement, it would take many years, but we estimate that in 1 to 2 years, about 10% to 20% of the maximum settlement could occur, or about 3 to 7 inches.

Consolidation settlement of the clay soils below the stockpile could lead to destabilizing or cracking of the granular platform under the stockpile, along with the movement of surrounding utilities.

However, based on the thickness of the pavement in Fort Street and Dearborn Street, it is possible the pavement structure bridged the soil settlement under the respective roadways. In addition, the predicted consolidation may have caused some utilities to move and shift, possibly causing compromised gas lines, which could explain the gas odors (i.e., leaks) reported by neighboring residents.

Our analyses indicated that the consolidation settlement for the presumed stockpile dimensions could extend out 50 feet in each direction from the edges of the stockpile.

The additional effect of the consolidation and settling of the stockpile area would be an apparent “lowering” of the stockpile, likely leading to more stockpiling of the material and increasing the stockpile load. The magnitude of the consolidation/settlement would be greatest under the middle of the stockpile, creating a bowl effect under the stockpile, allowing for pooling of groundwater.

6.0 CONCLUSIONS

The prior section summarizes the possible causes considered for the incident, with the most likely cause being the heavy unit weight and height of the mill scale stockpiled on the Fort Iron site. Ultimately, it is our professional engineering opinion that the weight of the stockpiled material exceeded the shear capacity of the underlying clay soils to cause the heaved areas and disruption to the structures adjacent to the Fort Iron site. It is our opinion that other factors such as groundwater due to above-average precipitation or leaking utilities did not have any significant effect on the failure and the primary cause of the soil failure was the load imposed by the mill scale stockpile.

It does appear that the readings obtained from the inclinometer installed in Somat_B-01 did detect a zone of residual soil movement between elevations 549 and 544 feet, which correlates to a zone of very soft to soft clay.

From our analysis, it is unclear as to why the failure happened at the day and time it did. What was special about the evening of September 11, 2021? With geotechnical failures of the types analyzed, they can be gradual until a critical amount of load or a critical amount of movement is reached. Based on our involvement with the reconstruction of the M-85 Bascule bridge, which is approximately 1,500 feet away from the incident site, the soft clay soils in the area of the bridge have experienced a slow creep under sustained load. Prior to the bridge reconstruction, the two-leaf bridge would regularly need the ends of the spans shaved so that they would close due to the abutments shifting together. The theory of the failure was that the river embankment slopes were slowly moving over the years.

With the stockpile at the Fort Iron site, the operations of the scrap yard were cyclical, and the height of the mill scale varied over the three years of available data. Sometimes it was near the critical height that we calculated to be about 20 feet (based on the two-layer bearing capacity analysis), and sometimes it was less than this.

One reasonable explanation for the timing of the incident could be that the underlying soft clays had consolidated over several years under the stockpile loading. On this particular day, the strain in that settlement reached a point to create a shear crack in the “platform” soils under the stockpile. This would have greatly reduced the shear strength capacity of that profile, allowing for a rapid bearing capacity or slope failure. The slow-occurring and time-dependent consolidations would also slowly shift surrounding utilities, which could cause breaks in piping and leaks.

Based on our observations, research, and calculations, it is our engineering opinion that the placement and height of the mill scale is the sole cause of the movement, with the mechanism of failure (bearing capacity, slope stability, or a combination that included consolidation settlement) left to interpretation.

While our soil borings performed within the project vicinity showed clay soils with low strength, we acknowledge that these soils may be disturbed from the movement. However, with the historical borings in the area available for this report, the sensitivity of the clay soils, and the modeling prepared for the analysis, we believe the shear strengths used in the modeling are a reasonable estimate.

In addition, we have provided data showing that the shear strength of the clay is independent of moisture conditions. Further, the moisture conditions in the clay soil samples obtained recently are similar to the moisture conditions in the historic borings. All of which indicate that a leaking utility or excessive rainfall did not reduce the shear strength of the clay soils.

7.0 LIMITATIONS

The information, analysis, and conclusions presented in this report are based on the information collected by Somat during our investigation and research, along with other information provided by the City and participating consultants. Should additional information be provided after the submission of our report, we reserve the right to review our conclusions and update if necessary.

TABLE 1

SUMMARY TABLE OF GEOTECHNICAL BORINGS
(GROUND SURFACE ELEVATION AND BORING COORDINATES)

Table 1 - Summary of Geotechnical Borings

Purpose of Investigation	Boring ID	Boring Depth (ft.)	*Ground Surface Elevation (ft.)	*Northing	*Easting	Location Information Determined By
Ground Upheaval	B-01	84.5	584.7	291415.90	13456298.90	Project Surveyor
	B-02	85.0	586.8	296134.20	13456292.30	Project Surveyor

Note: Horizontal datum “North American Datum of 1983” (NAD 83) (NSRS 2011) and vertical datum “North American Vertical Datum of 1988” (NAVD 88) were utilized.

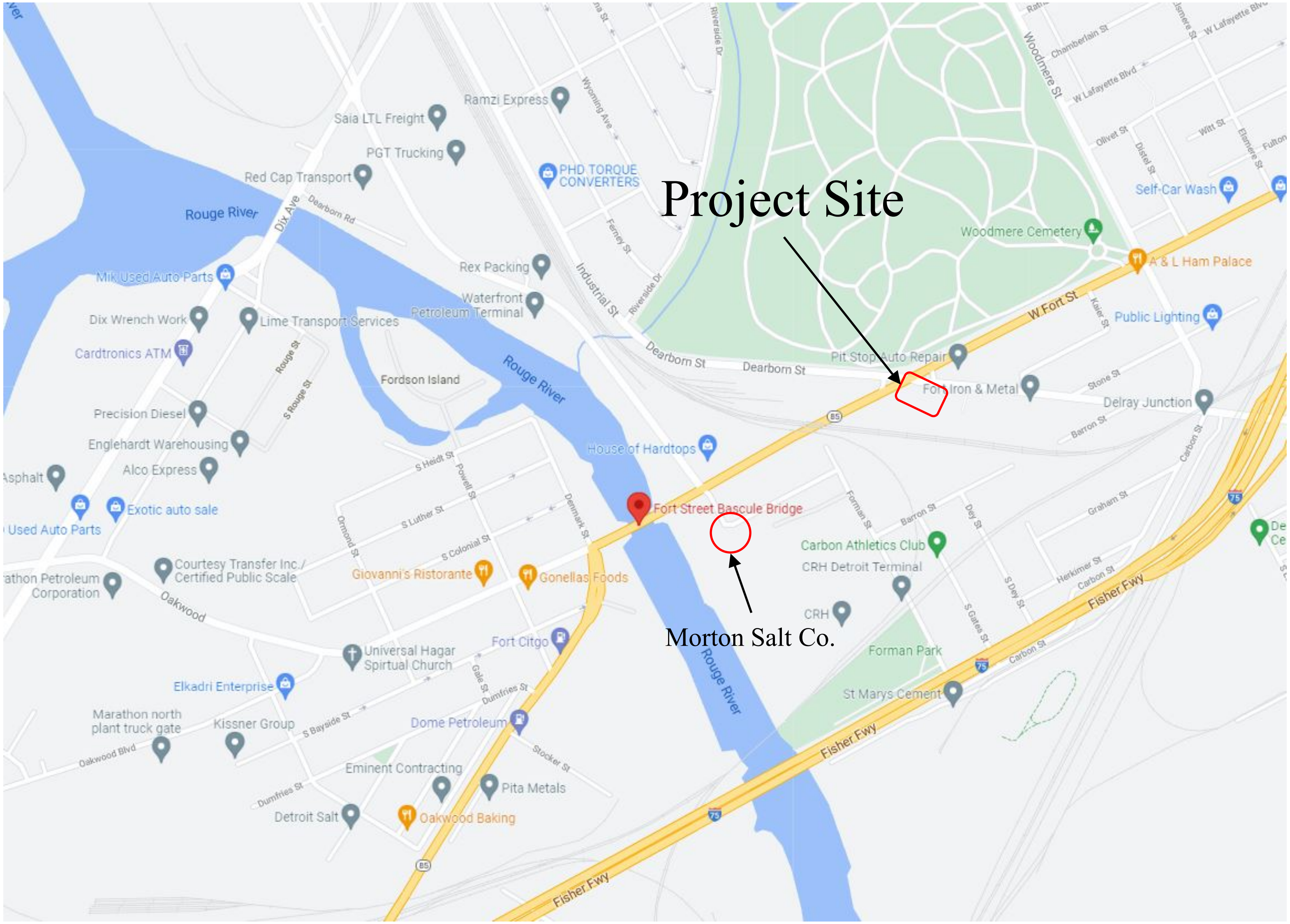
* Coordinates and ground surface elevations were obtained by Project Surveyor.

FIGURES

SITE VICINITY MAP, AERIAL MAP OF BORING LOCATIONS, VARIOUS VANTAGE POINTS, PROJECT SITE PROGRESSION FROM 2017 TO 2021 AND TOPOGRAPHIC MAP OF PROJECT SITE, SOIL AND UTILITY PROFILE

FIGURE 1

SITE VICINITY MAP



Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: None

SOURCE: Google Maps, 2021

SCALE: Not to Scale

Figure 1: Site Vicinity Map
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021** **Page: 1**

FIGURE 2

SOIL BORING LOCATION DIAGRAMS

◉ - Soil Boring Location

▣ - Soil Boring Location (Boring logs not available)

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: See above

SOURCE: nearmap, 2021

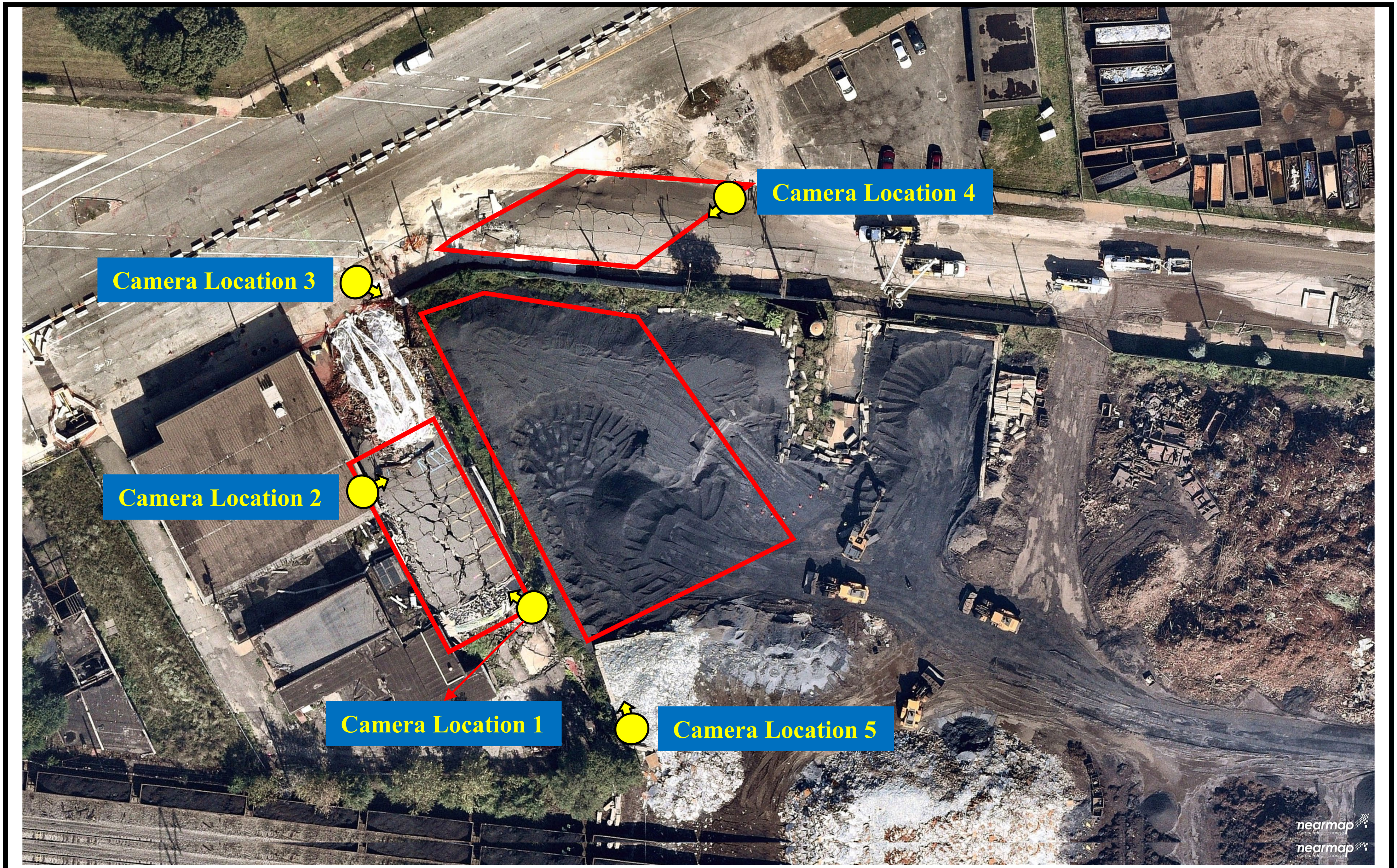
SCALE: Not to scale

Figure 2: Aerial Map of Boring Locations
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021** **Page: 2**

FIGURE 3

VARIOUS VANTAGE POINTS



Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021** **Page: 1**

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 1

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021**

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 1

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 2

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021** **Page: 4**

Camera Location 2: After

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 2

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021**

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 3

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021**

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable
SOURCE: Camera Location 3
SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E
Date: 10-22-2021

Google Image Date: 11/2020

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 4 (Google Maps)

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021**

Camera Location 4: After

Google Image Date: 08/2021

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 4 (Google Maps)

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-22-2021**

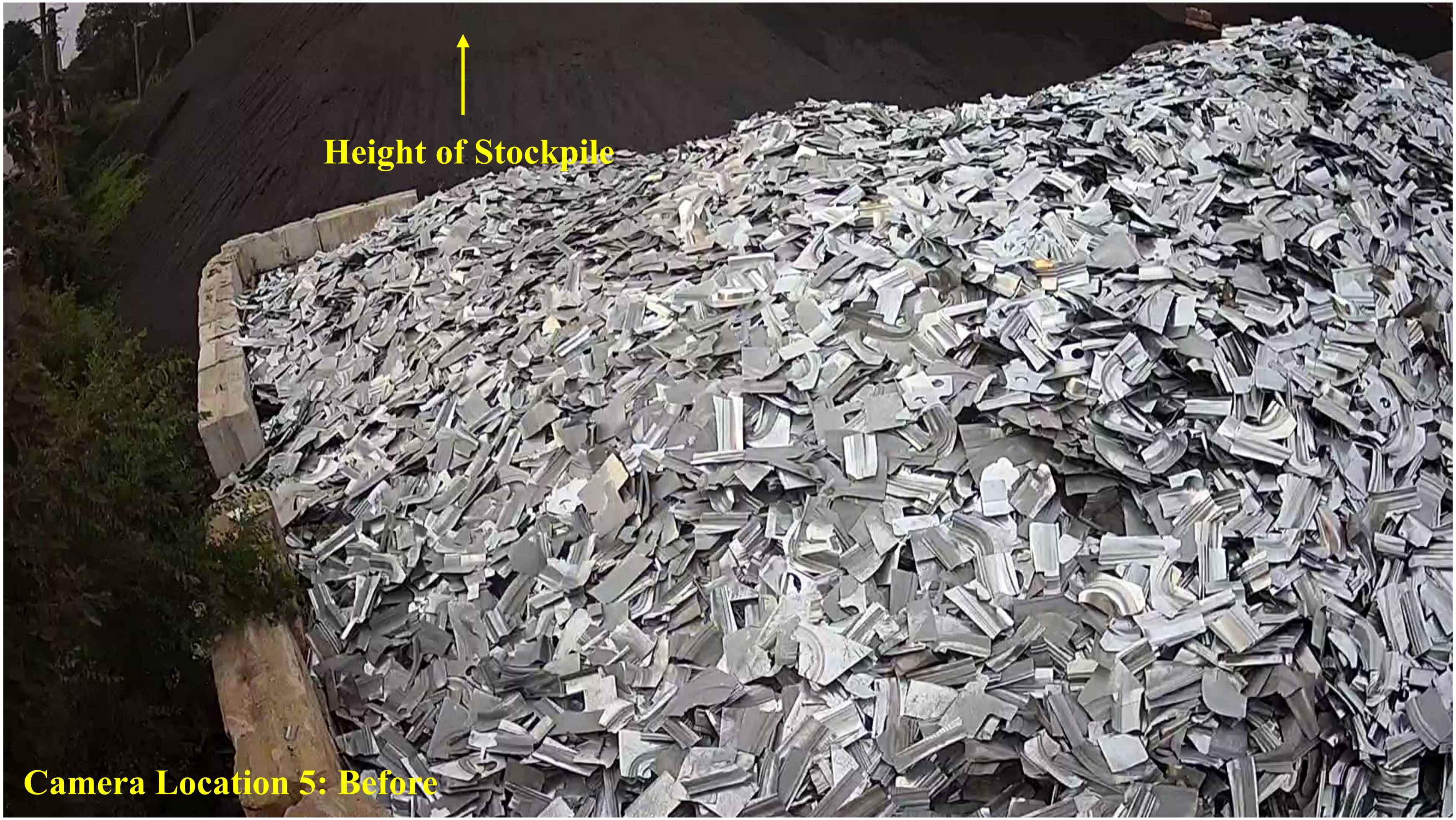


Image Date: 9-11-2021 at 6.59 PM

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 4 (Google Maps)

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

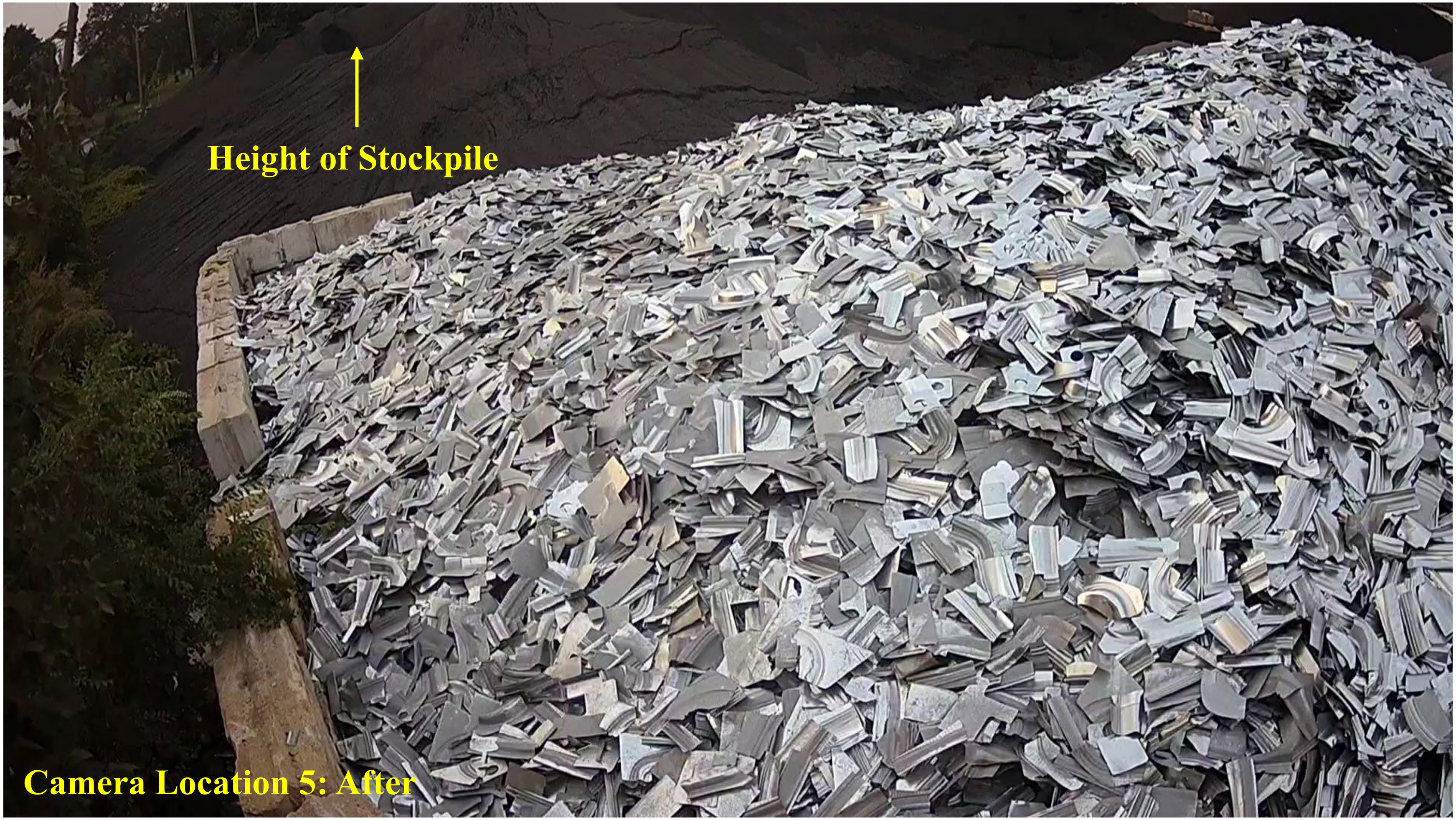


Image Date: 9-11-2021 at 7:46 PM

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: Camera Location 4 (Google Maps)

SCALE: Not applicable

Figure 3: Various Vantage Points
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

FIGURE 4

PROJECT SITE PROGRESSION FROM 2017 TO 2021

Image Date: 04-17-2017

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 04-18-2017

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021** **Page: 2**

Image Date: 10-02-2017

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021**

Image Date: 11-24-2017

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021**

Image Date: 11-28-2017

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable
SOURCE: nearmap, 2021
SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021** **Page: 5**

Image Date: 03-22-2018

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021** **Page: 6**

Image Date: 07-11-2018

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 07-17-2018

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 10-25-2018

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable
SOURCE: nearmap, 2021
SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021**

Image Date: 03-25-2019

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 06-22-2019

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 09-19-2019

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 03-07-2020

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 07-10-2020

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable
SOURCE: nearmap, 2021
SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 09-19-2020

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 03-12-2021

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021**

Image Date: 07-04-2021

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Image Date: 09-06-2021

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable
SOURCE: nearmap, 2021
SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

Somat Project No.: 2019086E **Date: 10-20-2021**

Image Date: 09-24-2021

Somat Engineering, Inc.
3031 West Grand Boulevard, Suite 228
Detroit, MI 48202
Phone: (313) 963-2721

LEGEND: Not applicable

SOURCE: nearmap, 2021

SCALE: As Noted

Figure 4: Project Site Progression from 2017 to 2021
Ground Upheaval - Dearborn Street at Fort Street, Detroit, Michigan

FIGURE 5

TOPOGRAPHIC MAP OF PROJECT SITE
FROM
OCTOBER 9, 2021
SEPTEMBER 17, 2021
SEPTEMBER 14, 2021
2017

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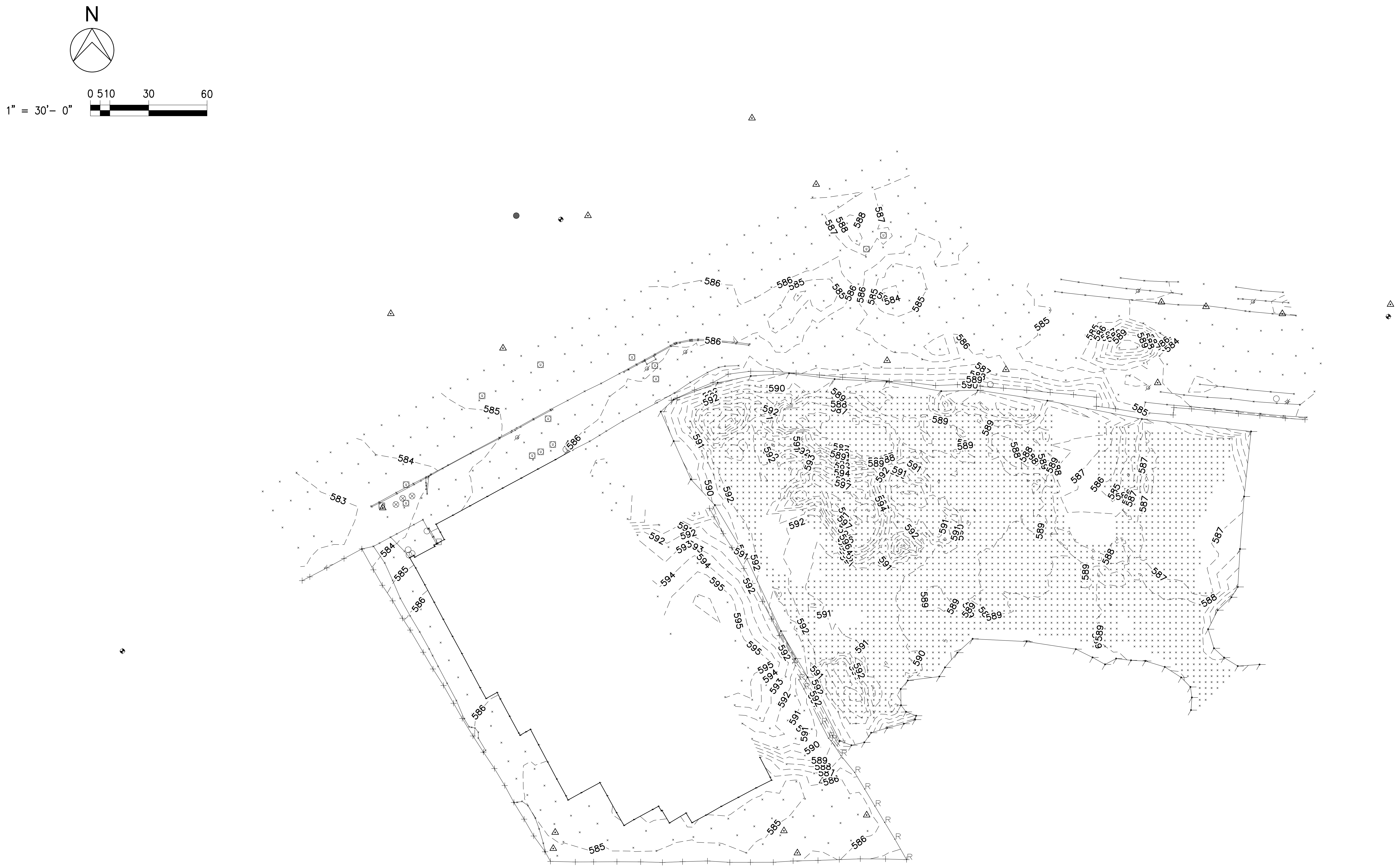
Zoneske, Jaime N



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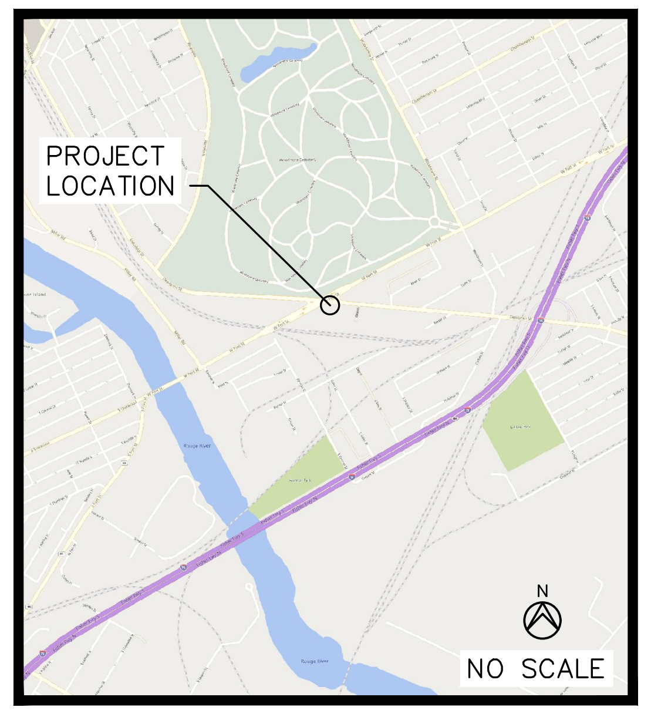

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DEPARTMENT OF PUBLIC WORKS

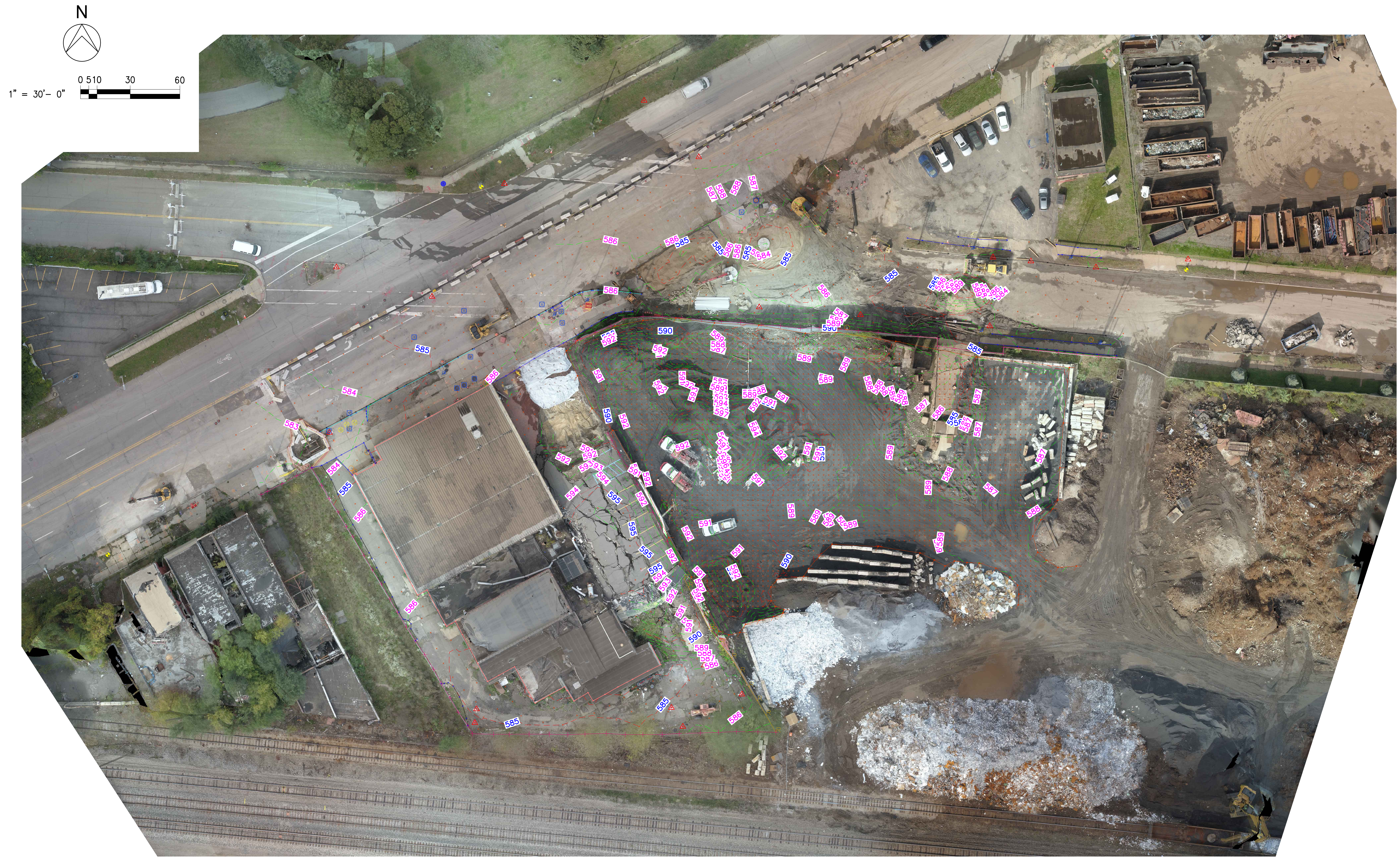
DEARBORN STREET GEOTECH AND SURVEY

OCTOBER 9, 2021

LiDAR RECORD SURVEY

HRC JOB NO.	SCALE
20190113	1" = 30'–0"
DATE	SHEET NO.
October 2021	1 OF 4

ORIGINAL PLOT SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)



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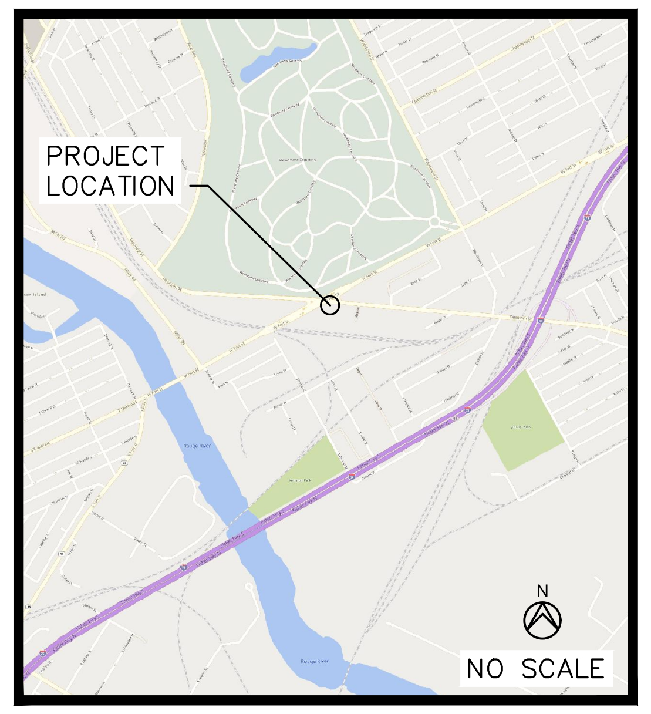

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DEARBORN STREET
GEOTECH AND SURVEY

OCTOBER 9, 2021

LiDAR RECORD SURVEY

HRC JOB NO.	SCALE
20190113	1" = 30'-0"
DATE October 2021	SHEET NO. 2 OF 4

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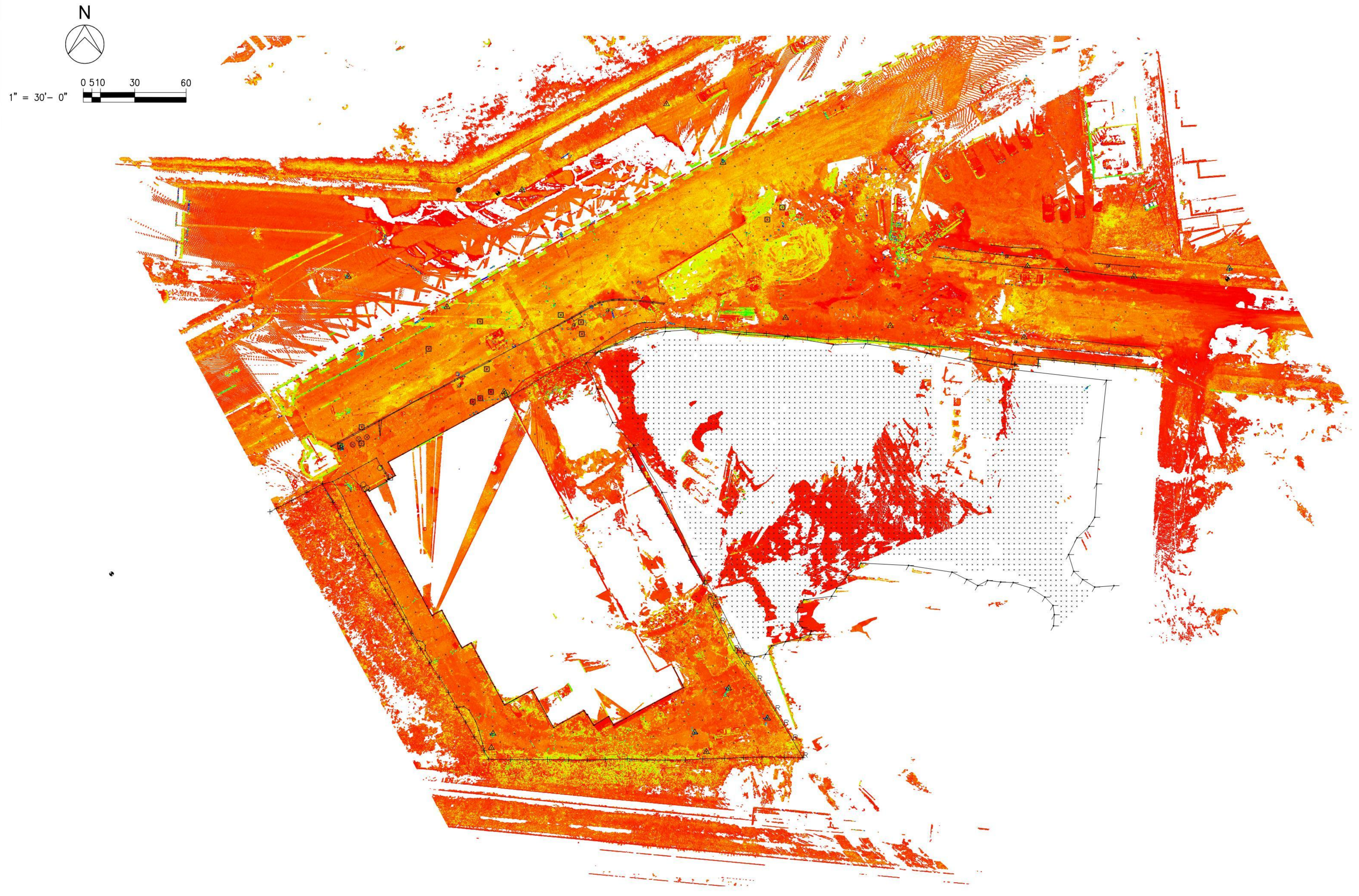
Zaneske, Jaime N



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592.00	597.00	🟦
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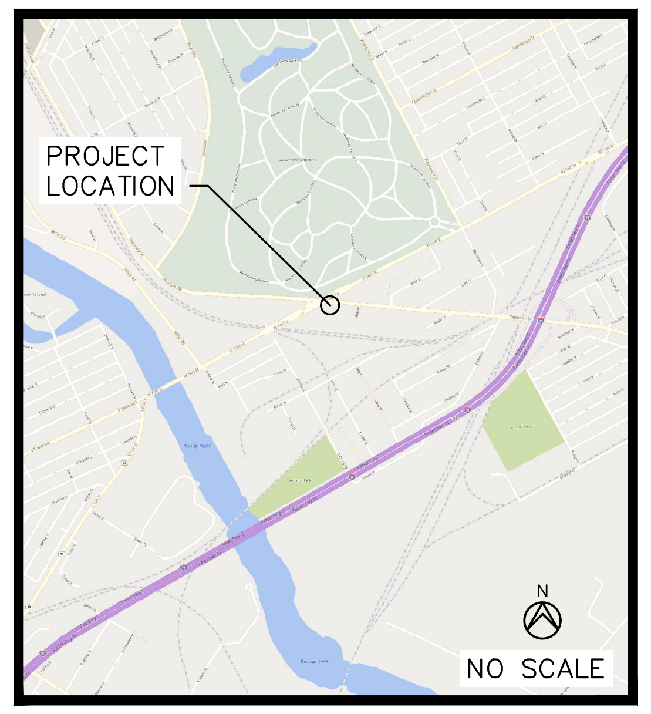

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OCTOBER 9, 2021

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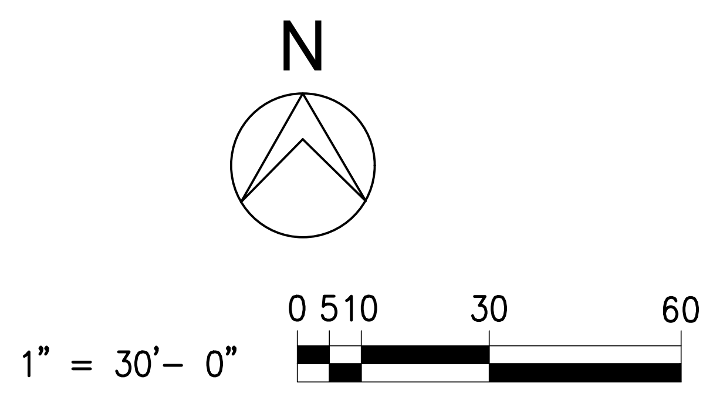

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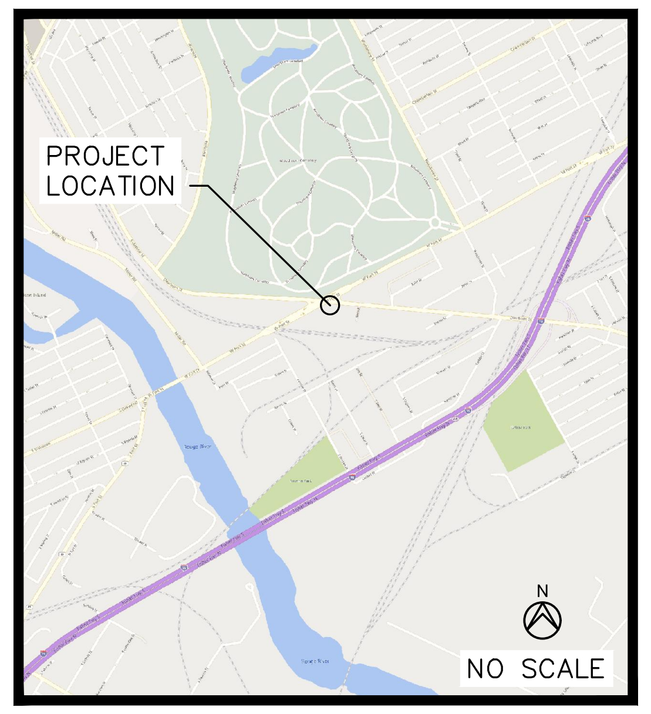

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SEPTEMBER 17, 2021

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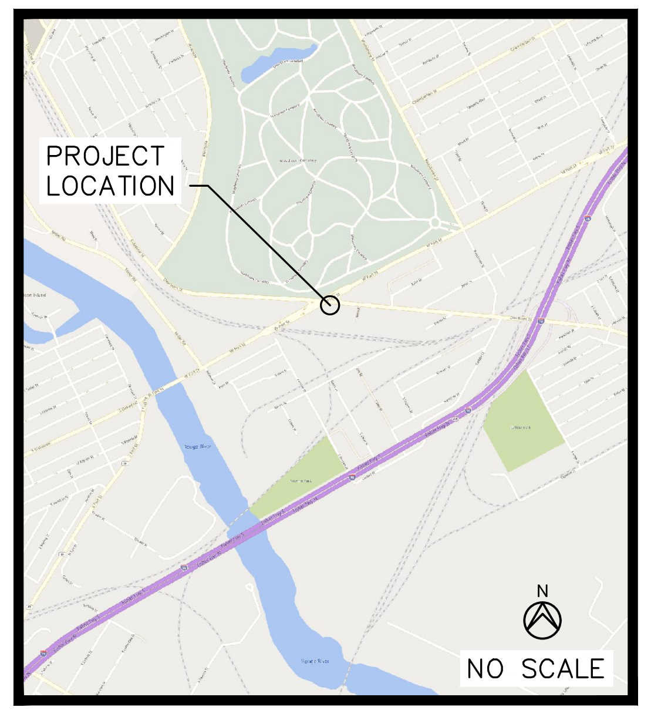

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GEOTECH AND SURVEY

SEPTEMBER 17, 2021

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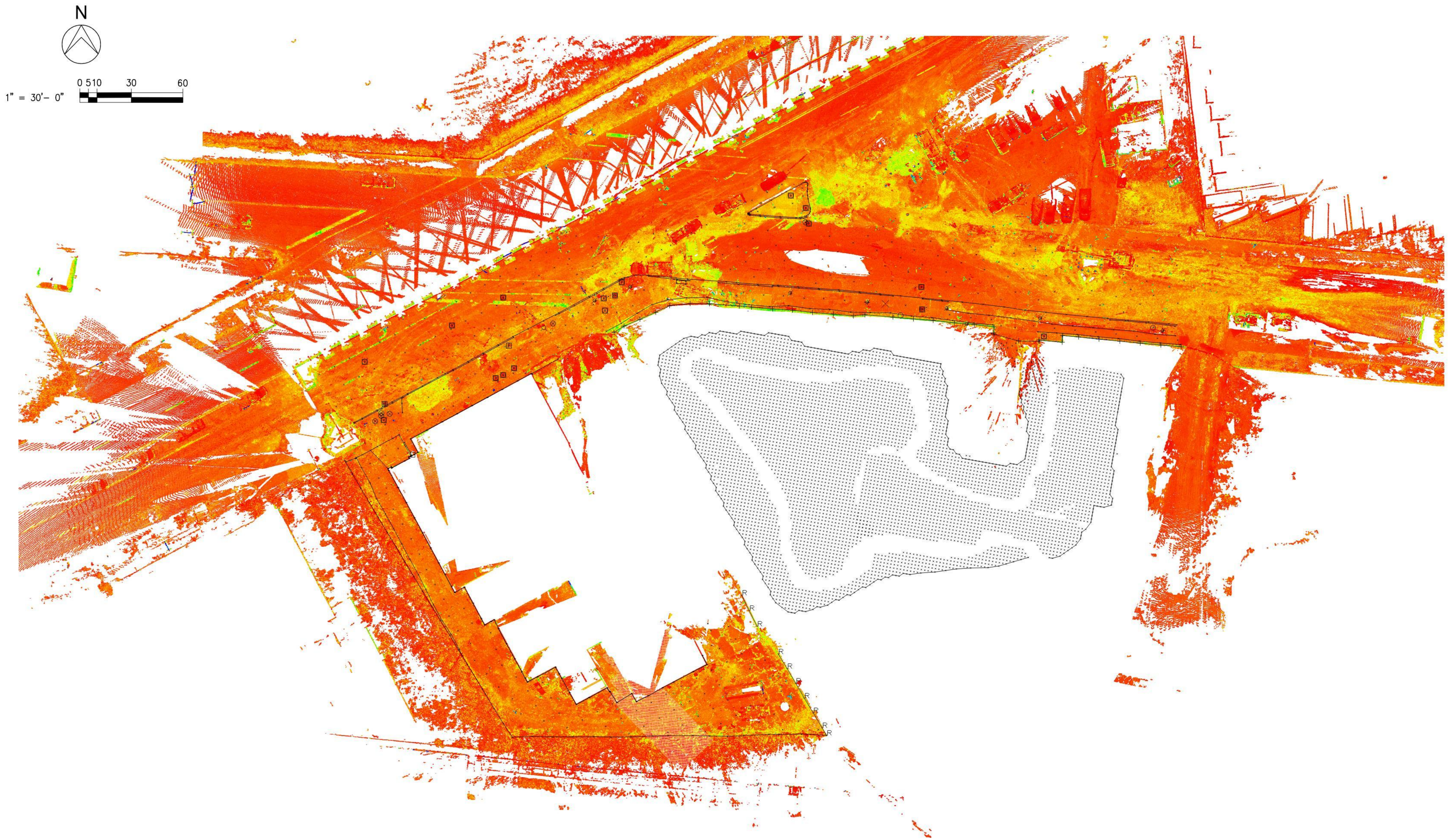

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SEPTEMBER 17, 2021

LiDAR RECORD SURVEY

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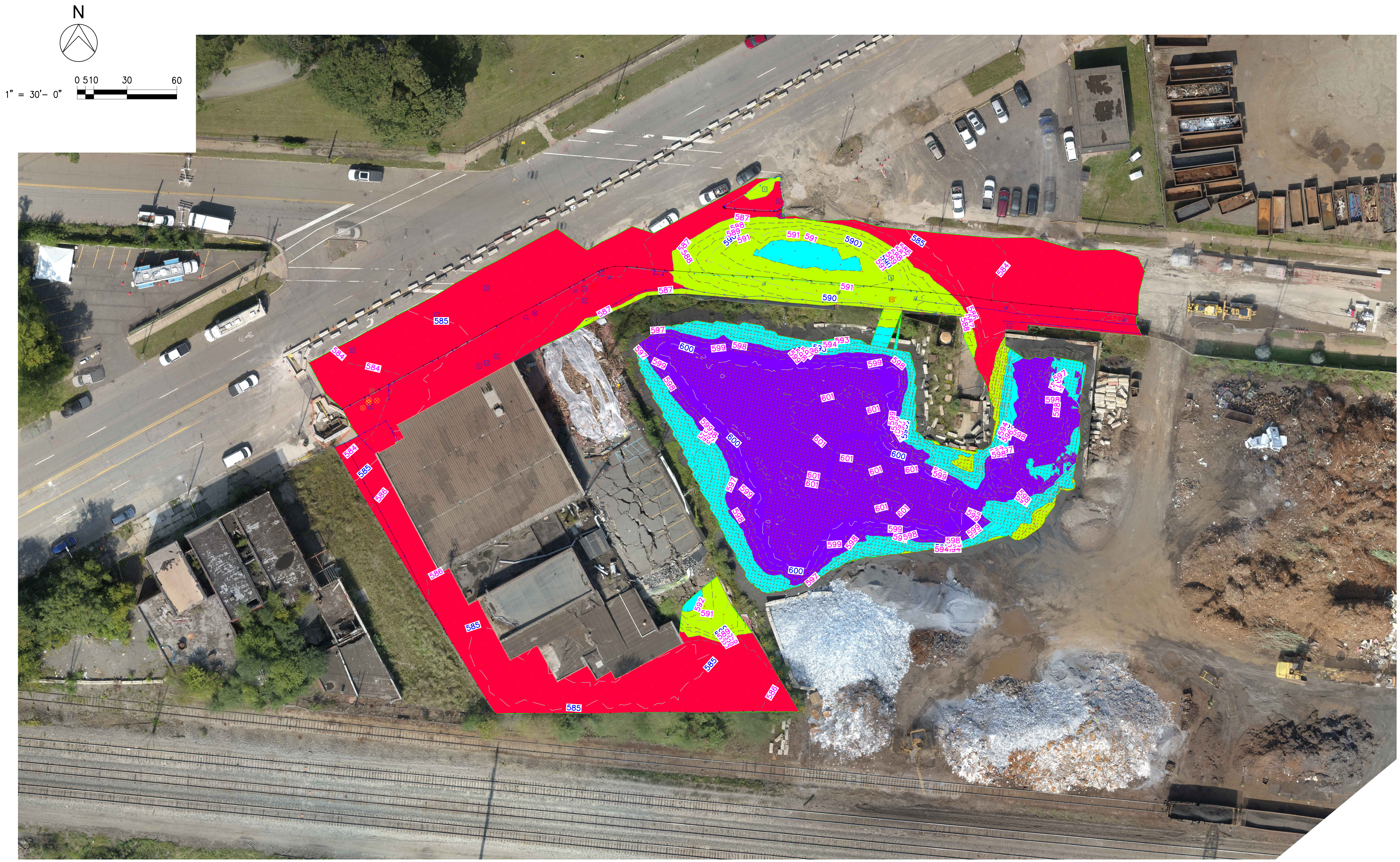

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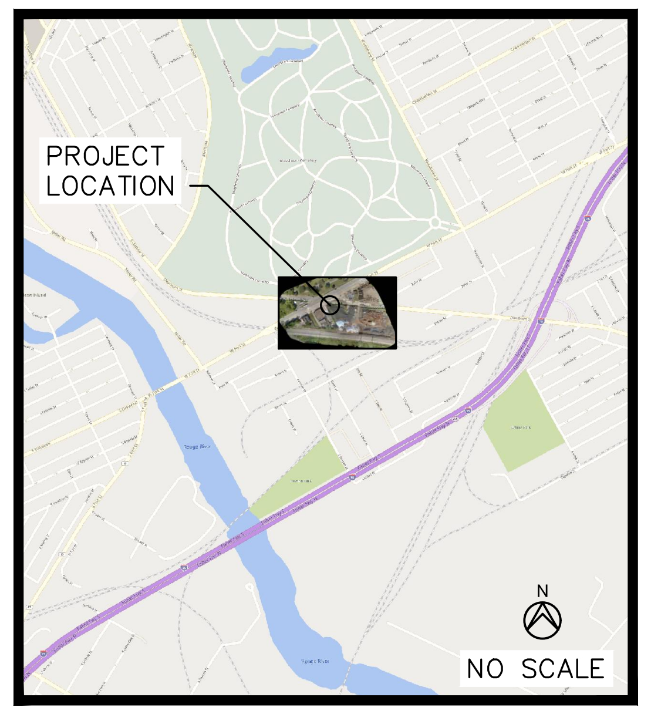

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DEARBORN STREET GEOTECH AND SURVEY

SEPTEMBER 17, 2021

LiDAR RECORD SURVEY

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612.00	617.00	🟪

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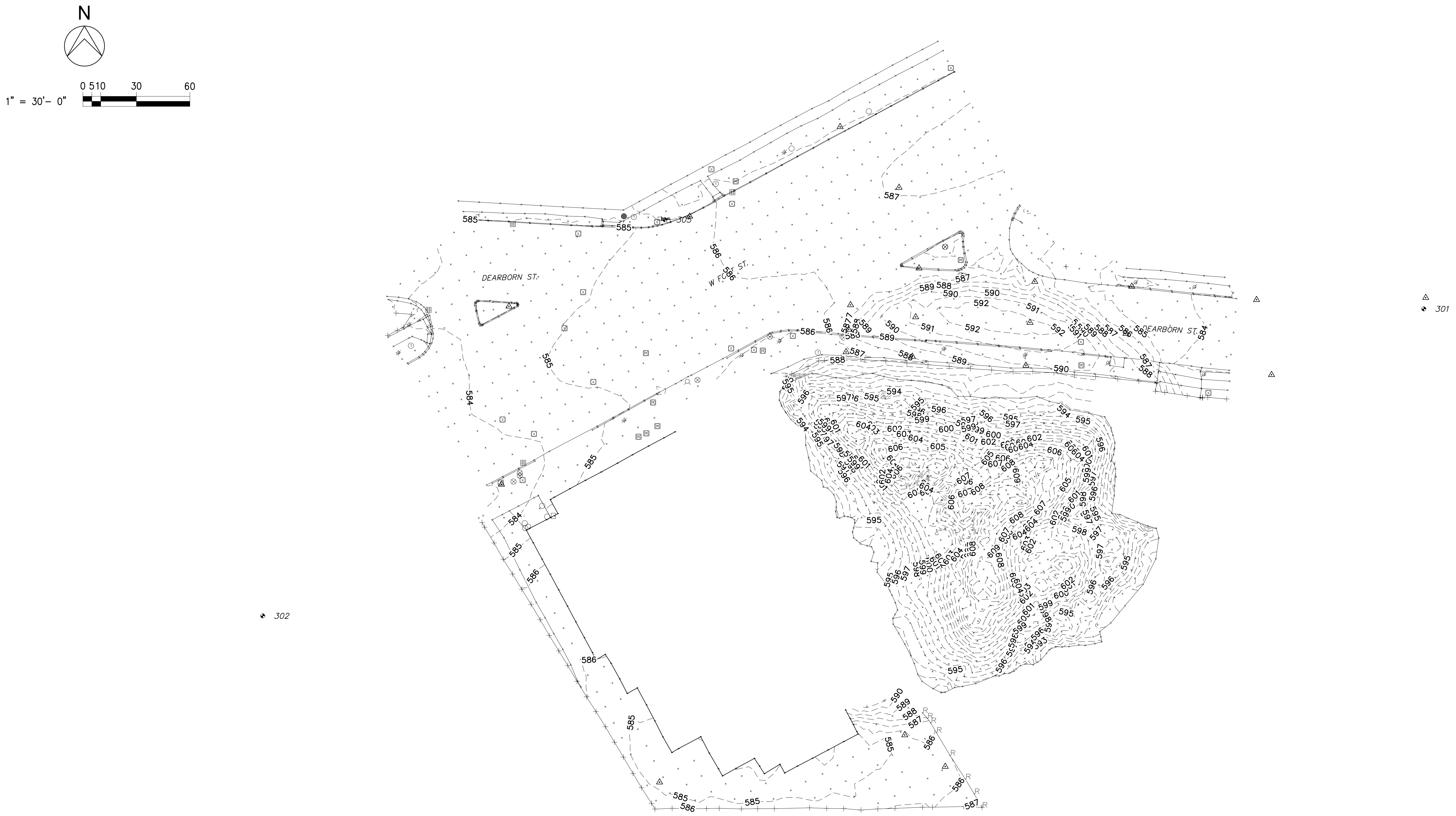

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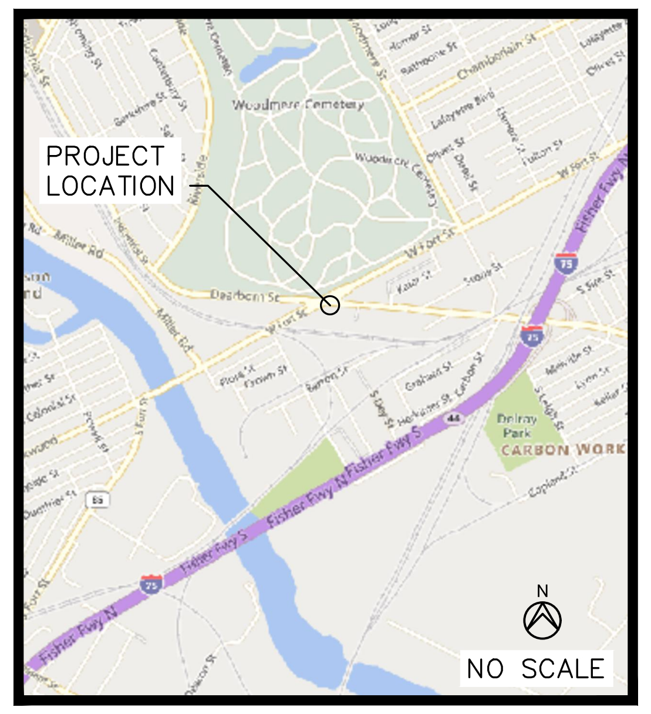

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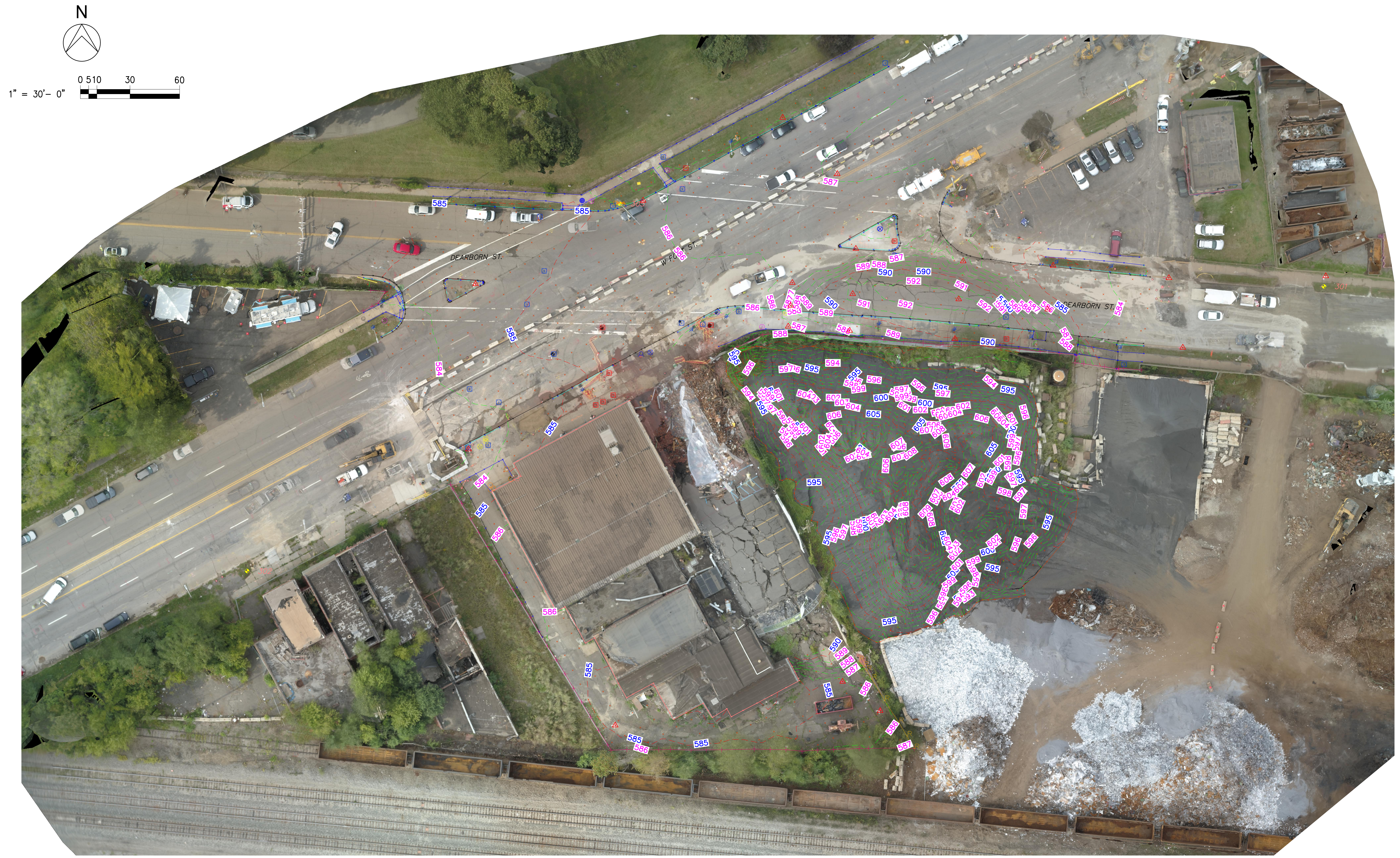
Zaneske, Jaime N



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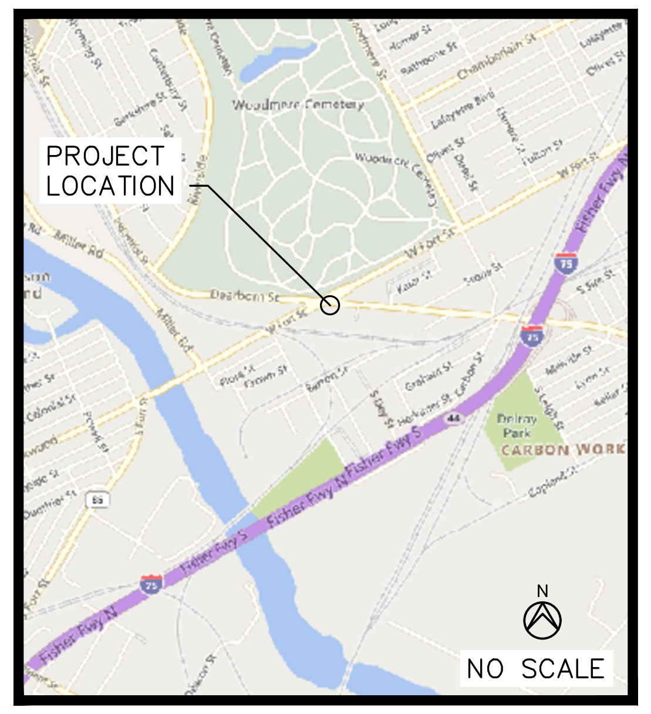

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DEARBORN STREET GEOTECH AND SURVEY

SEPTEMBER 14, 2021

LiDAR RECORD SURVEY

HRC JOB NO.	SCALE
20190113	1" = 30'–0"
DATE October 2021	SHEET NO. 2 OF 4

ORIGINAL PLOT SIZE: ANSI FULL BLEED D (34.00 X 22.00 INCHES)

10/28/2021 9:22 AM

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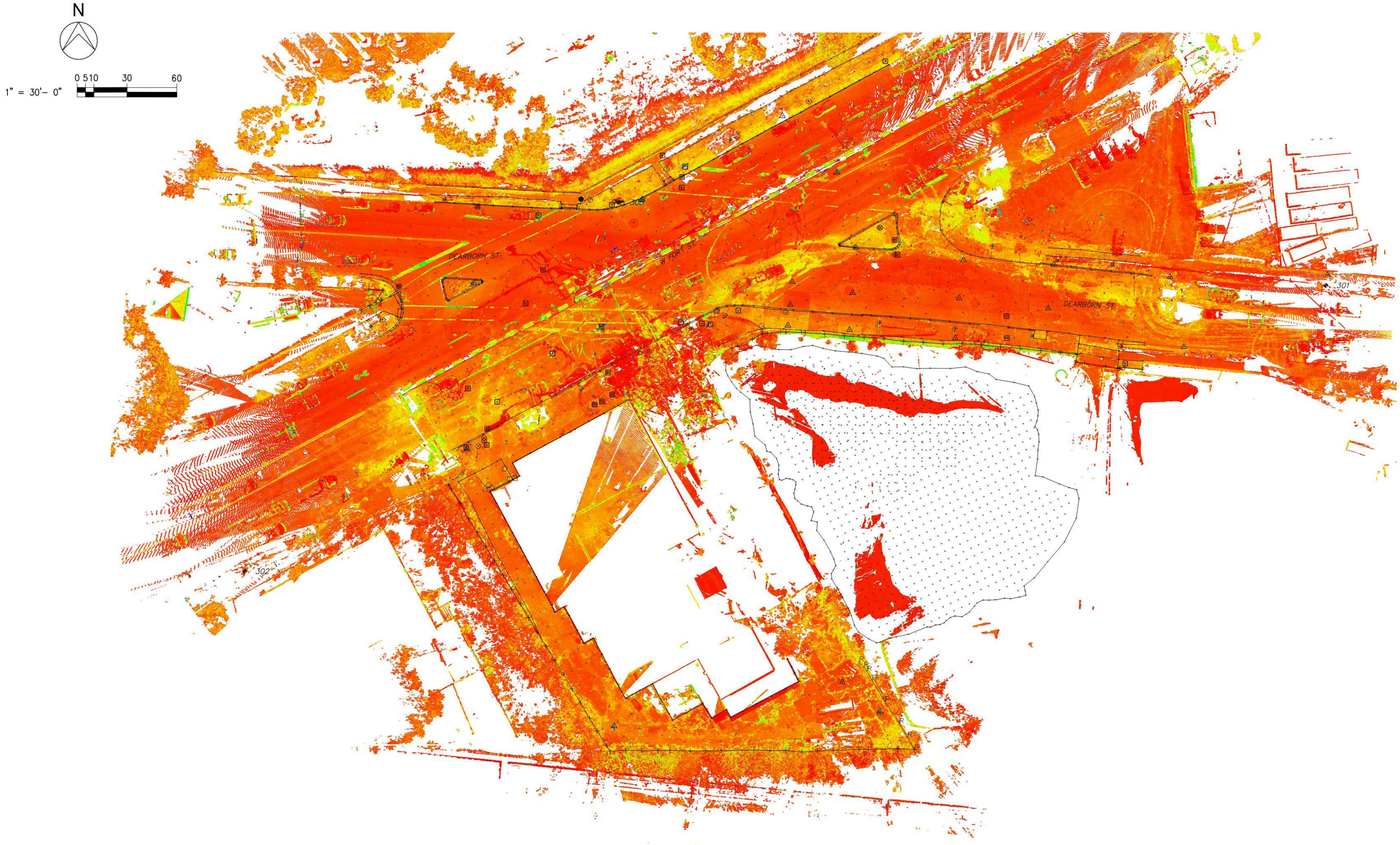
Zaneske, Jaime N



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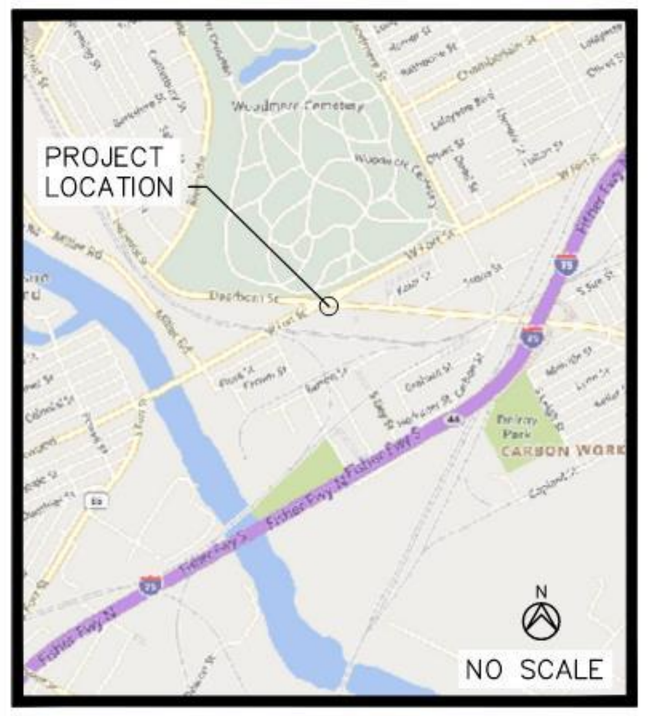

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DEARBORN STREET GEOTECH AND SURVEY

SEPTEMBER 14, 2021

LiDAR RECORD SURVEY

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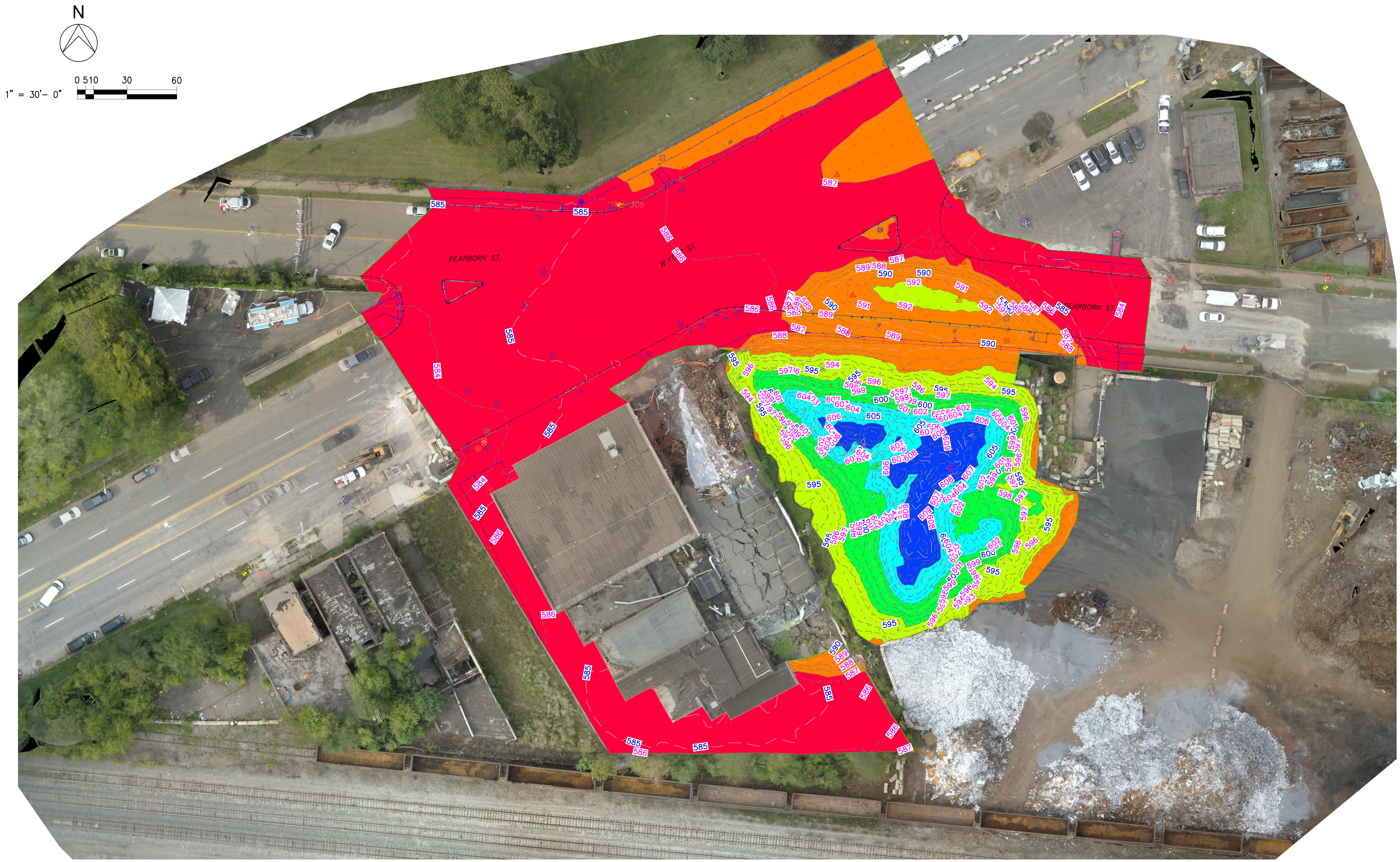

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587.00	592.00	🟨
592.00	597.00	🟩
597.00	602.00	🟦
602.00	607.00	🟦
612.00	617.00	🟪

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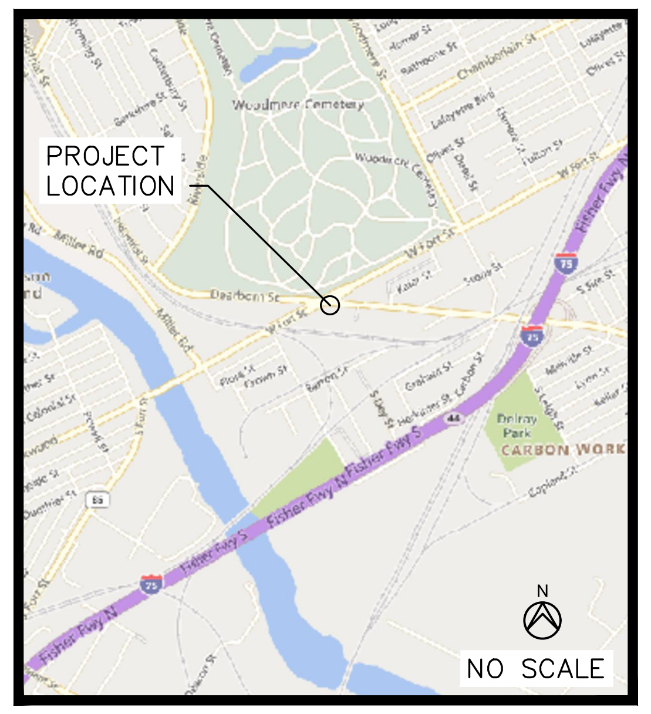

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DEARBORN STREET GEOTECH AND SURVEY

SEPTEMBER 14, 2021

LiDAR RECORD SURVEY

HRC JOB NO. 20190113
SCALE 1" = 30'-0"
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SHEET NO. 4 OF 4

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Roth, Scott

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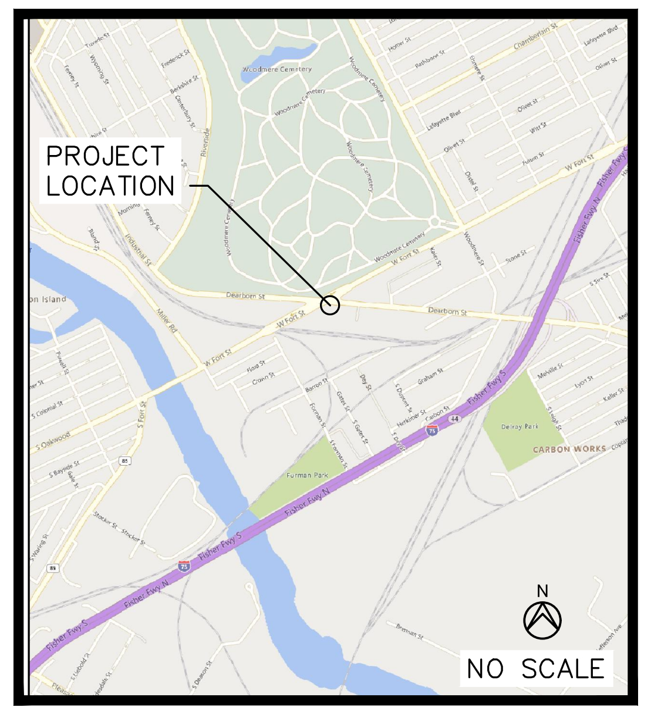

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DEARBORN STREET GEOTECH AND SURVEY

2017

USGS LiDAR SURVEY

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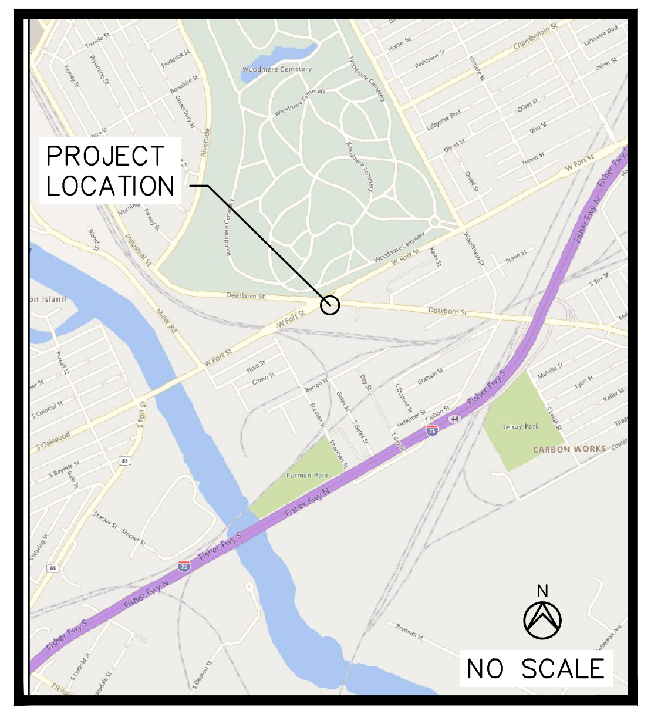

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DEARBORN STREET
GEOTECH AND SURVEY

2017

USGS LiDAR SURVEY

HRC JOB NO. 20190113	SCALE 1" = 30'-0"
DATE October 31, 2021	SHEET NO. 2 OF 4

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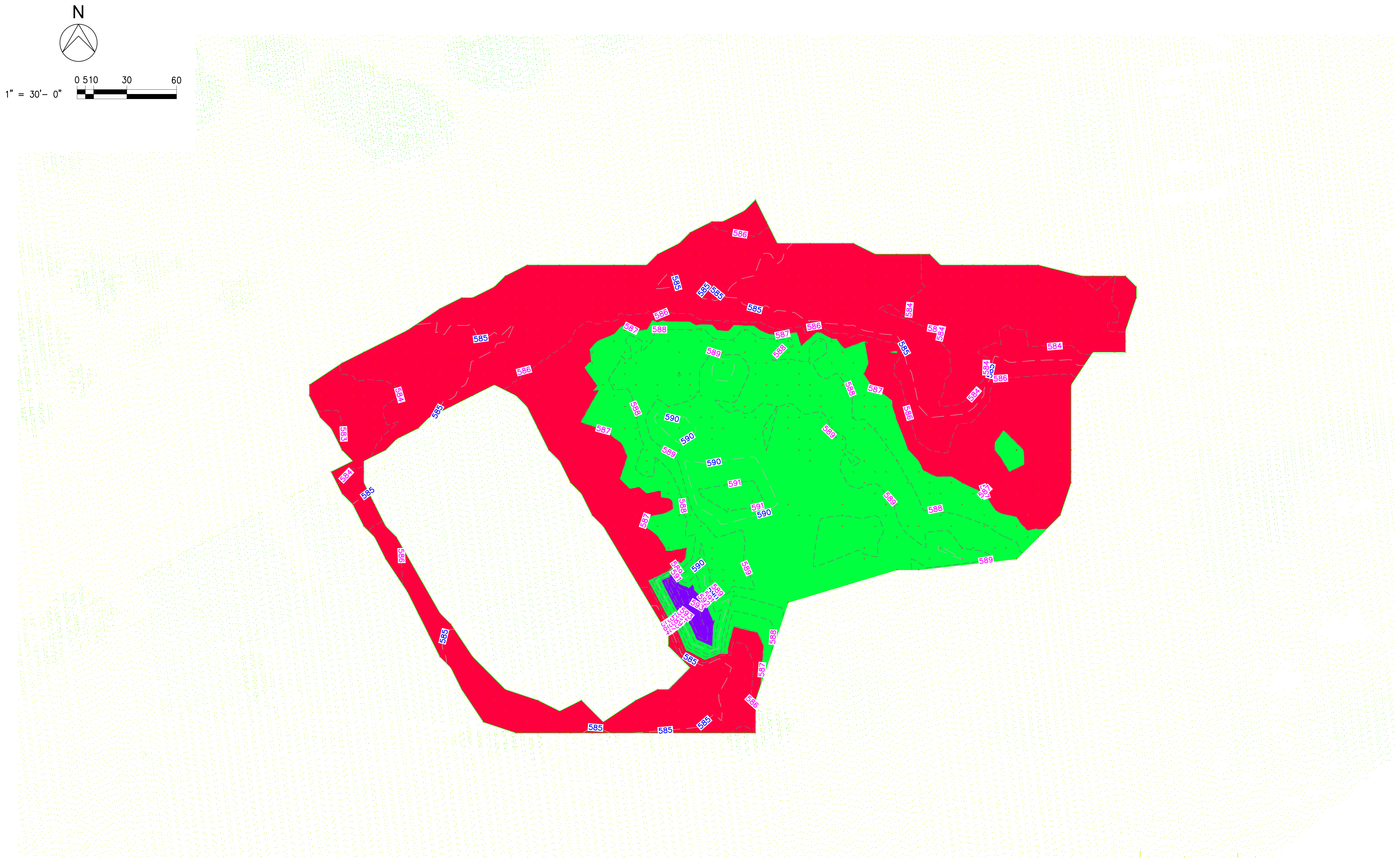

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587.00	592.00	🟩
592.00	597.00	🟪

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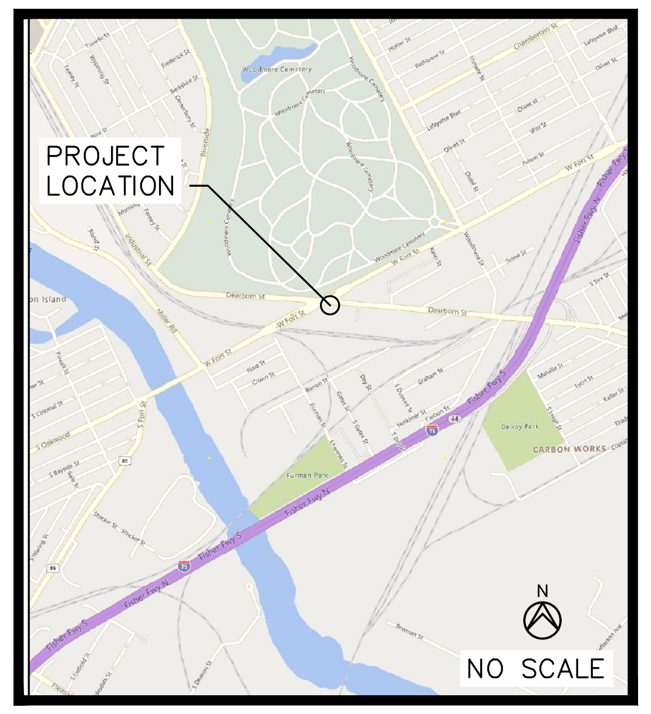

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DEARBORN STREET
GEOTECH AND SURVEY

2017

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DATE October 31, 2021
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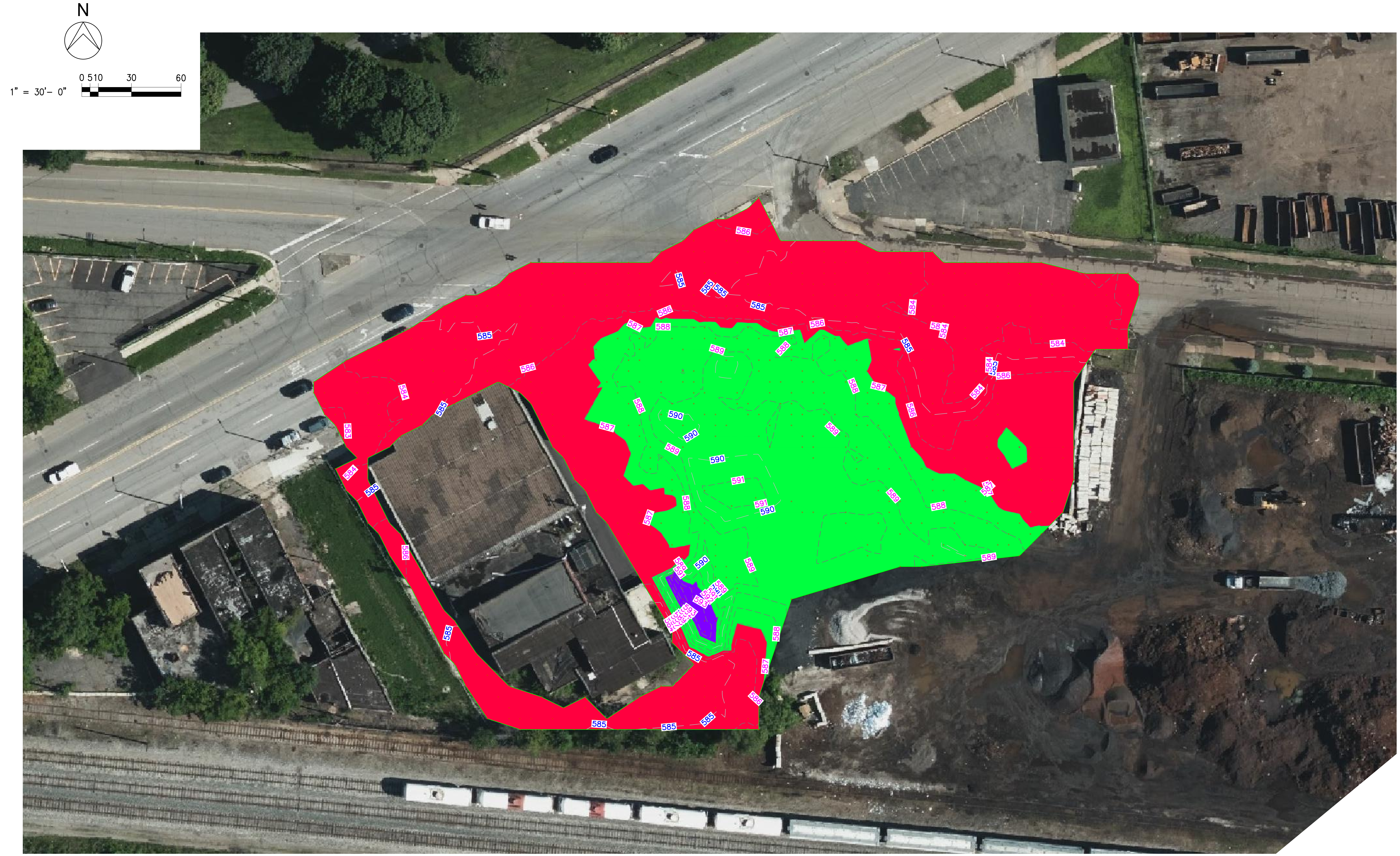

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587.00	592.00	🟩
592.00	597.00	🟪

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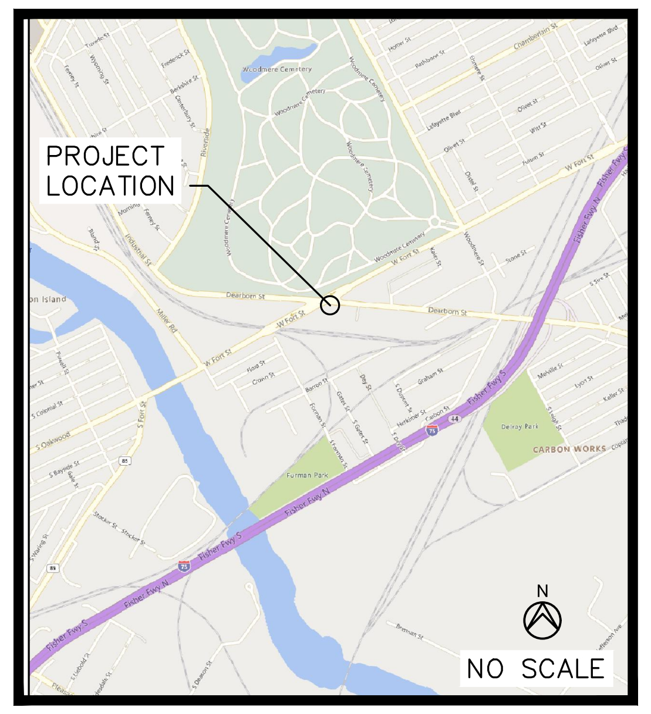

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DEARBORN STREET GEOTECH AND SURVEY

2017

USGS LiDAR SURVEY

HRC JOB NO.
20190113

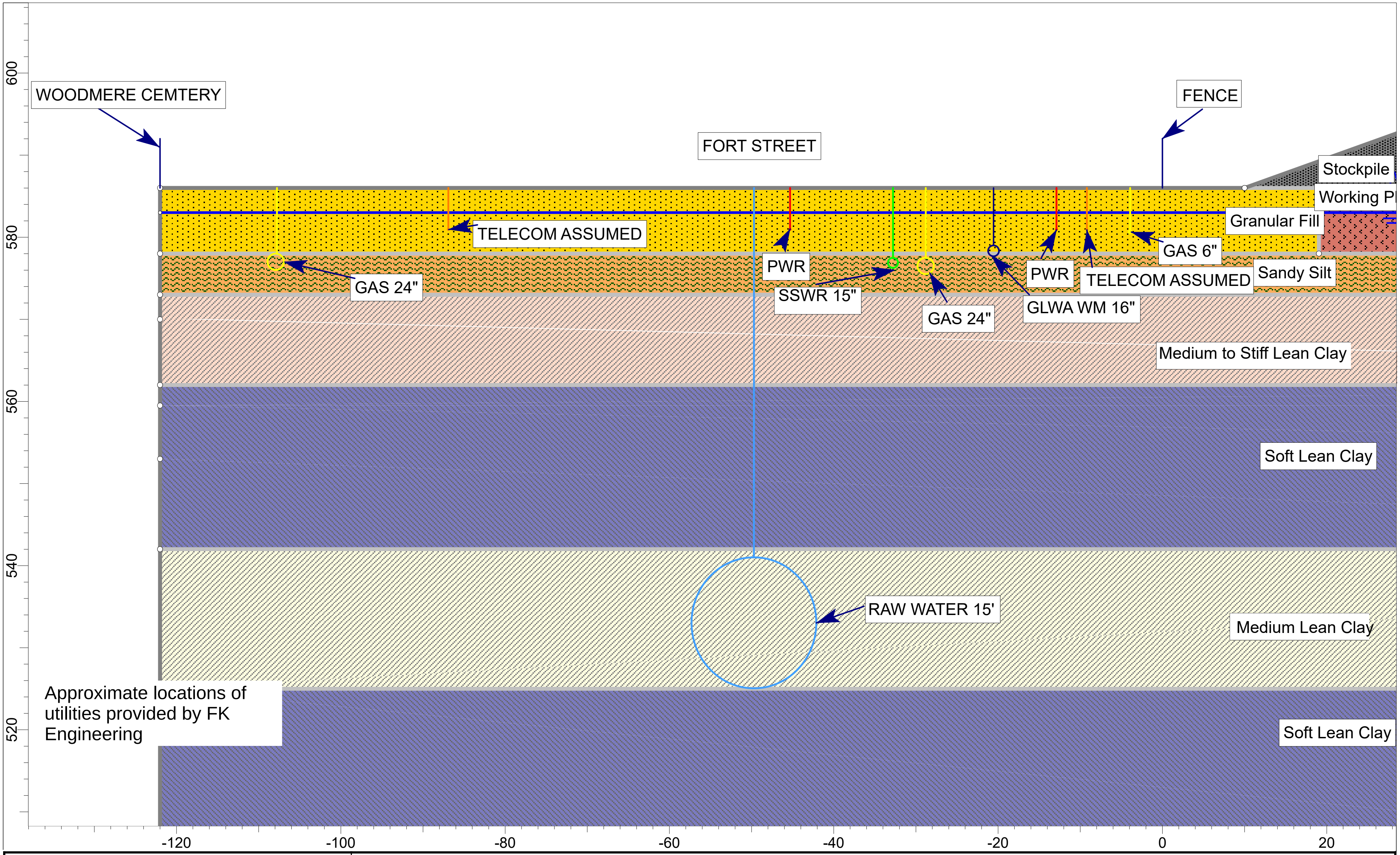
SCALE
1" = 30'–0"

DATE
October 31, 2021

SHEET NO.
4
OF 4

FIGURE 6

SOIL AND UTILITY PROFILE



Approximate locations of utilities provided by FK Engineering

Somat Engineering, INCORPORATED

SLIDE 9.010

Project	Ground Upheaval - Fort Street at Dearborn Street		
Analysis Description	Preliminary - Boring B-02 through Fort Street - Cross Section.		
	AA	*Company*	Somat Engineering, Inc
	11/23/2021	*File Name*	Fort Street.slmd

APPENDIX A

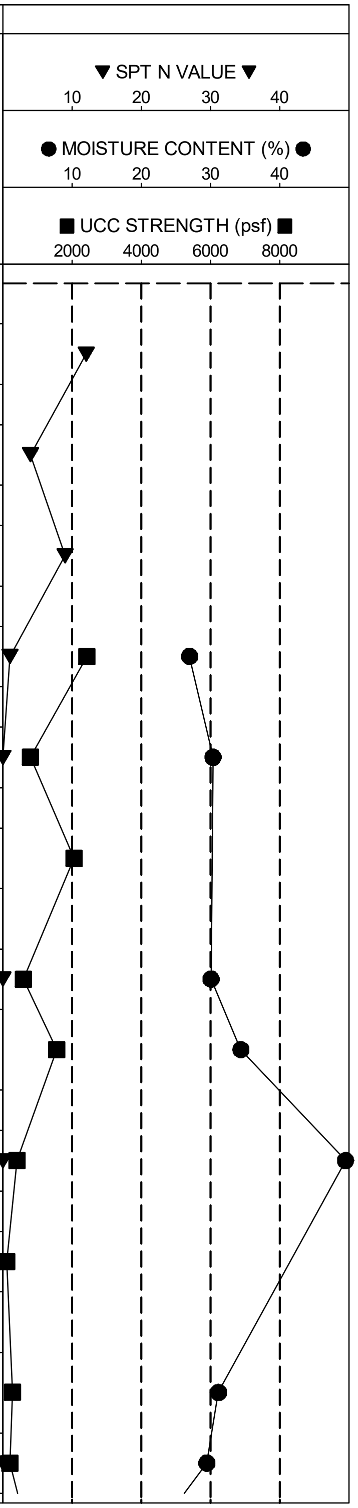
CURRENT SOIL INVESTIGATION TEST BORINGS LOGS, GENERAL NOTES, PIEZOMETER DATA AND SOMAT FIELD OBSERVATION SUMMARY

APPENDIX A-1

SOMAT TEST BORING LOGS AND GENERAL NOTES

PROJECT NO. 2019086E **DATE STARTED:** 9/15/2021 **DATE COMPLETED:** 9/16/2021 **LOG OF TEST BORING Somat B-01**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 584.71 ft	0											
584.0	8 inches of ASPHALTIC CEMENT CONCRETE 0.7												
581.2	FILL - Medium dense fine to coarse sand with silt, trace gravel, trace concrete debris, trace glass debris, black, moist (SP-SM) 3.5		SS1	8	8-8-4	12	2.5						
578.7	FILL - Very loose poorly graded fine sand, trace silt, trace gravel, gray with pockets of black, wet (SP) 6.0	5	SS2	4	1-0-4	4	5.0						
576.2	FILL - Loose sandy silt/silty fine sand, trace gravel, gray with pockets of black, wet (ML)/(SM) 8.5		SS3	18	6-5-4	9	7.5						
573.7	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL) 11.0	10	SS4	12	3-1-0	1	10.0	2420	27.0	101			
564.7	Soft to stiff LEAN CLAY, trace sand, trace gravel, occasional silt partings, gray (CL) 20.0		SS5	18	0-0-0	0	12.5	800#	30.4				
		15	VS1				15.0	2050					
			SS6	18	0-0-0	0	18.0	600#	30.1				
		20	ST7	24			20.0	1550	34.4	88	46	25	99
554.7	Very soft LEAN CLAY, trace sand, trace gravel, occasional silt partings, gray (CL) 30.0		SS8	18	0-0-0	0	22.5	400#	49.5				
		25	VS2				25.0	120					
			ST9	24			28.5	280	31.1	92			
		30	SS10	18	0-0-0	0	30.0	200#	29.5				



GROUNDWATER READINGS

First Encountered: 3.5 feet
Upon Completion: n/a

BORING LOCATION INFORMATION

Northing: 291415.9
Easting: 13456298.9

Coordinates/GSE determined by:
Project Surveyor

KEY

\# Torvane
* Penetrometer
<> Disturbed Sample

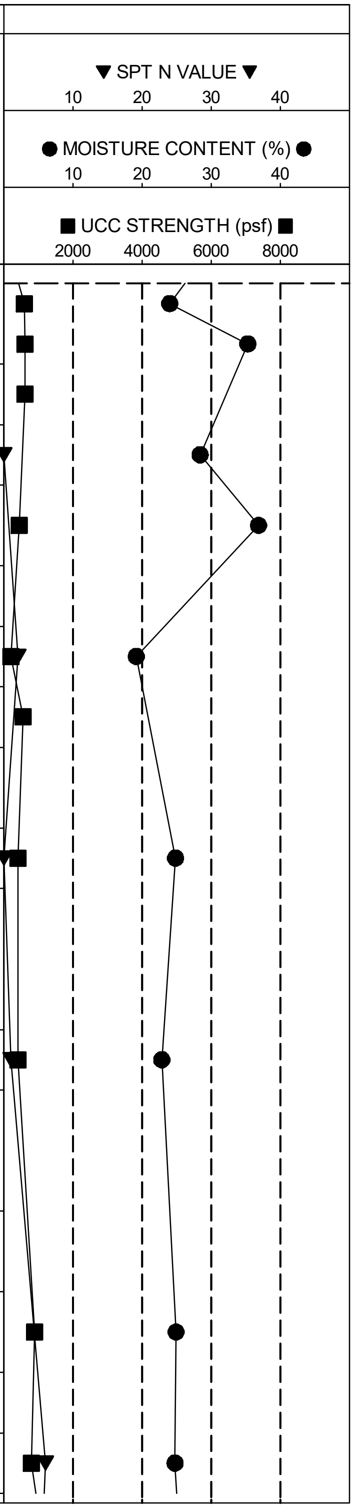
Drilling Company: DLZ American Drilling
Drill Rig: Geoprobe 3126GT
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Temporary Inclinometer
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

PROJECT NO. 2019086E **DATE STARTED:** 9/15/2021 **DATE COMPLETED:** 9/16/2021 **LOG OF TEST BORING Somat B-01**

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 584.71 ft	30											
			ST11	24			32.0	590 620	24.0 35.3	100 92	37 36	20 19	93
			VS3				33.5	620					
	Soft to very soft LEAN CLAY, trace sand, trace gravel, occasional silt partings, gray (CL)		SS12	18	0-0-0	0	35.0	<>	28.4				
		35	ST13	24			37.0	440	36.8	86			
546.7		38.0											
	Very soft LEAN CLAY, few sand, trace gravel, gray (CL)		SS14	18	0-0-2	2	40.0	200#	19.2				
544.7		40.0											
		40	VS4				41.5	560					
	NOTE: Field Engineer reported difficulty getting inclinometer casing down starting at 45 ft., final depth of casing is 57 ft.		SS15	18	0-0-0	0	45.0	400#	24.8				
		45											
	Very soft to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS16	18	0-0-1	1	50.0	400#	22.8				
		50											
	NOTE: No recovery on ST attempt 53-55 ft.		ST17	0			55.0						
		55	ST18	16			57.0	890	24.9	100			
			SS19	18	0-3-3	6	60.0	800#	24.8				
		60											



GROUNDWATER READINGS
First Encountered: 3.5 feet
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 291415.9
Easting: 13456298.9

Coordinates/GSE determined by:
Project Surveyor

KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

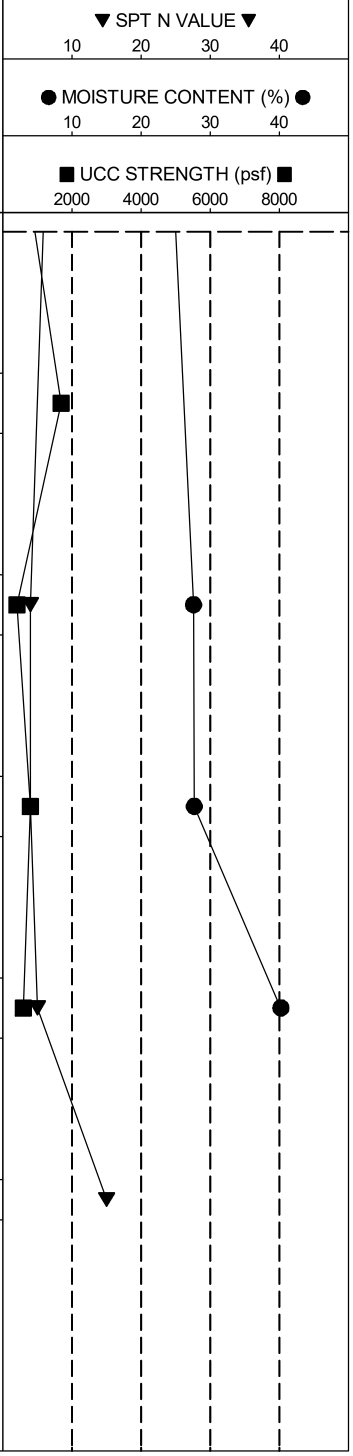
Drilling Company: DLZ American Drilling
Drill Rig: Geoprobe 3126GT
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Temporary Inclinometer
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

PROJECT NO. 2019086E **DATE STARTED:** 9/15/2021 **DATE COMPLETED:** 9/16/2021 **LOG OF TEST BORING Somat B-01**

LOG OF SOIL PROFILE				FIELD DATA					LABORATORY DATA					
ELEVATION ft			DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
		Ground Surface Elevation 584.71 ft												
	▨	Very soft to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	60											
				VS5				65.0	1680					
			65											
				SS20	17	0-2-2	4	70.0	400#	27.6				
			70											
				SS21	18	0-2-2	4	75.0	800#	27.7				
			75											
				SS22	18	1-3-2	5	80.0	600#	40.2				
504.7		80.0	80											
	▨	CLAYEY FINE SAND, trace gravel, gray, moist (SC)												
				SS23		7-15	15+	84.5						
500.2		84.5												
		End of Boring at 84.5 feet (Boring terminated on apparent split spoon refusal after 4 blows/0 inches)	85											
			90											



GROUNDWATER READINGS

First Encountered: 3.5 feet
Upon Completion: n/a

BORING LOCATION INFORMATION

Northing: 291415.9
Easting: 13456298.9

Coordinates/GSE determined by:
Project Surveyor

KEY

\# Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: Geoprobe 3126GT
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Temporary Inclinometer
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

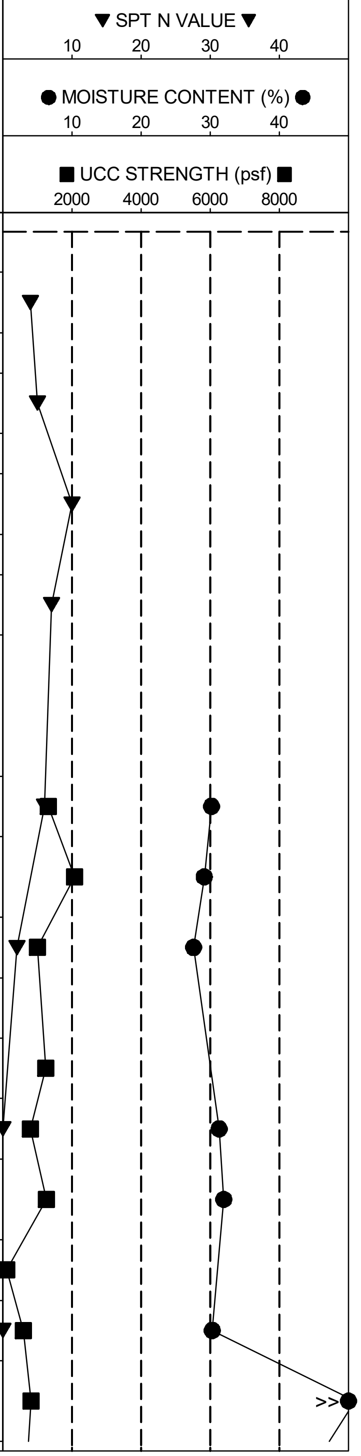
Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

PROJECT NO. 2019086E **DATE STARTED:** 9/17/2021 **DATE COMPLETED:** 9/18/2021 **LOG OF TEST BORING Somat B-02**

LOG OF SOIL PROFILE

ELEVATION ft		Depth (ft)
	Ground Surface Elevation 586.76 ft	0
586.4	4.5 inches of PORTLAND CEMENT CONCRETE	0.4
583.3	FILL - Very loose poorly graded fine sand with silt, few gravel, occasional clay pockets, dark brown, moist (SP-SM)	3.5
580.8	FILL - Loose poorly graded fine sand with silt, trace gravel, brown and dark brown, moist (SP-SM)	6.0
578.8	FILL - Medium dense sandy silt/silty fine sand, brown, wet (ML) (SM)	8.0
573.3	Loose SANDY SILT, gray, wet (ML)	13.5
569.8	Medium to stiff LEAN CLAY, trace sand, trace gravel, frequent silt partings between 15-17 ft., brown-gray (CL)	17.0
561.8	Medium LEAN CLAY, trace sand, trace gravel, occasional silty clay seams, gray (CL) NOTE: Invalid vane shear test from 18-20 ft. NOTE: Soft lean clay layer from 21.5 to 23 ft.	25.0
	NOTE: Field Engineer reported hole squeezing in at about a depth of 25-30 ft., and re-drill with tri-cone bit was necessary to keep the hole open as drilling progressed Very soft to soft LEAN CLAY, trace sand, trace gravel, gray (CL)	30

	FIELD DATA					LABORATORY DATA					
SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)		UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
SS1	3	3-2-2	4	2.5							
SS2	3	2-2-3	5	5.0							
SS3	15	3-4-6	10	7.5							
SS4	18	3-3-4	7	10.0							
SS5	18	2-3-3	6	15.0		1320	30.2	95			
ST6	24			17.0		2080	29.1	97	37	19	
SS7	18	1-1-1	2	18.5		1000#	27.6				
VS1				20.0							
VS2				21.5		1240					
SS8	18	0-0-0	0	23.0		800#	31.3				
ST9	19			25.0		1260	32.0	92	36	18	
VS3				26.5		120					
SS10	18	0-0-0	0	28.0		600#	30.3				
ST11	24			30.0		810	51.0	72	38	21	



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 296134.2
Easting: 13456292.3

Coordinates/GSE determined by:
Project Surveyor

KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

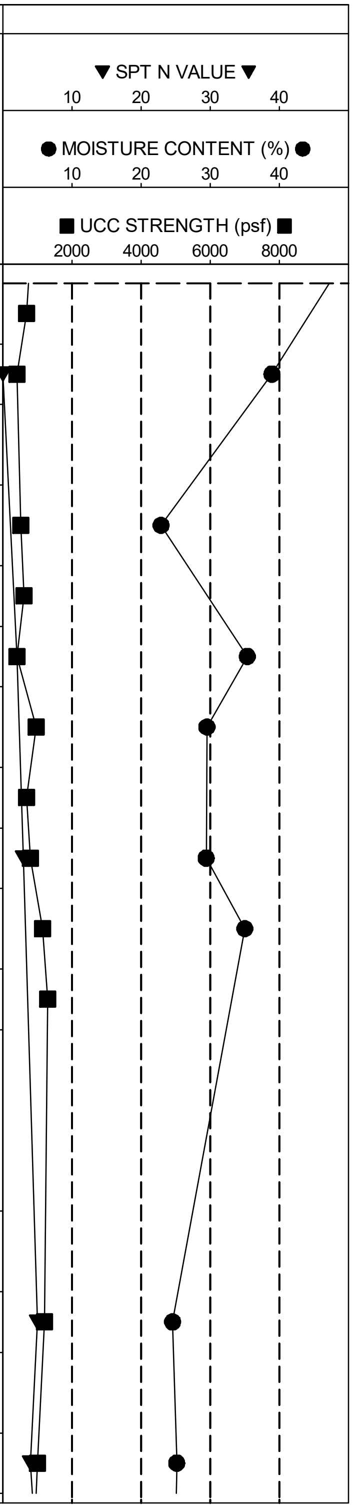
Drilling Company: DLZ American Drilling
Drill Rig: CME 850 ATV (Rig 400472)
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Grout/Asphalt Patch
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

PROJECT NO. 2019086E **DATE STARTED:** 9/17/2021 **DATE COMPLETED:** 9/18/2021 **LOG OF TEST BORING Somat B-02**

LOG OF SOIL PROFILE				FIELD DATA					LABORATORY DATA					
ELEVATION ft			DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
		Ground Surface Elevation 586.76 ft												
	▨		30	VS4				31.5	680					
	▨			SS12	18	0-0-0	0	33.0	400#	38.9				
	▨	NOTE: No recovery on ST attempt 33-35 ft.		ST13	0			35.0						
	▨		35	ST14	24			37.0	520	22.9	102	36	20	
	▨	Very soft to soft LEAN CLAY, trace sand, trace gravel, gray (CL)		VS5				38.5	620					
	▨	NOTE: Driller reported squeezing at 40 ft.		SS15	18	0-0-2	2	40.0	400#	35.4				
	▨		40	ST16	24			42.0	970	29.5	97	49	28	
	▨			VS6				43.5	680					
541.8	▨	45.0		SS17	18	0-1-2	3	45.0	800#	29.4				
539.8	▨	Medium FAT CLAY with sand, trace gravel, gray (CL) 47.0	45	ST18	24			47.0	1150	35.0	100	66	41	72
	▨			VS7				48.5	1300					
	▨		50											
	▨	Medium LEAN CLAY, trace sand, trace gravel, gray (CL) NOTE: No recovery on ST attempt 53-55 ft.		ST19	0			55.0						
	▨		55	SS20	18	0-1-4	5	56.5	1200#	24.6				
	▨													
	▨		60	SS21	18	2-2-2	4	60.0	1000#	25.1		33	16	



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 296134.2
Easting: 13456292.3

Coordinates/GSE determined by:
Project Surveyor

KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

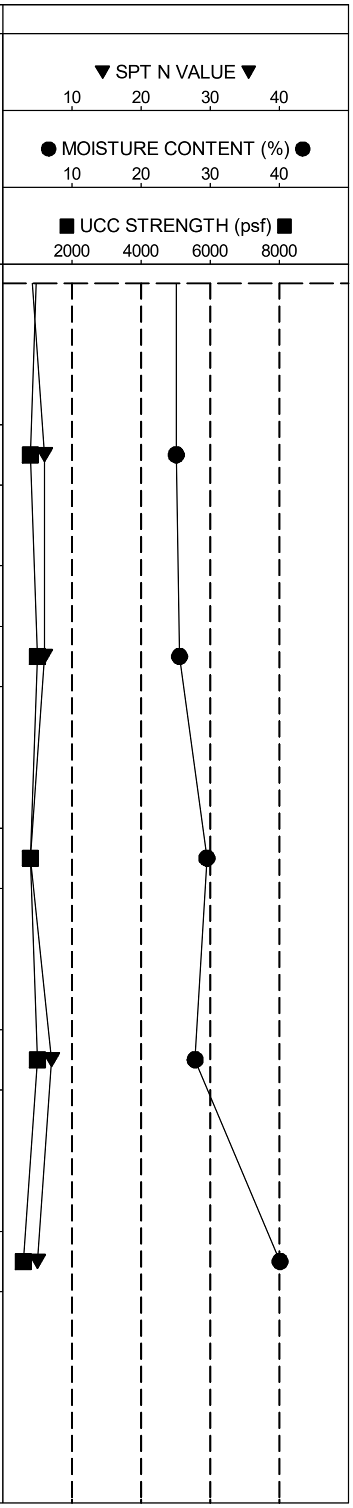
Drilling Company: DLZ American Drilling
Drill Rig: CME 850 ATV (Rig 400472)
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Grout/Asphalt Patch
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

PROJECT NO. 2019086E **DATE STARTED:** 9/17/2021 **DATE COMPLETED:** 9/18/2021 **LOG OF TEST BORING** **Somat B-02**

LOG OF SOIL PROFILE				FIELD DATA					LABORATORY DATA					
ELEVATION ft			DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
		Ground Surface Elevation 586.76 ft	60											
524.8	▨	Medium LEAN CLAY, trace sand, trace gravel, gray (CL)	62.0											
	▨			SS22	18	0-3-3	6	65.0	800#	25.1				
	▨	NOTE: No recovery on ST attempt 65-67 ft.	65	ST23	0			67.0						
	▨			SS24	18	3-3-3	6	70.0	1000#	25.6				
	▨		70											
	▨	Soft to medium LEAN CLAY, trace sand, trace gravel, gray (CL)		SS25	18	1-2-2	4	75.0	800#	29.5				
	▨		75											
	▨			SS26	18	3-3-4	7	80.0	1000#	27.8				
	▨		80											
501.8	▨		85.0	SS27	18	3-2-3	5	85.0	600#	40.1				
		End of Boring at 85 feet	85											
			90											



GROUNDWATER READINGS
First Encountered: 6 feet
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 296134.2
Easting: 13456292.3

Coordinates/GSE determined by:
Project Surveyor

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 850 ATV (Rig 400472)
Logged By: R. Calkins
Drilling Method: 3 1/4 inch HSA/3 7/8 inch WR
Method Notes: ---
Hammer Type: Automatic
Backfilled With: Grout/Asphalt Patch
Checked By: ALOG
QA/QC By: CRH
Remarks:

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2488 (Modified)

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1 3/8″ I.D., 2″ O.D. (standard)
S :	Split Spoon – non-standard size, as noted
ST:	Thin-Walled Tube – 3″ O.D., (unless otherwise noted)
LS:	Liner Sample
PA:	Power Auger
HA:	Hand Auger
AU:	Auger Sample
BS:	Bulk Sample
HSA:	Hollow Stem Auger
DP:	Direct Push

PS:	Piston Sample
PT:	Pitcher Sample
WS:	Wash Sample
RC:	Rock Core with diamond bit, NX size, (unless otherwise noted)
RB:	Rock Bit/Roller Bit
WR:	Wash Rotary
NR:	No Recovery
VS:	Vane Shear Test

Standard Penetration Test Resistance, N-Value: Sum of 2nd and 3rd 6-inch increments, in blows per foot of a 140-pound hammer falling 30 inches and driving an 18-inch long, 2-inch OD split spoon.

WATER LEVEL MEASUREMENT:

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of a groundwater table. In low permeability soils (clays and silts), the accurate determination of groundwater levels may not be possible with only short-term observations. Groundwater levels at times and locations other than when and where individual borings were performed could vary.

DESCRIPTIVE SOIL CLASSIFICATION:

Soil classification is based on the Unified Soil Classification (USC) System and ASTM Standards D-2487 and D-2488. Coarse-grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are generally described as: clays, if they are plastic, and silts, if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their apparent in-place density and fine-grained soils on the basis of their apparent in-place density (silty soils) or consistency (clayey soils).

CONSISTENCIES OF COHESIVE SOILS:

The pocket penetrometer, pocket torvane, and in-situ vane shear test results are converted into an estimated unconfined compressive strength, in pounds per square feet (psf), for presentation on the logs. The unconfined compressive strength is estimated to be about two times the shear strength.

DESCRIPTORS OF MINOR CONSTITUANTS

Primary Constituent	**Fine Grained (Silt & Clay)**	**Coarse Grained (Sand & Gravel)**	
Descriptor of Other Constituents	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**	**Relative Portion of Fine Grained Soils as a % of Dry Weight**	**Relative Portion of Coarse Grained Soils as a % of Dry Weight**
Trace	<5%	<5%	<5%
Few	≥5% - <15%	N/A	≥5% - <15%
With	≥15% - <30%	≥5% - 12%	≥15%
Modifier	≥30%	>12%	N/A

FINE-GRAINED SOILS

COARSE-GRAINED SOILS

Unconfined Compressive Strength Qu, psf	**Consistency**	**N-Value**	**Apparent Density**
< 500	Very Soft	0 – 4	Very Loose
500 - <1,000	Soft	5 – 9	Loose
1,000 - <2,000	Medium	10 – 29	Medium Dense
2,000 - <4,000	Stiff	30 – 49	Dense
4,000 - <8,000	Very Stiff	50 – 80	Very Dense
≥ 8,000	Hard	>80	Extremely Dense

DEFINITIONS OF PAVEMENT CONDITION

Condition		**Description**
Good	ACC	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks and Transverse cracks (open ¼ inch). No patching or very few patches in excellent condition.
	PCC	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (¼ inch wide) longitudinal or transverse joints.
Fair	ACC	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½ inch deep or less).
	PCC	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (½ inch with fair ride. Several slabs have multiple transverse or meander cracks with moderate spalling.
Poor	ACC	Alligator cracking (over 25% of surface). Severe distortions (over 2 inches deep) Extensive patching in poor condition. Potholes.
	PCC	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements or frost heaves.

DEFINITIONS OF STRUCTURAL AND DEPOSITIONAL FEATURES

Term	**Definition**
Parting	≤ 1/16 inch (1.6 mm) thick
Seam	> 1/16 inch (1.6 mm) → ½ inch (12.7 mm) thick
Layer	> ½ inch (12.7 mm) to ≤ 12 inches (305 mm) thick
Pocket	Small, erratic deposits of limited lateral extent
Lens	Lenticular deposit
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Varved	Alternating partings or seams (1 mm – 12 mm) of silt and/or clay and sometimes fine sand
Stratified	Alternating layers of varying material or color with layers ≥ 6 mm thick
Laminated	Alternating layers of varying material or color with layers < 6 mm thick
Fissured	Contains shears or separations along planes of weakness
Slickensided	Shear planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Homogeneous	Same color and appearance throughout
Occasional	One or less per foot (305 mm) of thickness
Frequent	More than one per foot (305 mm) of thickness
Interbedded	Applied to strata of soil lying between or alternating with other strata of a different nature

GRAIN SIZE TERMINOLOGY

Major Component of Sample	**Size Range**
Boulders	≥ 12″ (300 mm)
Cobbles	< 12″ - 3″ (300 mm – 75 mm)
Gravel - Coarse	< 3″ - ¾″ (75 mm – 19 mm)
Gravel – Fine	< ¾″ - #4 (19 mm – 4.75 mm)
Sand – Coarse	< #4 - #10 (4.75 mm – 2 mm)
Sand – Medium	< #10 - #40 (2 mm - 0.425 mm)
Sand – Fine	< #40 - #200 (0.425 mm -0 .074 mm)
Silt	< 0.074 mm - 0.005 mm
Clay	<0 .005 mm

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
COARSE-GRAINED More than 50 % retained on No. 200 sieve	**Gravels** (More than 50 % of coarse fraction retained on No. 4 sieve)	**Clean Gravels**	Cu ≥ 4 and 1 ≤ Cc ≤ 3[D]	GW	Well-graded gravel [E]
		(Less than 5% fines [C])	Cu < 4 and/or [Cc < 1 or Cc > 3][D]	GP	Poorly graded gravel [E]
		Gravels with Fines	Fines classify as ML or MH	GM	Silty gravel [E,F,G]
		(More than 12 % fines [C])	Fines classify as CL or CH	GC	Clayey gravel [E,F,G]
	Sands (50 % or more of coarse fraction passes No. 4 sieve)	**Clean Sands**	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [D]	SW	Well-graded sand [I]
		(Less than 5 % fines [H])	Cu < 6 and/or [Cc < 1 or Cc > 3] [D]	SP	Poorly graded sand [I]
		Sands with Fines	Fines classify as ML or MH	SM	Silty sand [F,G,I]
		(More than 12 % fines [H])	Fines classify as CL or CH	SC	Clayey sand [F,G,I]
FINE-GRAINED SOILS 50 % or more passes the No. 200 sieve	**Silts and Clays** Liquid limit less than 50	**inorganic**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays Liquid limit more than 50	**inorganic**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic silt [K,L,M]
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			Pt	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12 % fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10} \times D_{60})$

[E] If soil contains ≥15 % sand, add "with sand" to group name.

[F] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[G] If fines are organic, add "with organic fines" to group name.

[H] Sands with 5 to 12 % fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[I] If soil contains ≥15 % gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to <30 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥30 % plus No. 200, predominantly sand, add "sand " to group name.

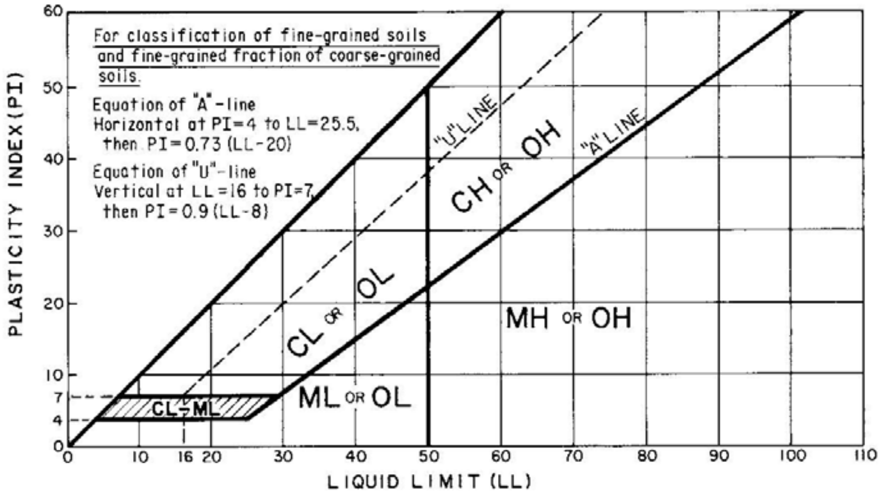
[M] If soil contains ≥30 % plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Order of Classification: 1) Consistency or Apparent Density, 2) Type of Soil, 3) Minor Soil Type(s), 4) Inclusions, 5) Layered Soils, 6) Color, 7) Water Content, 8) USCS Symbol, 9) Geological Name

APPENDIX A-2

SME TEST BORING LOGS, PIEZOMETER DATA AND BORING LOG TERMINOLOGY

10/13/21 2:27:05 PM

SME

DRAFT

BORING DTE-1

PAGE 1 OF 2

BORING DEPTH: 69 FEET

PROJECT NAME: Dearborn Street Heave

PROJECT NUMBER: 087678.00

CLIENT: DTE

PROJECT LOCATION: Detroit, Michigan

DATE STARTED: 9/29/21

COMPLETED: 9/30/21

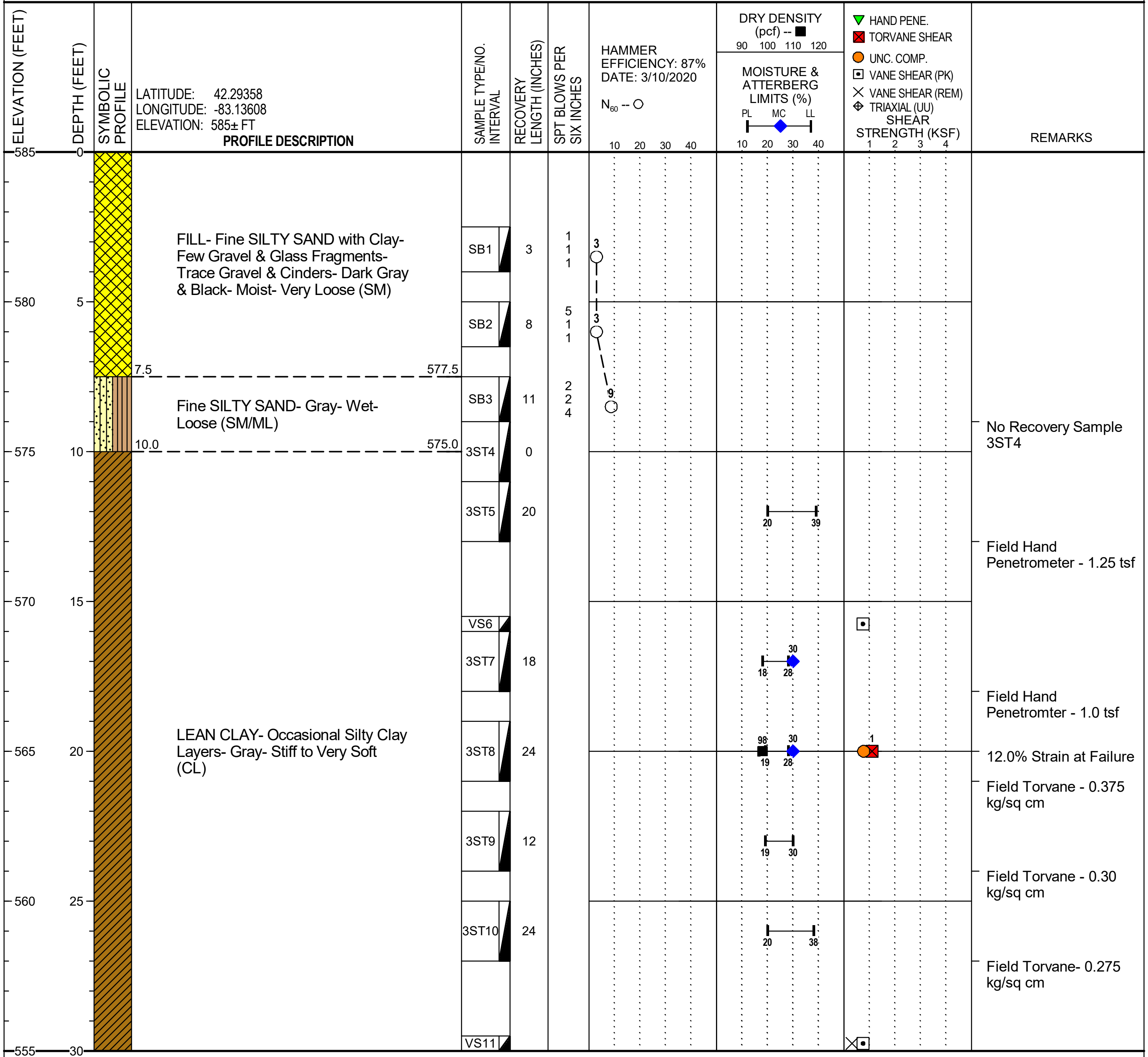
BORING METHOD: Hollow-stem Augers

DRILLER: JR

RIG NO.: 552 (CME 55)

LOGGED BY: PJS

CHECKED BY: LMJ



Depth (ft)	Profile description
0–7.5	FILL- Fine SILTY SAND with Clay- Few Gravel & Glass Fragments- Trace Gravel & Cinders- Dark Gray & Black- Moist- Very Loose (SM)
7.5–10.0	Fine SILTY SAND- Gray- Wet- Loose (SM/ML)
10.0–	LEAN CLAY- Occasional Silty Clay Layers- Gray- Stiff to Very Soft (CL)

SB1	3	1 1 1	
SB2	8	5 1 1	
SB3	11	2 2 4	
3ST4	0		No Recovery Sample 3ST4
3ST5	20		Field Hand Penetrometer - 1.25 tsf
VS6			
3ST7	18		Field Hand Penetromter - 1.0 tsf
3ST8	24		12.0% Strain at Failure
			Field Torvane - 0.375 kg/sq cm
3ST9	12		Field Torvane - 0.30 kg/sq cm
3ST10	24		Field Torvane- 0.275 kg/sq cm
VS11			

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	See Note 4	
▼ **AT END OF BORING:**	See Note 5	

BACKFILL METHOD: See Note 3

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.
3. A bolt on the augers sheared on 9/30/21, resulting in 55 feet of hollow-stem augers remaining in the ground. The augers were retrieved on 10/11/21 and the resulting auger hole grouted with bentonite and cement grout to about 8 feet below the ground surface. The earthwork contractor, DVM, who excavated to allow for auger retrieval, backfilled the resulting excavation to the ground surface with excavated soil.
4. Light perched water was encountered at 7.5 feet (approx. elevation 577.5 feet) during drilling.
5. Due to augers remaining in place after initial drilling, a groundwater level upon completion of drilling is unavailable.
6. 1 kg/sq cm is equal to 1.02 tsf.

(Continued Next Page)

SME

DRAFT

BORING DTE-1

PAGE 2 OF 2

BORING DEPTH: 69 FEET

PROJECT NAME: Dearborn Street Heave

PROJECT NUMBER: 087678.00

CLIENT: DTE

PROJECT LOCATION: Detroit, Michigan

LATITUDE: 42.29358
LONGITUDE: -83.13608
ELEVATION: 585± FT

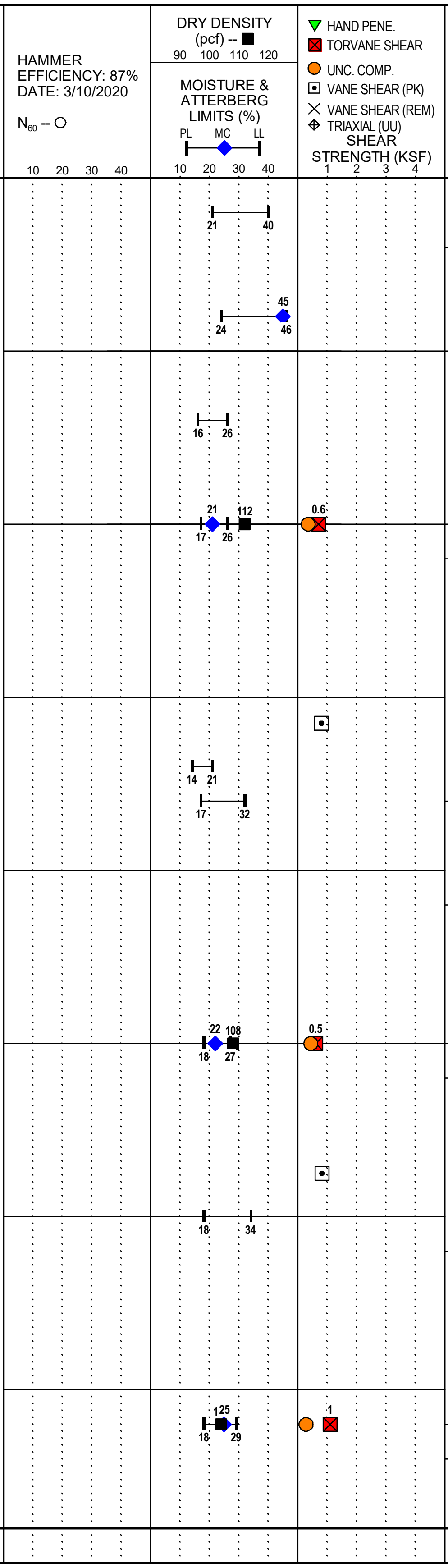
HAMMER EFFICIENCY: 87%
DATE: 3/10/2020
N_{60} -- ○

PROFILE DESCRIPTION

LEAN CLAY- Occasional Silty Clay Layers- Gray- Stiff to Very Soft (CL) *(continued)*

ELEVATION (FEET)	DEPTH (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES	REMARKS
555	30				
		3ST12	24		Field Torvane - 0.20 kg/sq cm
		3ST13	24		
550	35				Field Torvane- 0.175 kg/sq cm
		3ST14	20		
545	40	3ST15	24		14.6% Strain at Failure Field Torvane- 0.275 kg/sq cm
540	45				
		VS16			
		3ST17	24		Field Torvane - 0.40 kg/sq cm
535	50	3ST18	24		Field Torvane - 0.50 kg/sq cm
530	55	3ST19	18		14.9% Strain at Failure Field Torvane - 0.30 kg/sq cm
		VS20			
525	60	3ST21	24		Field Torvane - 0.475 kg/sq cm
520	65				
		3ST22	12		14.4% Strain at Failure Field Torvane- 0.35 kg/sq cm
516.0	69.0				
515	70				

END OF BORING AT 69.0 FEET.



Piezometer Readings
Dearborn Street Heave
Detroit, Michigan

SME Project No. 087678.00

Date	16 ft (psi)	31 ft (psi)
9/30/21	6.98	20.47
10/5/21	7.28	19.35
10/12/21	6.93	19.19

LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX
ASTM D4318 - A

PROJECT: [redacted]
LOCATION:
PROJECT#: 082914.00
DATE: January 15, 2020

DATE OBTAINED: November 7, 2020
SAMPLE NUMBER: SB3
SAMPLE LOCATION: B2
SAMPLE DESCRIPTION: Lean Clay - Gray
TECHNICIAN: Errol Gilbert, CET

TEST METHOD: ASTM D4318
METHOD - A

TEST DATA:

LIQUID LIMIT

Point #:	1	2	3
Wet Wt + Tare, g:	32.07	32.61	33.92
Dry Wt + Tare, g:	28.43	28.61	29.37
Tare Wt.:	19.44	19.43	19.39
Water Content:	40.49	43.57	45.59
Number of Blows:	35	25	19

Water Content corrected for method B:	44

PLASTIC LIMIT TEST

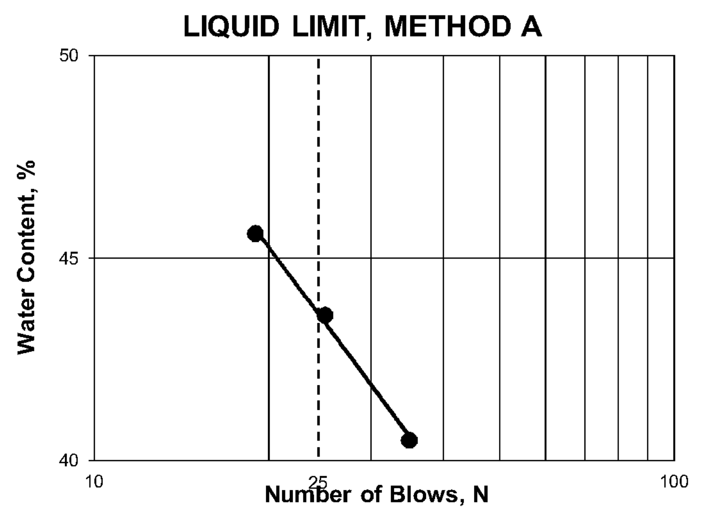
Wet Wt + Tare, g:	24.72	24.85
Dry Wt + Tare, g:	23.76	23.93
Tare Wt, g:	19.45	19.82
Water Content:	22.27	22.38

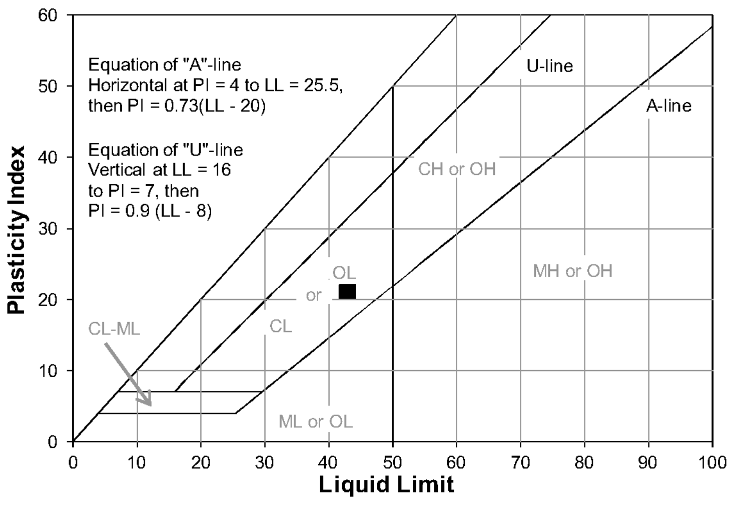
PLASTICITY INDEX

LIQUID LIMIT:	43
PLASTIC LIMIT:	22
PLASTICITY INDEX:	21

CLASSIFICATION: CL

REMARKS: Sample air dried prior to testing





APPENDIX A-3

SOMAT FIELD OBSERVATION SUMMARY

Somat Engineering Field Observation Summary

Driller: TEC – Ian Mickle

Engineer: G2 Consultants – Jeffrey Crow, Mike Dagher, Ethan Talabo

Somat Engineering: Bob Calkins, Jonathan Zaremski, Sankar Swaminathan

TEC_B1 Started 9-19-21 and completed 9-20-21

Approximate Coordinates: 42.293113°, -83.135373° (using phone GPS)

CME-45B drill rig used

Semi continuous split spoon samples to 10 feet. Five-foot split spoon sampling intervals from 10 to 25 feet. Continuous split spoon and Shelby tube sampling started at 25 feet to around 50 feet then switch to standard five-foot sampling intervals to termination depth of 87 feet.

Mill Scale with metal debris encountered to depth of 7.5 feet. Clayey sand with concrete from 7.5 to 10 feet. Moist brown sand, trace clay from 10 to 15 feet. Gray clay at 15 feet, with N values ranging from 0 to 3, extending to about 60 feet. Gray clay continues but with N values from 5 to 6. Field torvanes all about 0.1 to 0.2 tsf. Considerable squeezing of clay soils between 40 and 60 feet.

G2_B1 Started 10-7-21 and completed 10-12-21

Approximate Coordinates: 42.293330°, -83.136111° (using phone GPS)

CME-45B and CME-55 drill rig used

Continuous split spoon, Shelby tube sampling and in-situ vane shear testing

Note: calibration certificate of force gauge from 2003, neither engineer or driller claimed experience performing vane shear test

Mill Scale with metal debris encountered to a depth of 14 feet below grade. Dense mixture of sand, gravel, and asphalt millings from 14 to 23 feet. Silty sand encountered below 14 feet and gray clay at 25 feet. Similar blow counts to Somat and SME borings.

Considerable squeezing of clay soils between 35 and 70 feet. Crew had to use casing to combat the squeezing.

Total depth of 89.5 feet on spoon refusal

G2_B2 Started 10-13-21 and completed 10-18-21

Approximate Coordinates: 42.293522°, -83.135793° (using phone GPS)

CME-45B drill rig used

Continuous split spoon, Shelby tube sampling and in-situ vane shear testing

Notes: TEC used same force gauge as on G2_B1

Mill Scale encountered to a depth of 2 to 3 feet below grade. Dense mixture of sand and gravel with trace metals to 11 feet. Wet silty sand from 11 to 14 feet with gray clay tagged at 14 feet.

Total depth of 90 feet on spoon refusal

G2_B3 Started 10-19-21 and completed 10-20-21

Approximate Coordinates: 42.293494°, -83.135432° (using phone GPS)

CME-45B drill rig used

Brown wet sand encountered at 4 feet, gray silt at 6 feet, and lean clay at 8 feet.

Total depth of 50 feet

APPENDIX B

FIELD TEST RESULTS AND INSTRUMENTATION

APPENDIX B-1

VANE SHEAR TEST RESULTS

FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	Ground Upheaval - Fort Dearborn	**Boring No.**	Somat B-1
Project No.	2019086E	**Depth of Test Point**	15.0 ft.
Date:	15-Sep-21	**Ground Surface Elevation**	584.7 ft.
Client:	City of Detroit	**Elevation of Test Point**	569.7 ft.
Drilling Company:	DLZ-American		
Driller:	V. Dearing		

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	25	5 °	8
10 °	33	10 °	9
15 °	30	15 °	9
20 °	27	20 °	9
25 °	26	25 °	9
30 °	25	30 °	.
35 °	24	35 °	
40 °	24	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	33	9	
Applied Torque (in-lbs)	396	108	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	1026	280	= Applied Torque x Vane Constant
Sensitivity	**3.67** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 15-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-1
Depth of Test Point 25.0 ft.
Ground Surface Elevation 584.7 ft.
Elevation of Test Point 559.7 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	2	5 °	1
10 °	2	10 °	1
15 °	2	15 °	1
20 °	2	20 °	1
25 °		25 °	
30 °		30 °	.
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	2	1	
Applied Torque (in-lbs)	24	12	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	62	31	= Applied Torque x Vane Constant
Sensitivity	**2.00** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition. Vane sinking into clay after pushed 18 inches into very soft clay.

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name:	Ground Upheaval - Fort Dearborn	**Boring No.**	Somat B-1
Project No.	2019086E	**Depth of Test Point**	33.5 ft.
Date:	16-Sep-21	**Ground Surface Elevation**	584.7 ft.
Client:	City of Detroit	**Elevation of Test Point**	551.2 ft.
Drilling Company:	DLZ-American		
Driller:	V. Dearing		

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	8	5 °	5
10 °	10	10 °	6
15 °	10	15 °	6
20 °	9	20 °	6
25 °	9	25 °	6
30 °	9	30 °	.
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	10	6	
Applied Torque (in-lbs)	120	72	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	311	186	= Applied Torque x Vane Constant
Sensitivity	**1.67** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 16-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-1
Depth of Test Point 41.5 ft.
Ground Surface Elevation 584.7 ft.
Elevation of Test Point 543.2 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	8	5 °	6
10 °	9	10 °	7
15 °	9	15 °	7
20 °	7	20 °	6
25 °	6	25 °	6
30 °	6	30 °	.
35 °	6	35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	9	7	
Applied Torque (in-lbs)	108	84	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	280	218	= Applied Torque x Vane Constant
Sensitivity	**1.29** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 16-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-1
Depth of Test Point 65.0 ft.
Ground Surface Elevation 584.7 ft.
Elevation of Test Point 519.7 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	18	5 °	8
10 °	23	10 °	9
15 °	24	15 °	9
20 °	26	20 °	9
25 °	27	25 °	9
30 °	26	30 °	.
35 °	26	35 °	
40 °	26	40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	27	9	
Applied Torque (in-lbs)	324	108	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	839	280	= Applied Torque x Vane Constant
Sensitivity	**3.00** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 17-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 21.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 565.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	19	5 °	10
10 °	20	10 °	11
15 °	17	15 °	12
20 °	16	20 °	12
25 °	16	25 °	11
30 °	16	30 °	11
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	20	12	
Applied Torque (in-lbs)	240	144	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	622	373	= Applied Torque x Vane Constant
Sensitivity	**1.67** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 17-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 26.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 560.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	2	5 °	2
10 °	2	10 °	2
15 °	2	15 °	1
20 °	2	20 °	1
25 °	2	25 °	1
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	2	2	
Applied Torque (in-lbs)	24	24	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	62	62	= Applied Torque x Vane Constant
Sensitivity	**1.00** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 17-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 31.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 555.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10	5 °	2
10 °	11	10 °	2
15 °	9	15 °	3
20 °	8	20 °	3
25 °	8	25 °	3
30 °		30 °	3
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	11	3	
Applied Torque (in-lbs)	132	36	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	342	93	= Applied Torque x Vane Constant
Sensitivity	**3.67** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition. Vane sank approximately 12" into clay without pushing.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 18-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 38.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 548.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10	5 °	3
10 °	10	10 °	4
15 °	9	15 °	4
20 °	8	20 °	3
25 °	7	25 °	3
30 °		30 °	3
35 °		35 °	2
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	10	4	
Applied Torque (in-lbs)	120	48	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	311	124	= Applied Torque x Vane Constant
Sensitivity	**2.50** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: S. Swaminathan

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 18-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 43.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 543.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	10	5 °	3
10 °	11	10 °	3
15 °	10	15 °	3
20 °	9	20 °	3
25 °	8	25 °	
30 °		30 °	
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	11	3	
Applied Torque (in-lbs)	132	36	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	342	93	= Applied Torque x Vane Constant
Sensitivity	**3.67** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

Somat Engineering

FIELD VANE SHEAR TEST
ASTM D2573

Project Name: Ground Upheaval - Fort Dearborn
Project No. 2019086E
Date: 18-Sep-21
Client: City of Detroit
Drilling Company: DLZ-American
Driller: V. Dearing

Boring No. Somat B-2
Depth of Test Point 48.5 ft.
Ground Surface Elevation 586.8 ft.
Elevation of Test Point 538.3 ft.

Torque Arm Length		Vane Diameter		Vane Constant	
6"		2"		5.17	
12"	X	2 1/2"	X	2.59	X
18"		3 5/8"		0.905	

FORCE GAGE READINGS

Rate of rotation is to one turn of crank every five (5) seconds. Gage readings are to be recorded every 5 degrees.
(10 turns of crank = 5 degrees of rotation)

Undisturbed Condition		Remolded Condition (5 Minutes)	
Deg of Rotation	Dial Reading	Deg of Rotation	Dial Reading
5 °	17	5 °	12
10 °	21	10 °	13
15 °	21	15 °	13
20 °	20	20 °	12
25 °	19	25 °	12
30 °	18	30 °	11
35 °		35 °	
40 °		40 °	
45 °		45 °	
50 °		50 °	
55 °		55 °	
60 °		60 °	
65 °		65 °	
70 °		70 °	

Calculations	Undisturbed Condition	Remolded Condition	
Maximum Force Gauge Reading for Vane (lbs)	21	13	
Applied Torque (in-lbs)	252	156	= Net Force x Torque Arm
Ultimate Shear Strength (psf)	653	404	= Applied Torque x Vane Constant
Sensitivity	**1.62** Insensitive		= Undist. Strength/ Remold. Strength

Test Performed By: R. Calkins

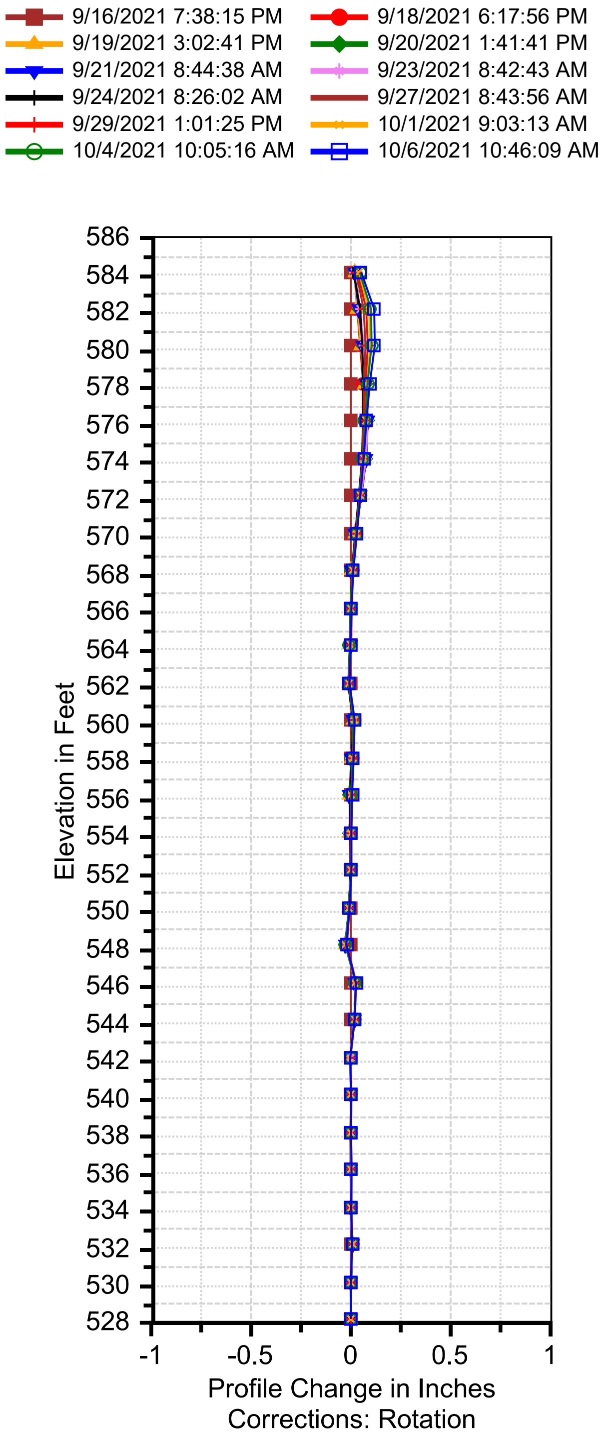
NOTES: Vane fully calibrated on 4/1/2021. Vane in good condition.

Infrastructure Engineering Solutions

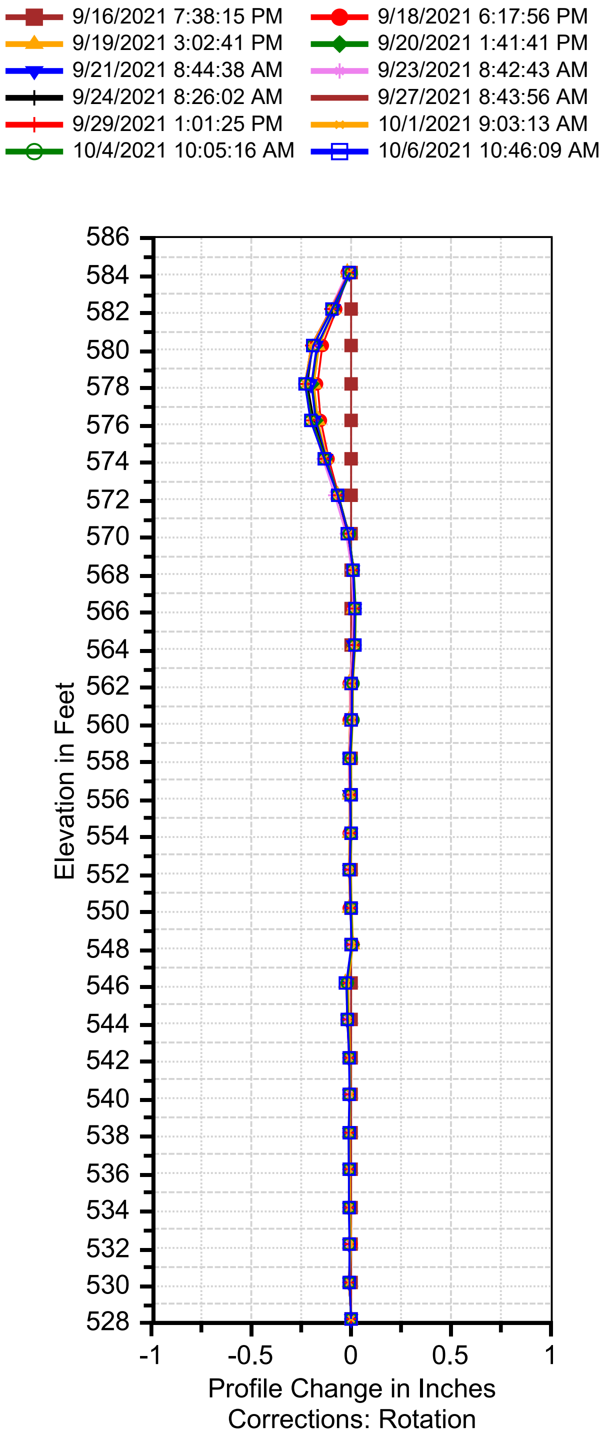
APPENDIX B-2

INCLINOMETER READINGS

2019086E B-1 A



2019086E B-1 B



Somat Engineering, INCORPORATED

Ground Upheaval - Dearborn Street
at Fort Street, Detroit, Michigan
Somat Project: 2019086E

APPENDIX C

GEOTECHNICAL LABORATORY TEST RESULTS

APPENDIX C-1

SUMMARY TABLE OF GEOTECHNICAL LABORATORY TEST RESULTS

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

SUMMARY OF LABORATORY RESULTS

PROJECT NO. 2019086E

Borehole	Top Depth of Test Sample (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	UCC (psf)	FIne Sg
Somat B-01	8.5							27.0	101.1	2420	
Somat B-01	11.0							30.4		800#	
Somat B-01	13.5									2050	
Somat B-01	16.5							30.1		600#	
Somat B-01	18.0	46	21	25	9.5	99	CL	34.4	88.3	1550	
Somat B-01	21.0							49.5		400#	
Somat B-01	23.5									120	
Somat B-01	26.5							31.1	91.8	280	
Somat B-01	28.5							29.5		200#	
Somat B-01		37	17	20	9.5	93	CL	24.0	99.9	590	
Somat B-01		36	17	19				35.3	91.7	620	
Somat B-01	32.0									620	
Somat B-01	33.5							28.4		<>	
Somat B-01	35.0							36.8	85.6	440	
Somat B-01	38.5							19.2		200#	
Somat B-01	40.0									560	
Somat B-01	43.5							24.8		400#	
Somat B-01	48.5							22.8		400#	
Somat B-01	55.0							24.9	99.9	890	
Somat B-01	58.5							24.8		800#	
Somat B-01	63.5									1680	
Somat B-01	68.5							27.6		400#	
Somat B-01	73.5							27.7		800#	
Somat B-01	78.5							40.2		600#	
Somat B-02	13.5							30.2	95.1	1320	
Somat B-02	15.0	37	18	19				29.1	97.0	2080	
Somat B-02	17.0							27.6		1000#	
Somat B-02	20.0									1240	
Somat B-02	21.5							31.3		800#	
Somat B-02	23.0	36	18	18				32.0	91.7	1260	
Somat B-02	25.0									120	
Somat B-02	26.5							30.3		600#	
Somat B-02	28.0	38	17	21				51.0	71.8	810	
Somat B-02	30.0									680	
Somat B-02	31.5							38.9		400#	
Somat B-02	35.0	36	16	20				22.9	102.0	520	
Somat B-02	37.0									620	
Somat B-02	38.5							35.4		400#	
Somat B-02	40.0	49	21	28				29.5	96.6	970	
Somat B-02	42.0									680	
Somat B-02	43.5							29.4		800#	
Somat B-02	45.0	66	25	41	9.5	72	CH	35.0	100.3	1150	
Somat B-02	47.0									1300	

\# Torvane
* Pocket Penetrometer
<> Disturbed Sample

SUMMARY OF LABORATORY RESULTS

Borehole	Top Depth of Test Sample (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	UCC (psf)	FIne Sg
Somat B-02	55.0							24.6		1200#	
Somat B-02	58.5	33	17	16				25.1		1000#	
Somat B-02	63.5							25.1		800#	
Somat B-02	68.5							25.6		1000#	
Somat B-02	73.5							29.5		800#	
Somat B-02	78.5							27.8		1000#	
Somat B-02	83.5							40.1		600#	

Torvane
* Pocket Penetrometer
<> Disturbed Sample

APPENDIX C-2

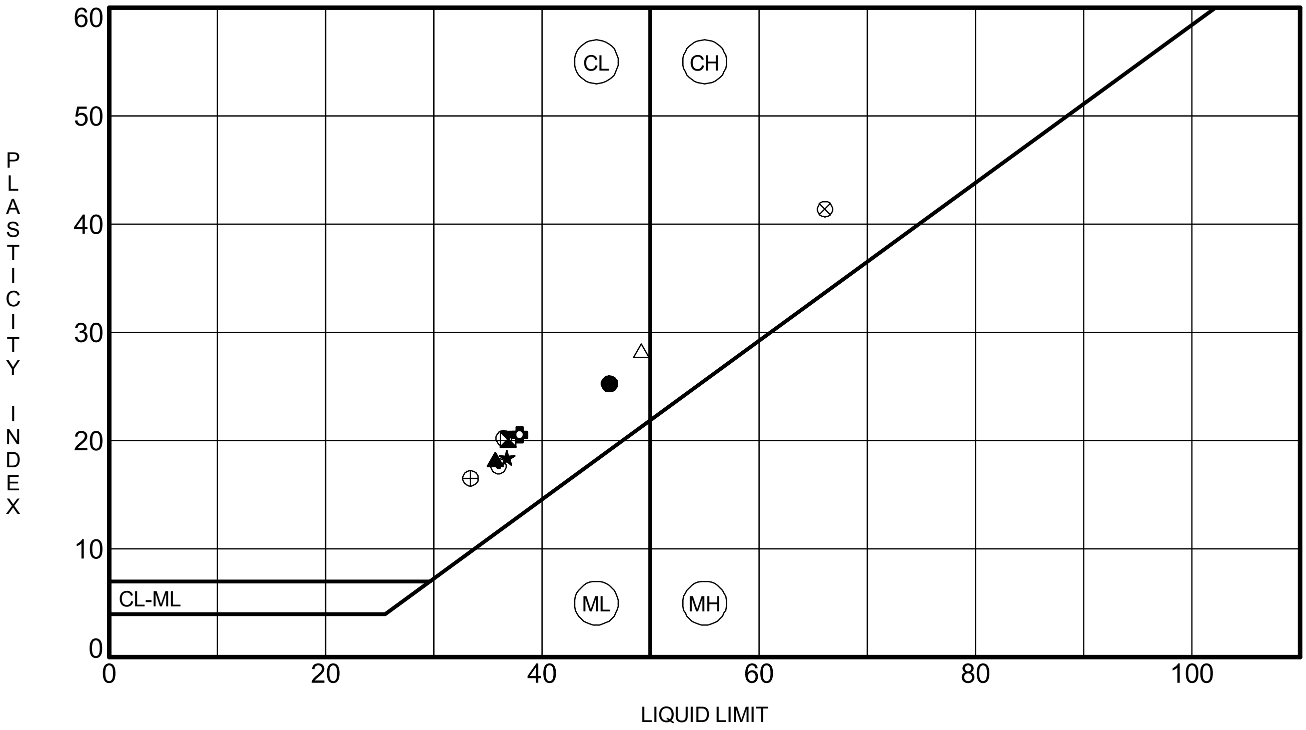
RESULTS OF ATTERBERG LIMITS

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

ATTERBERG LIMITS RESULTS
ASTM D4318

PROJECT NO. 2019086E



Specimen Identification	Depth	LL	PL	PI	Fines	Remarks
● **Somat B-01**	**18.0**	**46**	**21**	**25**	**99**	
⧗ **Somat B-01**	**30.5**	**37**	**17**	**20**	**93**	
▲ **Somat B-01**	**31.5**	**36**	**17**	**19**		
★ **Somat B-02**	**15.0**	**37**	**18**	**19**		
⊙ **Somat B-02**	**23.0**	**36**	**18**	**18**		
✿ **Somat B-02**	**28.0**	**38**	**17**	**21**		
○ **Somat B-02**	**35.0**	**36**	**16**	**20**		
△ **Somat B-02**	**40.0**	**49**	**21**	**28**		
⊗ **Somat B-02**	**45.0**	**66**	**25**	**41**	**72**	
⊕ **Somat B-02**	**58.5**	**33**	**17**	**16**		

ATTERBERG LIMITS FORT DEARBORN.GPJ SOMAT.GDT 10/29/21

APPENDIX C-3

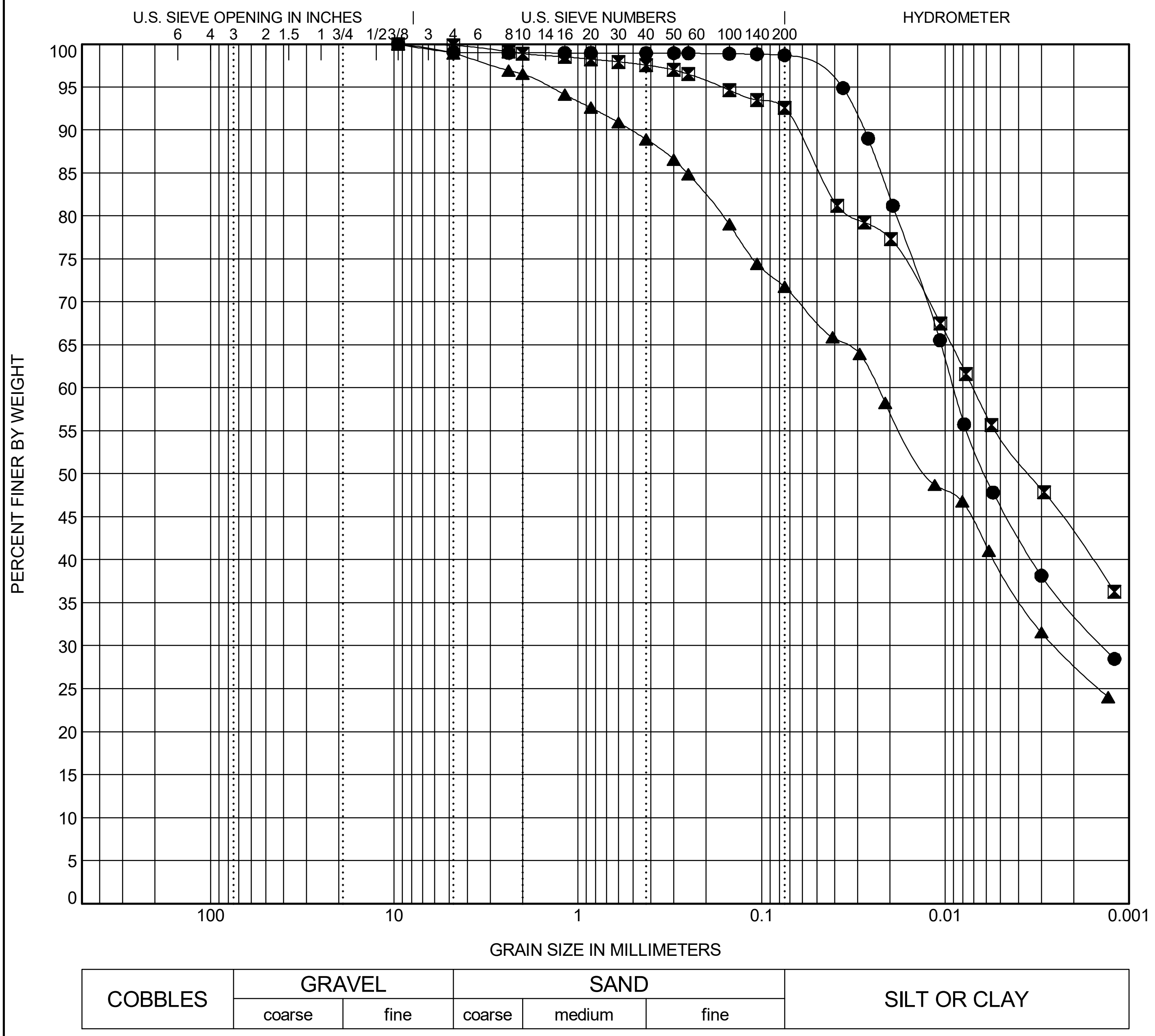
GRAIN SIZE ANALYSIS TEST RESULTS

Somat Engineering, Inc.

Ground Upheaval - Dearborn Street at Fort Street
Detroit, Michigan

GRAIN SIZE DISTRIBUTION

PROJECT NO. 2019086E



	Specimen Identification	Depth ft.	Remarks	LL	PL	PI	Cc	Cu
●	**Somat B-01**	**18.0**		**46**	**21**	**25**		
☒	**Somat B-01**	**30.5**		**37**	**17**	**20**		
▲	**Somat B-02**	**45.0**		**66**	**25**	**41**		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Somat B-01**	**18.0**	**9.5**	**0.009**	**0.001**		**1.0**	**0.3**	**52.4**	**46.3**
☒	**Somat B-01**	**30.5**	**9.5**	**0.007**			**0.2**	**7.3**	**38.2**	**54.3**
▲	**Somat B-02**	**45.0**	**9.5**	**0.023**	**0.003**		**1.1**	**27.2**	**32.9**	**38.9**

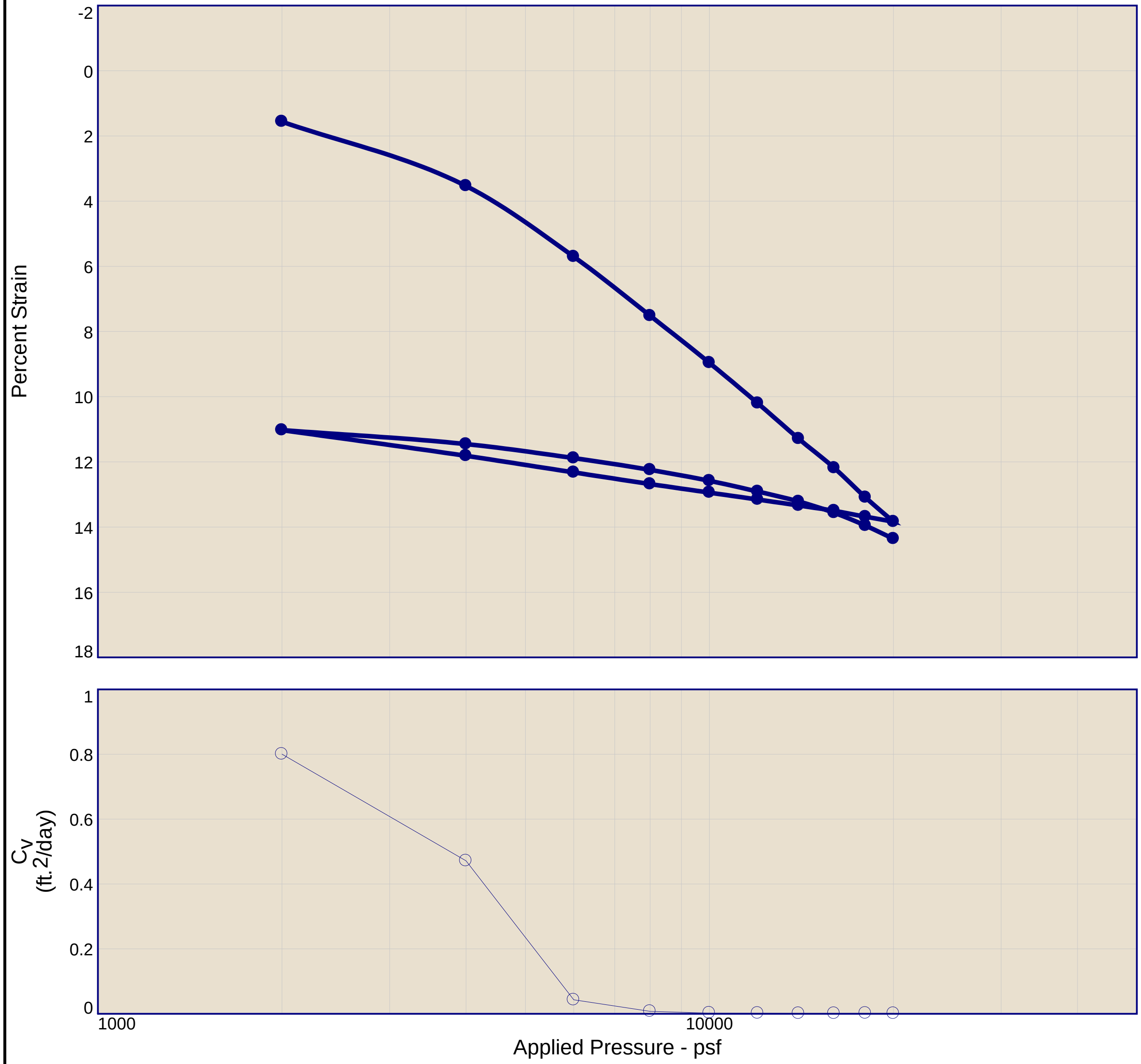
GRAIN SIZE FORT DEARBORN.GPJ SOMAT.GDT 10/29/21

10/29/21

APPENDIX C-4

CONSOLIDATION TEST RESULTS

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	31.1 %	91.2			2.7	2400				0.847

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 2121- **Client:** Somat

Project: Somat Project 2019086E

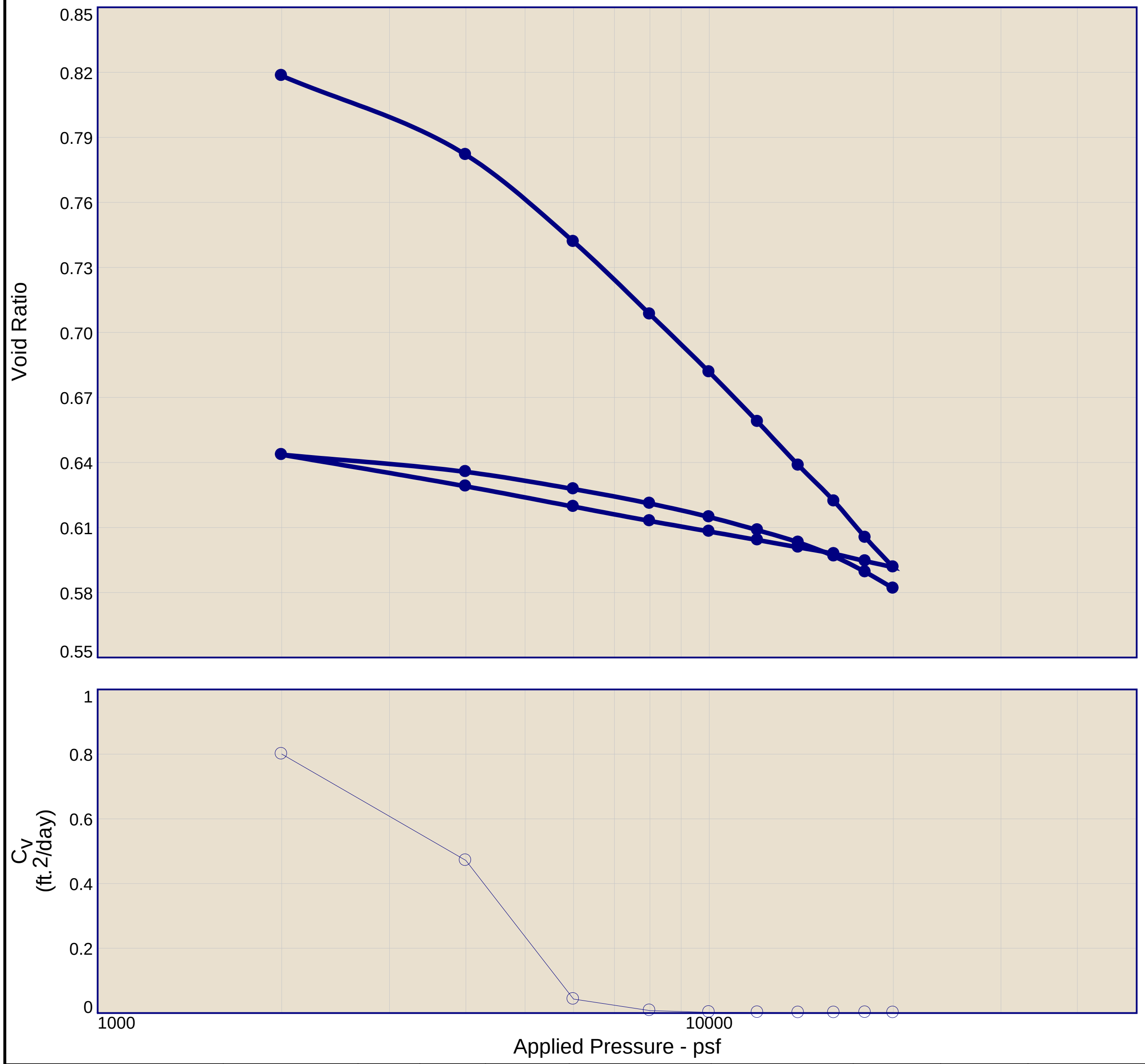
Source of Sample: B-1 **Depth:** 20.0' **Sample Number:** ST-7

DLZ

Remarks:

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	31.1 %	91.2			2.7	2400				0.847

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 2121- **Client:** Somat
Project: Somat Project 2019086E

Source of Sample: B-1 **Depth:** 20.0' **Sample Number:** ST-7

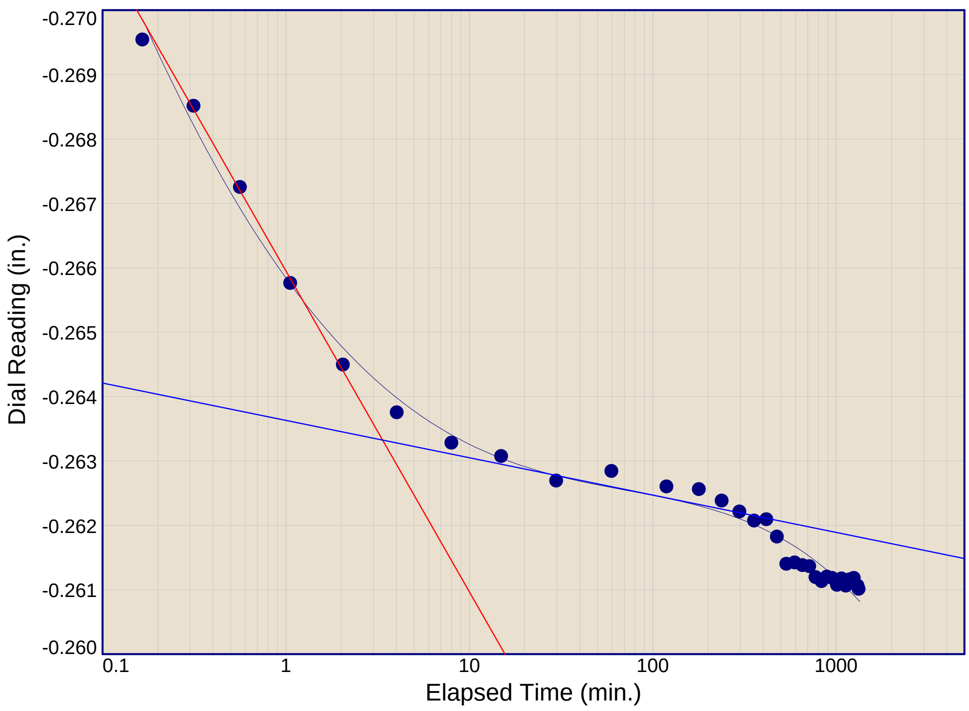
Remarks:

Figure

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-1 Depth: 20.0' Sample Number: ST-7



Load No.= 1

Load= 2000 psf

D_0 = -0.2727

D_{50} = -0.2680

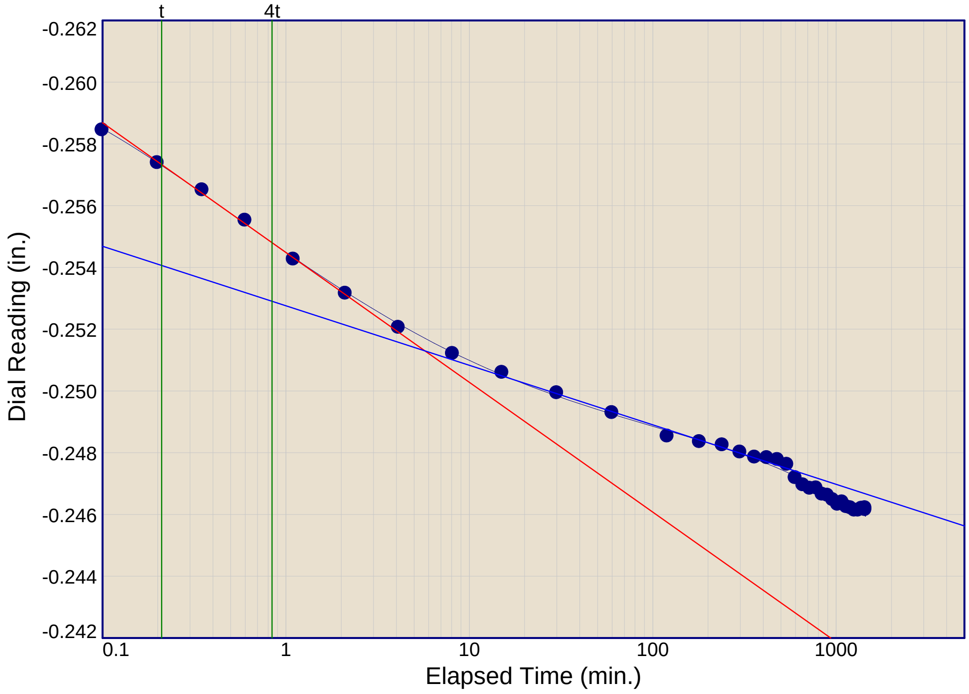
D_{100} = -0.2633

T_{50} = 0.34 min.

C_v @ T_{50}

0.800 ft.^{2}/day

C_α = 0.001



Load No.= 2

Load= 4000 psf

D_0 = -0.2598

D_{50} = -0.2555

D_{100} = -0.2513

T_{50} = 0.56 min.

C_v @ T_{50}

0.472 ft.^{2}/day

C_α = 0.005

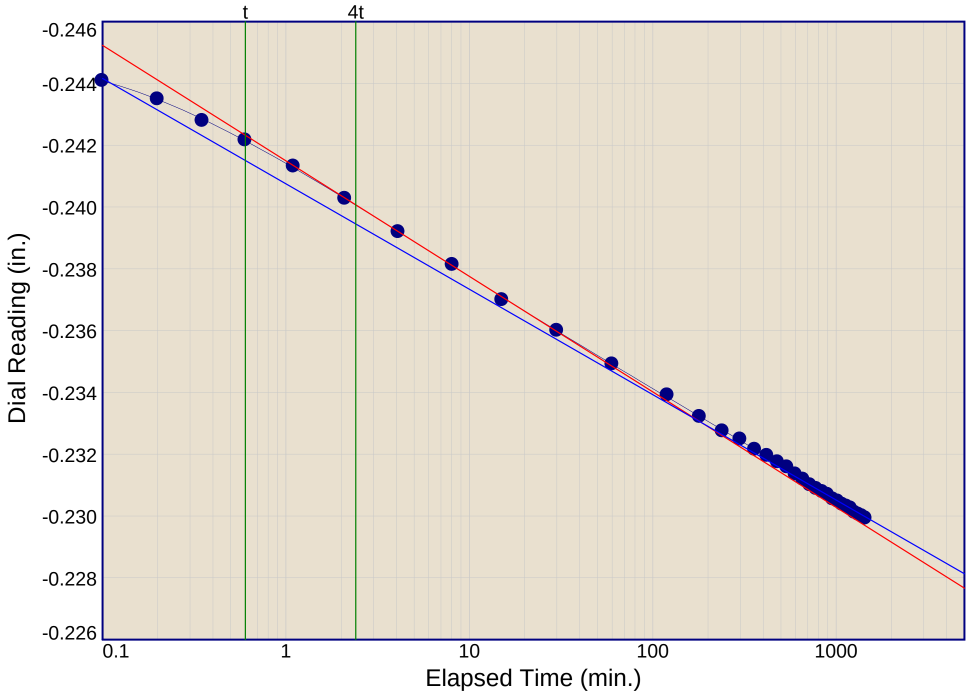
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-1 Depth: 20.0' Sample Number: ST-7



Load No.= 3

Load= 6000 psf

D_0 = -0.2442

D_{50} = -0.2386

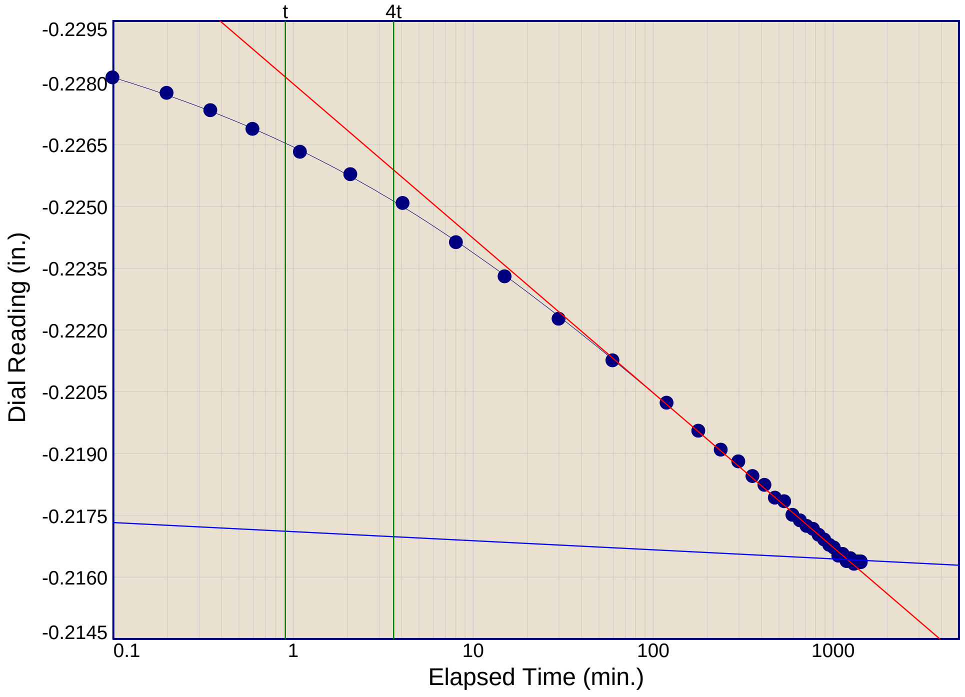
D_{100} = -0.2330

T_{50} = 5.86 min.

C_v @ T_{50}

0.043 ft.^{2}/day

C_α = 0.008



Load No.= 4

Load= 8000 psf

D_0 = -0.2279

D_{50} = -0.2222

D_{100} = -0.2164

T_{50} = 33.04 min.

C_v @ T_{50}

0.007 ft.^{2}/day

C_α = 0.001

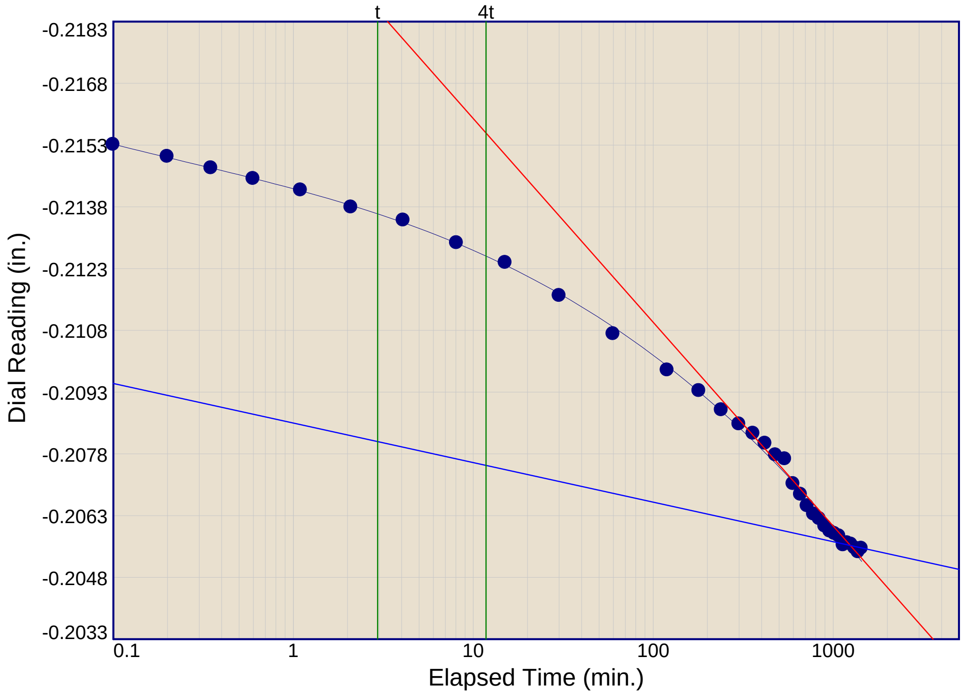
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-1   Depth: 20.0'   Sample Number: ST-7



Load No.= 5

Load= 10000 psf

D_0 = -0.2147

D_{50} = -0.2101

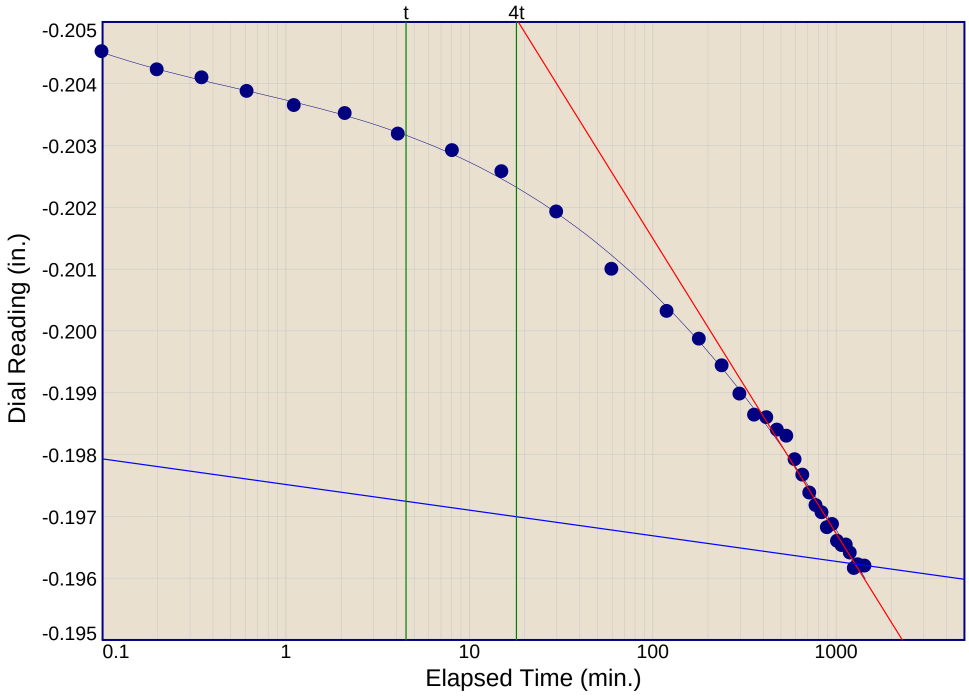
D_{100} = -0.2056

T_{50} = 105.65 min.

C_v @ T_{50}

0.002 ft.^{2}/day

C_α = 0.002



Load No.= 6

Load= 12000 psf

D_0 = -0.2040

D_{50} = -0.2001

D_{100} = -0.1962

T_{50} = 146.07 min.

C_v @ T_{50}

0.002 ft.^{2}/day

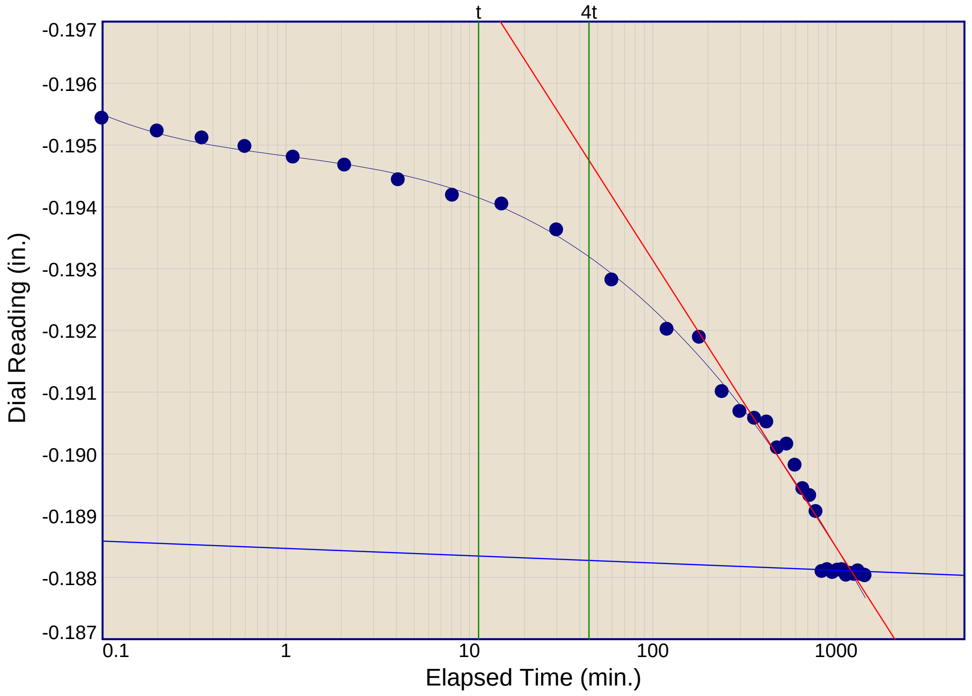
C_α = 0.001

Figure

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-1 Depth: 20.0' Sample Number: ST-7



Load No.= 7

Load= 14000 psf

D_0 = -0.1951

D_{50} = -0.1916

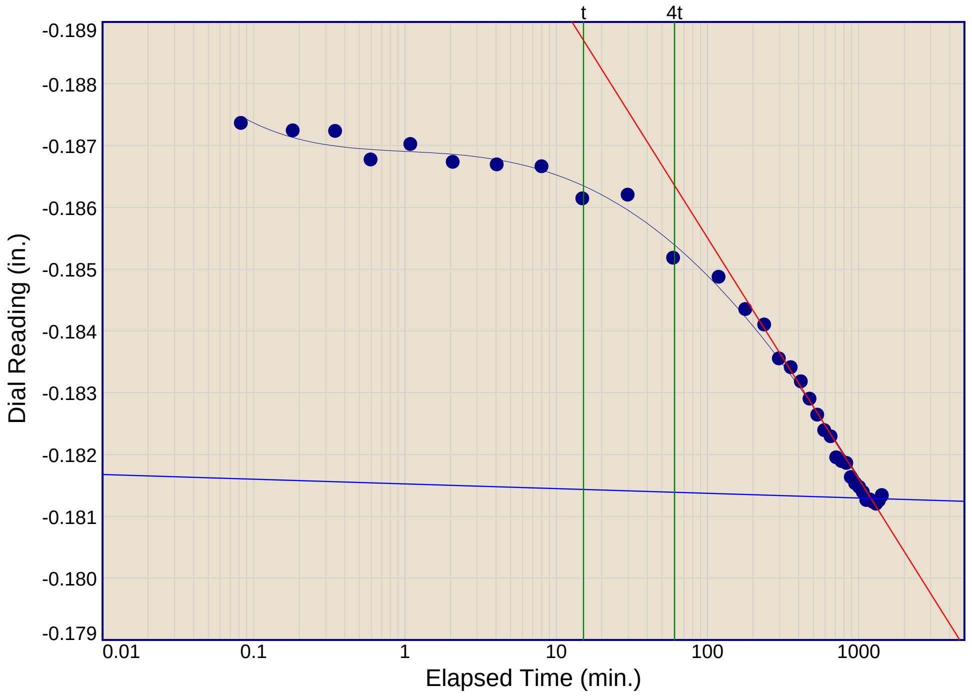
D_{100} = -0.1881

T_{50} = 176.13 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.000



Load No.= 8

Load= 16000 psf

D_0 = -0.1873

D_{50} = -0.1843

D_{100} = -0.1813

T_{50} = 168.11 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.000

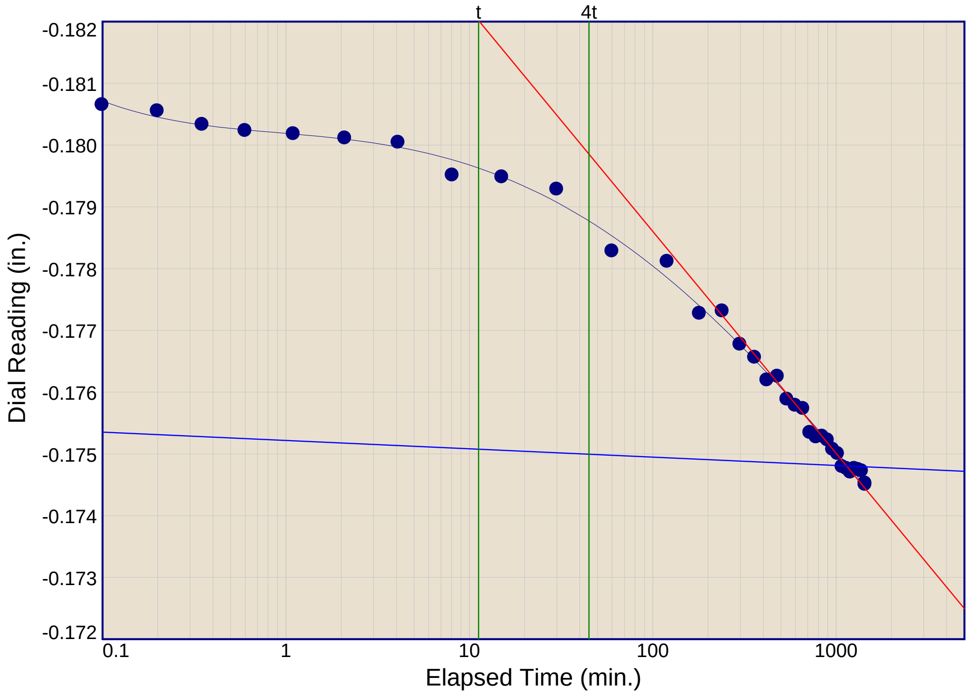
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-1 Depth: 20.0' Sample Number: ST-7



Load No.= 9

Load= 18000 psf

D_0 = -0.1805

D_{50} = -0.1776

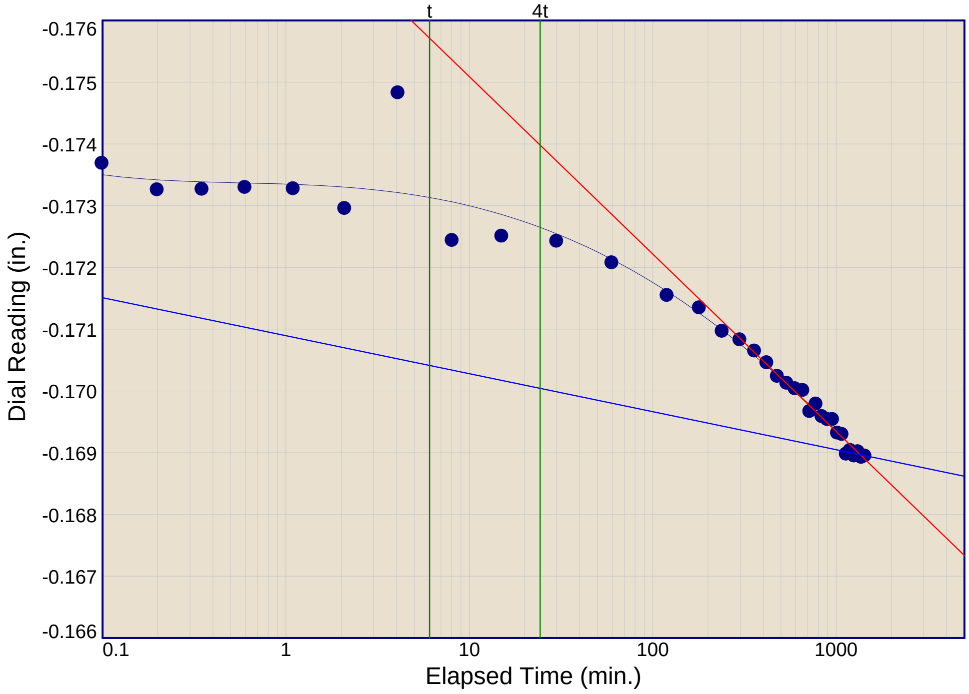
D_{100} = -0.1748

T_{50} = 144.70 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.000



Load No.= 10

Load= 20000 psf

D_0 = -0.1736

D_{50} = -0.1713

D_{100} = -0.1690

T_{50} = 172.81 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.002

Figure

CONSOLIDATION TEST DATA

11/1/2021

Client: Somat
Project: Somat Project 2019086E
Project Number: 2121-4619.01
Location: B-1
Depth: 20.0' **Sample Number:** ST-7

Test Specimen Data

NATURAL MOISTURE	**VOID RATIO**	**AFTER TEST**
Wet w+t = 115.60 g.	**Spec. Gr. =** 2.7	**Wet w+t =** 169.96 g.
Dry w+t = 88.18 g.	**Est. Ht. Solids =** 0.406 in.	**Dry w+t =** 149.00 g.
Tare Wt. = 0.00 g.	**Init. V.R. =** 0.847	**Tare Wt. =** 60.82 g.
Moisture = 31.1 %	**Init. Sat. =** 99.1 %	**Moisture =** 23.8 %
UNIT WEIGHT	**TEST START**	**Dry Wt. =** 88.18* g.
Height = 0.750 in.	**Height =** 0.750 in.	
Diameter = 2.500 in.	**Diameter =** 2.500 in.	
Weight = 115.60 g.		
Dry Dens. = 91.2 pcf		

*** Final dry weight used as mineral solids weight**

End-Of-Load Summary

Pressure (psf)	Final Dial (in.)	Deformation (in.)	C_V (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	-0.27271	0.00000			0.847	
2000	-0.26100	0.01171	0.800	0.001	0.818	1.6 Comprs.
4000	-0.24621	0.02650	0.472	0.005	0.782	3.5 Comprs.
6000	-0.22993	0.04278	0.043	0.008	0.742	5.7 Comprs.
8000	-0.21634	0.05637	0.007	0.001	0.708	7.5 Comprs.
10000	-0.20550	0.06721	0.002	0.002	0.682	9.0 Comprs.
12000	-0.19619	0.07652	0.002	0.001	0.659	10.2 Comprs.
14000	-0.18802	0.08469	0.001	0.000	0.639	11.3 Comprs.
16000	-0.18133	0.09138	0.001	0.000	0.622	12.2 Comprs.
18000	-0.17452	0.09819	0.001	0.000	0.605	13.1 Comprs.
20000	-0.16894	0.10377	0.001	0.002	0.592	13.8 Comprs.
18000	-0.17009	0.10262			0.594	13.7 Comprs.
16000	-0.17145	0.10126			0.598	13.5 Comprs.
14000	-0.17267	0.10004			0.601	13.3 Comprs.
12000	-0.17404	0.09867			0.604	13.2 Comprs.
10000	-0.17564	0.09707			0.608	12.9 Comprs.
8000	-0.17761	0.09510			0.613	12.7 Comprs.
6000	-0.18029	0.09242			0.620	12.3 Comprs.
4000	-0.18410	0.08861		0.000	0.629	11.8 Comprs.
2000	-0.19002	0.08269			0.644	11.0 Comprs.
4000	-0.18680	0.08591		0.001	0.636	11.5 Comprs.
6000	-0.18358	0.08913		0.000	0.628	11.9 Comprs.
8000	-0.18087	0.09184		0.000	0.621	12.2 Comprs.
10000	-0.17835	0.09436		0.000	0.615	12.6 Comprs.
12000	-0.17588	0.09683		0.000	0.609	12.9 Comprs.
14000	-0.17359	0.09912		0.000	0.603	13.2 Comprs.

End-Of-Load Summary (Continued)

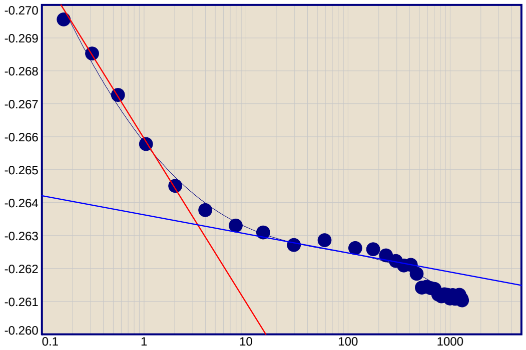
Pressure (psf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
16000	-0.17099	0.10172		0.000	0.597	13.6 Comprs.
18000	-0.16805	0.10466		0.000	0.589	14.0 Comprs.
20000	-0.16500	0.10771		0.001	0.582	14.4 Comprs.

Compression index (C_c), psf = 0.31 **Preconsolidation pressure (P_p), psf =** 5402 **Void ratio at P_p (e_m) =** 0.753

Overburden (σ_{vo}), psf = 2400 **Void ratio at σ_{vo} (e_o) =** 0.811 **Recompression index (C_r) =** 0.03

Pressure: 2000 psf **TEST READINGS** **Load No. 1**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.27271	18	480.0667	-0.26181
2	0.1667	-0.26953	19	540.0667	-0.26139
3	0.3167	-0.26850	20	600.0667	-0.26141
4	0.5667	-0.26724	21	660.0667	-0.26137
5	1.0667	-0.26575	22	720.0667	-0.26135
6	2.0667	-0.26448	23	780.0667	-0.26118
7	4.0667	-0.26374	24	840.0833	-0.26112
8	8.0667	-0.26327	25	900.0833	-0.26119
9	15.0667	-0.26306	26	960.0833	-0.26117
10	30.0667	-0.26268	27	1020.0833	-0.26106
11	60.0667	-0.26283	28	1080.0833	-0.26116
12	120.0667	-0.26259	29	1140.0833	-0.26105
13	180.0667	-0.26255	30	1200.0833	-0.26115
14	240.0667	-0.26237	31	1260.0833	-0.26117
15	300.0667	-0.26220	32	1320.0833	-0.26105
16	360.0667	-0.26206	33	1339.4833	-0.26100
17	420.0667	-0.26208			

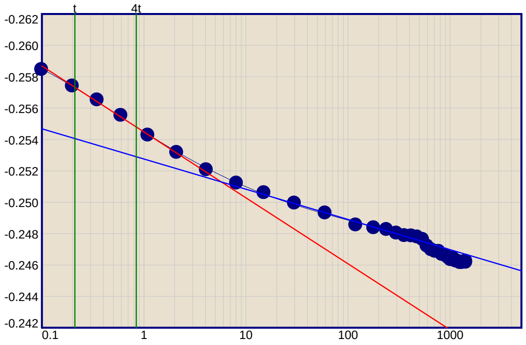


Void Ratio = 0.818 **Compression =** 1.6%

D_0 = -0.2727 **D_{50} =** -0.2680 **D_{100} =** -0.2633 **C_v at 0.34 min. =** 0.800 ft.^{2}/day **C_α =** 0.001

Pressure: 4000 psf **TEST READINGS** **Load No. 2**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.26100	11	30.1167	-0.24993
2	0.1000	-0.25844	12	60.1167	-0.24929
3	0.2000	-0.25738	13	120.1167	-0.24853
4	0.3500	-0.25650	14	180.1167	-0.24835
5	0.6000	-0.25552	15	240.1167	-0.24824
6	1.1000	-0.25426	16	300.1167	-0.24801
7	2.1167	-0.25315	17	360.1167	-0.24785
8	4.1167	-0.25205	18	420.1167	-0.24783
9	8.1167	-0.25120	19	480.1167	-0.24777
10	15.1167	-0.25059	20	540.1167	-0.24761



Pressure: 4000 psf **TEST READINGS (continued)** **Load No. 2**

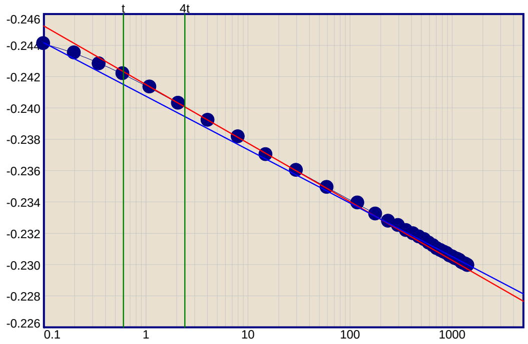
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
21	600.1167	-0.24718	31	1200.1333	-0.24621
22	660.1167	-0.24695	32	1260.1333	-0.24613
23	720.1167	-0.24684	33	1320.1333	-0.24613
24	780.1167	-0.24685	34	1380.1333	-0.24619
25	840.1167	-0.24665	35	1440.1333	-0.24615
26	900.1167	-0.24661	36	1440.4500	-0.24621
27	960.1333	-0.24647			
28	1020.1333	-0.24632			
29	1080.1333	-0.24640			
30	1140.1333	-0.24624			

Void Ratio = 0.782 **Compression =** 3.5%

D_0 = -0.2598 **D_{50} =** -0.2555 **D_{100} =** -0.2513 **C_v at 0.56 min. =** 0.472 ft.^{2}/day **C_α =** 0.005

Pressure: 6000 psf **TEST READINGS** **Load No. 3**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.24621	19	480.1167	-0.23174
2	0.1000	-0.24408	20	540.1167	-0.23158
3	0.2000	-0.24349	21	600.1167	-0.23135
4	0.3500	-0.24279	22	660.1167	-0.23118
5	0.6000	-0.24216	23	720.1167	-0.23100
6	1.1000	-0.24131	24	780.1167	-0.23088
7	2.1000	-0.24027	25	840.1167	-0.23078
8	4.1000	-0.23919	26	900.1167	-0.23069
9	8.1000	-0.23813	27	960.1167	-0.23054
10	15.1000	-0.23699	28	1020.1167	-0.23047
11	30.1000	-0.23600	29	1080.1167	-0.23037
12	60.1000	-0.23491	30	1140.1167	-0.23031
13	120.1000	-0.23391	31	1200.1167	-0.23025
14	180.1000	-0.23321	32	1260.1167	-0.23011
15	240.1000	-0.23274	33	1320.1167	-0.23005
16	300.1000	-0.23248	34	1380.1167	-0.23000
17	360.1000	-0.23215	35	1440.1167	-0.22992
18	420.1167	-0.23195	36	1440.4500	-0.22993

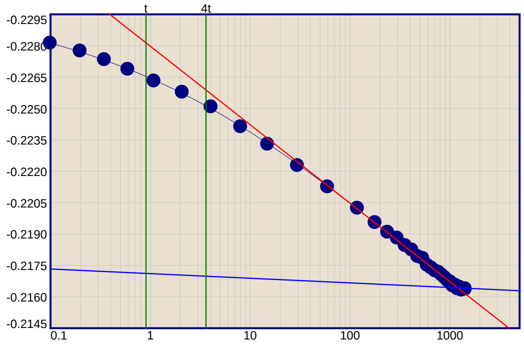


Void Ratio = 0.742 **Compression =** 5.7%

D_0 = -0.2442 **D_{50} =** -0.2386 **D_{100} =** -0.2330 **C_v at 5.86 min. =** 0.043 ft.^{2}/day **C_α =** 0.008

Pressure: 8000 psf **TEST READINGS** **Load No. 4**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.22993	19	480.1167	-0.21791
2	0.1000	-0.22811	20	540.1167	-0.21782
3	0.2000	-0.22773	21	600.1167	-0.21749
4	0.3500	-0.22731	22	660.1167	-0.21736
5	0.6000	-0.22686	23	720.1167	-0.21722
6	1.1000	-0.22630	24	780.1167	-0.21715
7	2.1000	-0.22576	25	840.1167	-0.21701
8	4.1000	-0.22506	26	900.1167	-0.21689
9	8.1000	-0.22411	27	960.1167	-0.21676
10	15.1000	-0.22328	28	1020.1167	-0.21670
11	30.1000	-0.22225	29	1080.1167	-0.21650
12	60.1000	-0.22124	30	1140.1167	-0.21654
13	120.1000	-0.22021	31	1200.1167	-0.21637
14	180.1167	-0.21953	32	1260.1167	-0.21644
15	240.1167	-0.21907	33	1320.1167	-0.21630
16	300.1167	-0.21879	34	1380.1167	-0.21636
17	360.1167	-0.21843	35	1440.1167	-0.21636
18	420.1167	-0.21822	36	1440.3667	-0.21634

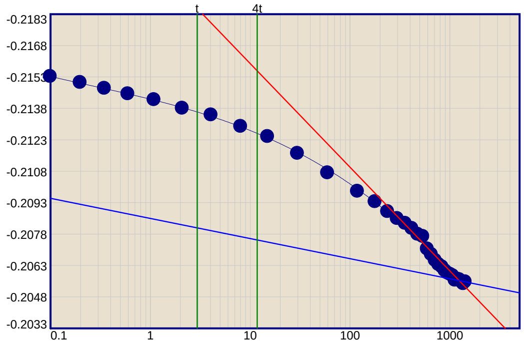


Void Ratio = 0.708 **Compression =** 7.5%

D_0 = -0.2279 **D_{50} =** -0.2222 **D_{100} =** -0.2164 **C_v at 33.04 min. =** 0.007 ft.^{2}/day **C_α =** 0.001

Pressure: 10000 psf **TEST READINGS** **Load No. 5**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.21634	18	420.1167	-0.20805
2	0.1000	-0.21531	19	480.1167	-0.20777
3	0.2000	-0.21502	20	540.1167	-0.20767
4	0.3500	-0.21474	21	600.1167	-0.20707
5	0.6000	-0.21448	22	660.1167	-0.20681
6	1.1000	-0.21420	23	720.1167	-0.20653
7	2.1000	-0.21379	24	780.1167	-0.20633
8	4.1000	-0.21347	25	840.1167	-0.20622
9	8.1000	-0.21292	26	900.1167	-0.20604
10	15.1000	-0.21244	27	960.1167	-0.20592
11	30.1000	-0.21164	28	1020.1167	-0.20586
12	60.1000	-0.21071	29	1080.1333	-0.20580
13	120.1000	-0.20983	30	1140.1333	-0.20558
14	180.1000	-0.20933	31	1200.1333	-0.20563
15	240.1000	-0.20886	32	1260.1333	-0.20560
16	300.1167	-0.20852	33	1320.1333	-0.20551
17	360.1167	-0.20829	34	1380.1333	-0.20541



Pressure: 10000 psf **TEST READINGS (continued)** **Load No. 5**

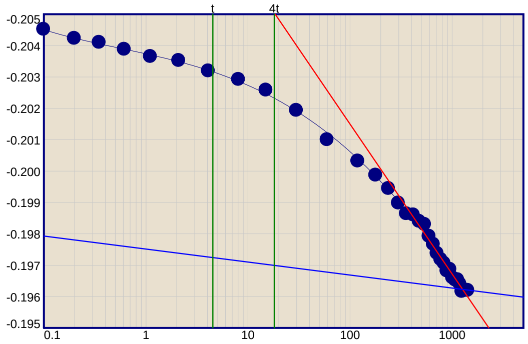
No.	Elapsed Time	Dial Reading
35	1440.0667	-0.20550

Void Ratio = 0.682 **Compression =** 9.0%

D_0 = -0.2147 **D_{50} =** -0.2101 **D_{100} =** -0.2056 **C_v at 105.65 min. =** 0.002 ft.^{2}/day **C_α =** 0.002

Pressure: 12000 psf **TEST READINGS** **Load No. 6**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.20549	19	480.1167	-0.19839
2	0.1000	-0.20451	20	540.1167	-0.19829
3	0.2000	-0.20422	21	600.1167	-0.19791
4	0.3500	-0.20409	22	660.1167	-0.19766
5	0.6167	-0.20387	23	720.1167	-0.19737
6	1.1167	-0.20364	24	780.1167	-0.19717
7	2.1167	-0.20351	25	840.1167	-0.19705
8	4.1167	-0.20318	26	900.1167	-0.19681
9	8.1167	-0.20291	27	960.1167	-0.19686
10	15.1167	-0.20257	28	1020.1333	-0.19659
11	30.1167	-0.20192	29	1080.1333	-0.19652
12	60.1167	-0.20099	30	1140.1333	-0.19653
13	120.1167	-0.20031	31	1200.1333	-0.19640
14	180.1167	-0.19986	32	1260.1333	-0.19615
15	240.1167	-0.19943	33	1320.1333	-0.19621
16	300.1167	-0.19897	34	1380.1333	-0.19619
17	360.1167	-0.19863	35	1440.0167	-0.19619
18	420.1167	-0.19859			

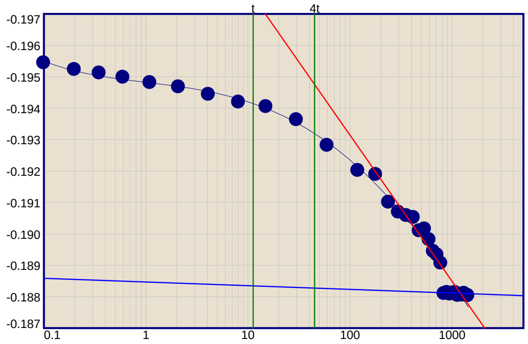


Void Ratio = 0.659 **Compression =** 10.2%

D_0 = -0.2040 **D_{50} =** -0.2001 **D_{100} =** -0.1962 **C_v at 146.07 min. =** 0.002 ft.^{2}/day **C_α =** 0.001

Pressure: 14000 psf **TEST READINGS** **Load No. 7**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.19619	11	30.1167	-0.19362
2	0.1000	-0.19543	12	60.1167	-0.19281
3	0.2000	-0.19522	13	120.1167	-0.19201
4	0.3500	-0.19511	14	180.1167	-0.19188
5	0.6000	-0.19497	15	240.1167	-0.19100
6	1.1000	-0.19480	16	300.1167	-0.19068
7	2.1000	-0.19467	17	360.1167	-0.19057
8	4.1167	-0.19443	18	420.1167	-0.19051
9	8.1167	-0.19418	19	480.1167	-0.19009
10	15.1167	-0.19404	20	540.1167	-0.19015



Pressure: 14000 psf **TEST READINGS (continued)** **Load No. 7**

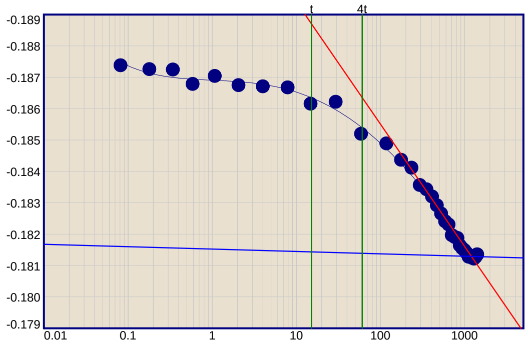
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
21	600.1167	-0.18981	31	1200.1333	-0.18806
22	660.1167	-0.18943	32	1260.1333	-0.18804
23	720.1167	-0.18932	33	1320.1333	-0.18810
24	780.1167	-0.18906	34	1380.1333	-0.18804
25	840.1167	-0.18809	35	1440.1333	-0.18803
26	900.1167	-0.18812	36	1440.1833	-0.18802
27	960.1167	-0.18807			
28	1020.1167	-0.18811			
29	1080.1167	-0.18812			
30	1140.1333	-0.18803			

Void Ratio = 0.639 **Compression** = 11.3%

D_0 = -0.1951 **D_{50}** = -0.1916 **D_{100}** = -0.1881 **C_v at 176.13 min.** = 0.001 ft.^{2}/day **C_α** = 0.000

Pressure: 16000 psf **TEST READINGS** **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18802	19	480.1167	-0.18289
2	0.0833	-0.18735	20	540.1167	-0.18263
3	0.1833	-0.18723	21	600.1167	-0.18238
4	0.3500	-0.18722	22	660.1167	-0.18228
5	0.6000	-0.18676	23	720.1167	-0.18194
6	1.1000	-0.18701	24	780.1167	-0.18188
7	2.1000	-0.18672	25	840.1167	-0.18185
8	4.1000	-0.18668	26	900.1167	-0.18162
9	8.1000	-0.18665	27	960.1167	-0.18152
10	15.1000	-0.18613	28	1020.1167	-0.18146
11	30.1000	-0.18619	29	1080.1167	-0.18138
12	60.1000	-0.18517	30	1140.1333	-0.18125
13	120.1000	-0.18486	31	1200.1333	-0.18126
14	180.1167	-0.18434	32	1260.1333	-0.18122
15	240.1167	-0.18409	33	1320.1333	-0.18119
16	300.1167	-0.18354	34	1380.1333	-0.18124
17	360.1167	-0.18340	35	1440.1333	-0.18132
18	420.1167	-0.18317	36	1440.3667	-0.18133

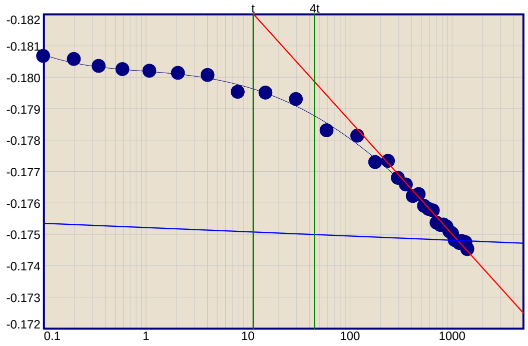


Void Ratio = 0.622 **Compression** = 12.2%

D_0 = -0.1873 **D_{50}** = -0.1843 **D_{100}** = -0.1813 **C_v at 168.11 min.** = 0.001 ft.^{2}/day **C_α** = 0.000

Pressure: 18000 psf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18133	19	480.1167	-0.17625
2	0.1000	-0.18065	20	540.1167	-0.17588
3	0.2000	-0.18055	21	600.1167	-0.17578
4	0.3500	-0.18033	22	660.1167	-0.17573
5	0.6000	-0.18023	23	720.1167	-0.17534
6	1.1000	-0.18018	24	780.1167	-0.17527
7	2.1000	-0.18011	25	840.1167	-0.17528
8	4.1000	-0.18004	26	900.1167	-0.17522
9	8.1000	-0.17951	27	960.1167	-0.17507
10	15.1000	-0.17948	28	1020.1167	-0.17500
11	30.1167	-0.17928	29	1080.1333	-0.17479
12	60.1167	-0.17828	30	1140.1333	-0.17476
13	120.1167	-0.17811	31	1200.1333	-0.17470
14	180.1167	-0.17727	32	1260.1333	-0.17476
15	240.1167	-0.17731	33	1320.1333	-0.17474
16	300.1167	-0.17677	34	1380.1333	-0.17472
17	360.1167	-0.17656	35	1440.1333	-0.17450
18	420.1167	-0.17619	36	1440.1667	-0.17452

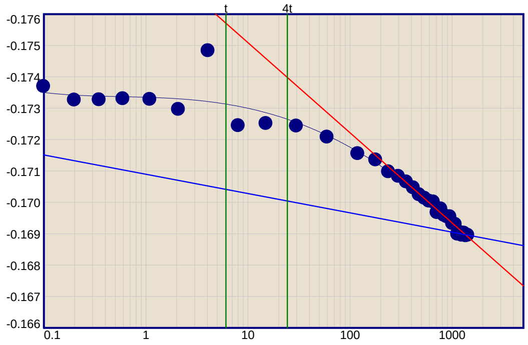


Void Ratio = 0.605 **Compression =** 13.1%

D_0 = -0.1805 **D_{50} =** -0.1776 **D_{100} =** -0.1748 **C_v at 144.70 min. =** 0.001 ft.^{2}/day **C_α =** 0.000

Pressure: 20000 psf **TEST READINGS** **Load No. 10**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17453	18	420.1000	-0.17045
2	0.1000	-0.17368	19	480.1000	-0.17023
3	0.2000	-0.17325	20	540.1167	-0.17012
4	0.3500	-0.17326	21	600.1167	-0.17003
5	0.6000	-0.17329	22	660.1167	-0.17000
6	1.1000	-0.17327	23	720.1167	-0.16966
7	2.1000	-0.17295	24	780.1167	-0.16978
8	4.1000	-0.17482	25	840.1167	-0.16958
9	8.1000	-0.17243	26	900.1167	-0.16953
10	15.1000	-0.17250	27	960.1167	-0.16953
11	30.1000	-0.17242	28	1020.1167	-0.16931
12	60.1000	-0.17207	29	1080.1167	-0.16929
13	120.1000	-0.17154	30	1140.1167	-0.16897
14	180.1000	-0.17134	31	1200.1167	-0.16903
15	240.1000	-0.17096	32	1260.1167	-0.16894
16	300.1000	-0.17082	33	1320.1167	-0.16901
17	360.1000	-0.17064	34	1380.1167	-0.16892



Pressure: 20000 psf TEST READINGS (continued) Load No. 10

No.	Elapsed Time	Dial Reading
35	1440.1333	-0.16894

Void Ratio = 0.592 **Compression =** 13.8%

D_0 = -0.1736 **D_{50} =** -0.1713 **D_{100} =** -0.1690 **C_v at 172.81 min. =** 0.001 ft.^{2}/day **C_α =** 0.002

Pressure: 18000 psf TEST READINGS Load No. 11

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.16891	13	120.1167	-0.16950	25	840.1167	-0.16942
2	0.1000	-0.16939	14	180.1167	-0.16946	26	900.1167	-0.16944
3	0.2000	-0.16939	15	240.1167	-0.16947	27	960.1167	-0.16947
4	0.3500	-0.16944	16	300.1167	-0.16952	28	1020.1167	-0.16945
5	0.6000	-0.16941	17	360.1167	-0.16953	29	1080.1333	-0.16945
6	1.1000	-0.16944	18	420.1167	-0.16951	30	1140.1333	-0.16943
7	2.1000	-0.16941	19	480.1167	-0.16949	31	1200.1333	-0.16944
8	4.1000	-0.16946	20	540.1167	-0.16950	32	1260.1333	-0.16965
9	8.1000	-0.16944	21	600.1167	-0.16944	33	1320.1333	-0.16988
10	15.1167	-0.16946	22	660.1167	-0.16952	34	1380.1333	-0.17006
11	30.1167	-0.16948	23	720.1167	-0.16945	35	1440.1333	-0.17010
12	60.1167	-0.16949	24	780.1167	-0.16943	36	1440.4500	-0.17009

Void Ratio = 0.594 **Compression =** 13.7%

Pressure: 16000 psf TEST READINGS Load No. 12

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17009	13	120.1000	-0.17134	25	840.1167	-0.17147
2	0.1000	-0.17113	14	180.1167	-0.17130	26	900.1167	-0.17143
3	0.2000	-0.17119	15	240.1167	-0.17126	27	960.1333	-0.17144
4	0.3500	-0.17119	16	300.1167	-0.17136	28	1020.1333	-0.17139
5	0.6000	-0.17122	17	360.1167	-0.17130	29	1080.1333	-0.17137
6	1.1000	-0.17120	18	420.1167	-0.17151	30	1140.1333	-0.17144
7	2.1000	-0.17122	19	480.1167	-0.17156	31	1200.1333	-0.17132
8	4.1000	-0.17121	20	540.1167	-0.17147	32	1260.1333	-0.17143
9	8.1000	-0.17114	21	600.1167	-0.17149	33	1320.1333	-0.17140
10	15.1000	-0.17125	22	660.1167	-0.17150	34	1380.1333	-0.17139
11	30.1000	-0.17126	23	720.1167	-0.17140	35	1440.0333	-0.17145
12	60.1000	-0.17125	24	780.1167	-0.17153			

Void Ratio = 0.598 **Compression =** 13.5%

Pressure: 14000 psf **TEST READINGS** **Load No. 13**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17145	13	120.1000	-0.17255	25	840.1167	-0.17260
2	0.0833	-0.17245	14	180.1000	-0.17262	26	900.1167	-0.17259
3	0.2000	-0.17249	15	240.1167	-0.17257	27	960.1167	-0.17256
4	0.3500	-0.17254	16	300.1167	-0.17286	28	1020.1167	-0.17256
5	0.6000	-0.17257	17	360.1167	-0.17273	29	1080.1167	-0.17261
6	1.1000	-0.17254	18	420.1167	-0.17278	30	1140.1167	-0.17261
7	2.1000	-0.17256	19	480.1167	-0.17284	31	1200.1167	-0.17263
8	4.1000	-0.17247	20	540.1167	-0.17291	32	1260.1333	-0.17253
9	8.1000	-0.17257	21	600.1167	-0.17276	33	1320.1333	-0.17261
10	15.1000	-0.17260	22	660.1167	-0.17275	34	1380.1333	-0.17267
11	30.1000	-0.17262	23	720.1167	-0.17257	35	1440.1333	-0.17266
12	60.1000	-0.17261	24	780.1167	-0.17274	36	1440.2167	-0.17267

Void Ratio = 0.601 **Compression =** 13.3%

Pressure: 12000 psf **TEST READINGS** **Load No. 14**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17267	13	120.1000	-0.17379	25	840.1167	-0.17395
2	0.0833	-0.17333	14	180.1000	-0.17400	26	900.1167	-0.17400
3	0.2000	-0.17331	15	240.1000	-0.17394	27	960.1167	-0.17405
4	0.3500	-0.17343	16	300.1000	-0.17399	28	1020.1167	-0.17397
5	0.6000	-0.17344	17	360.1000	-0.17412	29	1080.1167	-0.17396
6	1.1000	-0.17346	18	420.1000	-0.17409	30	1140.1167	-0.17395
7	2.1000	-0.17351	19	480.1167	-0.17405	31	1200.1167	-0.17400
8	4.1000	-0.17351	20	540.1167	-0.17417	32	1260.1167	-0.17400
9	8.1000	-0.17354	21	600.1167	-0.17405	33	1320.1167	-0.17390
10	15.1000	-0.17350	22	660.1167	-0.17401	34	1380.1167	-0.17404
11	30.1000	-0.17356	23	720.1167	-0.17408	35	1440.1333	-0.17407
12	60.1000	-0.17355	24	780.1167	-0.17403	36	1440.4000	-0.17404

Void Ratio = 0.604 **Compression =** 13.2%

Pressure: 10000 psf **TEST READINGS** **Load No. 15**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17404	13	120.1000	-0.17561	25	840.1167	-0.17559
2	0.1000	-0.17511	14	180.1000	-0.17567	26	900.1167	-0.17566
3	0.2000	-0.17526	15	240.1000	-0.17573	27	960.1167	-0.17563
4	0.3500	-0.17531	16	300.1000	-0.17569	28	1020.1167	-0.17567
5	0.6000	-0.17539	17	360.1000	-0.17571	29	1080.1167	-0.17571
6	1.1000	-0.17530	18	420.1000	-0.17573	30	1140.1167	-0.17562
7	2.1000	-0.17541	19	480.1167	-0.17576	31	1200.1167	-0.17565
8	4.1000	-0.17543	20	540.1167	-0.17568	32	1260.1167	-0.17567
9	8.1000	-0.17548	21	600.1167	-0.17573	33	1320.1167	-0.17564
10	15.1000	-0.17559	22	660.1167	-0.17569	34	1380.1167	-0.17567
11	30.1000	-0.17565	23	720.1167	-0.17564	35	1440.1167	-0.17566
12	60.1000	-0.17570	24	780.1167	-0.17568	36	1440.1667	-0.17564

Void Ratio = 0.608 **Compression =** 12.9%

Pressure: 8000 psf **TEST READINGS** **Load No. 16**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17565	13	120.1167	-0.17752	25	840.1167	-0.17762
2	0.1000	-0.17688	14	180.1167	-0.17752	26	900.1333	-0.17763
3	0.2000	-0.17706	15	240.1167	-0.17757	27	960.1333	-0.17763
4	0.3667	-0.17709	16	300.1167	-0.17758	28	1020.1333	-0.17762
5	0.6167	-0.17719	17	360.1167	-0.17767	29	1080.1333	-0.17765
6	1.1167	-0.17730	18	420.1167	-0.17766	30	1140.1333	-0.17761
7	2.1167	-0.17730	19	480.1167	-0.17763	31	1200.1333	-0.17764
8	4.1167	-0.17729	20	540.1167	-0.17768	32	1260.1333	-0.17759
9	8.1167	-0.17743	21	600.1167	-0.17768	33	1320.1333	-0.17765
10	15.1167	-0.17736	22	660.1167	-0.17767	34	1380.1333	-0.17763
11	30.1167	-0.17743	23	720.1167	-0.17762	35	1440.1333	-0.17760
12	60.1167	-0.17748	24	780.1167	-0.17767	36	1440.3667	-0.17761

Void Ratio = 0.613 **Compression =** 12.7%

Pressure: 6000 psf **TEST READINGS** **Load No. 17**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17760	13	120.1000	-0.17964	25	840.1167	-0.17992
2	0.0833	-0.17859	14	180.1000	-0.17964	26	900.1167	-0.17994
3	0.1833	-0.17876	15	240.1000	-0.17966	27	960.1167	-0.17995
4	0.3333	-0.17892	16	300.1000	-0.17973	28	1020.1167	-0.18003
5	0.6000	-0.17903	17	360.1000	-0.17967	29	1080.1167	-0.18005
6	1.1000	-0.17912	18	420.1000	-0.17970	30	1140.1167	-0.18006
7	2.1000	-0.17921	19	480.1000	-0.17978	31	1200.1167	-0.18005
8	4.1000	-0.17927	20	540.1000	-0.17973	32	1260.1167	-0.18018
9	8.1000	-0.17938	21	600.1000	-0.17977	33	1320.1167	-0.18017
10	15.1000	-0.17939	22	660.1167	-0.17979	34	1380.1167	-0.18025
11	30.1000	-0.17947	23	720.1167	-0.17983	35	1440.1167	-0.18029
12	60.1000	-0.17958	24	780.1167	-0.17983	36	1440.1500	-0.18029

Void Ratio = 0.620 **Compression =** 12.3%

Pressure: 4000 psf **TEST READINGS** **Load No. 18**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18030	13	120.1167	-0.18350	25	840.1333	-0.18374
2	0.1000	-0.18169	14	180.1167	-0.18349	26	900.1333	-0.18391
3	0.2000	-0.18192	15	240.1167	-0.18349	27	960.1333	-0.18389
4	0.3500	-0.18215	16	300.1167	-0.18346	28	1020.1333	-0.18396
5	0.6000	-0.18237	17	360.1167	-0.18353	29	1080.1333	-0.18401
6	1.1000	-0.18257	18	420.1167	-0.18355	30	1140.1333	-0.18409
7	2.1000	-0.18281	19	480.1167	-0.18357	31	1200.1333	-0.18403
8	4.1000	-0.18295	20	540.1167	-0.18359	32	1260.1333	-0.18406
9	8.1000	-0.18308	21	600.1333	-0.18362	33	1320.1333	-0.18407
10	15.1167	-0.18312	22	660.1333	-0.18369	34	1380.1333	-0.18409
11	30.1167	-0.18324	23	720.1333	-0.18369	35	1440.1333	-0.18410
12	60.1167	-0.18333	24	780.1333	-0.18375	36	1440.1667	-0.18410

Void Ratio = 0.629 **Compression =** 11.8%

Pressure: 2000 psf **TEST READINGS** **Load No. 19**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18404	13	120.1000	-0.18943	25	840.1167	-0.18981
2	0.0833	-0.18578	14	180.1000	-0.18956	26	900.1167	-0.18983
3	0.2000	-0.18604	15	240.1000	-0.18959	27	960.1167	-0.18975
4	0.3500	-0.18641	16	300.1000	-0.18964	28	1020.1167	-0.18977
5	0.6000	-0.18676	17	360.1000	-0.18973	29	1080.1167	-0.18978
6	1.1000	-0.18729	18	420.1167	-0.18977	30	1140.1167	-0.18980
7	2.1000	-0.18777	19	480.1167	-0.18971	31	1200.1167	-0.18990
8	4.1000	-0.18837	20	540.1167	-0.18982	32	1260.1167	-0.18988
9	8.1000	-0.18873	21	600.1167	-0.18979	33	1320.1167	-0.18986
10	15.1000	-0.18893	22	660.1167	-0.18978	34	1380.1167	-0.19005
11	30.1000	-0.18916	23	720.1167	-0.18976	35	1440.1167	-0.19001
12	60.1000	-0.18940	24	780.1167	-0.18975	36	1440.2667	-0.19002

Void Ratio = 0.644 **Compression =** 11.0%

Pressure: 4000 psf **TEST READINGS** **Load No. 20**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.19001	13	120.1167	-0.18721	25	840.1333	-0.18697
2	0.1000	-0.18883	14	180.1167	-0.18716	26	900.1333	-0.18687
3	0.2000	-0.18859	15	240.1167	-0.18715	27	960.1333	-0.18690
4	0.3500	-0.18833	16	300.1167	-0.18716	28	1020.1333	-0.18694
5	0.6000	-0.18809	17	360.1167	-0.18714	29	1080.1333	-0.18690
6	1.1000	-0.18783	18	420.1167	-0.18714	30	1140.1333	-0.18686
7	2.1000	-0.18775	19	480.1167	-0.18710	31	1200.1333	-0.18689
8	4.1000	-0.18763	20	540.1167	-0.18708	32	1260.1333	-0.18680
9	8.1000	-0.18755	21	600.1167	-0.18713	33	1320.1333	-0.18687
10	15.1000	-0.18751	22	660.1167	-0.18707	34	1380.1333	-0.18684
11	30.1167	-0.18749	23	720.1167	-0.18706	35	1440.1333	-0.18680
12	60.1167	-0.18737	24	780.1167	-0.18703	36	1440.1667	-0.18680

Void Ratio = 0.636 **Compression =** 11.5%

Pressure: 6000 psf **TEST READINGS** **Load No. 21**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18681	13	120.1000	-0.18412	25	840.1167	-0.18374
2	0.1000	-0.18570	14	180.1000	-0.18400	26	900.1167	-0.18369
3	0.2000	-0.18539	15	240.1167	-0.18404	27	960.1167	-0.18369
4	0.3500	-0.18515	16	300.1167	-0.18405	28	1020.1167	-0.18369
5	0.6000	-0.18491	17	360.1167	-0.18401	29	1080.1167	-0.18370
6	1.1000	-0.18470	18	420.1167	-0.18406	30	1140.1167	-0.18361
7	2.1000	-0.18456	19	480.1167	-0.18399	31	1200.1167	-0.18367
8	4.1000	-0.18448	20	540.1167	-0.18404	32	1260.1167	-0.18369
9	8.1000	-0.18444	21	600.1167	-0.18401	33	1320.1167	-0.18360
10	15.1000	-0.18436	22	660.1167	-0.18392	34	1380.1167	-0.18362
11	30.1000	-0.18428	23	720.1167	-0.18382	35	1440.0000	-0.18358
12	60.1000	-0.18423	24	780.1167	-0.18381			

Void Ratio = 0.628 **Compression =** 11.9%

Pressure: 8000 psf **TEST READINGS** **Load No. 22**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18359	13	120.1167	-0.18117	25	840.1167	-0.18095
2	0.1000	-0.18245	14	180.1167	-0.18114	26	900.1167	-0.18098
3	0.2000	-0.18226	15	240.1167	-0.18117	27	960.1167	-0.18094
4	0.3500	-0.18201	16	300.1167	-0.18107	28	1020.1167	-0.18098
5	0.6000	-0.18183	17	360.1167	-0.18112	29	1080.1167	-0.18087
6	1.1000	-0.18171	18	420.1167	-0.18110	30	1140.1333	-0.18085
7	2.1000	-0.18159	19	480.1167	-0.18118	31	1200.1333	-0.18079
8	4.1000	-0.18152	20	540.1167	-0.18117	32	1260.1333	-0.18087
9	8.1000	-0.18148	21	600.1167	-0.18110	33	1320.1333	-0.18082
10	15.1000	-0.18141	22	660.1167	-0.18105	34	1380.1333	-0.18090
11	30.1000	-0.18133	23	720.1167	-0.18101	35	1440.1000	-0.18087
12	60.1167	-0.18134	24	780.1167	-0.18104			

Void Ratio = 0.621 **Compression =** 12.2%

Pressure: 10000 psf **TEST READINGS** **Load No. 23**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18087	13	120.1000	-0.17868	25	840.1167	-0.17836
2	0.1000	-0.17977	14	180.1000	-0.17873	26	900.1167	-0.17832
3	0.2000	-0.17957	15	240.1000	-0.17868	27	960.1167	-0.17832
4	0.3500	-0.17942	16	300.1000	-0.17865	28	1020.1167	-0.17829
5	0.6000	-0.17928	17	360.1000	-0.17859	29	1080.1167	-0.17836
6	1.1000	-0.17921	18	420.1000	-0.17858	30	1140.1167	-0.17827
7	2.1000	-0.17914	19	480.1000	-0.17856	31	1200.1167	-0.17838
8	4.1000	-0.17914	20	540.1167	-0.17855	32	1260.1167	-0.17838
9	8.1000	-0.17911	21	600.1167	-0.17835	33	1320.1167	-0.17839
10	15.1000	-0.17902	22	660.1167	-0.17839	34	1380.1167	-0.17829
11	30.1000	-0.17888	23	720.1167	-0.17839	35	1440.0333	-0.17835
12	60.1000	-0.17888	24	780.1167	-0.17840			

Void Ratio = 0.615 **Compression =** 12.6%

Pressure: 12000 psf **TEST READINGS** **Load No. 24**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17834	13	120.1167	-0.17624	25	840.1333	-0.17586
2	0.1000	-0.17718	14	180.1167	-0.17620	26	900.1333	-0.17586
3	0.2000	-0.17701	15	240.1167	-0.17603	27	960.1333	-0.17591
4	0.3500	-0.17691	16	300.1167	-0.17610	28	1020.1333	-0.17583
5	0.6000	-0.17678	17	360.1167	-0.17608	29	1080.1333	-0.17587
6	1.1000	-0.17668	18	420.1167	-0.17600	30	1140.1333	-0.17593
7	2.1000	-0.17671	19	480.1167	-0.17598	31	1200.1333	-0.17590
8	4.1000	-0.17665	20	540.1167	-0.17592	32	1260.1333	-0.17591
9	8.1000	-0.17657	21	600.1167	-0.17591	33	1320.1333	-0.17588
10	15.1000	-0.17654	22	660.1167	-0.17589	34	1380.1333	-0.17582
11	30.1167	-0.17642	23	720.1167	-0.17592	35	1440.0167	-0.17588
12	60.1167	-0.17633	24	780.1333	-0.17588			

Void Ratio = 0.609 **Compression =** 12.9%

Pressure: 14000 psf **TEST READINGS** **Load No. 25**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17588	13	120.1000	-0.17400	25	840.1000	-0.17358
2	0.0833	-0.17478	14	180.1000	-0.17392	26	900.1167	-0.17353
3	0.1833	-0.17461	15	240.1000	-0.17382	27	960.1167	-0.17358
4	0.3500	-0.17456	16	300.1000	-0.17384	28	1020.1167	-0.17356
5	0.6000	-0.17451	17	360.1000	-0.17381	29	1080.1167	-0.17353
6	1.1000	-0.17443	18	420.1000	-0.17372	30	1140.1167	-0.17351
7	2.1000	-0.17435	19	480.1000	-0.17363	31	1200.1167	-0.17356
8	4.1000	-0.17431	20	540.1000	-0.17371	32	1260.1167	-0.17360
9	8.1000	-0.17425	21	600.1000	-0.17366	33	1320.1167	-0.17349
10	15.1000	-0.17431	22	660.1000	-0.17359	34	1380.1167	-0.17350
11	30.1000	-0.17419	23	720.1000	-0.17363	35	1440.1167	-0.17357
12	60.1000	-0.17412	24	780.1000	-0.17349	36	1440.2833	-0.17359

Void Ratio = 0.603 **Compression =** 13.2%

Pressure: 16000 psf **TEST READINGS** **Load No. 26**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17359	13	120.1167	-0.17125	25	840.1167	-0.17104
2	0.1000	-0.17249	14	180.1167	-0.17123	26	900.1167	-0.17101
3	0.2000	-0.17240	15	240.1167	-0.17125	27	960.1167	-0.17102
4	0.3500	-0.17236	16	300.1167	-0.17132	28	1020.1167	-0.17108
5	0.6000	-0.17228	17	360.1167	-0.17124	29	1080.1167	-0.17097
6	1.1000	-0.17217	18	420.1167	-0.17131	30	1140.1333	-0.17109
7	2.1000	-0.17215	19	480.1167	-0.17127	31	1200.1333	-0.17106
8	4.1000	-0.17210	20	540.1167	-0.17130	32	1260.1333	-0.17102
9	8.1167	-0.17209	21	600.1167	-0.17121	33	1320.1333	-0.17103
10	15.1167	-0.17198	22	660.1167	-0.17114	34	1380.1333	-0.17104
11	30.1167	-0.17185	23	720.1167	-0.17109	35	1440.1333	-0.17100
12	60.1167	-0.17132	24	780.1167	-0.17112	36	1440.2833	-0.17099

Void Ratio = 0.597 **Compression =** 13.6%

Pressure: 18000 psf **TEST READINGS** **Load No. 27**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17099	13	120.1167	-0.16880	25	840.1333	-0.16822
2	0.1000	-0.17009	14	180.1167	-0.16834	26	900.1333	-0.16827
3	0.2000	-0.17004	15	240.1167	-0.16829	27	960.1333	-0.16828
4	0.3500	-0.16988	16	300.1167	-0.16830	28	1020.1333	-0.16825
5	0.6000	-0.16982	17	360.1167	-0.16826	29	1080.1333	-0.16828
6	1.1167	-0.16978	18	420.1167	-0.16836	30	1140.1333	-0.16821
7	2.1167	-0.16969	19	480.1167	-0.16827	31	1200.1333	-0.16820
8	4.1167	-0.16955	20	540.1167	-0.16827	32	1260.1333	-0.16838
9	8.1167	-0.16960	21	600.1167	-0.16828	33	1320.1333	-0.16815
10	15.1167	-0.16956	22	660.1333	-0.16831	34	1380.1333	-0.16812
11	30.1167	-0.16941	23	720.1333	-0.16835	35	1440.0333	-0.16805
12	60.1167	-0.16909	24	780.1333	-0.16830			

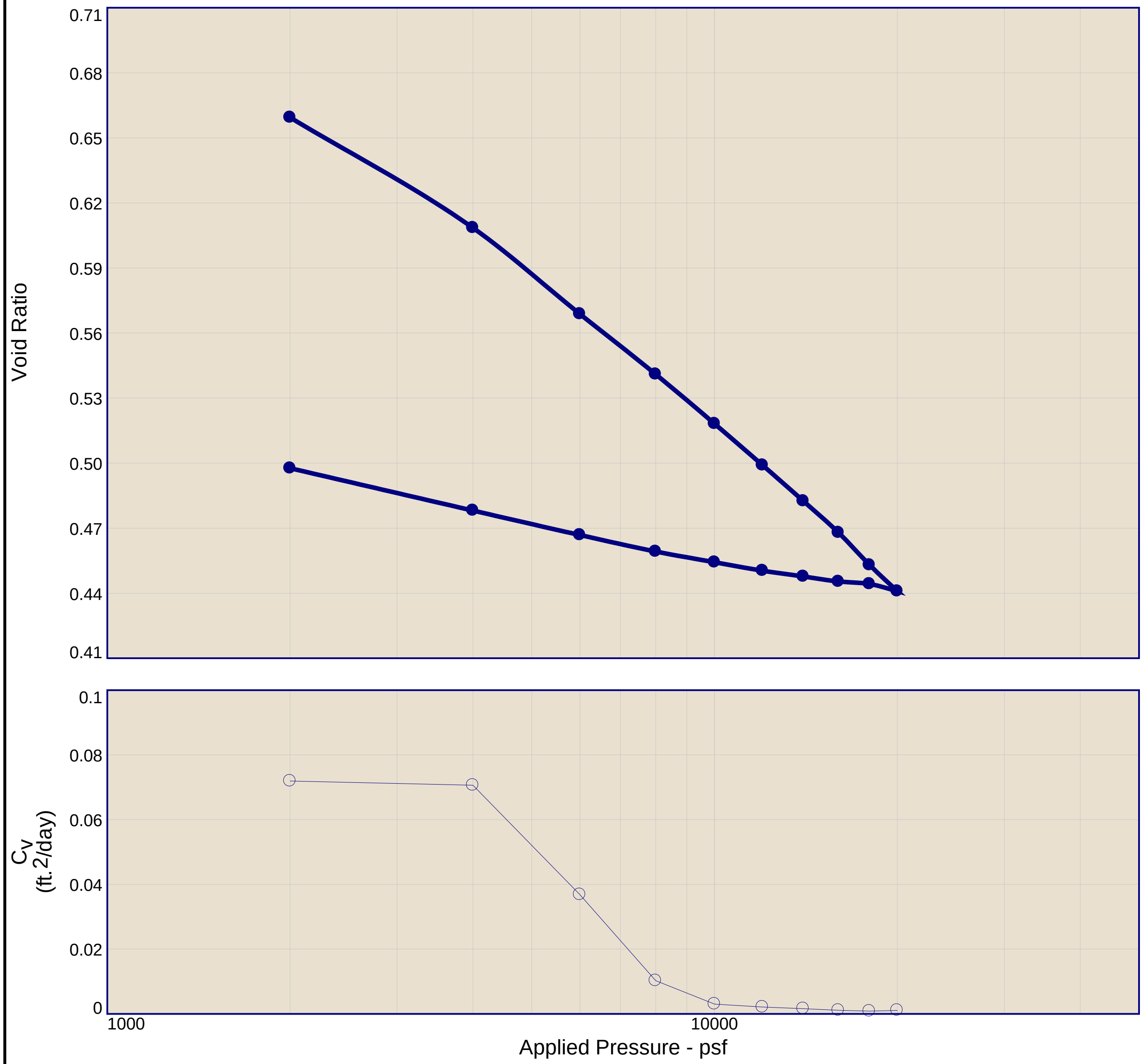
Void Ratio = 0.589 **Compression =** 14.0%

Pressure: 20000 psf **TEST READINGS** **Load No. 28**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.16805	13	120.1000	-0.16608	25	840.1000	-0.16512
2	0.0833	-0.16753	14	180.1000	-0.16608	26	900.1000	-0.16510
3	0.1833	-0.16742	15	240.1000	-0.16589	27	960.1167	-0.16507
4	0.3500	-0.16733	16	300.1000	-0.16568	28	1020.1167	-0.16515
5	0.6000	-0.16735	17	360.1000	-0.16572	29	1080.1167	-0.16505
6	1.1000	-0.16720	18	420.1000	-0.16573	30	1140.1167	-0.16519
7	2.1000	-0.16720	19	480.1000	-0.16555	31	1200.1167	-0.16505
8	4.1000	-0.16702	20	540.1000	-0.16570	32	1260.1167	-0.16501
9	8.1000	-0.16692	21	600.1000	-0.16570	33	1320.1167	-0.16542
10	15.1000	-0.16679	22	660.1000	-0.16538	34	1380.1167	-0.16501
11	30.1000	-0.16676	23	720.1000	-0.16521	35	1440.1167	-0.16498
12	60.1000	-0.16648	24	780.1000	-0.16513	36	1440.4167	-0.16500

Void Ratio = 0.582 **Compression =** 14.4%

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.4 %	26.4 %	96.9			2.7	4900				0.739

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 2121- **Client:** Somat

Project: Somat Project 2019086E

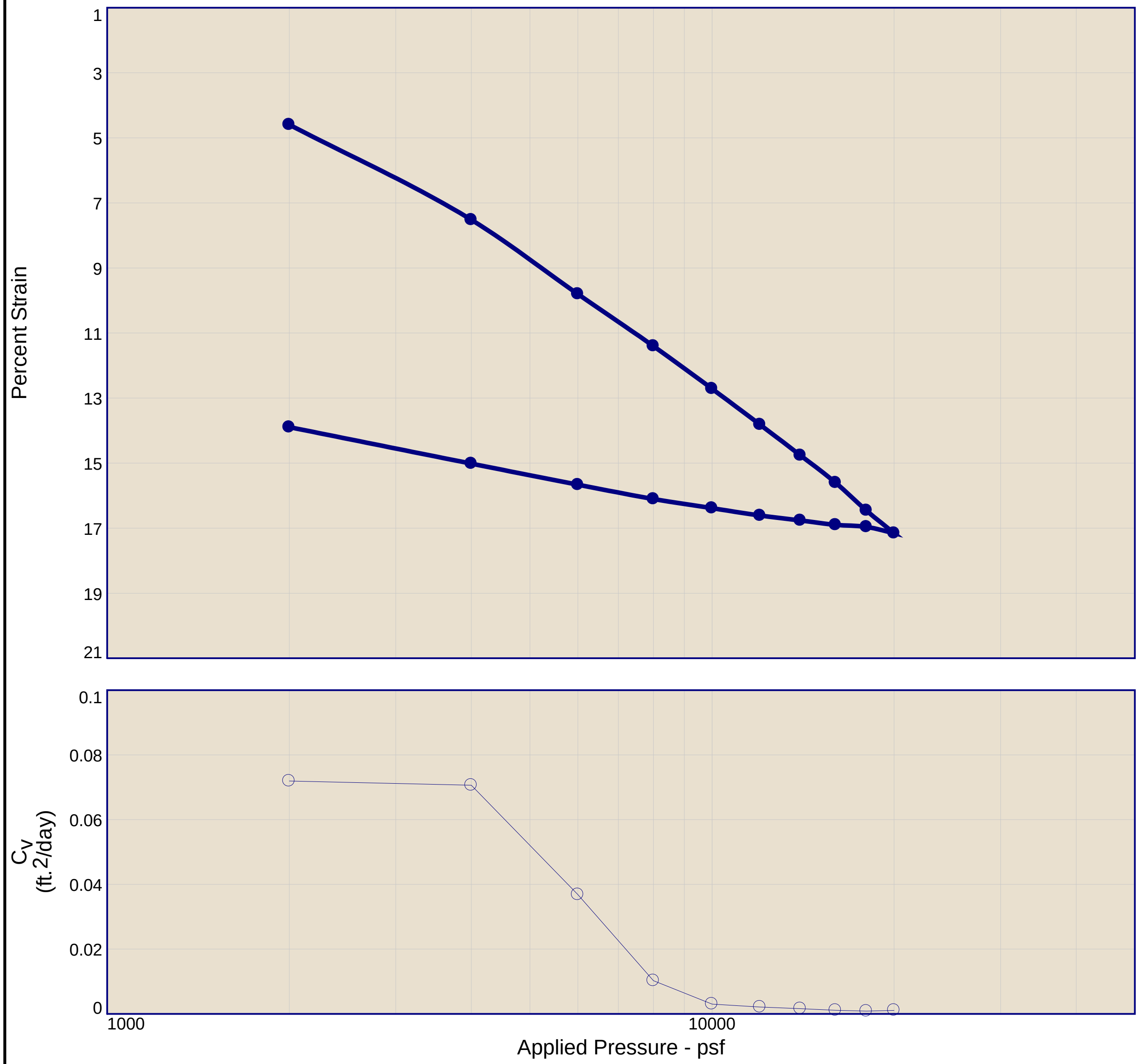
Source of Sample: B-2 **Depth:** 40.0'-42.0' **Sample Number:** ST-16

DLZ

Remarks:

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (psf)	P_c (psf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.4 %	26.4 %	96.9			2.7	4900				0.739

MATERIAL DESCRIPTION	USCS	AASHTO

Project No. 2121- **Client:** Somat

Project: Somat Project 2019086E

Source of Sample: B-2 **Depth:** 40.0'-42.0' **Sample Number:** ST-16

DLZ

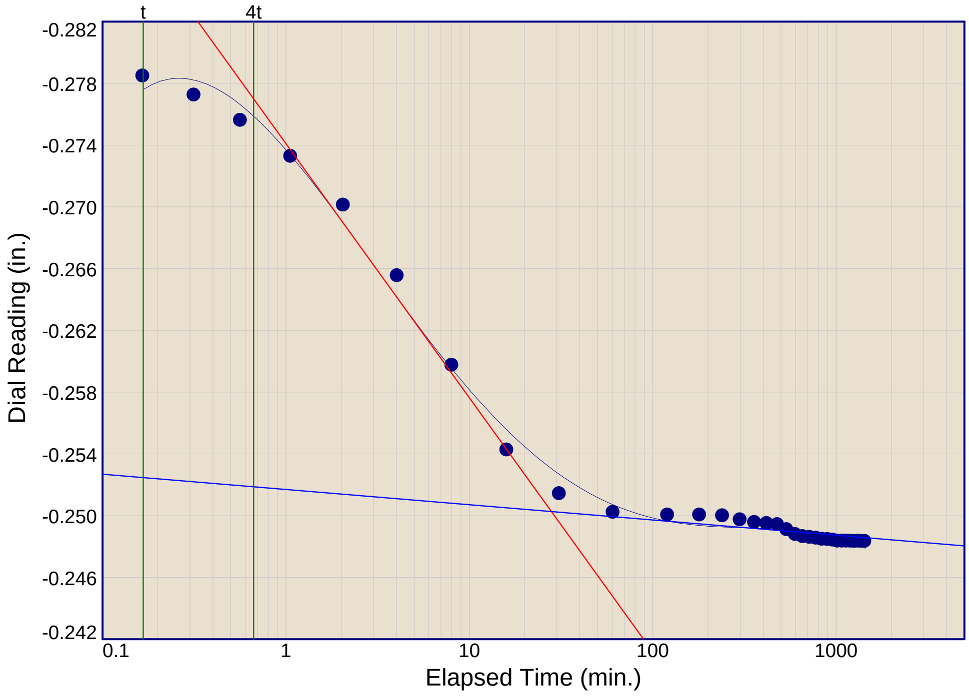
Remarks:

Figure

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-2 Depth: 40.0'-42.0' Sample Number: ST-16



Load No.= 1

Load= 2000 psf

D_0 = -0.2793

D_{50} = -0.2648

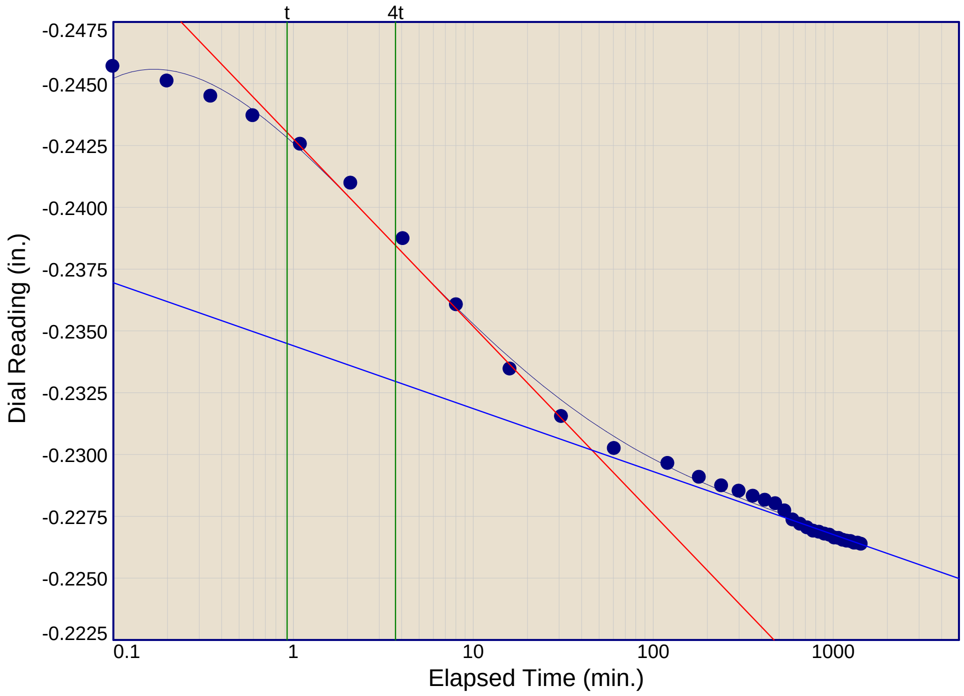
D_{100} = -0.2503

T_{50} = 3.68 min.

C_v @ T_{50}

0.072 ft.^{2}/day

C_α = 0.002



Load No.= 2

Load= 4000 psf

D_0 = -0.2472

D_{50} = -0.2387

D_{100} = -0.2302

T_{50} = 3.46 min.

C_v @ T_{50}

0.071 ft.^{2}/day

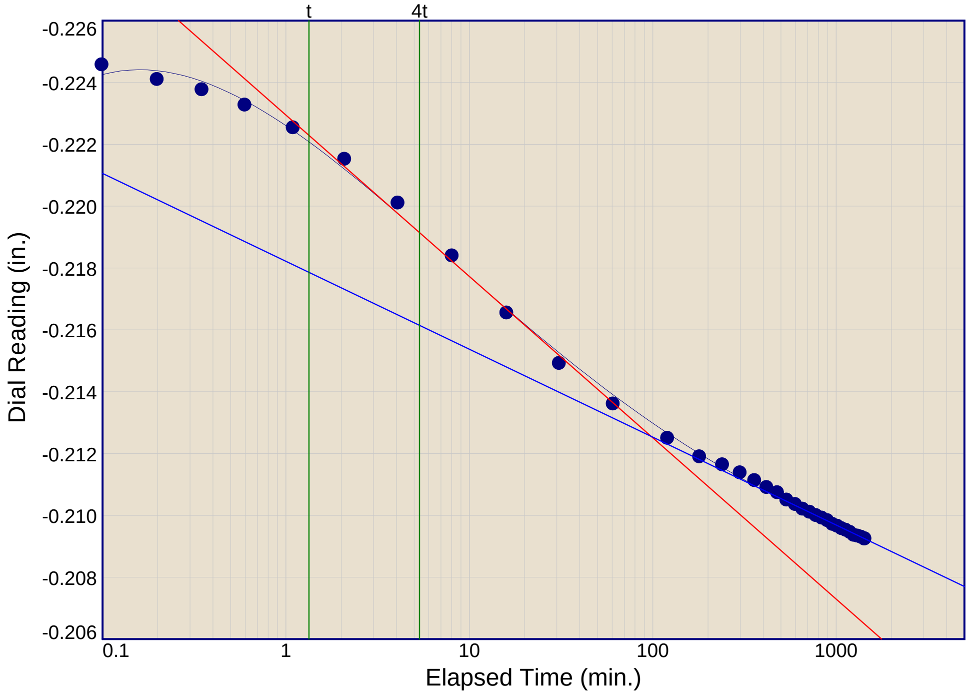
C_α = 0.006

Figure

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-2 Depth: 40.0'-42.0' Sample Number: ST-16



Load No.= 3

Load= 6000 psf

D_0 = -0.2250

D_{50} = -0.2188

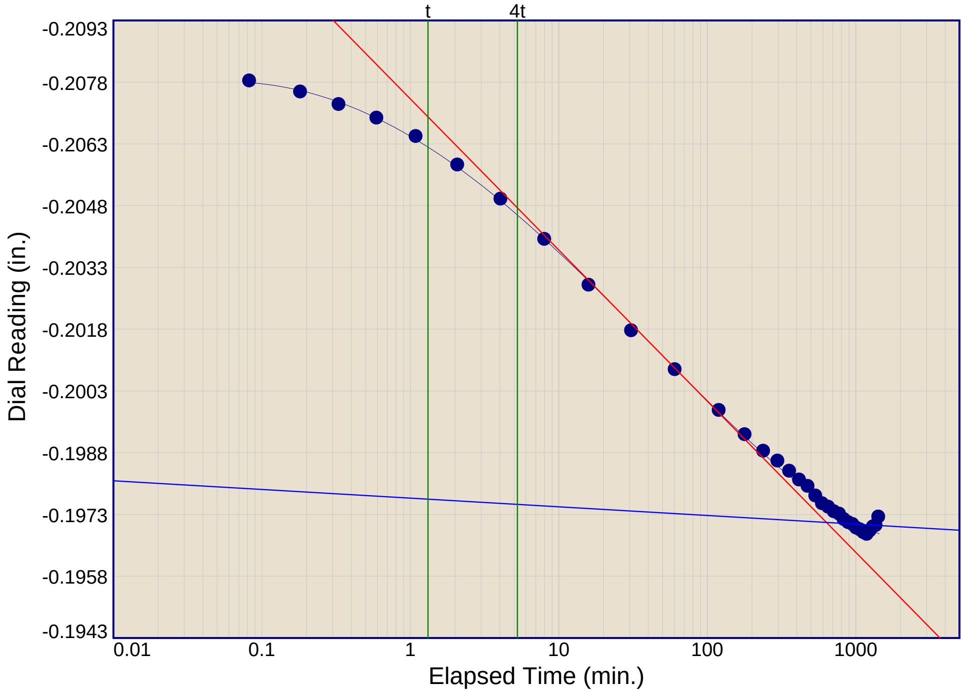
D_{100} = -0.2126

T_{50} = 6.28 min.

C_v @ T_{50}

0.037 ft.^{2}/day

C_α = 0.007



Load No.= 4

Load= 8000 psf

D_0 = -0.2079

D_{50} = -0.2025

D_{100} = -0.1971

T_{50} = 21.62 min.

C_v @ T_{50}

0.010 ft.^{2}/day

C_α = 0.000

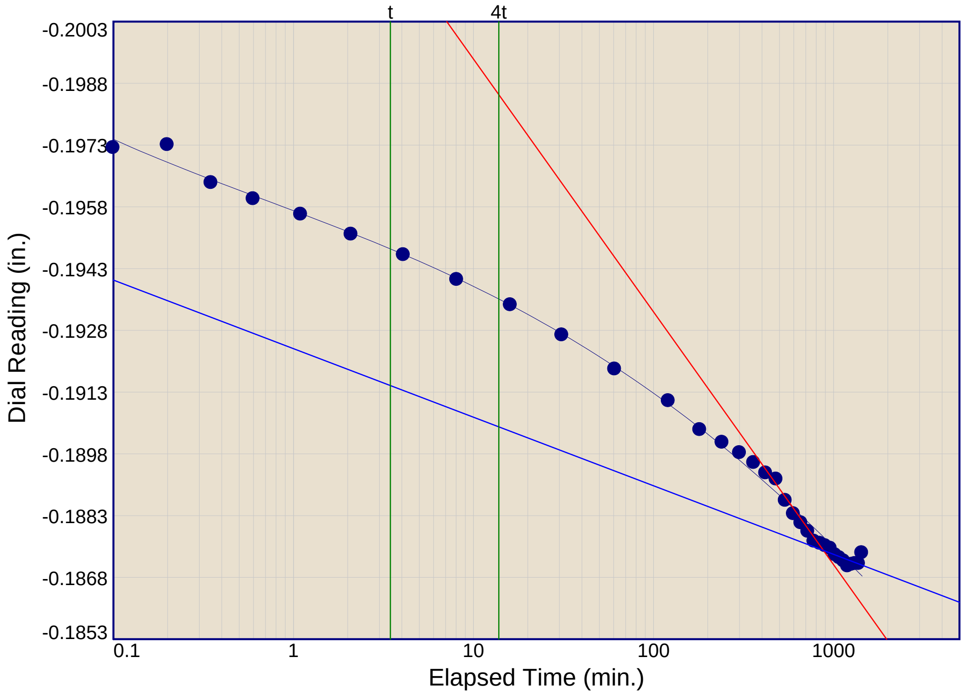
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-2 Depth: 40.0'-42.0' Sample Number: ST-16



Load No.= 5

Load= 10000 psf

D_0 = -0.1960

D_{50} = -0.1917

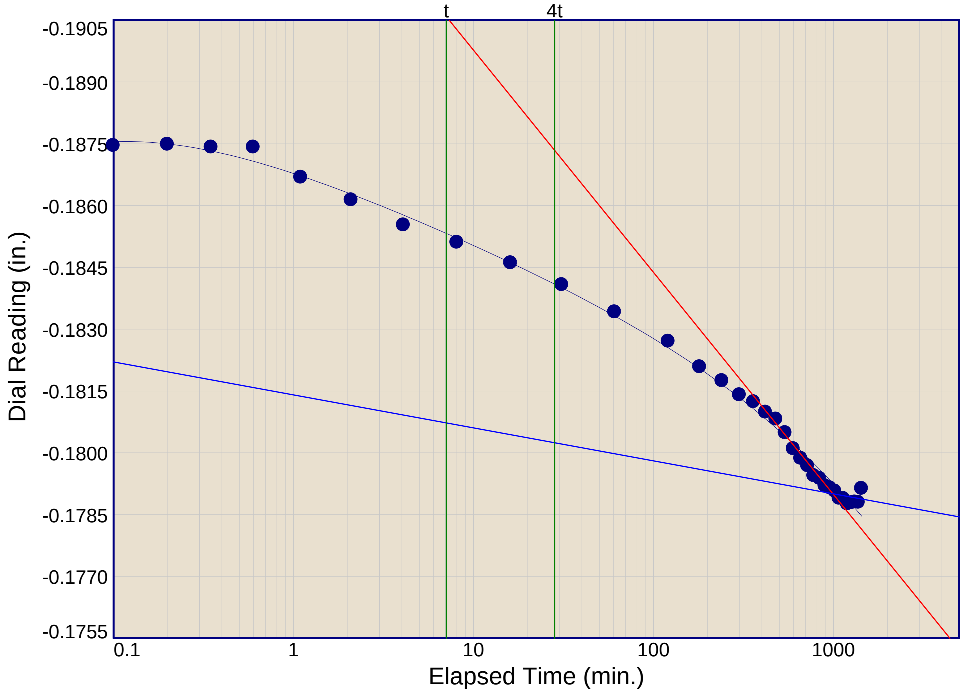
D_{100} = -0.1875

T_{50} = 70.95 min.

C_v @ T_{50}

0.003 ft.^{2}/day

C_α = 0.004



Load No.= 6

Load= 12000 psf

D_0 = -0.1866

D_{50} = -0.1828

D_{100} = -0.1790

T_{50} = 99.10 min.

C_v @ T_{50}

0.002 ft.^{2}/day

C_α = 0.002

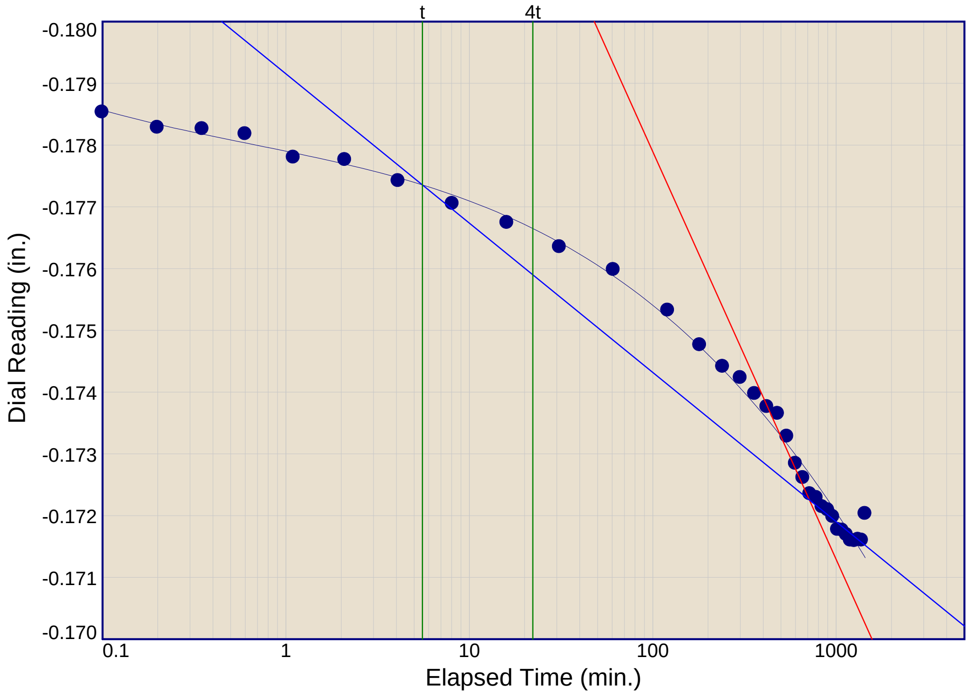
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-2 Depth: 40.0'-42.0' Sample Number: ST-16



Load No.= 7

Load= 14000 psf

D_0 = -0.1781

D_{50} = -0.1752

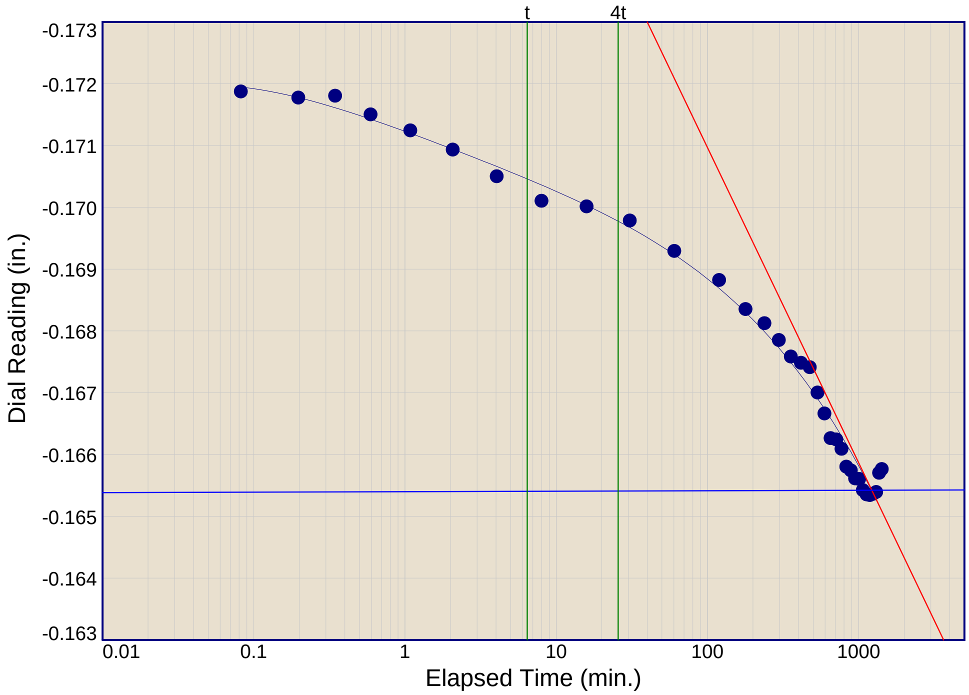
D_{100} = -0.1723

T_{50} = 126.20 min.

C_v @ T_{50}

0.002 ft.^{2}/day

C_α = 0.006



Load No.= 8

Load= 16000 psf

D_0 = -0.1711

D_{50} = -0.1683

D_{100} = -0.1654

T_{50} = 181.69 min.

C_v @ T_{50}

0.001 ft.^{2}/day

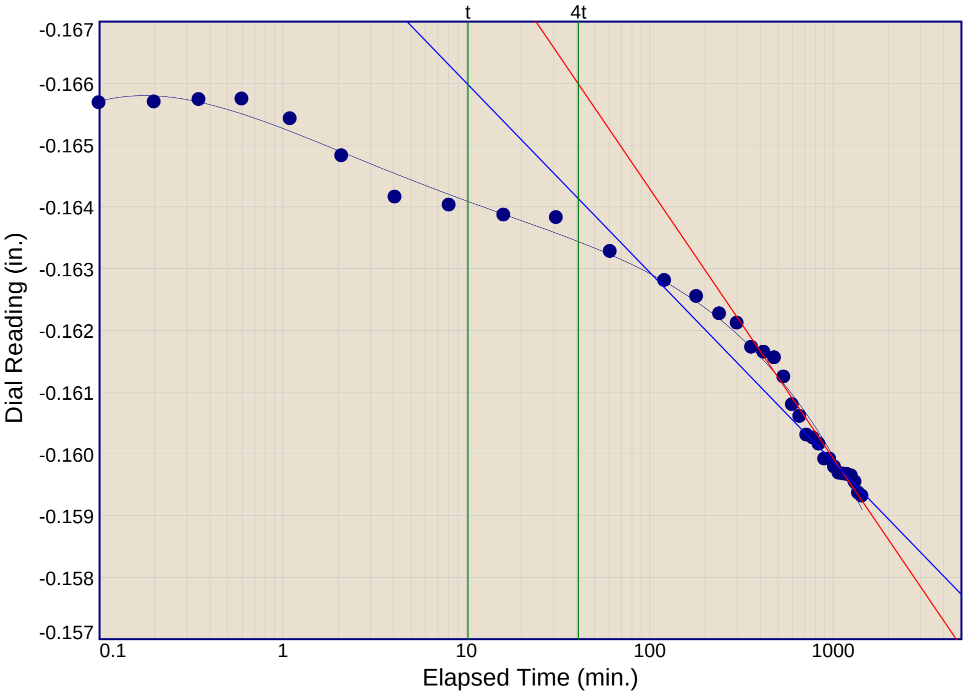
Figure

DLZ, INC.

Dial Reading vs. Time

Project No.: 2121-4619.01
Project: Somat Project 2019086E

Source of Sample: B-2 Depth: 40.0'-42.0' Sample Number: ST-16



Load No.= 9

Load= 18000 psf

D_0 = -0.1647

D_{50} = -0.1622

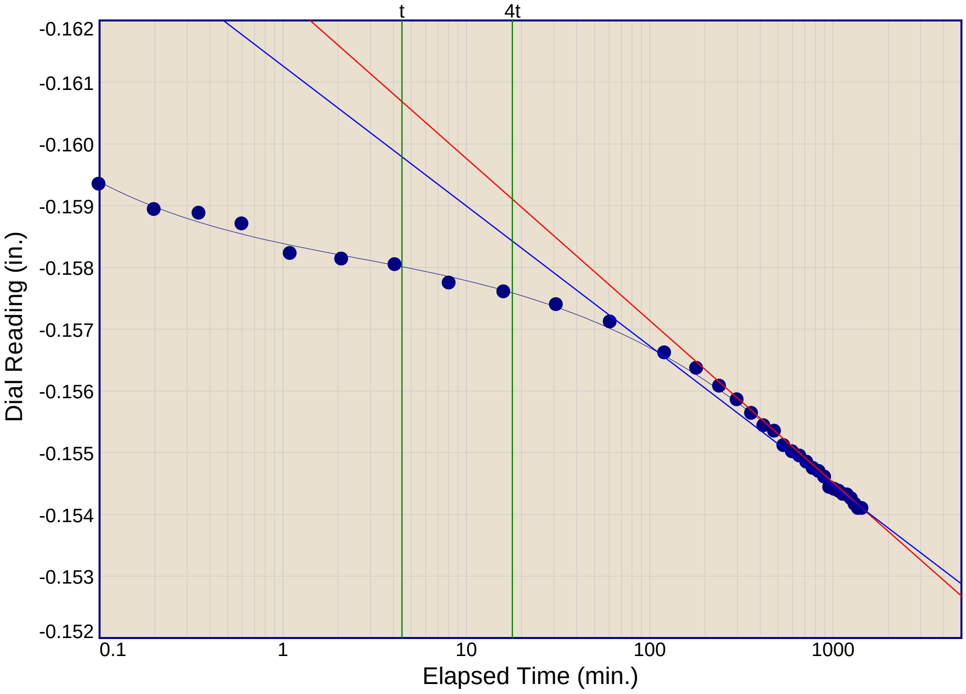
D_{100} = -0.1597

T_{50} = 228.59 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.007



Load No.= 10

Load= 20000 psf

D_0 = -0.1584

D_{50} = -0.1563

D_{100} = -0.1541

T_{50} = 176.76 min.

C_v @ T_{50}

0.001 ft.^{2}/day

C_α = 0.005

Figure

DLZ, INC.

CONSOLIDATION TEST DATA

10/19/2021

Client: Somat
Project: Somat Project 2019086E
Project Number: 2121-4619.01
Location: B-2
Depth: 40.0'-42.0'
Sample Number: ST-16

Test Specimen Data

NATURAL MOISTURE
Wet w+t = 343.06 g.
Dry w+t = 284.16 g.
Tare Wt. = 61.07 g.
Moisture = 26.4 %

VOID RATIO
Spec. Gr. = 2.7
Est. Ht. Solids = 0.431 in.
Init. V.R. = 0.739
Init. Sat. = 96.4 %

AFTER TEST
Wet w+t = g.
Dry w+t = g.
Tare Wt. = g.
Moisture = %

UNIT WEIGHT
Height = 0.750 in.
Diameter = 2.500 in.
Weight = 118.38 g.
Dry Dens. = 96.9 pcf

TEST START
Height = 0.750 in.
Diameter = 2.500 in.

Dry Wt. =

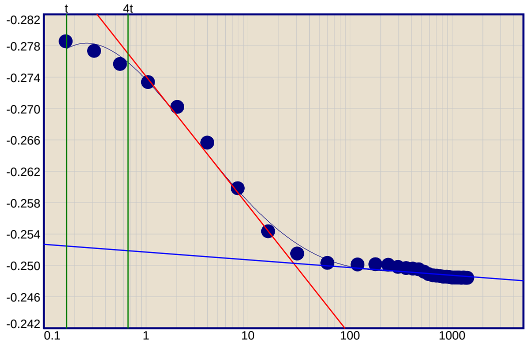
End-Of-Load Summary

Pressure (psf)	Final Dial (in.)	Deformation (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Strain
start	-0.28275	0.00000			0.739	
2000	-0.24830	0.03445	0.072	0.002	0.659	4.6 Comprs.
4000	-0.22636	0.05639	0.071	0.006	0.609	7.5 Comprs.
6000	-0.20923	0.07352	0.037	0.007	0.569	9.8 Comprs.
8000	-0.19723	0.08552	0.010	0.000	0.541	11.4 Comprs.
10000	-0.18739	0.09536	0.003	0.004	0.518	12.7 Comprs.
12000	-0.17913	0.10362	0.002	0.002	0.499	13.8 Comprs.
14000	-0.17203	0.11072	0.002	0.006	0.483	14.8 Comprs.
16000	-0.16575	0.11700	0.001		0.468	15.6 Comprs.
18000	-0.15931	0.12344	0.001	0.007	0.453	16.5 Comprs.
20000	-0.15409	0.12866	0.001	0.005	0.441	17.2 Comprs.
18000	-0.15554	0.12721			0.444	17.0 Comprs.
16000	-0.15602	0.12673			0.445	16.9 Comprs.
14000	-0.15702	0.12573			0.448	16.8 Comprs.
12000	-0.15817	0.12458			0.450	16.6 Comprs.
10000	-0.15986	0.12289			0.454	16.4 Comprs.
8000	-0.16198	0.12077		0.000	0.459	16.1 Comprs.
6000	-0.16527	0.11748			0.467	15.7 Comprs.
4000	-0.17013	0.11262			0.478	15.0 Comprs.
2000	-0.17855	0.10420			0.498	13.9 Comprs.

Compression index (C_c), psf = 0.28 **Preconsolidation pressure (P_p), psf =** 6264 **Void ratio at P_p (e_m) =** 0.565
Overburden (σ_{vo}), psf = 4900 **Void ratio at σ_{vo} (e_o) =** 0.589

Pressure: 2000 psf **TEST READINGS** **Load No. 1**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.28275	18	481.1000	-0.24940
2	0.1667	-0.27845	19	541.1000	-0.24907
3	0.3167	-0.27722	20	601.1000	-0.24876
4	0.5667	-0.27557	21	661.1000	-0.24862
5	1.0667	-0.27324	22	721.1000	-0.24856
6	2.0667	-0.27008	23	781.1167	-0.24852
7	4.0667	-0.26552	24	841.1167	-0.24844
8	8.0667	-0.25971	25	901.1167	-0.24842
9	16.0667	-0.25423	26	961.1167	-0.24839
10	31.0667	-0.25140	27	1021.1167	-0.24833
11	61.0667	-0.25019	28	1081.1167	-0.24833
12	121.0667	-0.25001	29	1141.1167	-0.24832
13	181.0667	-0.25002	30	1201.1167	-0.24832
14	241.0833	-0.24997	31	1261.1167	-0.24831
15	301.0833	-0.24970	32	1321.1167	-0.24832
16	361.0833	-0.24954	33	1381.1167	-0.24831
17	421.1000	-0.24947	34	1439.2500	-0.24830

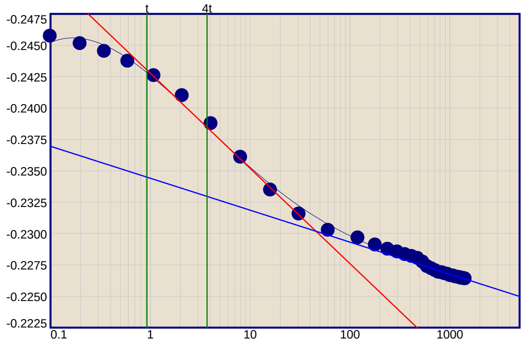


Void Ratio = 0.659 **Compression =** 4.6%

D_0 = -0.2793 **D_{50} =** -0.2648 **D_{100} =** -0.2503 **C_v at 3.68 min. =** 0.072 ft.^{2}/day **C_α =** 0.002

Pressure: 4000 psf **TEST READINGS** **Load No. 2**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.24830	19	481.1167	-0.22800
2	0.1000	-0.24569	20	541.1167	-0.22770
3	0.2000	-0.24509	21	601.1167	-0.22734
4	0.3500	-0.24448	22	661.1167	-0.22717
5	0.6000	-0.24369	23	721.1167	-0.22702
6	1.1000	-0.24254	24	781.1167	-0.22688
7	2.1000	-0.24096	25	841.1000	-0.22684
8	4.1000	-0.23872	26	901.1000	-0.22677
9	8.1000	-0.23604	27	961.1000	-0.22672
10	16.1000	-0.23344	28	1021.1000	-0.22661
11	31.1000	-0.23152	29	1081.1000	-0.22659
12	61.1000	-0.23023	30	1141.1000	-0.22652
13	121.1000	-0.22962	31	1201.1000	-0.22648
14	181.1000	-0.22906	32	1261.1000	-0.22646
15	241.1000	-0.22872	33	1321.1167	-0.22640
16	301.1167	-0.22850	34	1381.1333	-0.22640
17	361.1167	-0.22830	35	1440.1500	-0.22636
18	421.1167	-0.22814			

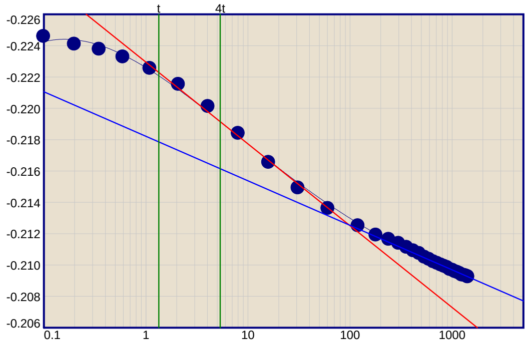


Void Ratio = 0.609 **Compression =** 7.5%

D_0 = -0.2472 **D_{50} =** -0.2387 **D_{100} =** -0.2302 **C_v at 3.46 min. =** 0.071 ft.^{2}/day **C_α =** 0.006

Pressure: 6000 psf **TEST READINGS** **Load No. 3**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.22636	19	481.0333	-0.21072
2	0.1000	-0.22456	20	540.9667	-0.21048
3	0.2000	-0.22408	21	600.9333	-0.21034
4	0.3500	-0.22375	22	660.9167	-0.21019
5	0.6000	-0.22325	23	720.8833	-0.21009
6	1.1000	-0.22252	24	780.8833	-0.20998
7	2.1000	-0.22150	25	840.8667	-0.20990
8	4.1000	-0.22009	26	900.8667	-0.20982
9	8.1000	-0.21838	27	960.8667	-0.20970
10	16.1000	-0.21653	28	1021.2333	-0.20964
11	31.1167	-0.21490	29	1077.5000	-0.20956
12	61.1167	-0.21359	30	1137.5000	-0.20951
13	121.1333	-0.21248	31	1197.5000	-0.20944
14	181.1333	-0.21188	32	1257.5000	-0.20934
15	241.1333	-0.21162	33	1317.5000	-0.20932
16	301.1500	-0.21136	34	1377.5000	-0.20928
17	361.1500	-0.21111	35	1437.5000	-0.20922
18	421.1333	-0.21089	36	1440.3000	-0.20923

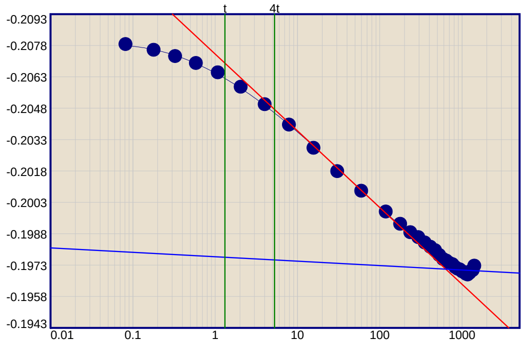


Void Ratio = 0.569 **Compression =** 9.8%

D_0 = -0.2250 **D_{50} =** -0.2188 **D_{100} =** -0.2126 **C_v at 6.28 min. =** 0.037 ft.^{2}/day **C_α =** 0.007

Pressure: 8000 psf **TEST READINGS** **Load No. 4**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.20922	18	421.1167	-0.19813
2	0.0833	-0.20782	19	481.1167	-0.19797
3	0.1833	-0.20755	20	541.1167	-0.19774
4	0.3333	-0.20725	21	601.1167	-0.19755
5	0.6000	-0.20692	22	661.1167	-0.19747
6	1.1000	-0.20647	23	721.1167	-0.19736
7	2.1000	-0.20578	24	781.1167	-0.19730
8	4.1000	-0.20495	25	841.1167	-0.19717
9	8.1000	-0.20397	26	901.1167	-0.19709
10	16.1000	-0.20286	27	961.1167	-0.19705
11	31.1000	-0.20175	28	1021.1167	-0.19696
12	61.1000	-0.20081	29	1081.1333	-0.19692
13	121.1000	-0.19982	30	1141.1333	-0.19685
14	181.1000	-0.19923	31	1201.1333	-0.19681
15	241.1000	-0.19883	32	1261.1333	-0.19689
16	301.1000	-0.19859	33	1321.1333	-0.19699
17	361.1167	-0.19834	34	1381.1333	-0.19702



Pressure: 8000 psf TEST READINGS (continued) Load No. 4

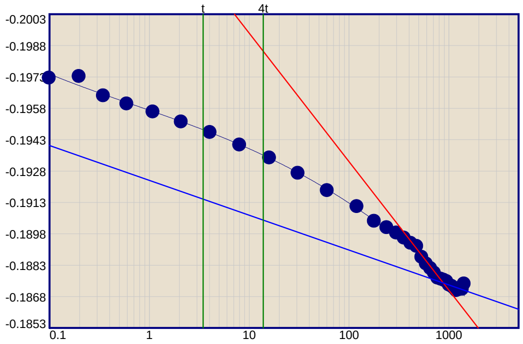
No.	Elapsed Time	Dial Reading
35	1440.2333	-0.19723

Void Ratio = 0.541 **Compression =** 11.4%

D_0 = -0.2079 **D_{50} =** -0.2025 **D_{100} =** -0.1971 **C_v at 21.62 min. =** 0.010 ft.^{2}/day **C_α =** 0.000

Pressure: 10000 psf TEST READINGS Load No. 5

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.19724	19	481.1167	-0.18918
2	0.1000	-0.19723	20	541.1167	-0.18866
3	0.2000	-0.19730	21	601.1167	-0.18834
4	0.3500	-0.19638	22	661.1167	-0.18812
5	0.6000	-0.19599	23	721.1167	-0.18791
6	1.1000	-0.19561	24	781.1167	-0.18767
7	2.1000	-0.19513	25	841.1333	-0.18762
8	4.1000	-0.19463	26	901.1333	-0.18756
9	8.1000	-0.19403	27	961.1333	-0.18750
10	16.1000	-0.19341	28	1021.1333	-0.18734
11	31.1000	-0.19268	29	1081.1333	-0.18727
12	61.1167	-0.19185	30	1141.1333	-0.18719
13	121.1167	-0.19108	31	1201.1333	-0.18707
14	181.1167	-0.19038	32	1261.1333	-0.18711
15	241.1167	-0.19007	33	1321.1333	-0.18713
16	301.1167	-0.18982	34	1381.1333	-0.18713
17	361.1167	-0.18958	35	1440.1667	-0.18739
18	421.1167	-0.18933			

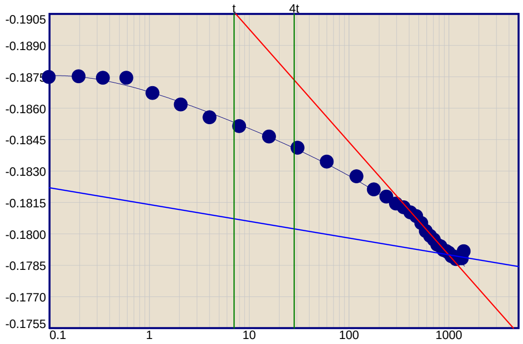


Void Ratio = 0.518 **Compression =** 12.7%

D_0 = -0.1960 **D_{50} =** -0.1917 **D_{100} =** -0.1875 **C_v at 70.95 min. =** 0.003 ft.^{2}/day **C_α =** 0.004

Pressure: 12000 psf TEST READINGS Load No. 6

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.18739	11	31.1167	-0.18407
2	0.1000	-0.18745	12	61.1167	-0.18341
3	0.2000	-0.18748	13	121.1167	-0.18270
4	0.3500	-0.18741	14	181.1167	-0.18208
5	0.6000	-0.18741	15	241.1167	-0.18174
6	1.1000	-0.18668	16	301.1167	-0.18140
7	2.1000	-0.18613	17	361.1167	-0.18123
8	4.1000	-0.18552	18	421.1167	-0.18098
9	8.1167	-0.18510	19	481.1167	-0.18081
10	16.1167	-0.18460	20	541.1333	-0.18048



Pressure: 12000 psf **TEST READINGS (continued)** **Load No. 6**

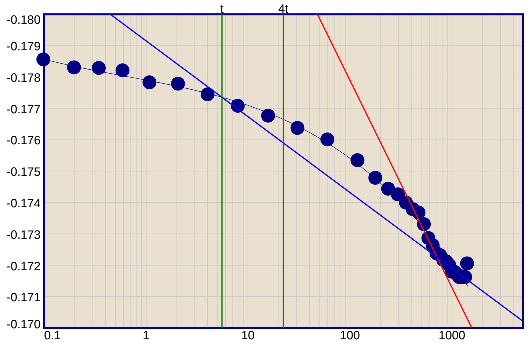
No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
21	601.1333	-0.18009	31	1201.1333	-0.17875
22	661.1333	-0.17986	32	1261.1333	-0.17878
23	721.1333	-0.17968	33	1321.1333	-0.17880
24	781.1333	-0.17944	34	1381.1333	-0.17879
25	841.1333	-0.17937	35	1440.4167	-0.17913
26	901.1333	-0.17919			
27	961.1333	-0.17914			
28	1021.1333	-0.17906			
29	1081.1333	-0.17889			
30	1141.1333	-0.17888			

Void Ratio = 0.499 **Compression =** 13.8%

D_0 = -0.1866 **D_{50} =** -0.1828 **D_{100} =** -0.1790 **C_v at 99.10 min. =** 0.002 ft.^{2}/day **C_α =** 0.002

Pressure: 14000 psf **TEST READINGS** **Load No. 7**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17913	19	481.1167	-0.17365
2	0.1000	-0.17853	20	541.1167	-0.17328
3	0.2000	-0.17828	21	601.1167	-0.17284
4	0.3500	-0.17826	22	661.1167	-0.17261
5	0.6000	-0.17818	23	721.1167	-0.17235
6	1.1000	-0.17780	24	781.1167	-0.17229
7	2.1000	-0.17776	25	841.1167	-0.17214
8	4.1000	-0.17742	26	901.1167	-0.17209
9	8.1000	-0.17705	27	961.1333	-0.17198
10	16.1000	-0.17674	28	1021.1333	-0.17177
11	31.1000	-0.17635	29	1081.1333	-0.17176
12	61.1000	-0.17598	30	1141.1333	-0.17169
13	121.1167	-0.17532	31	1201.1333	-0.17160
14	181.1167	-0.17476	32	1261.1333	-0.17159
15	241.1167	-0.17441	33	1321.1333	-0.17161
16	301.1167	-0.17423	34	1381.1333	-0.17160
17	361.1167	-0.17397	35	1440.4167	-0.17203
18	421.1167	-0.17376			

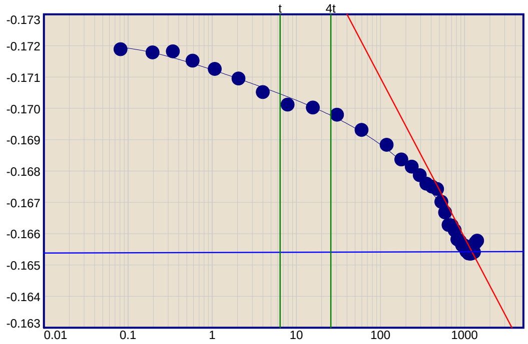


Void Ratio = 0.483 **Compression =** 14.8%

D_0 = -0.1781 **D_{50} =** -0.1752 **D_{100} =** -0.1723 **C_v at 126.20 min. =** 0.002 ft.^{2}/day **C_α =** 0.006

Pressure: 16000 psf **TEST READINGS** **Load No. 8**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17203	19	481.1167	-0.16740
2	0.0833	-0.17186	20	541.1167	-0.16699
3	0.2000	-0.17176	21	601.1167	-0.16665
4	0.3500	-0.17179	22	661.1167	-0.16625
5	0.6000	-0.17149	23	721.1167	-0.16623
6	1.1000	-0.17123	24	781.1167	-0.16608
7	2.1000	-0.17092	25	841.1167	-0.16579
8	4.1000	-0.17049	26	901.1167	-0.16573
9	8.1000	-0.17009	27	961.1167	-0.16560
10	16.1000	-0.17000	28	1021.1167	-0.16559
11	31.1000	-0.16977	29	1081.1167	-0.16541
12	61.1000	-0.16928	30	1141.1333	-0.16534
13	121.1000	-0.16881	31	1201.1333	-0.16533
14	181.1000	-0.16834	32	1261.1333	-0.16535
15	241.1000	-0.16811	33	1321.1333	-0.16538
16	301.1167	-0.16784	34	1381.1333	-0.16569
17	361.1167	-0.16757	35	1440.2500	-0.16575
18	421.1167	-0.16747			

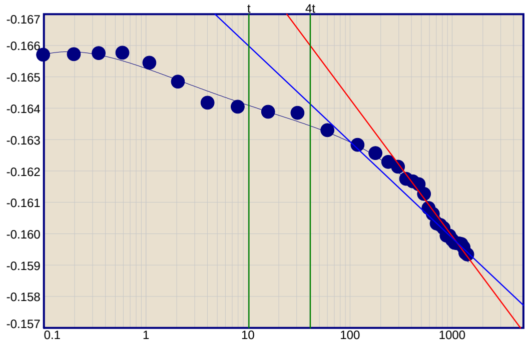


Void Ratio = 0.468 **Compression =** 15.6%

D_0 = -0.1711 **D_{50} =** -0.1683 **D_{100} =** -0.1654 **C_v at 181.69 min. =** 0.001 ft.^{2}/day

Pressure: 18000 psf **TEST READINGS** **Load No. 9**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.16568	18	421.1167	-0.16164
2	0.1000	-0.16568	19	481.1167	-0.16155
3	0.2000	-0.16569	20	541.1167	-0.16124
4	0.3500	-0.16573	21	601.1167	-0.16079
5	0.6000	-0.16574	22	661.1167	-0.16060
6	1.1000	-0.16542	23	721.1167	-0.16030
7	2.1000	-0.16482	24	781.1167	-0.16025
8	4.1000	-0.16415	25	841.1167	-0.16015
9	8.1000	-0.16402	26	901.1167	-0.15991
10	16.1000	-0.16386	27	961.1167	-0.15991
11	31.1000	-0.16382	28	1021.1333	-0.15978
12	61.1000	-0.16327	29	1081.1333	-0.15968
13	121.1167	-0.16280	30	1141.1333	-0.15967
14	181.1167	-0.16254	31	1201.1333	-0.15966
15	241.1167	-0.16226	32	1261.1333	-0.15964
16	301.1167	-0.16211	33	1321.1333	-0.15954
17	361.1167	-0.16172	34	1381.1333	-0.15936



Pressure: 18000 psf **TEST READINGS (continued)** **Load No. 9**

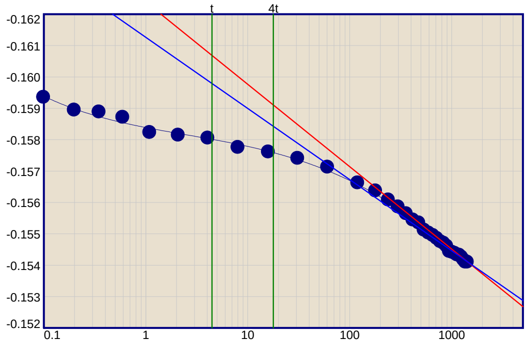
No.	Elapsed Time	Dial Reading
35	1440.3000	-0.15931

Void Ratio = 0.453 **Compression =** 16.5%

D_0 = -0.1647 **D_{50} =** -0.1622 **D_{100} =** -0.1597 **C_v at 228.59 min. =** 0.001 ft.^{2}/day **C_α =** 0.007

Pressure: 20000 psf **TEST READINGS** **Load No. 10**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15932	19	481.1000	-0.15534
2	0.1000	-0.15934	20	541.1000	-0.15511
3	0.2000	-0.15893	21	601.1000	-0.15501
4	0.3500	-0.15887	22	661.1000	-0.15494
5	0.6000	-0.15870	23	721.1000	-0.15484
6	1.1000	-0.15822	24	781.1000	-0.15474
7	2.1000	-0.15813	25	841.1000	-0.15469
8	4.1000	-0.15804	26	901.1000	-0.15460
9	8.1000	-0.15774	27	961.1000	-0.15443
10	16.1000	-0.15760	28	1021.1000	-0.15440
11	31.1000	-0.15739	29	1081.1167	-0.15437
12	61.1000	-0.15711	30	1141.1167	-0.15432
13	121.1000	-0.15661	31	1201.1167	-0.15431
14	181.1000	-0.15636	32	1261.1167	-0.15425
15	241.1000	-0.15607	33	1321.1167	-0.15416
16	301.1000	-0.15585	34	1381.1167	-0.15409
17	361.1000	-0.15563	35	1440.0333	-0.15409
18	421.1000	-0.15543			



Void Ratio = 0.441 **Compression =** 17.2%

D_0 = -0.1584 **D_{50} =** -0.1563 **D_{100} =** -0.1541 **C_v at 176.76 min. =** 0.001 ft.^{2}/day **C_α =** 0.005

Pressure: 18000 psf **TEST READINGS** **Load No. 11**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15410	11	31.1000	-0.15406	21	601.1167	-0.15408
2	0.0833	-0.15408	12	61.1000	-0.15406	22	661.1167	-0.15407
3	0.2000	-0.15408	13	121.1000	-0.15407	23	721.1167	-0.15406
4	0.3500	-0.15408	14	181.1000	-0.15405	24	781.1167	-0.15406
5	0.6000	-0.15407	15	241.1000	-0.15405	25	841.1167	-0.15407
6	1.1000	-0.15407	16	301.1000	-0.15405	26	901.1167	-0.15407
7	2.1000	-0.15407	17	361.1000	-0.15406	27	961.1167	-0.15406
8	4.1000	-0.15406	18	421.1000	-0.15405	28	1021.1167	-0.15407
9	8.1000	-0.15406	19	481.1167	-0.15407	29	1081.1167	-0.15406
10	16.1000	-0.15407	20	541.1167	-0.15407	30	1141.1167	-0.15407

Pressure: 18000 psf **TEST READINGS (continued)** **Load No. 11**

No.	Elapsed Time	Dial Reading
31	1201.1333	-0.15416
32	1261.1333	-0.15441
33	1321.1333	-0.15553
34	1381.1333	-0.15553
35	1440.0000	-0.15554

Void Ratio = 0.444 **Compression =** 17.0%

Pressure: 16000 psf **TEST READINGS** **Load No. 12**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15554	13	121.1167	-0.15617	25	841.1167	-0.15593
2	0.1000	-0.15553	14	181.1167	-0.15616	26	901.1167	-0.15593
3	0.2000	-0.15553	15	241.1167	-0.15615	27	961.1167	-0.15594
4	0.3500	-0.15554	16	301.1167	-0.15615	28	1021.1167	-0.15594
5	0.6000	-0.15554	17	361.1167	-0.15614	29	1081.1167	-0.15595
6	1.1000	-0.15557	18	421.1167	-0.15614	30	1141.1167	-0.15595
7	2.1000	-0.15561	19	481.1167	-0.15615	31	1201.1167	-0.15593
8	4.1000	-0.15563	20	541.1167	-0.15611	32	1261.1167	-0.15600
9	8.1167	-0.15581	21	601.1167	-0.15605	33	1321.1333	-0.15602
10	16.1167	-0.15581	22	661.1167	-0.15596	34	1381.1333	-0.15601
11	31.1167	-0.15582	23	721.1167	-0.15593	35	1440.1167	-0.15602
12	61.1167	-0.15581	24	781.1167	-0.15593			

Void Ratio = 0.445 **Compression =** 16.9%

Pressure: 14000 psf **TEST READINGS** **Load No. 13**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15602	13	121.1000	-0.15719	25	841.1167	-0.15704
2	0.1000	-0.15641	14	181.1000	-0.15718	26	901.1167	-0.15704
3	0.2000	-0.15647	15	241.1000	-0.15717	27	961.1167	-0.15704
4	0.3500	-0.15650	16	301.1000	-0.15717	28	1021.1167	-0.15704
5	0.6000	-0.15656	17	361.1000	-0.15716	29	1081.1167	-0.15702
6	1.1000	-0.15660	18	421.1000	-0.15717	30	1141.1167	-0.15701
7	2.1000	-0.15667	19	481.1167	-0.15716	31	1201.1333	-0.15702
8	4.1000	-0.15675	20	541.1167	-0.15711	32	1261.1333	-0.15704
9	8.1000	-0.15677	21	601.1167	-0.15707	33	1321.1333	-0.15703
10	16.1000	-0.15679	22	661.1167	-0.15706	34	1381.1333	-0.15702
11	31.1000	-0.15679	23	721.1167	-0.15703	35	1440.1333	-0.15702
12	61.1000	-0.15719	24	781.1167	-0.15703			

Void Ratio = 0.448 **Compression =** 16.8%

Pressure: 12000 psf **TEST READINGS** **Load No. 14**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15702	13	121.1167	-0.15804	25	841.1167	-0.15806
2	0.1000	-0.15701	14	181.1167	-0.15808	26	901.1167	-0.15805
3	0.2000	-0.15701	15	241.1167	-0.15807	27	961.1167	-0.15806
4	0.3500	-0.15708	16	301.1167	-0.15808	28	1021.1167	-0.15805
5	0.6000	-0.15716	17	361.1167	-0.15808	29	1081.1167	-0.15805
6	1.1000	-0.15723	18	421.1167	-0.15811	30	1141.1167	-0.15805
7	2.1167	-0.15732	19	481.1167	-0.15818	31	1201.1167	-0.15807
8	4.1167	-0.15736	20	541.1167	-0.15812	32	1261.1167	-0.15814
9	8.1167	-0.15742	21	601.1167	-0.15809	33	1321.1167	-0.15815
10	16.1167	-0.15753	22	661.1167	-0.15807	34	1381.1167	-0.15818
11	31.1167	-0.15777	23	721.1167	-0.15806	35	1440.2333	-0.15817
12	61.1167	-0.15798	24	781.1167	-0.15805			

Void Ratio = 0.450 **Compression =** 16.6%

Pressure: 10000 psf **TEST READINGS** **Load No. 15**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15816	13	121.1167	-0.15978	25	841.1333	-0.15975
2	0.1000	-0.15911	14	181.1167	-0.15979	26	901.1333	-0.15977
3	0.2000	-0.15918	15	241.1167	-0.15979	27	961.1333	-0.15976
4	0.3500	-0.15926	16	301.1167	-0.15980	28	1021.1333	-0.15977
5	0.6000	-0.15932	17	361.1167	-0.15981	29	1081.1333	-0.15977
6	1.1000	-0.15940	18	421.1167	-0.15985	30	1141.1333	-0.15978
7	2.1000	-0.15952	19	481.1167	-0.15984	31	1201.1333	-0.15977
8	4.1167	-0.15957	20	541.1167	-0.15979	32	1261.1333	-0.15983
9	8.1167	-0.15967	21	601.1167	-0.15975	33	1321.1333	-0.15985
10	16.1167	-0.15967	22	661.1167	-0.15974	34	1381.1333	-0.15986
11	31.1167	-0.15971	23	721.1167	-0.15973	35	1440.1833	-0.15986
12	61.1167	-0.15977	24	781.1167	-0.15975			

Void Ratio = 0.454 **Compression =** 16.4%

Pressure: 8000 psf **TEST READINGS** **Load No. 16**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.15986	13	121.1167	-0.16178	25	841.1167	-0.16200
2	0.1000	-0.16074	14	181.1167	-0.16179	26	901.1167	-0.16200
3	0.2000	-0.16082	15	241.1167	-0.16181	27	961.1167	-0.16200
4	0.3500	-0.16091	16	301.1167	-0.16186	28	1021.1167	-0.16200
5	0.6000	-0.16102	17	361.1167	-0.16199	29	1081.1333	-0.16200
6	1.1000	-0.16115	18	421.1167	-0.16201	30	1141.1333	-0.16200
7	2.1000	-0.16129	19	481.1167	-0.16205	31	1201.1333	-0.16199
8	4.1000	-0.16142	20	541.1167	-0.16202	32	1261.1333	-0.16198
9	8.1000	-0.16153	21	601.1167	-0.16199	33	1321.1333	-0.16198
10	16.1000	-0.16162	22	661.1167	-0.16198	34	1381.1333	-0.16198
11	31.1000	-0.16166	23	721.1167	-0.16199	35	1440.4833	-0.16198
12	61.1167	-0.16170	24	781.1167	-0.16200			

Void Ratio = 0.459 **Compression =** 16.1%

Pressure: 6000 psf **TEST READINGS** **Load No. 17**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.16198	13	121.1167	-0.16417	25	841.1333	-0.16478
2	0.1000	-0.16259	14	181.1167	-0.16423	26	901.1333	-0.16484
3	0.2000	-0.16272	15	241.1167	-0.16428	27	961.1333	-0.16488
4	0.3500	-0.16284	16	301.1167	-0.16434	28	1021.1333	-0.16490
5	0.6167	-0.16297	17	361.1167	-0.16440	29	1081.1333	-0.16495
6	1.1167	-0.16317	18	421.1167	-0.16440	30	1141.1333	-0.16498
7	2.1167	-0.16341	19	481.1167	-0.16446	31	1201.1333	-0.16503
8	4.1167	-0.16362	20	541.1167	-0.16449	32	1261.1333	-0.16511
9	8.1167	-0.16385	21	601.1333	-0.16460	33	1321.1333	-0.16516
10	16.1167	-0.16397	22	661.1333	-0.16464	34	1381.1333	-0.16521
11	31.1167	-0.16407	23	721.1333	-0.16469	35	1440.4167	-0.16527
12	61.1167	-0.16415	24	781.1333	-0.16476			

Void Ratio = 0.467 **Compression =** 15.7%

Pressure: 4000 psf **TEST READINGS** **Load No. 18**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.16527	13	121.1167	-0.16932	25	841.1333	-0.16978
2	0.1000	-0.16650	14	181.1167	-0.16935	26	901.1333	-0.16985
3	0.2000	-0.16666	15	241.1167	-0.16939	27	961.1333	-0.16987
4	0.3500	-0.16680	16	301.1167	-0.16945	28	1021.1333	-0.16989
5	0.6000	-0.16700	17	361.1167	-0.16947	29	1081.1333	-0.16995
6	1.1000	-0.16725	18	421.1167	-0.16951	30	1141.1333	-0.16998
7	2.1000	-0.16763	19	481.1167	-0.16959	31	1201.1333	-0.17000
8	4.1000	-0.16807	20	541.1167	-0.16959	32	1261.1333	-0.17006
9	8.1000	-0.16848	21	601.1167	-0.16960	33	1321.1333	-0.17010
10	16.1000	-0.16881	22	661.1167	-0.16966	34	1381.1333	-0.17012
11	31.1167	-0.16901	23	721.1167	-0.16975	35	1440.1667	-0.17013
12	61.1167	-0.16919	24	781.1167	-0.16975			

Void Ratio = 0.478 **Compression =** 15.0%

Pressure: 2000 psf **TEST READINGS** **Load No. 19**

No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading	No.	Elapsed Time	Dial Reading
1	0.0000	-0.17012	13	121.1167	-0.17796	25	841.1167	-0.17849
2	0.1000	-0.17166	14	181.1167	-0.17814	26	901.1167	-0.17850
3	0.2000	-0.17194	15	241.1167	-0.17833	27	961.1167	-0.17850
4	0.3500	-0.17219	16	301.1167	-0.17843	28	1021.1167	-0.17851
5	0.6000	-0.17247	17	361.1167	-0.17854	29	1081.1167	-0.17851
6	1.1000	-0.17290	18	421.1167	-0.17854	30	1141.1333	-0.17851
7	2.1000	-0.17353	19	481.1167	-0.17853	31	1201.1333	-0.17852
8	4.1000	-0.17440	20	541.1167	-0.17850	32	1261.1333	-0.17852
9	8.1000	-0.17550	21	601.1167	-0.17849	33	1321.1333	-0.17853
10	16.1000	-0.17655	22	661.1167	-0.17849	34	1381.1333	-0.17853
11	31.1000	-0.17731	23	721.1167	-0.17849	35	1440.3000	-0.17855
12	61.1167	-0.17773	24	781.1167	-0.17850			

Void Ratio = 0.498 **Compression =** 13.9%

APPENDIX C-5

MILL SCALE UNIT WEIGHT

Laboratory Test Report
Unit Weight Determination

Material: Mill Scale – As described by owner
Date sampled: September 18, 2021
Sampled by: Somat Engineering – J. Zaremski, PE & R.Calkins
Test performed by: Somat Engineering - B.Gondek, A. O'Grady
Date Tested: September 18, 2021 & September 21, 2021
Project Number: 2019086E-005

Volume of Mold: 0.0333 cubic feet Weight of Mold: 9.41 lbs

Loose Unit Weight – Material poured into mold: total weight = 14.31 lbs
Calculated Unit Weight: **147.15 pcf**

Compacted using **ASTM D698** procedure: total weight = 16.63 lbs
Calculated Unit Weight: **216.82 pcf**

Compacted using **ASTM D1557** procedure: total weight = 16.99 lbs
Calculated Unit Weight: **227.42 pcf**

Air Dried Moisture Content – Set out on 9-18-21 at 11am, measured at 9-22-21 at 11am:
Moisture Content = 3.4%

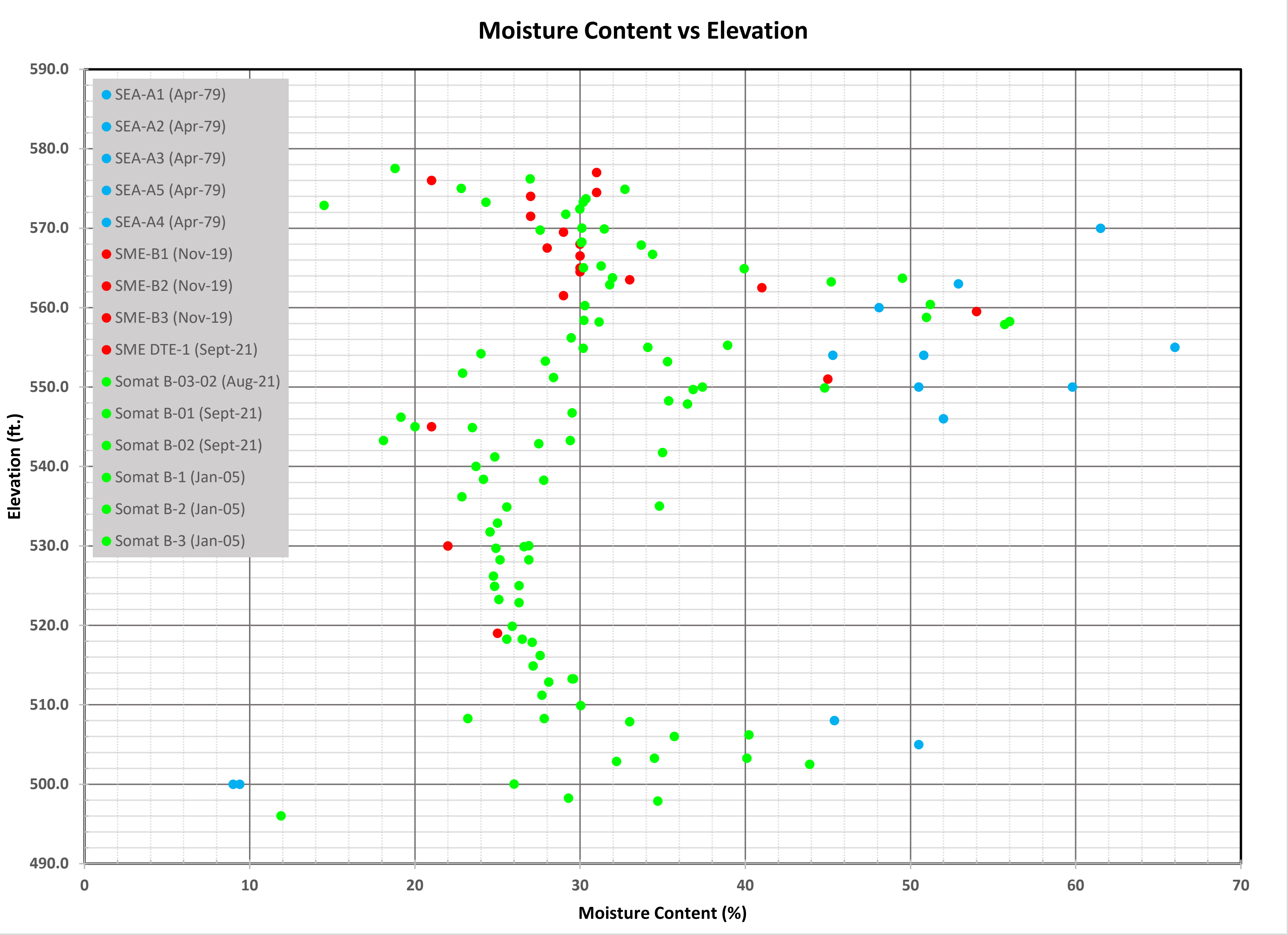
Soaked Test (ASTM D1557)
Volume of Mold: 0.075 cubic feet Weight of Mold: 15.93 lbs
Dry compacted into mold: total weight = 32.63 lbs
Calculated Unit Weight: **222.67 pcf**
Soaked for 24 hours in mold: total weight = 33.65 lbs
Calculated Unit Weight: **236.27 pcf**
Draining for 1 hour in mold: total weight = 33.51 lbs
Calculated Unit Weight: **234.40 pcf**

APPENDIX D

MOISTURE CONTENT VS ELEVATION AND ESTIMATED SHEAR STRENGTH VS ELEVATION PLOTS

APPENDIX D-1

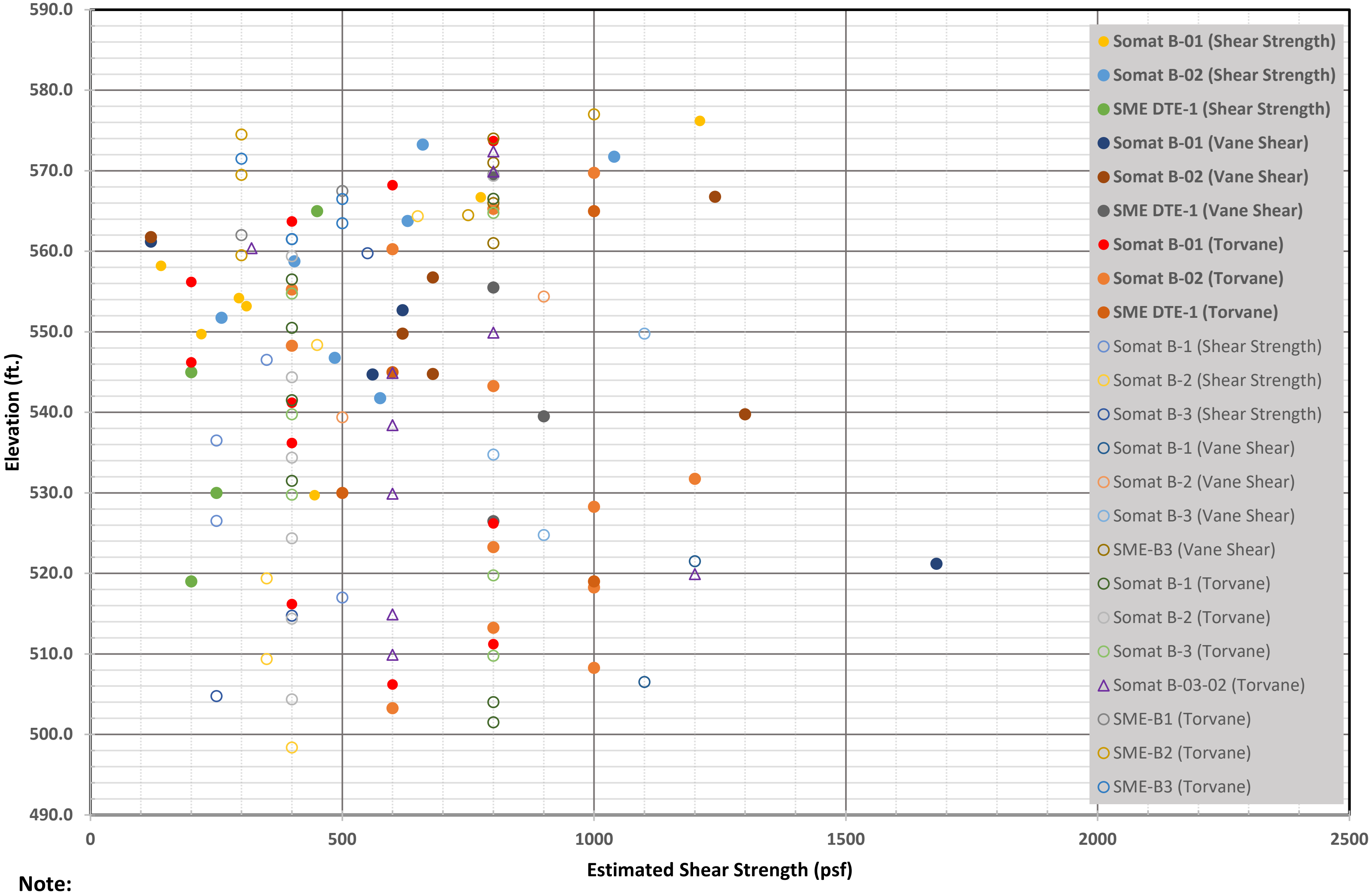
MOISTURE CONTENT VS ELEVATION PLOT


Moisture Content vs Elevation
590.0
580.0
570.0
560.0
550.0
540.0
530.0
520.0
510.0
500.0
490.0
Elevation (ft.)
0
10
20
30
40
50
60
70
Moisture Content (%)
SEA-A1 (Apr-79)
SEA-A2 (Apr-79)
SEA-A3 (Apr-79)
SEA-A5 (Apr-79)
SEA-A4 (Apr-79)
SME-B1 (Nov-19)
SME-B2 (Nov-19)
SME-B3 (Nov-19)
SME DTE-1 (Sept-21)
Somat B-03-02 (Aug-21)
Somat B-01 (Sept-21)
Somat B-02 (Sept-21)
Somat B-1 (Jan-05)
Somat B-2 (Jan-05)
Somat B-3 (Jan-05)

APPENDIX D-2

ESTIMATED SHEAR STRENGTH VS ELEVATION PLOT

Estimated Shear Strength vs Elevation



Note:

1. Shear Strength is assumed to be half of unconfined compressive strength.
2. Historic borings A-1, A-2, A-3 and A-4 from Stoll, Evans & Associates were not included.

APPENDIX E

CALCULATIONS AND ANALYSIS

APPENDIX E-1

BEARING CAPACITY ANALYSIS

Stockpile Bearing Capacity Analysis

Assumptions

- General shear failure.
- Use Terzaghi Bearing Capacity Formulas
- Stockpile placed on 8 feet of compacted granular fill working platform
- Effective stockpile footprint area dimensions 90 ft. x 90 ft.

Analyses

- Evaluate for bearing capacity on working platform
- Evaluate stockpile and working platform as effective footing

Bearing Capacity of Stockpile on Working Platform

- Working platform properties: Groundwater @ 5 feet below grade, γ'=120/58 pcf, ϕ = 32°
- "Footing" embedment = 0 ft.
- General Equation: $q_{ult} = 1.3\ c'\ N_c + \sigma'_{zD}\ N_q + 0.4\ \gamma'\ B\ N_\gamma$

  Where σ'_{zD}= 0 psf, N_c = 44.0, N_q = 28.5 , N_γ = 28.0

  q_{ult} = 1.3 x 0 psf x 44 + 0 psf x 28.5 + 0.4 x 58 pcf x 90 ft. x 28.0

  q_{ult} = 0 + 0 + 58,464 psf ≈ 58 ksf

  Results – bearing capacity failure of working platform unlikely.

Bearing Capacity of Stockpile and Working Platform

- Average c' of underlying clay = 500 psf (approximate average over 90 feet)
- "Footing" embedment of 8 ft.
- Vertical effective stress of 8 ft. of fill = 775 psf
- General Equation: $q_{ult} = 1.3\ c'\ N_c + \sigma'_{zD}\ N_q + 0.4\ \gamma'\ B\ N_\gamma$

  Where σ'_{zD}= 775 psf, N_c = 5.7, N_q = 1.0 , N_γ = 0.0

  q_{ult} = 1.3 x 500 psf x 5.7 + 775 psf x 1.0 + 0.4 x 58 pcf x 90 ft. x 0.0

  q_{ult} = 3705 psf + 775 psf + 0 = 4480 psf (remove 775 psf to determine stockpile loading)

  q_{ult} = 3705 psf (for stockpile loading)

  Results – Indicate bearing capacity failure is possible

  - dependent of footing embedment
  - highly dependent on effective cohesion of the underlying clay
  - not dependent of footing footprint dimensions
  - failure footprint likely matches depth of soft soil layer (~24 to 30 ft. below roadway grade - ~Elev. 562 to 556 feet±)

Estimated Stockpile Loading

- Unit weight of mill scale estimated at 230 pcf.
- Check vertical effective stress for different heights of material.

  5 feet x 230 pcf = 1,150 psf

  10 feet x 230 pcf = 2,300 psf

  15 feet x 230 pcf = 3,450 psf

  20 feet x 230 pcf = 4,600 psf

SOMAT Project No. 2019086E
Ground Upheaval - Fort Street and Dearborn Street
Detroit, Michigan

Calculations for the Factored Bearing Resistance q_R (using basic formulation method in cohesive soils)

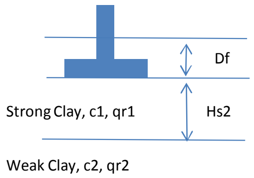
Strength Limit State

Assume L' = N/A

$q_n = c\ N_{cm} + \gamma\ D_f N_{qm} C_{wq} + 0.\ 5\gamma\ B\ N_{\gamma m}\ C_{w\gamma}$ (LRFD equation 10.6.3.1.2a-1)

$q_R = \varphi_b * q_n$

$N_{cm} =$ $N_c S_c$
$N_{qm} =$ $N_q S_q$
$N_{\gamma m} =$ $N_\gamma S_\gamma$



$\gamma =$	0.12	ksf	Unit weight of materal below bottom of footing elevation
$\gamma =$	0.12	ksf	Unit weight of materal above bottom of footing elevation
$D_f =$	10	feet	(assumed)
$\varphi_b =$	0.5		(LRFD table 10.5.5.2.2-1)

Theoretical, Clay - Boring B-01

Check for Two Layer System, stong layer over weak layer: Stiff/medium clay over soft clay

c1=	0.88	ksf	
c2=	0.35	ksf	
Hs2=	13	feet	(depth between bottom of footing and change in soil stratum)

Factored Bearing Resistance, one layer system - strong clay properties

L' (ft)	B' (ft)	Φ_f (deg.)	c1 (ksf)	Nc	Nq	Nγ	Sc	Sγ	S_q	Cwq	Cwγ	q_{n1} (ksf)	q_{R1} (ksf)
10	10	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	
20	20	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	
22	22	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	
23	23	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	
35	35	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	
50	50	0	0.88	5.14	1	0	1.200	1.000	1.000	0.500	0.500	6.03	

Factored Bearing Resistance, one layer system - weak clay properties

L' (ft)	B' (ft)	Φ_f (deg.)	c2 (ksf)	Nc	Nq	Nγ	Sc	Sγ	S_q	Cwq	Cwγ	q_{n2} (ksf)	q_{R2} (ksf)
10	10	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	
20	20	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	
22	22	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	
23	23	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	
35	35	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	
50	50	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.76	

Determine Critical Height for Two Layer System, strong clay over weak clay Ref 10.6.3.1.2d

$$\text{Hcritical} = \frac{3*B* \ln (qr1/qr2)}{2\ (1 + B/L)}$$

(LRFD equation 10.6.3.1.2a-1)

L' (ft)	B' (ft)	Hcritical (ft)	Two Layer System Needed?
10	10	5.86	One Layer
20	20	11.72	One Layer
22	22	12.90	One Layer
23	23	13.48	Two Layer
35	35	20.52	Two Layer
50	50	29.31	Two Layer

Factored Bearing Resistance, two layer system

$q_n = c1\ N_{cm} + \gamma\ D_f\ N_{qm}\ C_{wq} + 0.\ 5\gamma\ B\ N_{\gamma m}\ C_{w\gamma}$

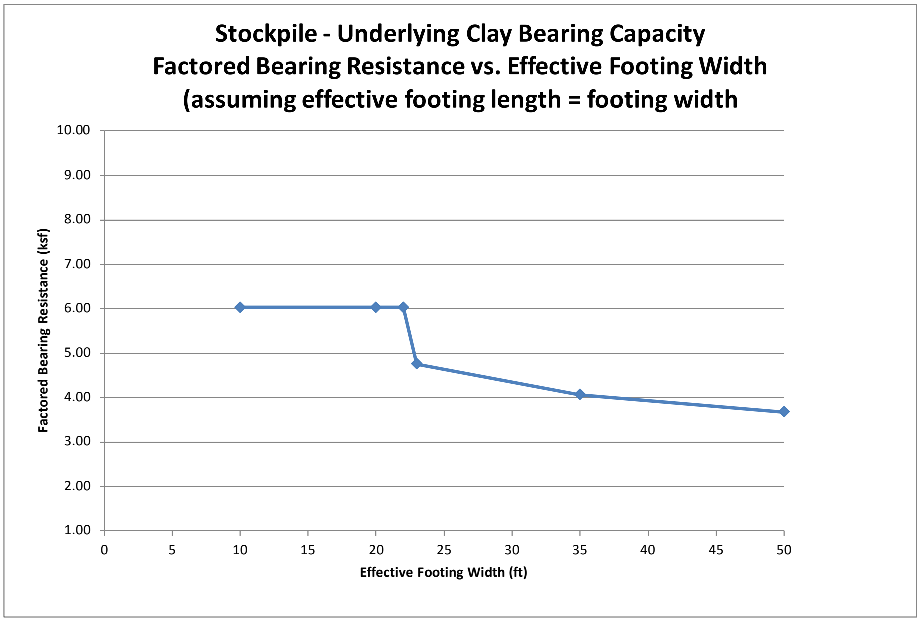
$N_{cm} =$ $N_{m = ((1/\beta m) + (kScNc)) <= ScNc}$

$N_{qm =}$ 1

$N_{\gamma m} =$ $N_\gamma S_\gamma$

Ref 10.6.3.1.2e
(Modified LRFD equation 10.6.3.1.2a-1)

L' (ft)	B' (ft)	Φ_f (deg.)	c1 (ksf)	Nc	Nq	Nγ	BBm	Nm	verify Nm <= Nc Sc	Sc	Sγ	S_q	Cwq	Cwγ	q_{n1} (ksf)	q_{R1} (ksf)
10	10														6.03	
20	20														6.03	
22	22														6.03	
23	23	0	0.88	5.14	1	0	0.44	4.71	4.71	1.200	1.000	1.000	0.500	0.500	4.75	
35	35	0	0.88	5.14	1	0	0.67	3.94	3.94	1.200	1.000	1.000	0.500	0.500	4.07	
50	50	0	0.88	5.14	1	0	0.96	3.49	3.49	1.200	1.000	1.000	0.500	0.500	3.67	



Calculations for the Factored Bearing Resistance q_R (using basic formulation method in cohesive soils)

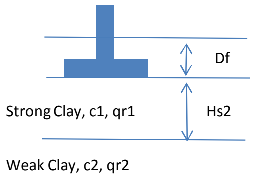
Strength Limit State

Assume L' = N/A

$q_n = c\ N_{cm} + \gamma\ D_f\ N_{qm}\ C_{wq} + 0.\ 5\gamma\ B\ N_{\gamma m}\ C_{w\gamma}$ (LRFD equation 10.6.3.1.2a-1)

$q_R = \varphi_b * q_n$

$N_{cm} =$ N_cS_c
$N_{qm} =$ N_qS_q
$N_{\gamma m} =$ $N_\gamma S_\gamma$



γ =	0.12	ksf	Unit weight of materal below bottom of footing elevation
γ =	0.12	ksf	Unit weight of materal above bottom of footing elevation
D_f =	13	Ft	(assumed)
φ_b =	0.5		(LRFD table 10.5.5.2.2-1)

Theoretical, Clay - Boring B-02

Check for Two Layer System, stong layer over weak layer: Stiff/Medium over Soft Clay

c1=	0.74	ksf	
c2=	0.35	ksf	
Hs2=	11	ft	Depth between bottom of footing and change in soil stratum

Factored Bearing Resistance, one layer system - strong clay properties

L' (ft)	B' (ft)	Φ_f (deg.)	c1 (ksf)	Nc	Nq	Nγ	Sc	Sγ	S_q	Cwq	Cwγ	q_{n1} (ksf)	q_{R1} (ksf)
10	10	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	
20	20	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	
24	24	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	
25	25	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	
35	35	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	
50	50	0	0.74	5.14	1	0	1.200	1.000	1.000	0.500	0.500	5.34	

Factored Bearing Resistance, one layer system - weak clay properties

L' (ft)	B' (ft)	Φ_f (deg.)	c2 (ksf)	Nc	Nq	Nγ	Sc	Sγ	S_q	Cwq	Cwγ	q_{n2} (ksf)	q_{R2} (ksf)
10	10	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	
20	20	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	
24	24	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	
25	25	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	
35	35	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	
50	50	0	0.35	5.14	1	0	1.200	1.000	1.000	0.500	0.500	2.94	

Determine Critical Height for Two Layer System, strong clay over weak clay Ref 10.6.3.1.2d

$$\text{Hcritical} = \frac{3*B*\ln(qr1/qr2)}{2\ (1 + B/L)}$$

(LRFD equation 10.6.3.1.2a-1)

L' (ft)	B' (ft)	Hcritical (ft)	Two Layer System Needed?
10	10	4.49	One Layer
20	20	8.97	One Layer
24	24	10.76	One Layer
25	25	11.21	Two Layer
35	35	15.70	Two Layer
50	50	22.43	Two Layer

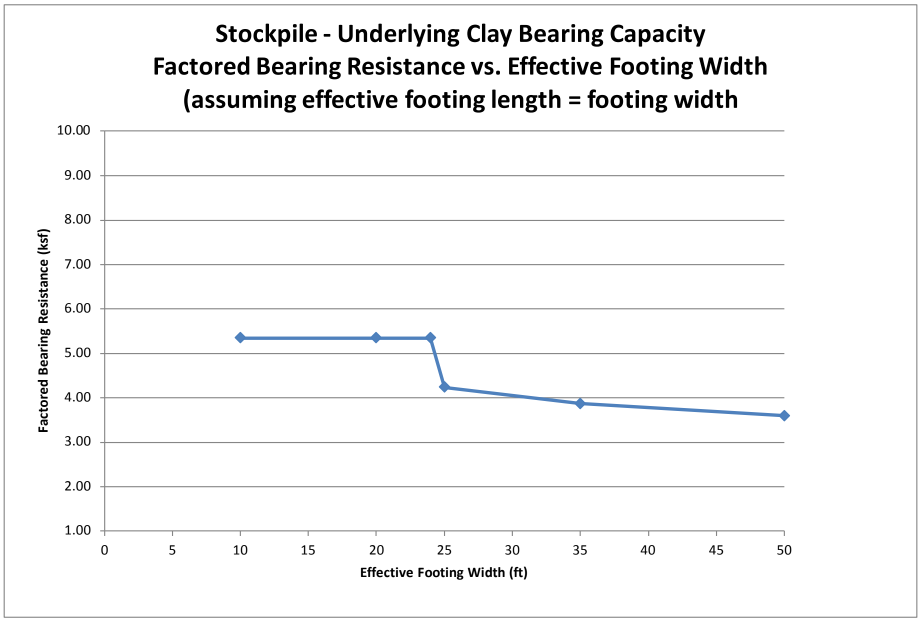
Factored Bearing Resistance, two layer system

Ref 10.6.3.1.2e
(Modified LRFD equation 10.6.3.1.2a-1)

$q_n = c1\ N_{cm} + \gamma\ D_f\ N_{qm}\ C_{wq} + 0.\ 5\gamma\ B\ N_{\gamma m}\ C_{w\gamma}$

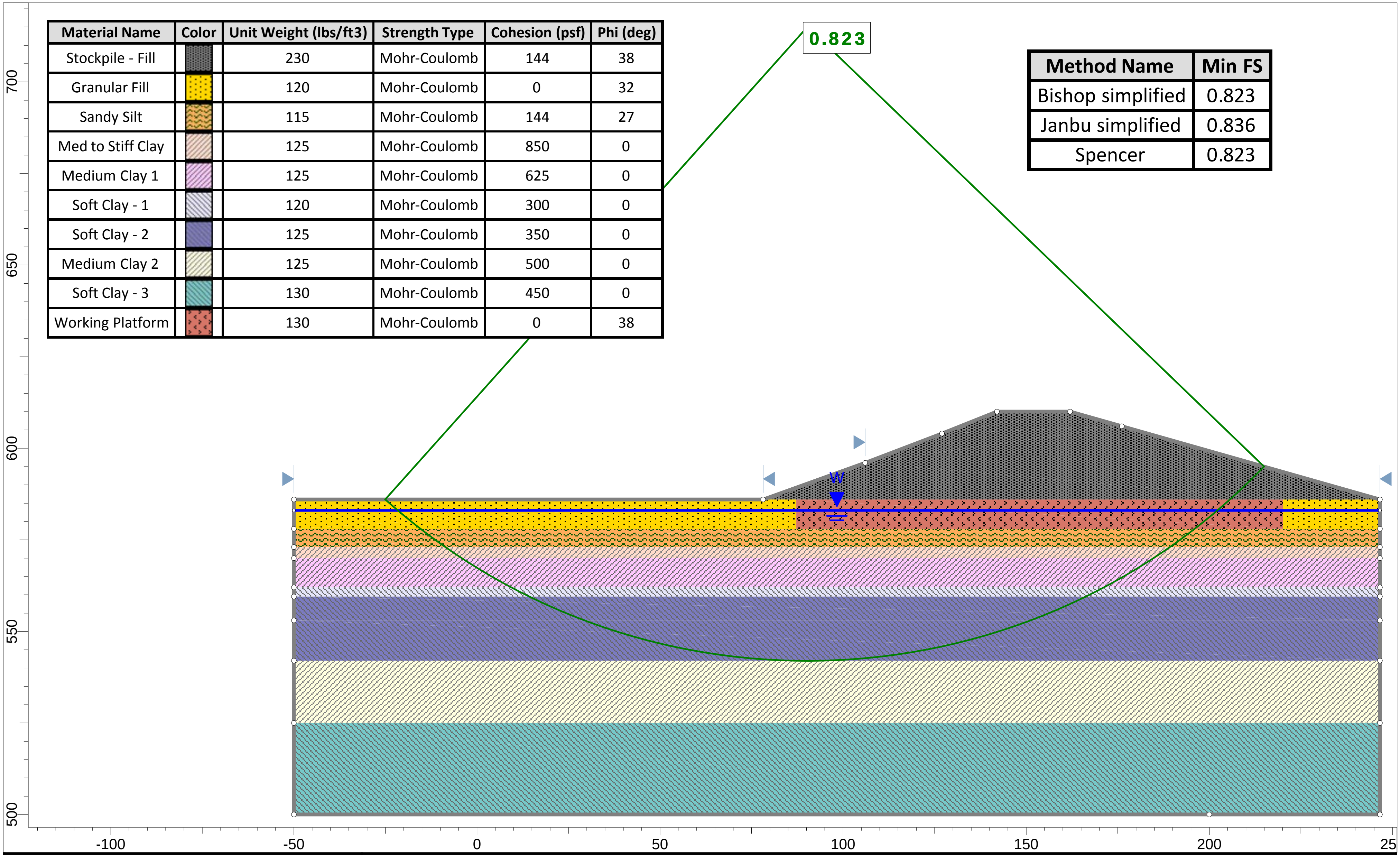
$N_{cm} =$ $N_{m = ((1/\beta m) + (kScNc)) <= ScNc}$
$N_{qm =}$ 1
$N_{\gamma m} =$ $N_\gamma S_\gamma$

L' (ft)	B' (ft)	Φ_f (deg.)	c1 (ksf)	Nc	Nq	Nγ	BBm	Nm	verify Nm <= Nc Sc	Sc	Sγ	S_q	Cwq	Cwγ	q_{n1} (ksf)	q_{R1} (ksf)
10	10														5.34	
20	20														5.34	
24	24														5.34	
25	25	0	0.74	5.14	1	0	0.57	4.68	4.68	1.200	1.000	1.000	0.500	0.500	4.24	
35	35	0	0.74	5.14	1	0	0.80	4.17	4.17	1.200	1.000	1.000	0.500	0.500	3.87	
50	50	0	0.74	5.14	1	0	1.14	3.80	3.80	1.200	1.000	1.000	0.500	0.500	3.59	



APPENDIX E-2

GLOBAL STABILITY ANALYSES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Stockpile - Fill	▨	230	Mohr-Coulomb	144	38
Granular Fill	▨	120	Mohr-Coulomb	0	32
Sandy Silt	▨	115	Mohr-Coulomb	144	27
Med to Stiff Clay	▨	125	Mohr-Coulomb	850	0
Medium Clay 1	▨	125	Mohr-Coulomb	625	0
Soft Clay - 1	▨	120	Mohr-Coulomb	300	0
Soft Clay - 2	▨	125	Mohr-Coulomb	350	0
Medium Clay 2	▨	125	Mohr-Coulomb	500	0
Soft Clay - 3	▨	130	Mohr-Coulomb	450	0
Working Platform	▨	130	Mohr-Coulomb	0	38

Method Name	Min FS
Bishop simplified	0.823
Janbu simplified	0.836
Spencer	0.823

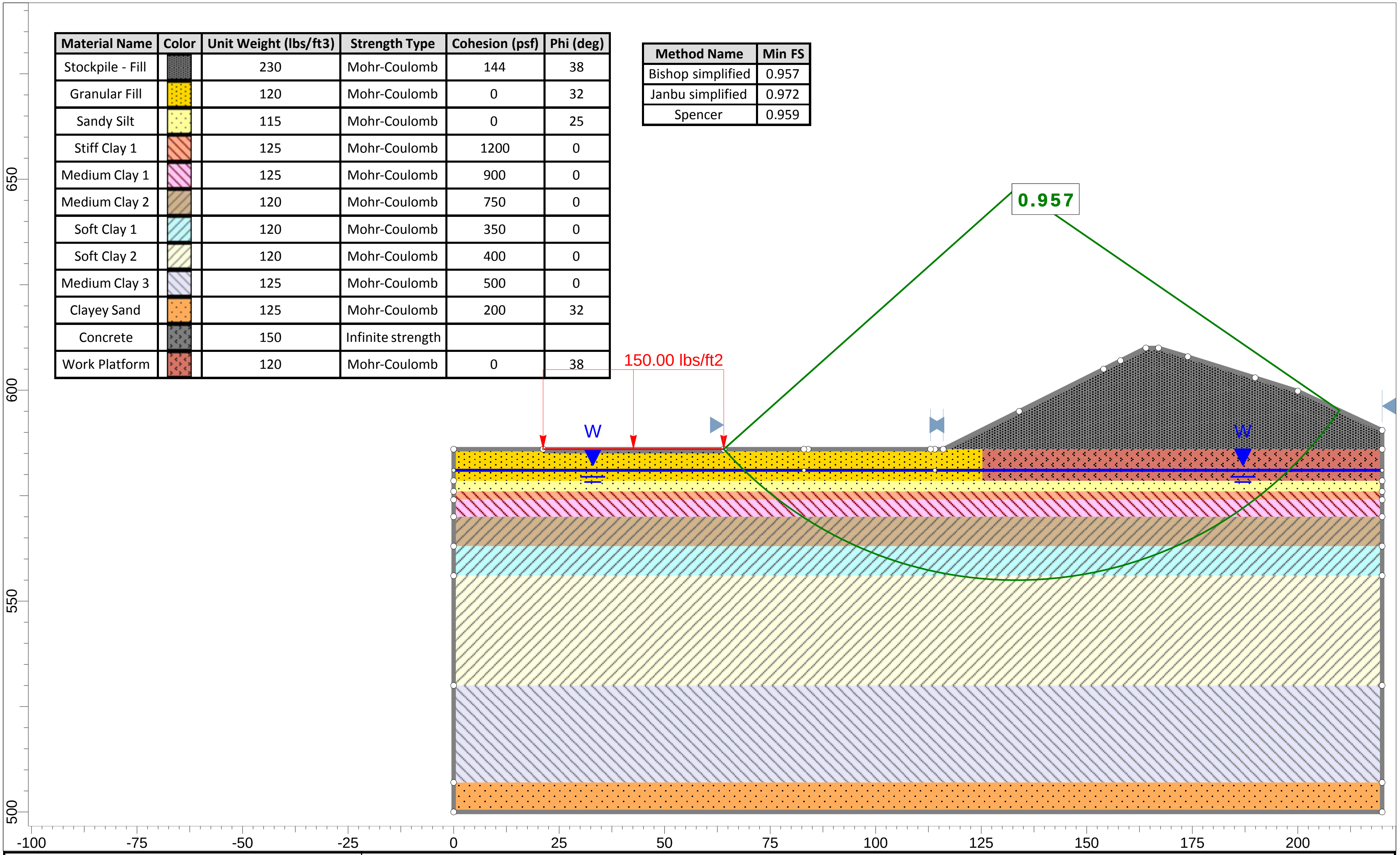
Somat Engineering, INCORPORATED

Project	**Ground Upheaval - Dearborn Street at Fort Street**
Analysis	Boring B-02 through Dearborn Street Cross-Section. Short Term/Undrained
Scenario	Pre-Failure Stockpile
Comments	
Date 10/22/2021	*Drawn By* JDH
File Name	*Dearborn Street.slmd*

SLIDEINTERPRET 9.012

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Stockpile - Fill	▨	230	Mohr-Coulomb	144	38
Granular Fill	▨	120	Mohr-Coulomb	0	32
Sandy Silt	▨	115	Mohr-Coulomb	0	25
Stiff Clay 1	▨	125	Mohr-Coulomb	1200	0
Medium Clay 1	▨	125	Mohr-Coulomb	900	0
Medium Clay 2	▨	120	Mohr-Coulomb	750	0
Soft Clay 1	▨	120	Mohr-Coulomb	350	0
Soft Clay 2	▨	120	Mohr-Coulomb	400	0
Medium Clay 3	▨	125	Mohr-Coulomb	500	0
Clayey Sand	▨	125	Mohr-Coulomb	200	32
Concrete	▨	150	Infinite strength		
Work Platform	▨	120	Mohr-Coulomb	0	38

Method Name	Min FS
Bishop simplified	0.957
Janbu simplified	0.972
Spencer	0.959



Somat Engineering, INCORPORATED

Project	**Ground Upheaval - 10015 W Fort Street**
Analysis	Boring B-1 through Parcel Cross-Section. Short Term/Undrained
Scenario	Initial Conditions Prior to Failure
Comments	Using estimated shear strengths prior to failure
File Name	*Heave Building_V1.slmd*

Date 10/22/2021
Drawn By JDH

SLIDEINTERPRET 9.012

APPENDIX E-3

SETTLEMENT CALCULATIONS

Fort Dearborn - Update - Time Rate
Report Creation Date: 2021/11/02, 13:50:07

Table of Contents

Settle3 Analysis Information

Fort Dearborn - Update - Time Rate

Project Settings

Document Name	Fort Dearborn - Update - Time Rate.s3z
Date Created	10/19/2021, 4:05:15 PM
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	days
Permeability Units	feet/year
Minimum settlement ratio for subgrade modulus	0.9
Use average properties to calculate layered stresses	
Improve consolidation accuracy	
Ignore negative effective stresses in settlement calculations	

Stage Settings

Stage #	Name	Time [days]
1	Stage 1	1
2	Stage 2	182
3	Stage 3	365
4	Stage 4	547
5	Stage 5	730
6	Stage 6	3650

Results

Time taken to compute: 1.37045 seconds

Stage: Stage 1 = 1 d

Data Type	Minimum	Maximum
Total Settlement [in]	0	0
Total Consolidation Settlement [in]	0	0
Virgin Consolidation Settlement [in]	0	0
Recompression Consolidation Settlement [in]	0	0
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	-4.16838e-09	5.82968
Effective Stress XX [ksf]	-0.926586	13.1064
Effective Stress YY [ksf]	0.528127	13.1122
Total Stress ZZ [ksf]	-4.16838e-09	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	0	0
Pore Water Pressure [ksf]	0	7.41297
Excess Pore Water Pressure [ksf]	0	5.51888
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [ksf]	0.0172502	6.37826
Over-consolidation Ratio	1	3.3
Void Ratio	0	0.85
Permeability [ft/y]	0	0.111576
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	0
Undrained Shear Strength	-2.77556e-17	0.049537

Stage: Stage 2 = 182 d

Data Type	Minimum	Maximum
Total Settlement [in]	-0.119661	5.74222
Total Consolidation Settlement [in]	-0.119661	5.74222
Virgin Consolidation Settlement [in]	0	3.26533
Recompression Consolidation Settlement [in]	-0.122193	2.4769
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	0	6.31078
Effective Stress XX [ksf]	-0.88895	12.8067
Effective Stress YY [ksf]	0.528127	12.8125
Total Stress ZZ [ksf]	0	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000924106	0.0700997
Pore Water Pressure [ksf]	0	7.71268
Excess Pore Water Pressure [ksf]	-0.0082769	4.47788
Degree of Consolidation [%]	0	15.9367
Pre-consolidation Stress [ksf]	0.0172502	6.37826
Over-consolidation Ratio	1	3.29657
Void Ratio	0	0.85171
Permeability [ft/y]	0	0.384408
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	60.4309
Undrained Shear Strength	-0.00161953	0.224428

Stage: Stage 3 = 365 d

Data Type	Minimum	Maximum
Total Settlement [in]	-0.193248	7.40618
Total Consolidation Settlement [in]	-0.193248	7.40618
Virgin Consolidation Settlement [in]	0	4.21672
Recompression Consolidation Settlement [in]	-0.21396	3.18946
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	0	6.31078
Effective Stress XX [ksf]	-0.88895	12.7602
Effective Stress YY [ksf]	0.528127	12.7845
Total Stress ZZ [ksf]	0	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.00137477	0.0701364
Pore Water Pressure [ksf]	0	7.85187
Excess Pore Water Pressure [ksf]	-0.0134048	3.9829
Degree of Consolidation [%]	0	20.391
Pre-consolidation Stress [ksf]	0.0172502	6.37826
Over-consolidation Ratio	1	3.28681
Void Ratio	0	0.852543
Permeability [ft/y]	0	0.384408
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	75.9742
Undrained Shear Strength	-0.00161953	0.235032

Stage: Stage 4 = 547 d

Data Type	Minimum	Maximum
Total Settlement [in]	-0.247764	8.55008
Total Consolidation Settlement [in]	-0.247764	8.55008
Virgin Consolidation Settlement [in]	0	5.07959
Recompression Consolidation Settlement [in]	-0.267363	3.47049
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	0	6.31078
Effective Stress XX [ksf]	-0.88895	13.13
Effective Stress YY [ksf]	0.528127	13.1542
Total Stress ZZ [ksf]	0	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.00171979	0.0701509
Pore Water Pressure [ksf]	0	7.95568
Excess Pore Water Pressure [ksf]	-0.00839558	3.70527
Degree of Consolidation [%]	0	23.5218
Pre-consolidation Stress [ksf]	0.0172502	6.37826
Over-consolidation Ratio	1	3.28041
Void Ratio	0	0.853182
Permeability [ft/y]	0	0.384408
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	81.851
Undrained Shear Strength	-0.00161953	0.245548

Stage: Stage 5 = 730 d

Data Type	Minimum	Maximum
Total Settlement [in]	-0.295263	9.41243
Total Consolidation Settlement [in]	-0.295263	9.41243
Virgin Consolidation Settlement [in]	0	5.78256
Recompression Consolidation Settlement [in]	-0.305535	3.62988
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	0	6.31078
Effective Stress XX [ksf]	-0.88895	13.3133
Effective Stress YY [ksf]	0.528127	13.3375
Total Stress ZZ [ksf]	0	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.00199416	0.0701582
Pore Water Pressure [ksf]	0	8.03656
Excess Pore Water Pressure [ksf]	-0.00856446	3.63689
Degree of Consolidation [%]	0	25.8759
Pre-consolidation Stress [ksf]	0.0172502	6.37826
Over-consolidation Ratio	1	3.27617
Void Ratio	0	0.853689
Permeability [ft/y]	0	0.384408
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	84.6518
Undrained Shear Strength	-0.00161953	0.252296

Stage: Stage 6 = 3650 d

Data Type	Minimum	Maximum
Total Settlement [in]	-0.0205631	16.9252
Total Consolidation Settlement [in]	-0.0205631	16.9252
Virgin Consolidation Settlement [in]	0	12.6292
Recompression Consolidation Settlement [in]	-0.0205631	4.29598
Immediate Settlement [in]	0	0
Secondary Settlement [in]	0	0
Loading Stress ZZ [ksf]	-4.16838e-09	5.52
Loading Stress XX [ksf]	-1.57324	8.22707
Loading Stress YY [ksf]	0.325202	8.23897
Effective Stress ZZ [ksf]	0	6.43814
Effective Stress XX [ksf]	-0.88895	13.1542
Effective Stress YY [ksf]	0.528127	13.1784
Total Stress ZZ [ksf]	0	12.4782
Total Stress XX [ksf]	-0.88895	20.5193
Total Stress YY [ksf]	0.528127	20.5251
Modulus of Subgrade Reaction (Total) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Immediate) [ksf/ft]	0	0
Modulus of Subgrade Reaction (Consolidation) [ksf/ft]	0	0
Total Strain	-0.000631521	0.0701733
Pore Water Pressure [ksf]	0	7.62008
Excess Pore Water Pressure [ksf]	-0.00767538	2.81528
Degree of Consolidation [%]	0	49.2699
Pre-consolidation Stress [ksf]	0.0172502	6.40148
Over-consolidation Ratio	1	3.24157
Void Ratio	0	0.851168
Permeability [ft/y]	0	0.384408
Coefficient of Consolidation [ft^2/y]	0	75
Hydroconsolidation Settlement [in]	0	0
Average Degree of Consolidation [%]	0	91.4049
Undrained Shear Strength	-0.00161651	0.250673

Embankments

1. Embankment: "Embankment Load 1"

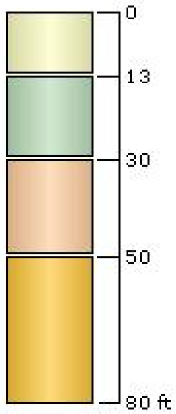
Label	Embankment Load 1
Center Line	(0, 0) to (58, 0)
Near End Angle	23 degrees
Far End Angle	23 degrees
Number of Layers	1
Base Width	170

Layer	Stage	Left Bench Width (ft)	Left Angle (deg)	Height (ft)	Unit Weight (kips/ft3)	Right Angle (deg)	Right Bench Width (ft)
1	Stage 1 = 1 d	0	23	24	0.23	23	0

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	Sand/Silt	13	0	No
2	Clay 1	17	13	No
3	Clay 2	20	30	No
4	Clay 3	30	50	No



Soil Properties

Property	Sand/Silt	Clay 1	Clay 2	Clay 3
Color	🟨	🟩	🟧	🟨
Unit Weight [kips/ft3]	0.115	0.125	0.125	0.125
Saturated Unit Weight [kips/ft3]	0.115	0.125	0.125	0.125
K0	1	1	1	1
Primary Consolidation	Disabled	Enabled	Enabled	Enabled
Material Type		Non-Linear	Non-Linear	Non-Linear
Cce	-	0.165	0.175	0.175
Cre	-	0.027	0.035	0.035
e0	-	0.85	0.85	0.85
OCR	-	3.3	1.53	1
Cv [ft2/y]	-	75	75	75
Cvr [ft2/y]	-	75	75	75
B-bar	-	1	1	1
Undrained Su A [kips/ft2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft3

Piezometric Line Entities

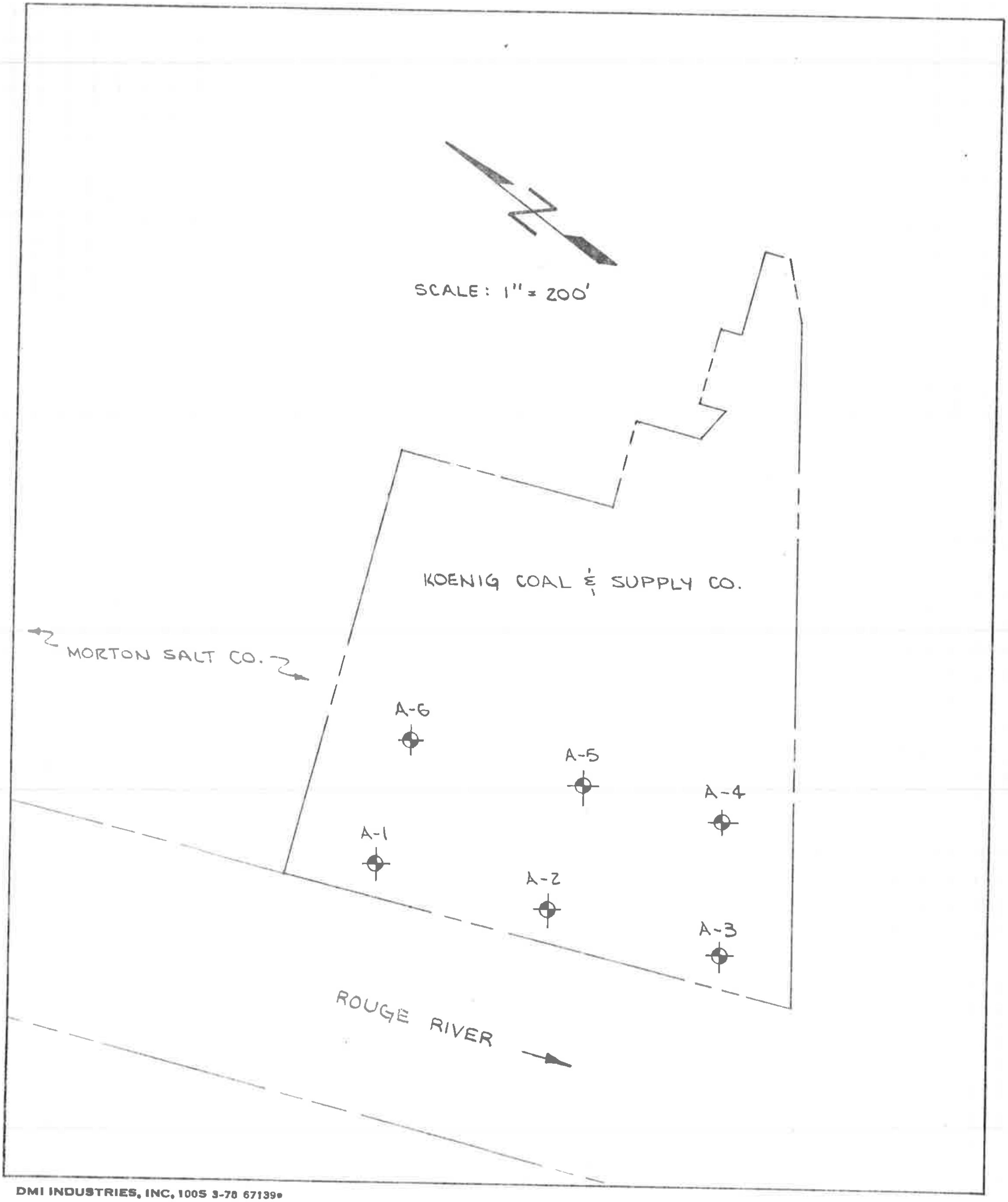
ID	Depth (ft)
1	3 ft

APPENDIX F

SHARED, HISTORIC BORINGS AND LABORATORY TEST RESULTS

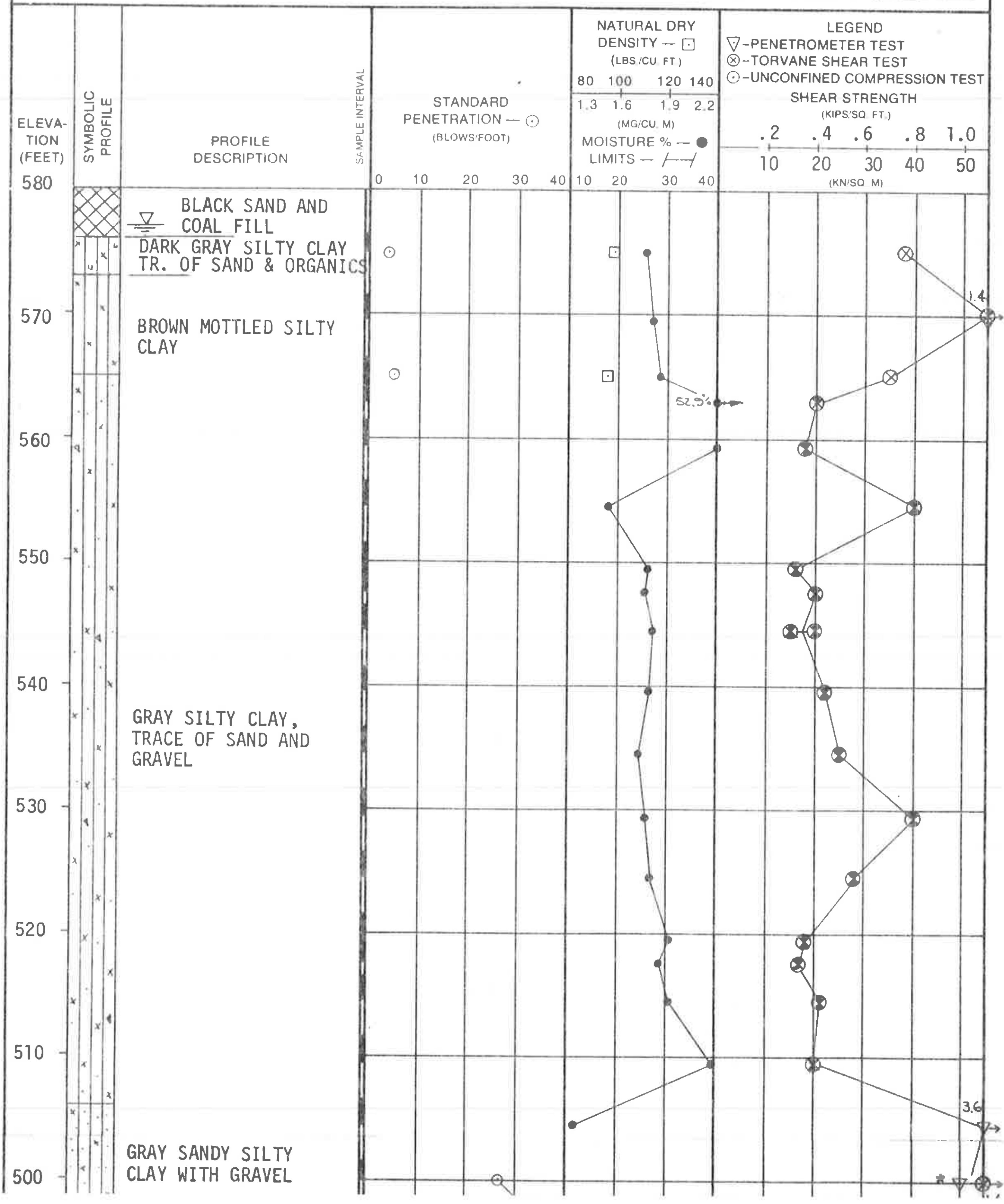
STOLL, EVANS & ASSOCIATES
soil mechanics and foundation consultants

JOB NAME: KOENIG COAL DOCK
JOB LOCATION: ROUGE RIVER, DETROIT
CLIENT: INDUSTRIAL FUEL CORPORATION
BY: UWS
DATE: 4/79
SHEET: A-1
SUBJECT: BORING LOCATION PLAN



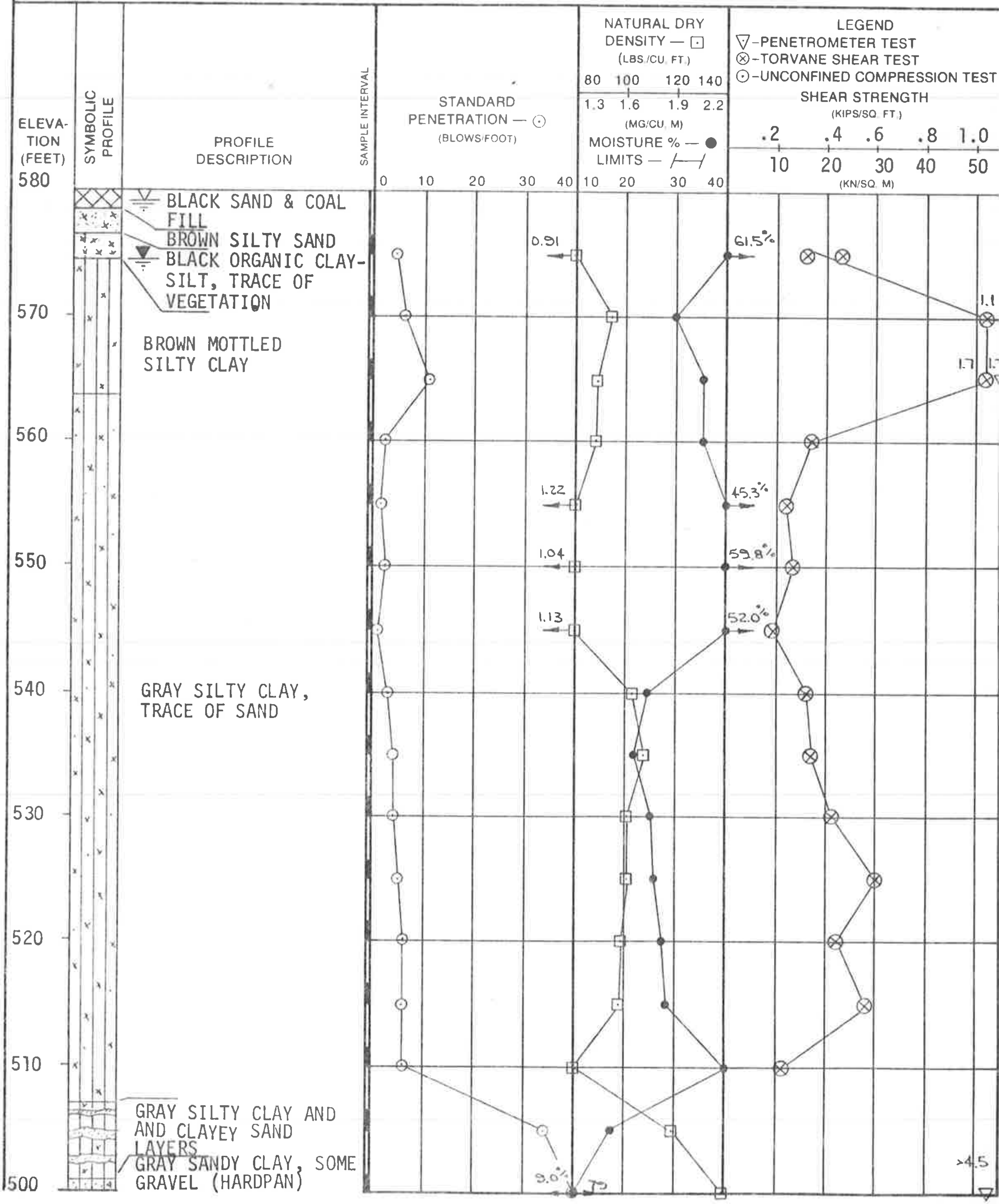
STOLL, EVANS & ASSOCIATES

JOB NAME: KOENIG COAL DOCK
JOB LOCATION: ROUGE RIVER, DETROIT
CLIENT: INDUSTRIAL FUEL CORPORATION
BY: LPJ
DATE: 4/79
SUBJECT: GRAPHICAL SUMMARY OF TESTS
BORING NO. A-1
SHEET NO. B-1



STOLL, EVANS & ASSOCIATES

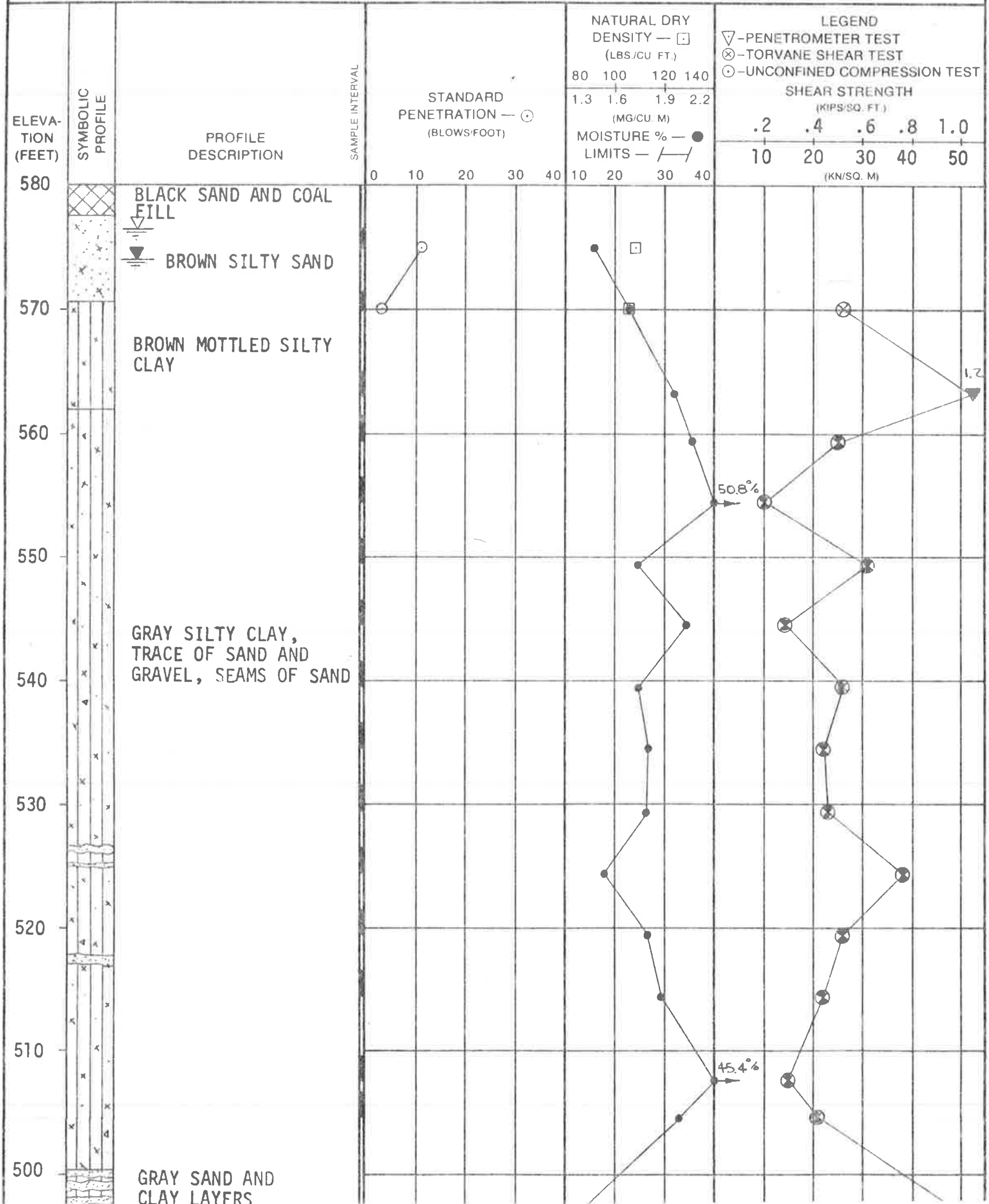
JOB NAME: KOENIG COAL DOCK
BY: LPJ
DATE: 4/79
JOB LOCATION: ROUGE RIVER, DETROIT
SUBJECT: GRAPHICAL SUMMARY OF TESTS
CLIENT: INDUSTRIAL FUEL CORPORATION
BORING NO. A-2
SHEET NO. B-2



STOLL, EVANS & ASSOCIATES

JOB NAME: KOENIG COAL DOCK
JOB LOCATION: ROUGE RIVER, DETROIT
CLIENT: INDUSTRIAL FUEL CORPORATION

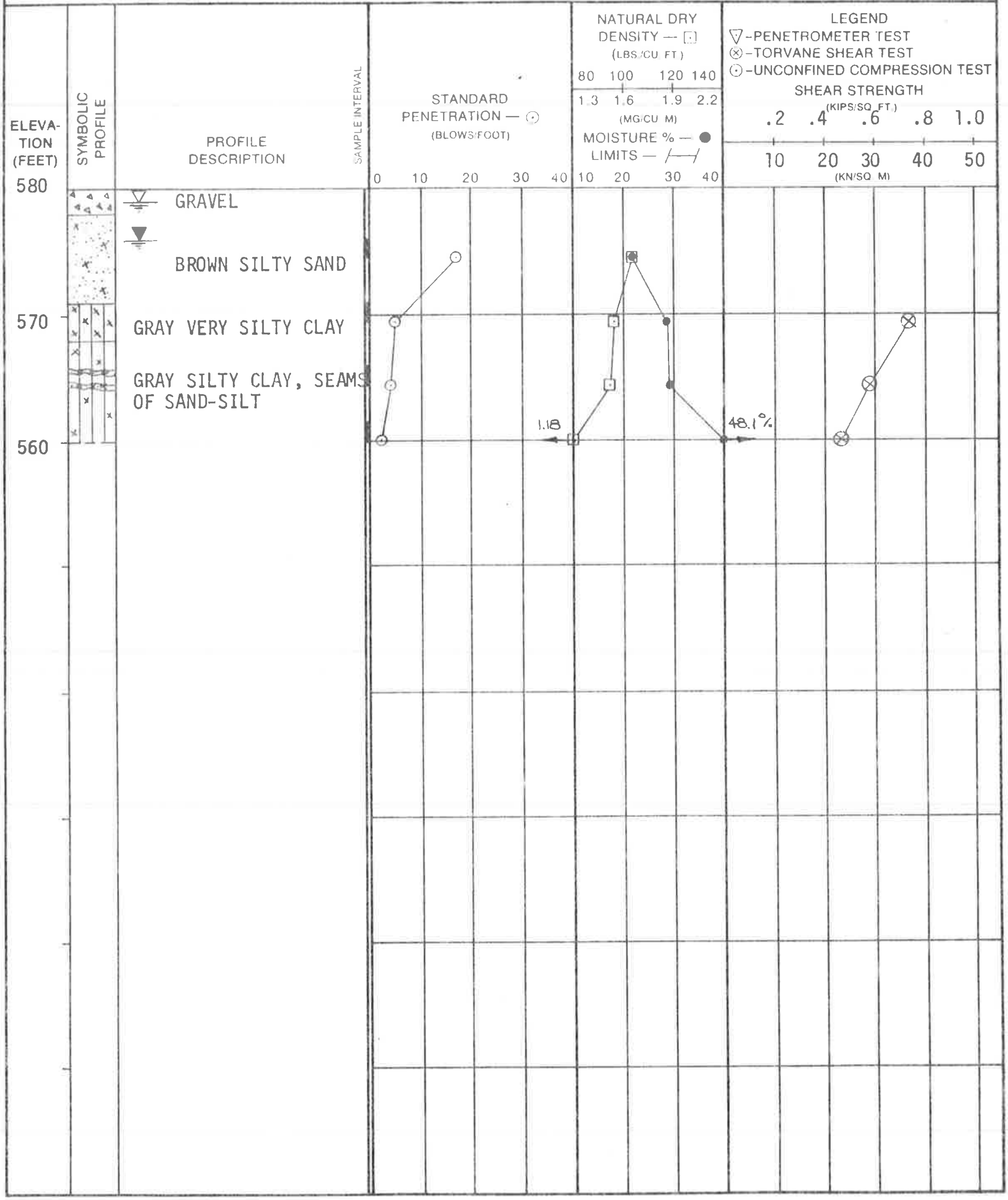
BY: LPJ
DATE: 4/79
SUBJECT: GRAPHICAL SUMMARY OF TESTS
BORING NO. A-3
SHEET NO. B-3



STOLL, EVANS & ASSOCIATES

JOB NAME: KOENIG COAL DOCK
JOB LOCATION: ROUGE RIVER, DETROIT
CLIENT: INDUSTRIAL FUEL CORPORATION

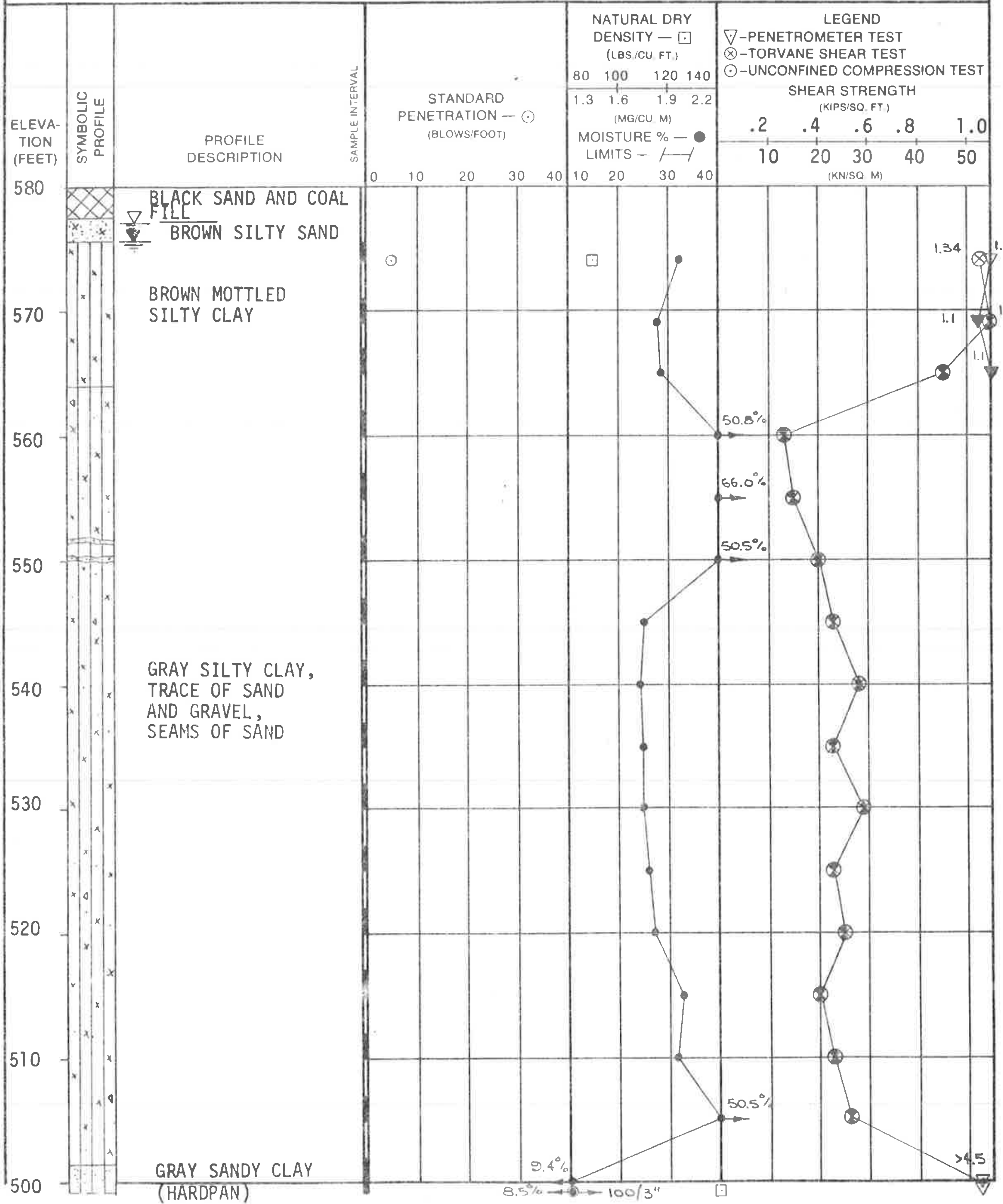
BY: LPJ DATE: 4/79
SUBJECT: GRAPHICAL SUMMARY OF TESTS
BORING NO. A-4 SHEET NO. B-4



STOLL, EVANS & ASSOCIATES

JOB NAME: KOENIG COAL DOCK
JOB LOCATION: ROUGE RIVER, DETROIT
CLIENT: INDUSTRIAL FUEL CORPORATION

BY: LPJ DATE: 4/79
SUBJECT: GRAPHICAL SUMMARY OF TESTS
BORING NO. A-5 SHEET NO. B-5



STOLL, EVANS & ASSOCIATES

JOB NAME: KOENIG COAL DOCK

JOB LOCATION: ROUGE RIVER, DETROIT

CLIENT: INDUSTRIAL FUEL CORPORATION

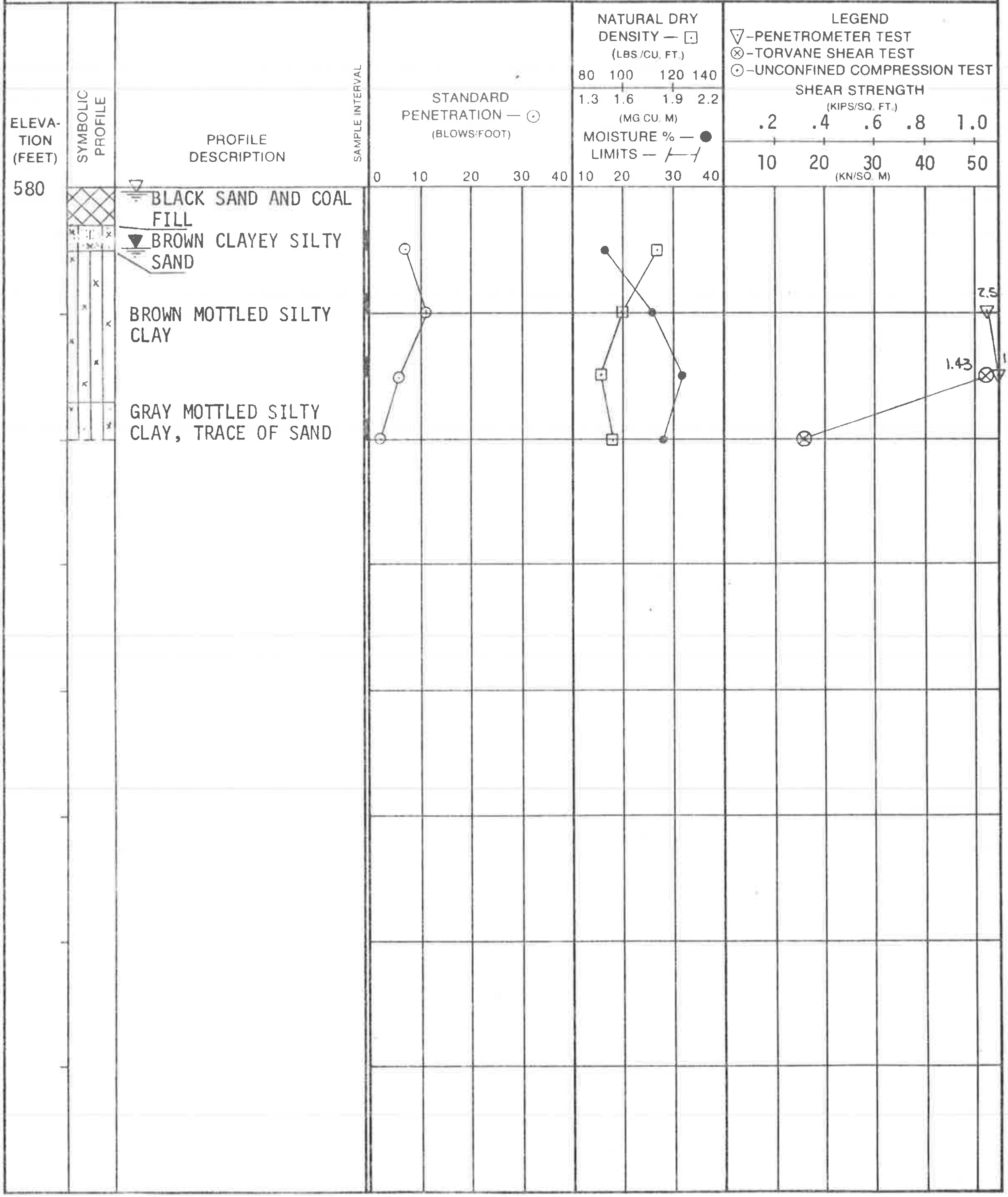
BY: LPJ

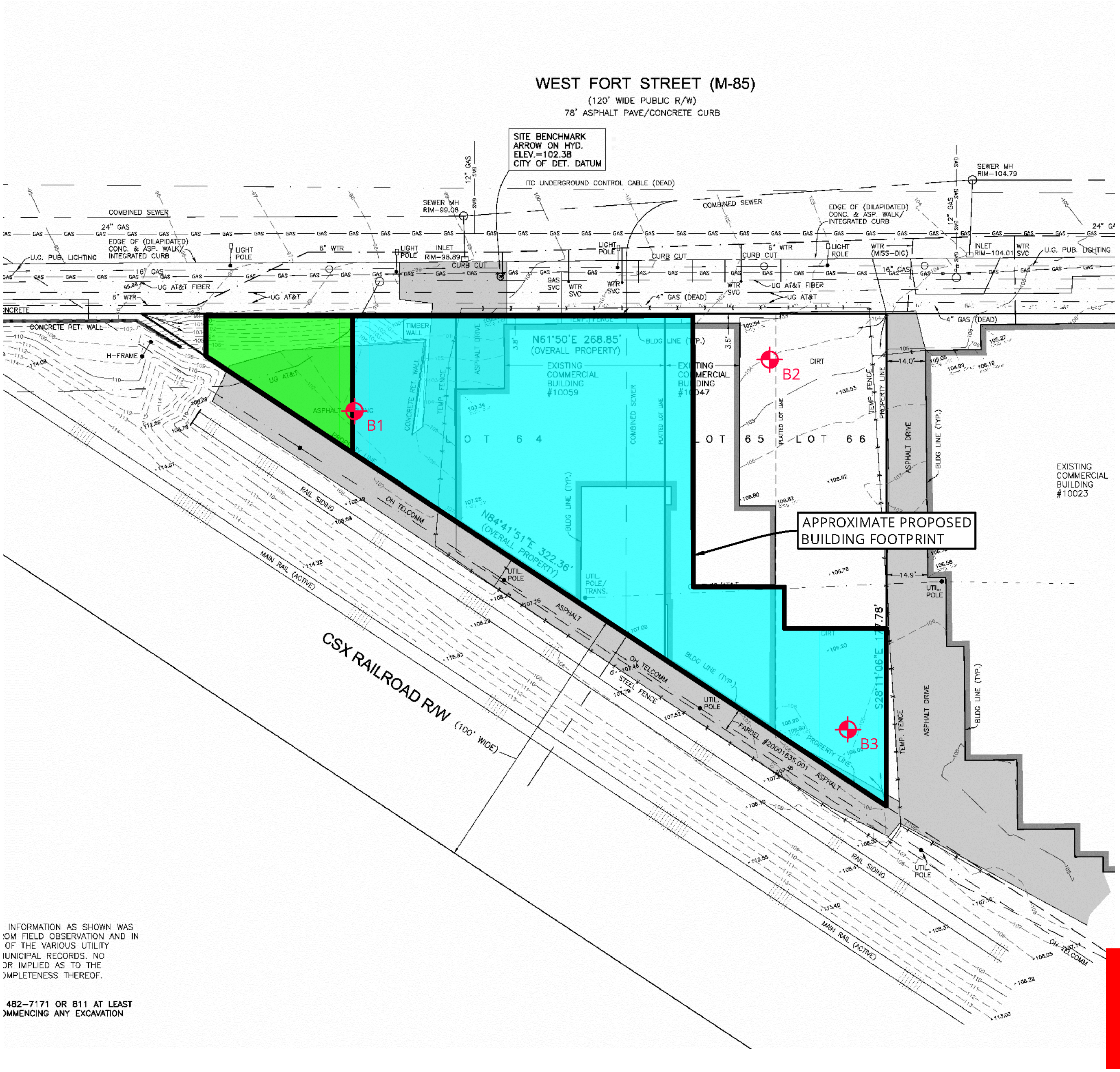
DATE: 4/79

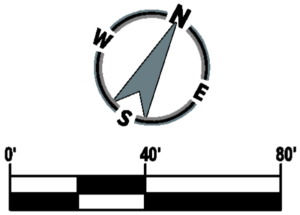
SUBJECT: GRAPHICAL SUMMARY OF TESTS

BORING NO. A-6

SHEET NO. B-6



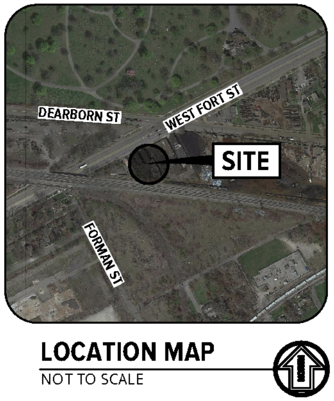




GRAPHIC SCALE: 1" = 40'

LEGEND

⊕	APPROXIMATE BORING LOCATION
🟦	PROPOSED FINISH FLOOR ELEV. 104'-4"
🟩	PROPOSED FINISH FLOOR ELEV. 102'-2"



LOCATION MAP

NOT TO SCALE

[redacted]

SME

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Project

[redacted]

Project Location

DETROIT, MICHIGAN

Sheet Name

BORING LOCATION DIAGRAM

No.	Revision Date

Date	01/14/2020
CADD	JGR
Designer	AJR
Scale	AS SHOWN
Project	082914.00
Figure No.	1

DRAWING NOTE: SCALE DEPICTED IS MEANT FOR 11" X 17" AND WILL SCALE INCORRECTLY IF PRINTED ON ANY OTHER SIZE MEDIA

NO REPRODUCTION SHALL BE MADE WITHOUT THE PRIOR CONSENT OF SME

\\Sme-inc\p\WIP\082914.00\CAD\DWGS\BLD\rev0\082914.00-BLD.dwg

PLOT DATE: Jan 16, 2020 - 12:05pm - rios

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL
(more than 50% of material is larger than No. 200 sieve size.)

	Clean Gravel (Less than 5% fines)		
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	▨	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
	▨	GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)		
	▨	GM	Silty gravel; gravel-sand-silt mixtures
	▨	GC	Clayey gravel; gravel-sand-clay mixtures
	Clean Sand (Less than 5% fines)		
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	▨	SW	Well-graded sand; sand-gravel mixtures, little or no fines
	▨	SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)		
	▨	SM	Silty sand; sand-silt-gravel mixtures
	▨	SC	Clayey sand; sand–clay-gravel mixtures

FINE-GRAINED SOIL
(50% or more of material is smaller than No. 200 sieve size)

SILT AND CLAY Liquid limit less than 50%	▨	ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
	▨	CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
	▨	OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater	▨	MH	Inorganic silt of high plasticity, elastic silt
	▨	CH	Inorganic clay of high plasticity, fat clay
	▨	OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL	▨	PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

■ Topsoil	□ Void	▨ Sandstone
▨ Asphalt	▨ Glacial Till	▨ Siltstone
▨ Base	▨ Coal	▨ Limestone
▨ Concrete	▨ Shale	▨ Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}^{\;2}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}^{\;2}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent…………………….……..GW, GP, SW, SP
More than 12 percent……………………..…..GM, GC, SM, SC
5 to 12 percent…………….……..Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

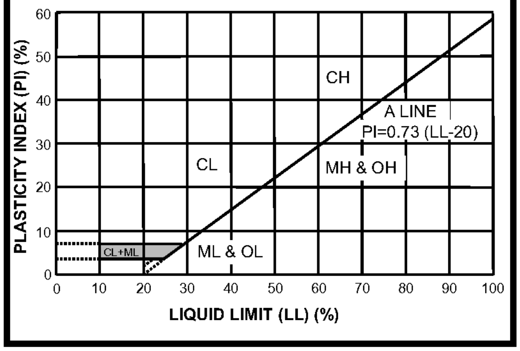
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)
- GM-GC (CLAYEY SILTY GRAVEL or CLAYEY SILTY GRAVEL with Sand)

PARTICLE SIZES

Boulders		-	Greater than 12 inches
Cobbles		-	3 inches to 12 inches
Gravel-	Coarse	-	3/4 inches to 3 inches
	Fine	-	No. 4 to 3/4 inches
Sand-	Coarse	-	No. 10 to No. 4
	Medium	-	No. 40 to No. 10
	Fine	-	No. 200 to No. 40
Silt and Clay		-	Less than (0.0074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)
- OL/OH (ORGANIC SILT or ORGANIC CLAY)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressure Meter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	**N-Value (Blows per foot)**
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	50 to 80
Extremely Dense	Over 80

Cohesive Soils

Consistency	**N-Value (Blows per foot)**	**Undrained Shear Strength (kips/ft^2)**
Very Soft	0 - 2	0.25 or less
Soft	2 - 4	0.25 to 0.50
Medium	4 - 8	0.50 to 1.0
Stiff	8 - 15	1.0 to 2.0
Very Stiff	15 - 30	2.0 to 4.0
Hard	> 30	4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted.

SME

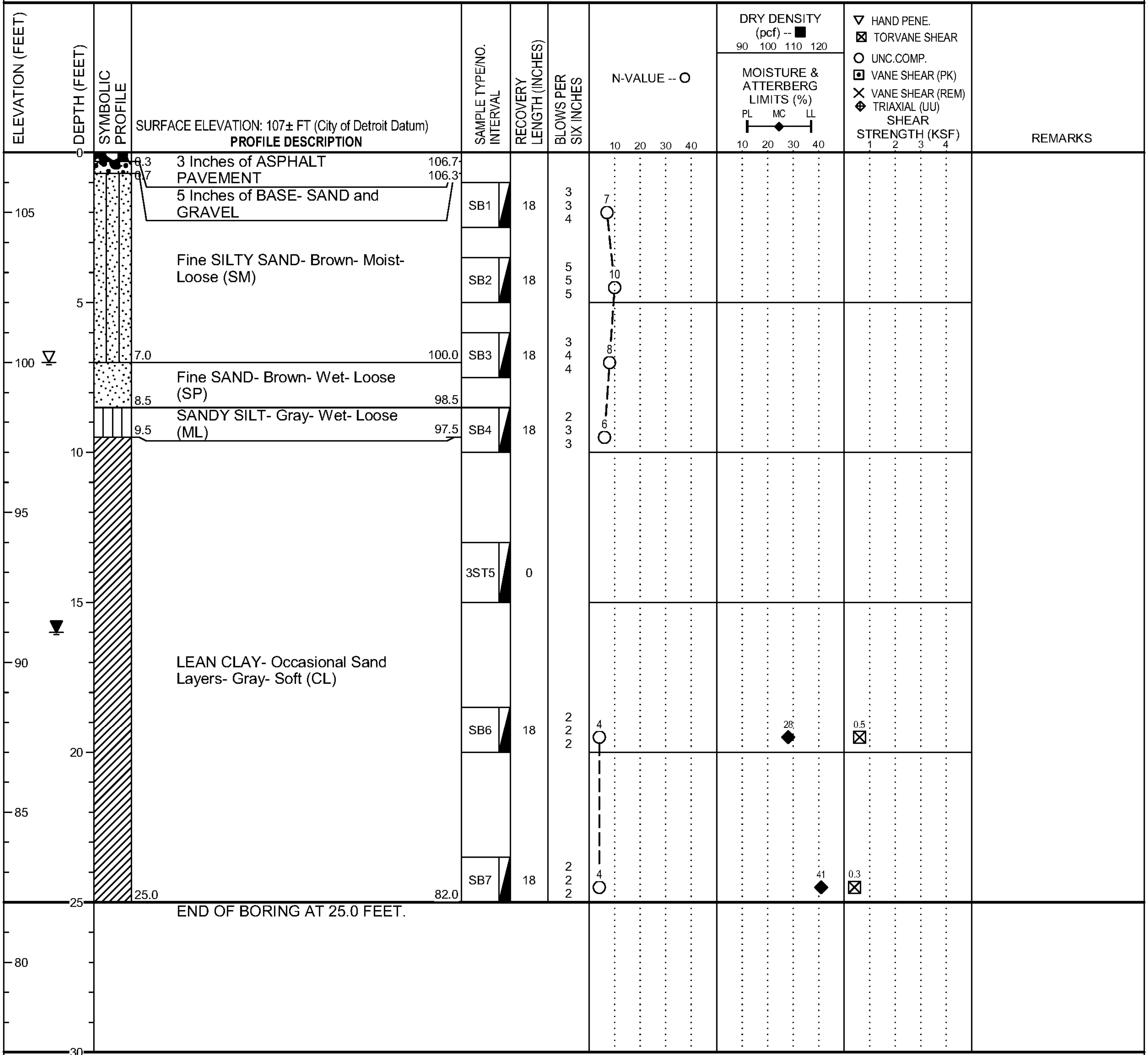
BORING B1

PAGE 1 OF 1

PROJEC[redacted]
CLIENT:

PROJECT NUMBER: 082914.00
PROJECT LOCATION: Detroit, Michigan

DATE STARTED: 11/7/19 **COMPLETED:** 11/7/19 **BORING METHOD:** Solid-stem Augers
DRILLER: RM **RIG NO.:** 531-CME550 LCX **LOGGED BY:** AJR **CHECKED BY:** JMK



DEPTH (FEET)	ELEVATION (FEET)	PROFILE DESCRIPTION
0.3	106.7	3 Inches of ASPHALT PAVEMENT
0.7	106.3	5 Inches of BASE- SAND and GRAVEL
7.0	100.0	Fine SILTY SAND- Brown- Moist- Loose (SM)
8.5	98.5	Fine SAND- Brown- Wet- Loose (SP)
9.5	97.5	SANDY SILT- Gray- Wet- Loose (ML)
25.0	82.0	LEAN CLAY- Occasional Sand Layers- Gray- Soft (CL)

END OF BORING AT 25.0 FEET.

SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MC (%)	TORVANE SHEAR (KSF)
SB1	18	3 3 4	7		
SB2	18	5 5 5	10		
SB3	18	3 4 4	8		
SB4	18	2 3 3	6		
3ST5	0				
SB6	18	2 2 2	4	28	0.5
SB7	18	2 2 2	4	41	0.3

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	7.0	100.0
▼ **AT END OF BORING:**	16.0	91.0

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.
2. Surface capped with asphalt cold patch after backfilling the borehole.

BORING B2

PAGE 1 OF 1

[redacted]

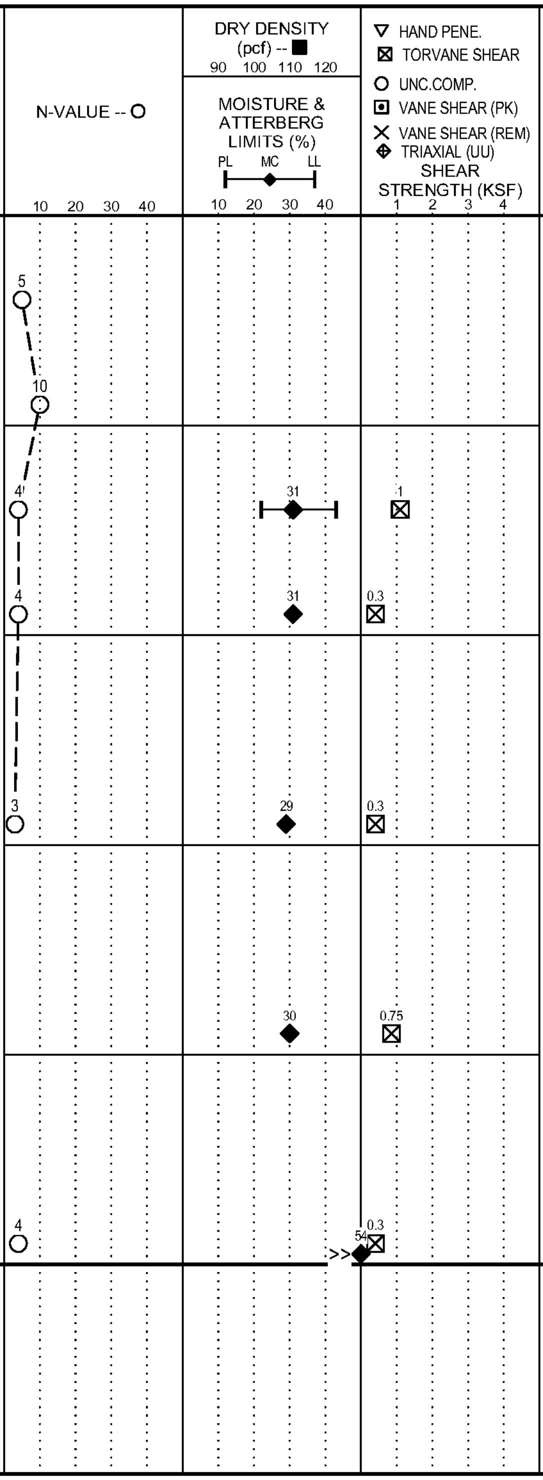
PROJECT NUMBER: 082914.00

PROJECT LOCATION: Detroit, Michigan

DATE STARTED: 11/7/19 **COMPLETED:** 11/7/19 **BORING METHOD:** Solid-stem Augers

DRILLER: RM **RIG NO.:** 531-CME550 LCX **LOGGED BY:** AJR **CHECKED BY:** JMK

SURFACE ELEVATION: 104± FT (City of Detroit Datum)



DEPTH (FEET)	PROFILE DESCRIPTION	ELEVATION (FEET)	SAMPLE TYPE/NO. INTERVAL	RECOVERY LENGTH (INCHES)	BLOWS PER SIX INCHES	N-VALUE	MOISTURE (%)	SHEAR STRENGTH (KSF)	REMARKS
0.7	8 Inches of TOPSOIL	103.3							
3.0	Fine SAND- Brown- Moist- Loose (SP)	101.0	SB1	18	2 2 3	5			
5.5	Fine SILTY SAND- Grayish Brown- Wet- Loose (SM)	98.5	SB2	18	4 5 5	10			
25.0	LEAN CLAY- Gray- Medium to Soft (CL)	79.0	SB3	18	2 2 2	4	31	1	
			SB4	18	2 2 2	4	31	0.3	
			SB5	18	2 1 2	3	29	0.3	
			3ST6	24			30	0.75	
			SB7	18	2 2 2	4	>>54	0.3	

END OF BORING AT 25.0 FEET.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	3.0	101.0
▼ **AT END OF BORING:**	22.0	82.0

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

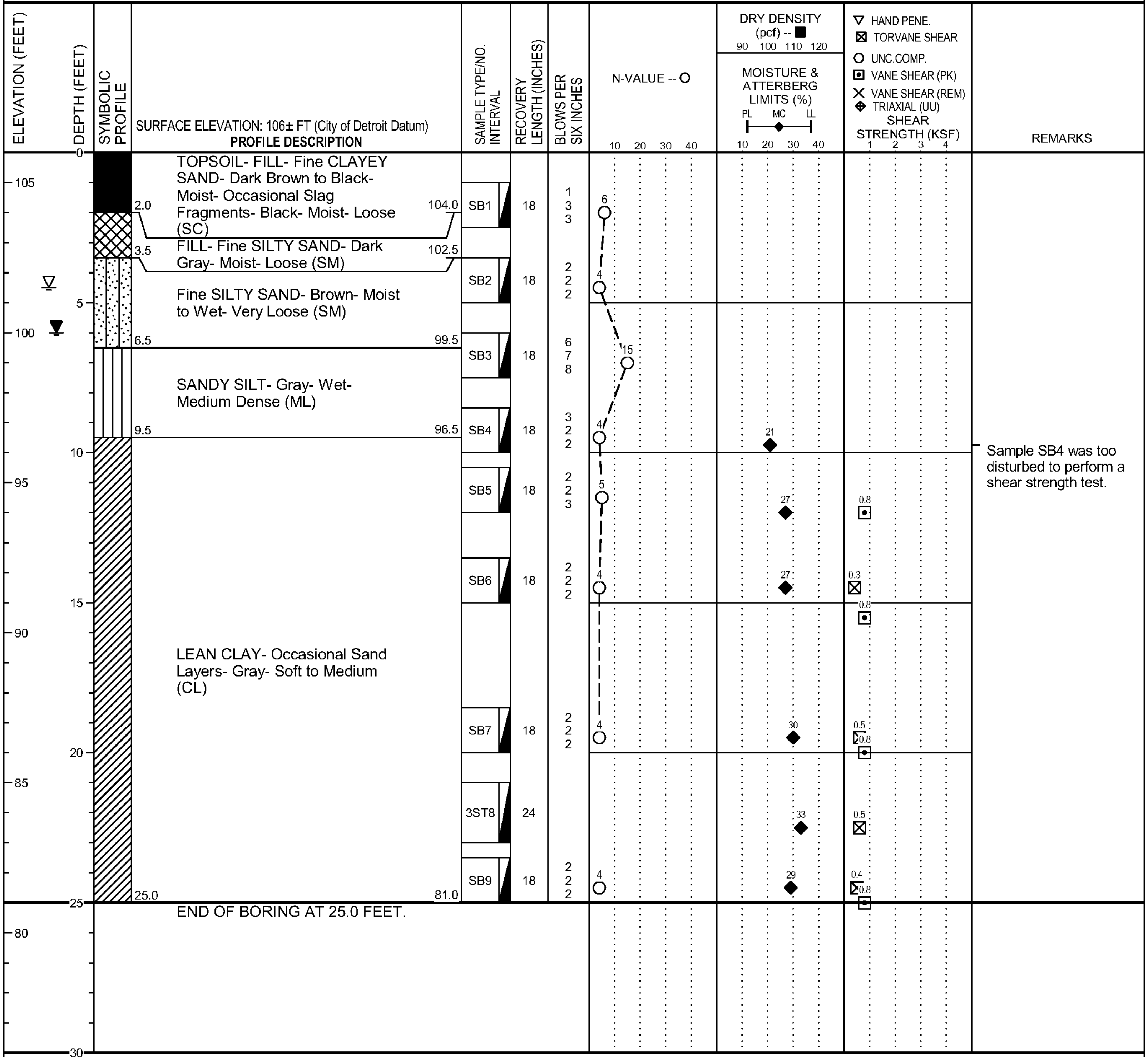
BORING B3

PAGE 1 OF 1

PROJ [redacted]
CLIE

PROJECT NUMBER: 082914.00
PROJECT LOCATION: Detroit, Michigan

DATE STARTED: 11/8/19 **COMPLETED:** 11/8/19 **BORING METHOD:** Solid-stem Augers
DRILLER: RM **RIG NO.:** 531-CME550 LCX **LOGGED BY:** AJR **CHECKED BY:** JMK



Depth (ft)	Elev. (ft)	Profile Description
2.0	104.0	TOPSOIL- FILL- Fine CLAYEY SAND- Dark Brown to Black- Moist- Occasional Slag Fragments- Black- Moist- Loose (SC)
3.5	102.5	FILL- Fine SILTY SAND- Dark Gray- Moist- Loose (SM)
6.5	99.5	Fine SILTY SAND- Brown- Moist to Wet- Very Loose (SM)
9.5	96.5	SANDY SILT- Gray- Wet- Medium Dense (ML)
25.0	81.0	LEAN CLAY- Occasional Sand Layers- Gray- Soft to Medium (CL)

END OF BORING AT 25.0 FEET.

SB1	18	1 3 3	6		
SB2	18	2 2 2	4		
SB3	18	6 7 8	15		
SB4	18	3 2 2	4	21	
SB5	18	2 2 3	5	27	0.8
SB6	18	2 2 2	4	27	0.3 0.8
SB7	18	2 2 2	4	30	0.5 0.8
3ST8	24			33	0.5
SB9	18	2 2 2	4	29	0.4 0.8

Sample SB4 was too disturbed to perform a shear strength test.

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)	ELEV (FT)
▽ **DURING BORING:**	4.5	101.5
▼ **AT END OF BORING:**	6.0	100.0

BACKFILL METHOD: Auger Cuttings

NOTES: 1. The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

SME

LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX
ASTM D4318 - A

PROJECT: [redacted]
LOCATION:
PROJECT#: 082914.00
DATE: January 15, 2020

DATE OBTAINED: November 7, 2020
SAMPLE NUMBER: SB3
SAMPLE LOCATION: B2
SAMPLE DESCRIPTION: Lean Clay - Gray
TECHNICIAN: Errol Gilbert, CET

TEST METHOD: ASTM D4318
METHOD - A

TEST DATA:

LIQUID LIMIT

Point #:	1	2	3
Wet Wt + Tare, g:	32.07	32.61	33.92
Dry Wt + Tare, g:	28.43	28.61	29.37
Tare Wt.:	19.44	19.43	19.39
Water Content:	40.49	43.57	45.59
Number of Blows:	35	25	19

Water Content corrected for method B:	44

PLASTIC LIMIT TEST

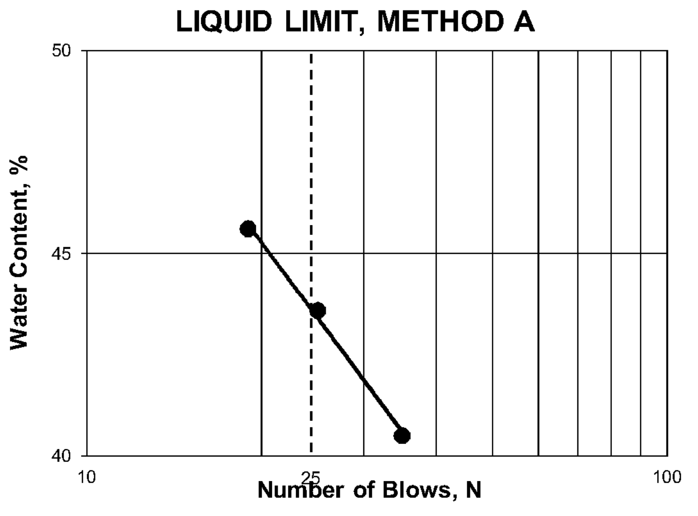
Wet Wt + Tare, g:	24.72	24.85
Dry Wt + Tare, g:	23.76	23.93
Tare Wt, g:	19.45	19.82
Water Content:	22.27	22.38

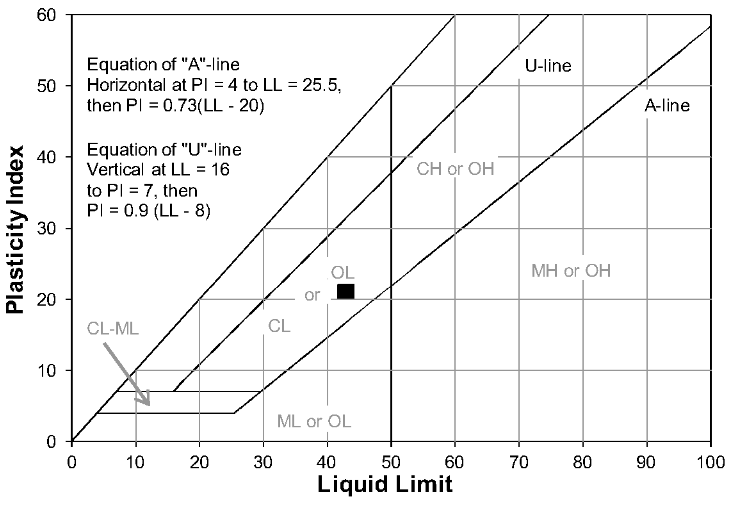
PLASTICITY INDEX

LIQUID LIMIT:	43
PLASTIC LIMIT:	22
PLASTICITY INDEX:	21

CLASSIFICATION: CL

REMARKS: Sample air dried prior to testing





TEST BORING NO. TB-12

PROJECT: TRAFFIC SIGNAL DESIGN PROJECT
LOCATION: NE QUAD., M-85 AT DEARBORN STREET
APPROXIMATE MDOT STATION: N/A
BORING OFFSET: 7 FT E OF PROPOSED LOCATION
DATE STARTED: 12/22/20, DATE COMPLETED: 12/22/20
INSPECTOR: R. MUTHALA
APPROXIMATE GROUND SURFACE ELEVATION: 586.5 FT
APPROXIMATE COORDINATES: N 91717.98, E 13456200.64

ELEV. (FT)			SOIL SAMPLE DATA MC	DD	PP	UCS
586.5	TOPSOIL: DARK BROWN SILTY SAND WITH ORGANIC MATTER					
585.8	FILL: DARK BROWN SAND WITH TRACE OF GRAVEL					
584.0		4 6 13				
581.5		2 2 3				
	FILL: BROWN SAND WITH TRACE OF GRAVEL					
579.0		3 4 5				
576.5		2 2 5				
576.0	VERY SOFT TO SOFT GRAY MOIST SILTY CLAY WITH TRACE TO LITTLE SAND AND TRACE OF GRAVEL					
574.0		2 2 1			0.3	
571.5		1 1 2			0.3	
569.0		WOH 2 1			0.3	
566.5		WOH 1 2			0.3	
564.0		WOH WOH 1			<0.3	
561.5		WOH WOH WOH			<0.3	
	E.O.B. 25 FT					

GROUNDWATER LEVELS:
AT TIME OF DRILLING: 5.5 FT
AT END OF DRILLING: DRY: CAVED AT 18 FT
24 HRS. AFTER DRILLING: NOT OBTAINED
BACKFILL PROCEDURE: BOREHOLE BACKFILLED WITH EXCAVATED MATERIALS.

TEST BORING NO. TB-13

PROJECT: TRAFFIC SIGNAL DESIGN PROJECT
LOCATION: SE QUAD., M-85 AT DEARBORN STREET
APPROXIMATE MDOT STATION: N/A
BORING OFFSET: 34 FT NE OF PROPOSED LOCATION
DATE STARTED: 7/8/20, DATE COMPLETED: 7/8/20
INSPECTOR: A. ALAQEELI
APPROXIMATE GROUND SURFACE ELEVATION: 587 FT
APPROXIMATE COORDINATES: N 291735.04, E 13456395.48

ELEV. (FT)			SOIL SAMPLE DATA MC	DD	PP	UCS
587.0	PAVEMENT: ASPHALT (6")					
586.5	PAVEMENT: CONCRETE (8")					
585.8	FILL: BROWN TO GRAY SAND WITH TRACE OF SILT AND GRAVEL					
584.5		10 10 10				
582.0		14 13 16				
579.5		7 10 11				
579.0	LOOSE GRAY WET SILTY SAND WITH TRACE OF CLAY AND GRAVEL					
577.0		5 5 5			0.8	
575.0	SOFT TO MEDIUM STIFF GRAY MOIST SILTY CLAY WITH TRACE TO LITTLE SAND AND TRACE OF GRAVEL					
574.5		2 3 3			0.5	
572.0		2 1 3			0.5	
569.5		3 2 2			0.5	
567.0		1 2 2			0.3	
564.5		1 1 2			0.3	
562.0		1 2 2				
	E.O.B. 25 FT					

GROUNDWATER LEVELS:
AT TIME OF DRILLING: 7.5 FT
AT END OF DRILLING: 10 FT
24 HRS. AFTER DRILLING: NOT OBTAINED
BACKFILL PROCEDURE: BOREHOLE BACKFILLED WITH EXCAVATED MATERIALS AND PAVEMENT REPAIRED WITH ASPHALT COLD PATCH.

TEST BORING NO. TB-14

PROJECT: TRAFFIC SIGNAL DESIGN PROJECT
LOCATION: SW QUAD., M-85 AT DEARBORN STREET
APPROXIMATE MDOT STATION: N/A
BORING OFFSET: 10 FT NW OF PROPOSED LOCATION
DATE STARTED: 7/8/20, DATE COMPLETED: 7/8/20
INSPECTOR: D. YIP
APPROXIMATE GROUND SURFACE ELEVATION: 585 FT
APPROXIMATE COORDINATES: N 291649.62, E 13456236.01

ELEV. (FT)			SOIL SAMPLE DATA MC	DD	PP	UCS
585.0	PAVEMENT: ASPHALT (10")					
584.2	PAVEMENT: CONCRETE (6")					
583.7	FILL: GRAY SAND WITH TRACE OF SILT, GRAVEL AND OCCASIONAL BRICK FRAGMENTS					
582.5		3 3 4				
580.0		3 2 6				
577.5		5 4 4				
	LOOSE BROWN TO GRAY WET SILTY SAND					
575.0		6 5 4				
574.5	VERY SOFT TO MEDIUM STIFF GRAY MOIST SILTY CLAY WITH TRACE TO LITTLE SAND AND TRACE OF GRAVEL					
572.5		2 2 3			0.8	
570.0		2 2 2			0.3	
567.5		2 2 2			0.3	
565.0		1 2 2			0.3	
562.5		2 2 2			<0.3	
560.0		2 1 2			<0.3	
	E.O.B. 25 FT					

GROUNDWATER LEVELS:
AT TIME OF DRILLING: 7.5 FT
AT END OF DRILLING: DRY
24 HRS. AFTER DRILLING: NOT OBTAINED
BACKFILL PROCEDURE: BOREHOLE BACKFILLED WITH EXCAVATED MATERIALS AND PAVEMENT REPAIRED WITH ASPHALT COLD PATCH.

TEST BORING NO. TB-15

PROJECT: TRAFFIC SIGNAL DESIGN PROJECT
LOCATION: NW QUAD., M-85 AT DEARBORN STREET
APPROXIMATE MDOT STATION: N/A
BORING OFFSET: 10 FT SW OF PROPOSED LOCATION
DATE STARTED: 7/9/20, DATE COMPLETED: 7/9/20
INSPECTOR: A. ALAQEELI
APPROXIMATE GROUND SURFACE ELEVATION: 583.5 FT
APPROXIMATE COORDINATES: N 291624.51, E 13456039.39

ELEV. (FT)			SOIL SAMPLE DATA MC	DD	PP	UCS
583.5	TOPSOIL: GRAY TO BROWN SAND WITH ORGANIC MATTER					
583.2	FILL: BROWN SILTY SAND WITH TRACE OF GRAVEL					
581.0		8 7 5				
579.0	MEDIUM DENSE GRAY MOIST TO WET SILTY SAND WITH TRACE OF CLAY AND GRAVEL					
578.5		5 5 9				
576.0		6 7 5				
575.5	VERY SOFT TO SOFT GRAY MOIST SILTY CLAY WITH TRACE OF SAND					
573.5		1 1 2			0.3	
571.0		1 1 2			0.3	
568.5		1 1 1			<0.3	
566.0		1 1 2			0.3	
563.5		1 1 1			<0.3	
561.0		1 2 2			0.3	
558.5		WOH WOH 1			<0.3	
	E.O.B. 25 FT					

GROUNDWATER LEVELS:
AT TIME OF DRILLING: 6.5 FT
AT END OF DRILLING: 16 FT
24 HRS. AFTER DRILLING: NOT OBTAINED
BACKFILL PROCEDURE: BOREHOLE BACKFILLED WITH EXCAVATED MATERIALS.

NOTES:

(0) 1ST 6 IN
(0) 2ND 6 IN
(0) 3RD 6 IN
NUMBERS IN CIRCLES DENOTE NUMBER OF BLOWS REQUIRED TO DRIVE A 2" O.D. (1.5" I.D.) SPLIT SPOON SAMPLER 3 SUCCESSIVE 6" INCREMENTS USING A 140 LB HAMMER FALLING 30".

THE BORING LOGS REPRESENT POINT INFORMATION. PRESENTATION OF THIS INFORMATION IN NO WAY IMPLIES THAT SUBSURFACE CONDITIONS ARE THE SAME AT OTHER THAN THE EXACT LOCATION OF THE BORING LOCATION.

GROUNDWATER LEVELS REPRESENT THE CONDITIONS AT THE TIME THE MEASUREMENTS WERE OBTAINED AND SHOULD BE EXPECTED TO FLUCTUATE THROUGHOUT THE YEAR. GROUNDWATER LEVELS MAY ALSO BE INFLUENCED BY RESIDUAL BORING WATER OR OTHER FACTORS.

BORING ELEVATIONS WERE ESTIMATED FROM THE PLAN PROVIDED BY OHM. NORTHING/EASTING AT THE AS-DRILLED BORING LOCATIONS WERE ESTIMATED FROM GOOGLE EARTH BASED ON THE PLAN PROVIDED BY OHM AND WERE NOT SURVEYED BY A LICENSED SURVEYOR. AS SUCH, THESE ELEVATIONS AND COORDINATES ARE CONSIDERED APPROXIMATE.

CONSISTENCY WAS DETERMINED BY INSPECTION OF SAMPLES AND SUBSTANTIATED BY SOILS RESISTANCE TO DRILLING TOOLS (CASING OR AUGER).

DRILL RIG TYPE: CME 45 TRUCK HAMMER TYPE: MANUAL

SPT HAMMER CALIBRATION: ASSUMED TO BE 60%
SAMPLING METHOD: SPT

LEGEND:

MC = MOISTURE CONTENT - (%)
DD = DRY DENSITY - LBS/CU.FT (PCF)
PP = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH - TONS/SQ.FT (TSF)
UCS = LAB DETERMINED UNCONFINED COMPRESSIVE STRENGTH - TONS/SQ.FT (TSF)
EOB = END OF BORING
N/A = NOT APPLICABLE
WOH = WEIGHT OF HAMMER

GEOTRAN PROJECT NO:	DATE:	GEOTRAN FIGURE NO
19-060066-10	05/19/2021	2
DRAWN BY: D. YIP	REVIEWED BY: M. LUCKHAM	

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

GeoTran Consultants, LLC

MDOT Michigan Department of Transportation

NO SCALE

FILE: 202768 BORING 005.DGN
DATE: 05/19/2021
DESIGN UNIT:
TSC:
CS:
JN: 202768PE

TEST BORING DATA
M-85 AT DEARBORN STREET
WAYNE COUNTY, MICHIGAN

DRAWING SBOR 005
SHEET SECT 1

DATE 8/4/21

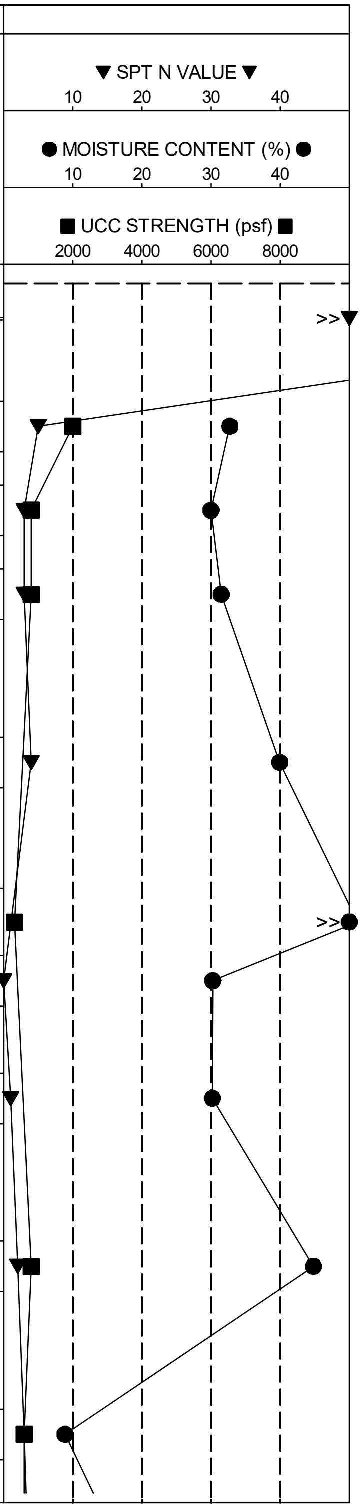
LOG OF TEST BORING B-03-02

LOG OF SOIL PROFILE

ELEVATION ft		DEPTH (ft)
	Ground Surface Elevation 578.4 ft	0
577.5	11 inches of ASPHALTIC CEMENT CONCRETE	0.9
577.2		1.2
576.4	FILL - Mixed sand and gravel, dark brown, moist	2.0
	Field Engineer reported PORTLAND CEMENT CONCRETE	
568.4	Stiff to soft LEAN CLAY, trace sand, trace gravel, frequent silt partings, gray (CL)	10.0
	NOTE: No recovery on initial SPT sample attempt 13.5-15 ft., sampler direct pushed to retrieve specimen	
548.4	Soft LEAN CLAY, trace sand, trace gravel, gray (CL)	30.0
	Soft to medium LEAN CLAY, few sand, trace gravel, gray (CL)	

FIELD DATA / LABORATORY DATA

SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
SS1	1	50/1"	50 +	1.1						
SS2	11	3-3-2	5	5.0	2000*	32.7				
SS3	10	2-1-2	3	7.5	800#	30.0				
SS4	13	1-2-1	3	10.0	800#	31.5				
DP5	0	2-2-2	4	15.0	<>	39.9				
ST6	24			20.0	320#	51.2				
SS7	18	0-0-0	0	21.5	<>	30.2				
SS8	18	0-0-1	1	25.0	<>	30.2				
SS9	18	0-1-1	2	30.0	800#	44.8				
SS10	14	1-1-2	3	35.0	600#	8.9				



GROUNDWATER READINGS
First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 291516.6
Easting: 13455909.8

Coordinates/GSE determined by:

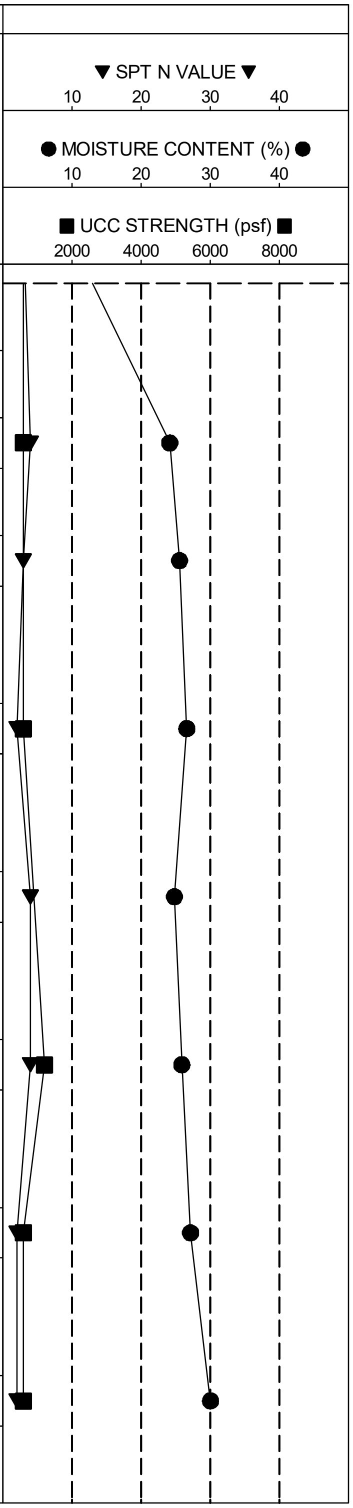
KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Driller: K. Conrad
Drill Rig: CME 75 (Rig 397777)
Logged By: S. Panetta
Drilling Method: 3 1/4 inch HSA/2 7/8 inch WR
Method Notes: WR started at 41.5 ft.
Hammer Type: Automatic
Backfilled With: Grout/Core/Patch
Checked By: ALOG
QA/QC By: KB
Remarks:

Somat Engineering, Inc.
Detroit, Michigan

DATE 8/4/21 **LOG OF TEST BORING B-03-02**

LOG OF SOIL PROFILE				FIELD DATA					LABORATORY DATA					
ELEVATION ft			DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
		Ground Surface Elevation 578.4 ft												
	▨	Soft to medium LEAN CLAY, few sand, trace gravel, gray (CL)		ST11	24			40.0						
	▨		40	SS12	8	0-2-2	4	41.5	600#	24.1				
	▨		45	SS13	15	0-1-2	3	45.0	<>	25.6				
	▨		50	SS14	18	0-1-1	2	50.0	600#	26.6				
	▨		55	SS15	18	0-2-2	4	55.0	<>	24.8				
518.4	▨	60.0	60	SS16	18	1-2-2	4	60.0	1200#	25.9				
	▨	Soft LEAN CLAY, few sand, trace gravel, gray (CL)	65	SS17	18	0-0-2	2	65.0	600#	27.2				
508.4	▨	70.0	70	SS18	18	0-0-2	2	70.0	600#	30.0				
		End of Boring at 70 feet												



GROUNDWATER READINGS
First Encountered: none
Upon Completion: n/a

BORING LOCATION INFORMATION
Northing: 291516.6
Easting: 13455909.8

Coordinates/GSE determined by:

KEY
\# Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Driller: K. Conrad
Drill Rig: CME 75 (Rig 397777)
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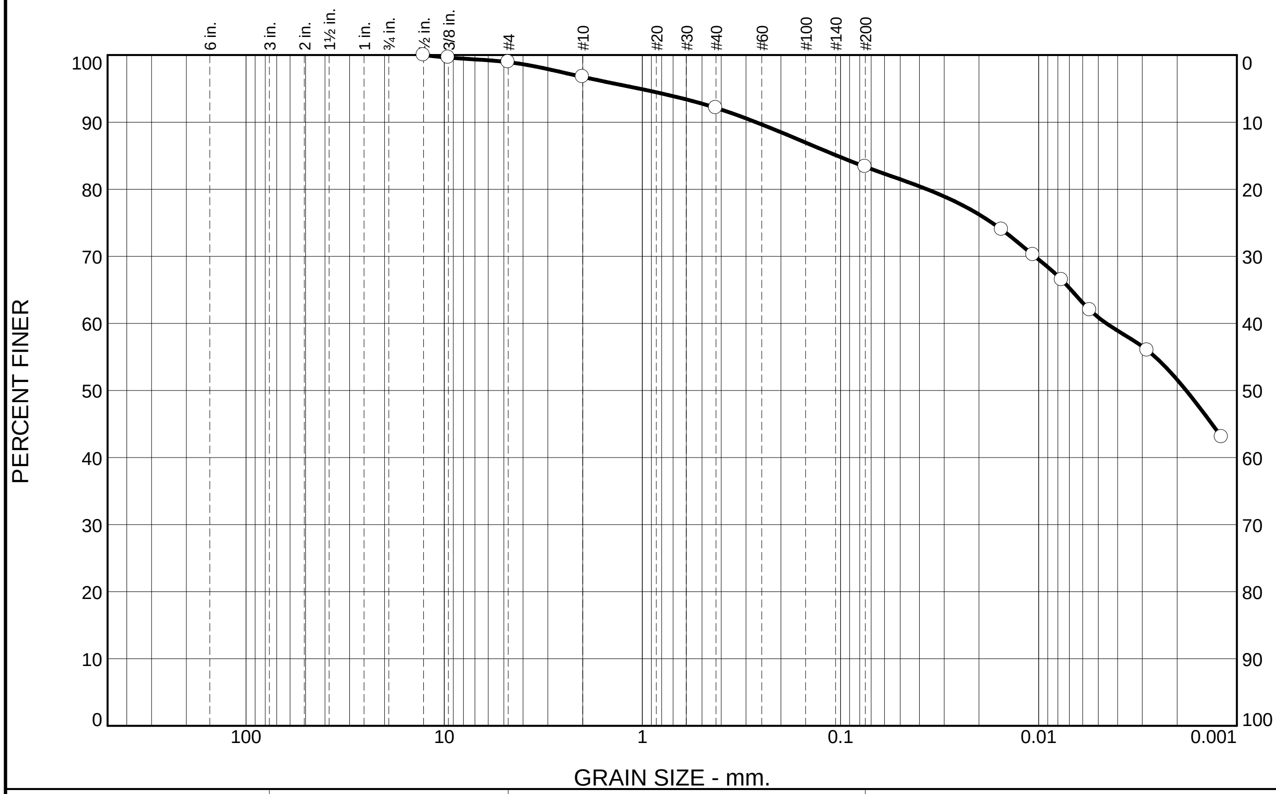
Drilling Method: 3 1/4 inch HSA/2 7/8 inch WR
Method Notes: WR started at 41.5 ft.
Hammer Type: Automatic
Backfilled With: Grout/Core/Patch
Checked By: ALOG
QA/QC By: KB
Remarks:

Somat Engineering, Inc.
Detroit, Michigan

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	2.3	4.6	8.7	22.5	60.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	99.6		
#4	99.0		
#10	96.7		
#40	92.1		
#200	83.4		

* (no specification provided)

Material Description

lean clay with sand

Atterberg Limits

PL= 16 LL= 34 PI= 18

Coefficients

D_{90}= 0.2672 D_{85}= 0.1041 D_{60}= 0.0046
D_{50}= 0.0018 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(14)

Remarks

Moisture Content = 38.1%

Source of Sample: B-03-05 **Depth:** 40.0'-42.0'
Sample Number: ST-11

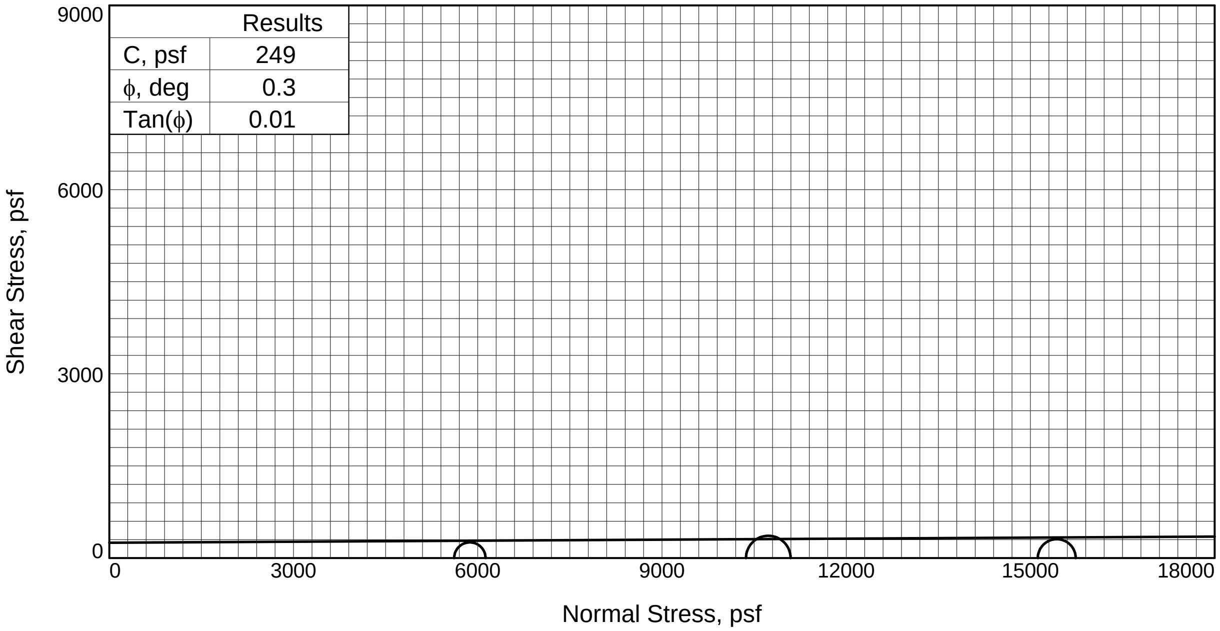
Date: 8-19-21

DLZ

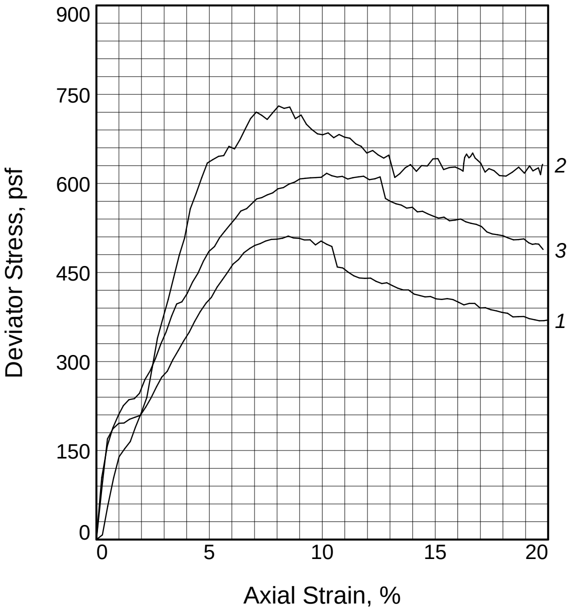
Client: Somat Engineering
Project: Fort St. DTE Main

Project No: 2121-4619.00 **Figure**

Tested By: KK **Checked By:** SR



	Results
C, psf	249
ϕ, deg	0.3
Tan(ϕ)	0.01



	Sample No.	1	2	3
Initial	Water Content, %	36.7	35.2	32.8
	Dry Density, pcf	85.5	88.4	90.6
	Saturation, %	99.3	102.0	99.9
	Void Ratio	1.0266	0.9589	0.9114
	Diameter, in.	2.88	2.83	2.84
	Height, in.	5.52	5.49	5.66
At Test	Water Content, %	37.0	34.6	32.8
	Dry Density, pcf	85.5	88.4	90.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0266	0.9589	0.9114
	Diameter, in.	2.88	2.83	2.84
	Height, in.	5.52	5.49	5.66
	Strain rate, in./min.	0.055	0.055	0.055
	Back Pressure, psi	0.00	0.00	0.00
	Cell Pressure, psi	39.00	72.00	105.00
	Fail. Stress, psf	511	726	617
	Strain, %	8.5	8.3	10.2
	Ult. Stress, psf	370	632	489
	Strain, %	20.0	19.8	19.8
	σ_1 Failure, psf	6127	11094	15737
	σ_3 Failure, psf	5616	10368	15120

Type of Test:
Unconsolidated Undrained

Sample Type: Intact

Description: lean clay with sand

LL= 34 **PL=** 16 **PI=** 18

Assumed Specific Gravity= 2.775

Remarks:

Figure ________

Client: Somat Engineering

Project: Fort St. DTE Main

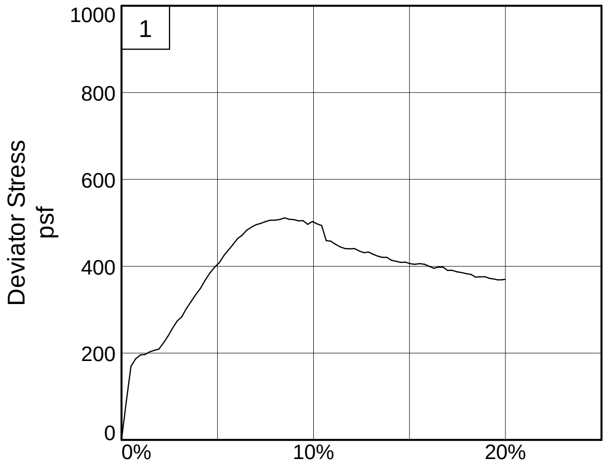
Source of Sample: B-03-05 **Depth:** 40.0'-42.0'

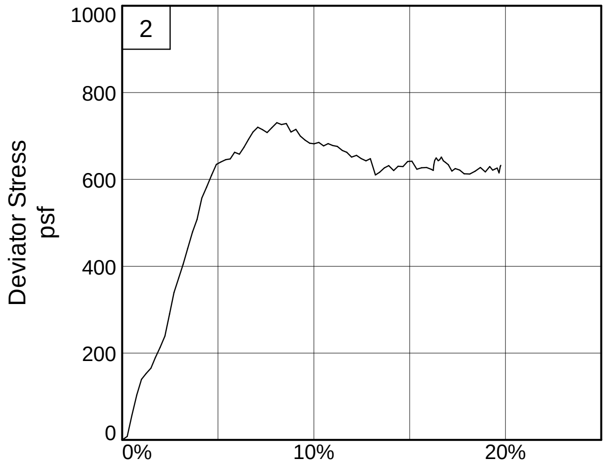
Sample Number: ST-11

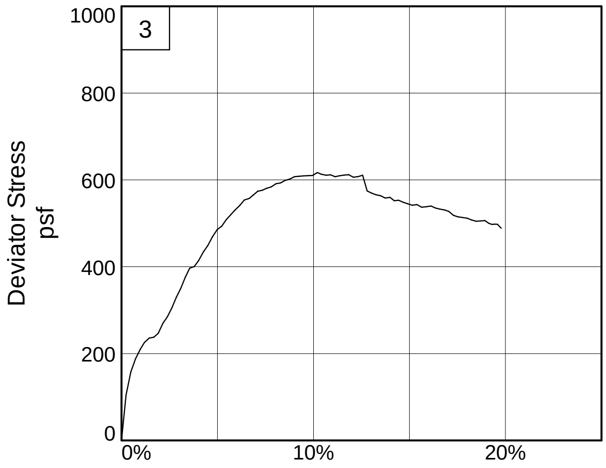
Proj. No.: 2121-4619.00 **Date Sampled:** 8-19-21

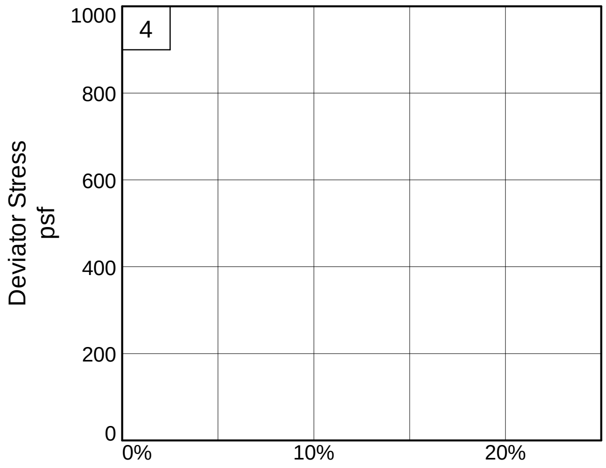
DLZ

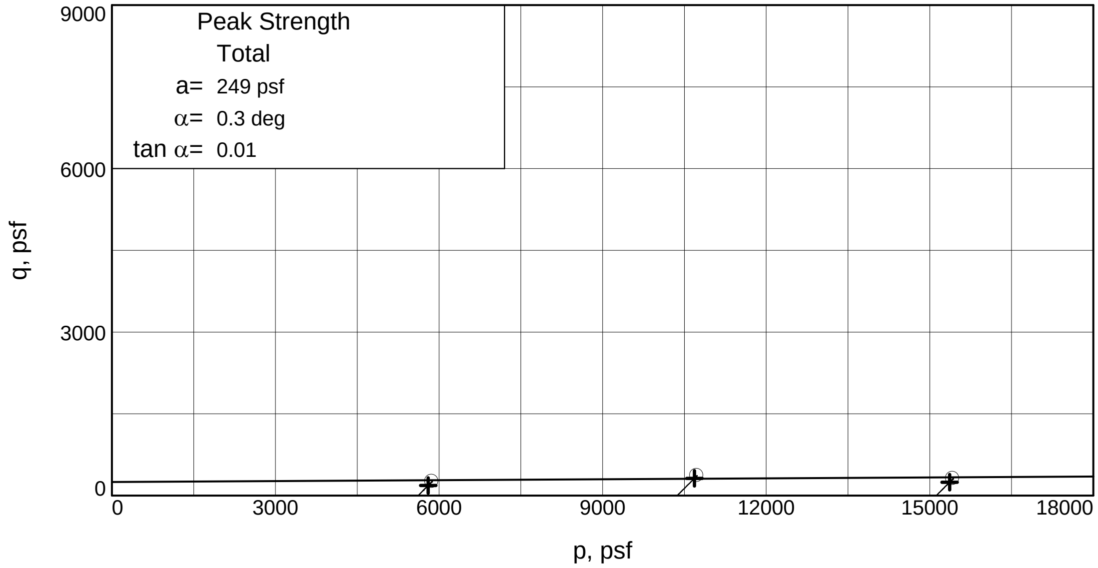
Tested By: WV **Checked By:** SR











Stress Paths: o indicates peak + indicates end

Client: Somat Engineering

Project: Fort St. DTE Main

Source of Sample: B-03-05 **Depth:** 40.0'-42.0' **Sample Number:** ST-11

Project No.: 2121-4619.00 **Figure** ________

DLZ, INC.

Tested By: WV **Checked By:** SR

Undisturbed Tube Samples

Project No. 21222-2002.00 Client 0 Project CHIA

Boring No P-219 Press No. 0 Sampling Date

Depth S-1 Sample No. 9-15 Laboratory Date 9/17/2021

Description Very soft light brown fat clay, moist

Recovery 27in

Depth 0.0"

H.P <.25

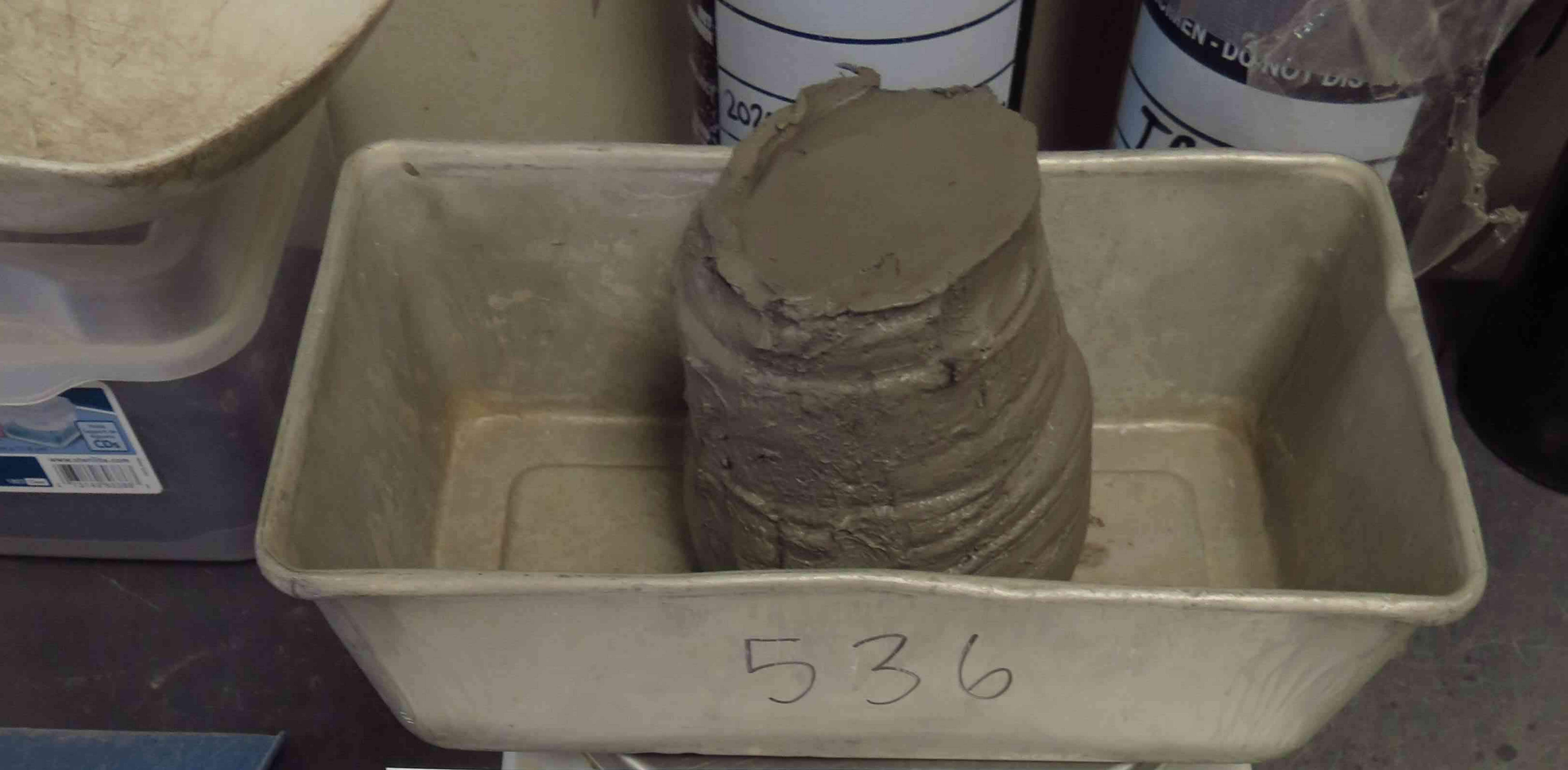
Moisture Content	
Container No.	
Wet Weight w/ Cont.	
Dry Weight w/ Cont.	
Weight of Container	
Moisture Content (%)	

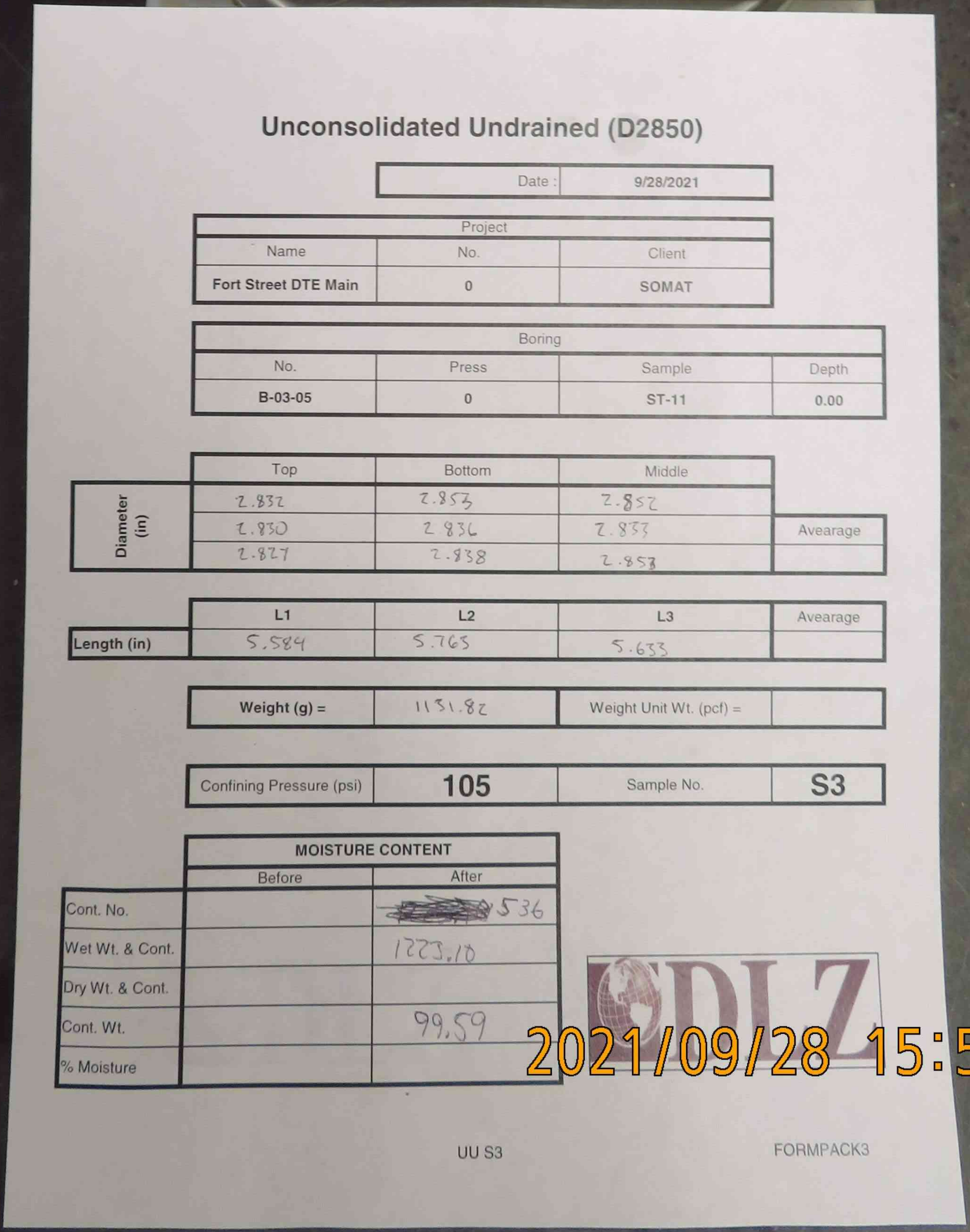
<.25

DLZ

FORMPACK3.xlsm

Undisturbed





Unconsolidated Undrained (D2850)

Date :	9/28/2021

Project		
Name	No.	Client
Fort Street DTE Main	**0**	**SOMAT**

Boring			
No.	Press	Sample	Depth
B-03-05	**0**	**ST-11**	**0.00**

	Top	Bottom	Middle	
Diameter (in)	2.832	2.853	2.852	
	2.830	2.836	2.833	Avearage
	2.827	2.838	2.853	

	L1	**L2**	**L3**	Avearage
Length (in)	5.584	5.765	5.633	

Weight (g) =	1131.82	Weight Unit Wt. (pcf) =	

Confining Pressure (psi)	**105**	Sample No.	**S3**

	MOISTURE CONTENT	
	Before	After
Cont. No.		536
Wet Wt. & Cont.		1223.10
Dry Wt. & Cont.		
Cont. Wt.		99.59
% Moisture		

CDLZ

2021/09/28 15:55

UU S3

FORMPACK3

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

10/6/2021
4:53 PM

Date: 8-19-21
Client: Somat Engineering
Project: Fort St. DTE Main
Project No.: 2121-4619.00
Location: B-03-05
Depth: 40.0'-42.0' **Sample Number:** ST-11
Description: lean clay with sand
Remarks:
Type of Sample: Intact
Assumed Specific Gravity=2.775 **LL=**34 **PL=**16 **PI=**18
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.			1190.970
Moisture content: Dry soil+tare, gms.			905.500
Moisture content: Tare, gms.			100.850
Moisture, %	36.7	37.0	35.5
Moist specimen weight, gms.	1100.2		
Diameter, in.	2.88	2.88	
Area, in.²	6.50	6.50	
Height, in.	5.52	5.52	
Net decrease in height, in.		0.00	
Wet density, pcf	116.9	117.1	
Dry density, pcf	85.5	85.5	
Void ratio	1.0266	1.0266	
Saturation, %	99.3	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Cell pressure = 39.00 psi (5616 psf)
Back pressure = 0.00 psi (0 psf)
Strain rate, in./min. = 0.055
Fail. Stress = 511 psf **at reading no.** 35
Ult. Stress = 370 psf **at reading no.** 83

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.0006	5.687	0.0	0.0	0	5616	5616	1.00	5616	0
1	0.0143	10.323	4.6	0.2	89	5616	5705	1.02	5660	44
2	0.0277	14.599	8.9	0.5	170	5616	5786	1.03	5701	85
3	0.0413	16.019	10.3	0.7	187	5616	5803	1.03	5709	93
4	0.0553	17.102	11.4	1.0	196	5616	5812	1.03	5714	98
5	0.0681	17.733	12.0	1.2	196	5616	5812	1.03	5714	98
6	0.0814	18.653	13.0	1.5	203	5616	5819	1.04	5717	101
7	0.0954	19.492	13.8	1.7	206	5616	5822	1.04	5719	103
8	0.1080	20.233	14.5	1.9	209	5616	5825	1.04	5721	105
9	0.1214	21.074	15.4	2.2	223	5616	5839	1.04	5728	112
10	0.1339	21.801	16.1	2.4	238	5616	5854	1.04	5735	119
11	0.1476	22.728	17.0	2.7	258	5616	5874	1.05	5745	129
12	0.1604	23.515	17.8	2.9	274	5616	5890	1.05	5753	137
13	0.1741	24.027	18.3	3.1	284	5616	5900	1.05	5758	142
14	0.1875	24.970	19.3	3.4	303	5616	5919	1.05	5767	151
15	0.2006	25.751	20.1	3.6	318	5616	5934	1.06	5775	159
16	0.2139	26.554	20.9	3.9	335	5616	5951	1.06	5783	167
17	0.2276	27.302	21.6	4.1	349	5616	5965	1.06	5791	175
18	0.2409	28.211	22.5	4.4	367	5616	5983	1.07	5800	184
19	0.2546	29.063	23.4	4.6	384	5616	6000	1.07	5808	192
20	0.2687	29.803	24.1	4.9	398	5616	6014	1.07	5815	199
21	0.2814	30.309	24.6	5.1	408	5616	6024	1.07	5820	204
22	0.2955	31.203	25.5	5.3	425	5616	6041	1.08	5829	213
23	0.3087	31.868	26.2	5.6	438	5616	6054	1.08	5835	219
24	0.3210	32.514	26.8	5.8	450	5616	6066	1.08	5841	225
25	0.3347	33.259	27.6	6.1	464	5616	6080	1.08	5848	232
26	0.3480	33.697	28.0	6.3	472	5616	6088	1.08	5852	236
27	0.3611	34.328	28.6	6.5	483	5616	6099	1.09	5858	242
28	0.3757	34.766	29.1	6.8	491	5616	6107	1.09	5861	245
29	0.3877	35.078	29.4	7.0	496	5616	6112	1.09	5864	248
30	0.4012	35.302	29.6	7.3	499	5616	6115	1.09	5865	249
31	0.4142	35.582	29.9	7.5	503	5616	6119	1.09	5867	251
32	0.4278	35.803	30.1	7.7	506	5616	6122	1.09	5869	253
33	0.4418	35.904	30.2	8.0	506	5616	6122	1.09	5869	253
34	0.4556	36.067	30.4	8.2	508	5616	6124	1.09	5870	254
35	0.4696	36.323	30.6	8.5	511	5616	6127	1.09	5872	256
36	0.4824	36.247	30.6	8.7	508	5616	6124	1.09	5870	254
37	0.4965	36.297	30.6	9.0	507	5616	6123	1.09	5870	254
38	0.5091	36.237	30.5	9.2	505	5616	6121	1.09	5868	252
39	0.5229	36.340	30.7	9.5	505	5616	6121	1.09	5869	253
40	0.5359	35.995	30.3	9.7	497	5616	6113	1.09	5864	248
41	0.5496	36.403	30.7	9.9	503	5616	6119	1.09	5867	251
42	0.5633	36.214	30.5	10.2	498	5616	6114	1.09	5865	249
43	0.5762	36.105	30.4	10.4	494	5616	6110	1.09	5863	247
44	0.5894	35.966	30.3	10.7	459	5616	6075	1.08	5846	230
45	0.6027	36.005	30.3	10.9	458	5616	6074	1.08	5845	229
46	0.6160	35.754	30.1	11.1	450	5616	6066	1.08	5841	225

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
47	0.6297	35.565	29.9	11.4	444	5616	6060	1.08	5838	222
48	0.6433	35.506	29.8	11.6	441	5616	6057	1.08	5836	220
49	0.6569	35.584	29.9	11.9	440	5616	6056	1.08	5836	220
50	0.6706	35.732	30.0	12.1	441	5616	6057	1.08	5836	220
51	0.6838	35.575	29.9	12.4	435	5616	6051	1.08	5834	218
52	0.6981	35.497	29.8	12.6	431	5616	6047	1.08	5832	216
53	0.7104	35.678	30.0	12.9	433	5616	6049	1.08	5832	216
54	0.7235	35.545	29.9	13.1	428	5616	6044	1.08	5830	214
55	0.7366	35.442	29.8	13.3	424	5616	6040	1.08	5828	212
56	0.7504	35.403	29.7	13.6	421	5616	6037	1.07	5826	210
57	0.7633	35.520	29.8	13.8	421	5616	6037	1.07	5826	210
58	0.7770	35.279	29.6	14.1	414	5616	6030	1.07	5823	207
59	0.7914	35.277	29.6	14.3	411	5616	6027	1.07	5822	206
60	0.8037	35.269	29.6	14.5	409	5616	6025	1.07	5820	204
61	0.8169	35.421	29.7	14.8	410	5616	6026	1.07	5821	205
62	0.8313	35.341	29.7	15.0	406	5616	6022	1.07	5819	203
63	0.8444	35.405	29.7	15.3	405	5616	6021	1.07	5818	202
64	0.8578	35.608	29.9	15.5	406	5616	6022	1.07	5819	203
65	0.8720	35.647	30.0	15.8	404	5616	6020	1.07	5818	202
66	0.8855	35.528	29.8	16.0	400	5616	6016	1.07	5816	200
67	0.8988	35.411	29.7	16.3	395	5616	6011	1.07	5814	198
68	0.9115	35.668	30.0	16.5	398	5616	6014	1.07	5815	199
69	0.9255	35.793	30.1	16.8	398	5616	6014	1.07	5815	199
70	0.9380	35.499	29.8	17.0	390	5616	6006	1.07	5811	195
71	0.9511	35.645	30.0	17.2	391	5616	6007	1.07	5811	195
72	0.9644	35.584	29.9	17.5	387	5616	6003	1.07	5810	194
73	0.9785	35.608	29.9	17.7	385	5616	6001	1.07	5809	193
74	0.9916	35.598	29.9	18.0	383	5616	5999	1.07	5807	191
75	1.0053	35.637	29.9	18.2	381	5616	5997	1.07	5807	191
76	1.0185	35.419	29.7	18.4	375	5616	5991	1.07	5804	188
77	1.0315	35.575	29.9	18.7	376	5616	5992	1.07	5804	188
78	1.0454	35.715	30.0	18.9	376	5616	5992	1.07	5804	188
79	1.0584	35.647	30.0	19.2	372	5616	5988	1.07	5802	186
80	1.0722	35.668	30.0	19.4	370	5616	5986	1.07	5801	185
81	1.0830	35.678	30.0	19.6	369	5616	5985	1.07	5800	184
82	1.0944	35.803	30.1	19.8	369	5616	5985	1.07	5800	184
83	1.1034	35.933	30.2	20.0	370	5616	5986	1.07	5801	185

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.			1193.520
Moisture content: Dry soil+tare, gms.			911.940
Moisture content: Tare, gms.			107.980
Moisture, %	35.2	34.6	35.0
Moist specimen weight, gms.	1087.2		
Diameter, in.	2.83	2.83	
Area, in.²	6.30	6.30	
Height, in.	5.49	5.49	
Net decrease in height, in.		0.00	
Wet density, pcf	119.6	119.0	
Dry density, pcf	88.4	88.4	
Void ratio	0.9589	0.9589	
Saturation, %	102.0	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Cell pressure = 72.00 psi (10368 psf)

Back pressure = 0.00 psi (0 psf)

Strain rate, in./min. = 0.055

Fail. Stress = 726 psf **at reading no.** 34

Ult. Stress = 632 psf **at reading no.** 91

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.0114	106.770	0.0	0.0	0	10368	10368	1.00	10368	0
1	0.0259	107.765	1.0	0.3	8	10368	10376	1.00	10372	4
2	0.0392	110.494	3.7	0.5	56	10368	10424	1.01	10396	28
3	0.0533	113.227	6.5	0.8	104	10368	10472	1.01	10420	52
4	0.0667	115.427	8.7	1.0	139	10368	10507	1.01	10438	70
5	0.0803	116.658	9.9	1.3	153	10368	10521	1.01	10444	76
6	0.0939	117.834	11.1	1.5	165	10368	10533	1.02	10451	83
7	0.1064	119.517	12.7	1.7	189	10368	10557	1.02	10463	95
8	0.1204	121.243	14.5	2.0	213	10368	10581	1.02	10475	107
9	0.1340	122.492	15.7	2.2	239	10368	10607	1.02	10488	120
10	0.1472	124.808	18.0	2.5	290	10368	10658	1.03	10513	145
11	0.1599	127.073	20.3	2.7	339	10368	10707	1.03	10538	170
12	0.1736	128.663	21.9	3.0	374	10368	10742	1.04	10555	187
13	0.1862	130.130	23.4	3.2	405	10368	10773	1.04	10570	202
14	0.1993	131.828	25.1	3.4	441	10368	10809	1.04	10589	221
15	0.2129	133.605	26.8	3.7	479	10368	10847	1.05	10607	239
16	0.2259	134.992	28.2	3.9	508	10368	10876	1.05	10622	254
17	0.2399	137.321	30.6	4.2	557	10368	10925	1.05	10647	279
18	0.2536	138.560	31.8	4.4	582	10368	10950	1.06	10659	291
19	0.2676	139.893	33.1	4.7	610	10368	10978	1.06	10673	305
20	0.2812	141.124	34.4	4.9	634	10368	11002	1.06	10685	317
21	0.2942	141.465	34.7	5.1	640	10368	11008	1.06	10688	320
22	0.3084	141.817	35.0	5.4	646	10368	11014	1.06	10691	323

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
23	0.3211	141.973	35.2	5.6	647	10368	11015	1.06	10692	324
24	0.3339	142.776	36.0	5.9	662	10368	11030	1.06	10699	331
25	0.3473	142.674	35.9	6.1	658	10368	11026	1.06	10697	329
26	0.3606	143.500	36.7	6.4	674	10368	11042	1.07	10705	337
27	0.3739	144.465	37.7	6.6	692	10368	11060	1.07	10714	346
28	0.3865	145.347	38.6	6.8	709	10368	11077	1.07	10723	355
29	0.4002	145.968	39.2	7.1	720	10368	11088	1.07	10728	360
30	0.4137	145.814	39.0	7.3	715	10368	11083	1.07	10725	357
31	0.4270	145.589	38.8	7.6	708	10368	11076	1.07	10722	354
32	0.4406	146.235	39.5	7.8	719	10368	11087	1.07	10728	360
33	0.4547	146.882	40.1	8.1	731	10368	11099	1.07	10733	365
34	0.4680	146.788	40.0	8.3	726	10368	11094	1.07	10731	363
35	0.4818	147.007	40.2	8.6	729	10368	11097	1.07	10732	364
36	0.4954	146.181	39.4	8.8	709	10368	11077	1.07	10723	355
37	0.5093	146.586	39.8	9.1	715	10368	11083	1.07	10726	358
38	0.5221	145.939	39.2	9.3	700	10368	11068	1.07	10718	350
39	0.5354	145.610	38.8	9.5	691	10368	11059	1.07	10713	345
40	0.5491	145.361	38.6	9.8	683	10368	11051	1.07	10710	342
41	0.5619	145.392	38.6	10.0	682	10368	11050	1.07	10709	341
42	0.5751	145.641	38.9	10.3	685	10368	11053	1.07	10711	343
43	0.5887	145.359	38.6	10.5	677	10368	11045	1.07	10707	339
44	0.6017	145.727	39.0	10.7	683	10368	11051	1.07	10709	341
45	0.6150	145.612	38.8	11.0	678	10368	11046	1.07	10707	339
46	0.6281	145.620	38.8	11.2	676	10368	11044	1.07	10706	338
47	0.6423	145.275	38.5	11.5	667	10368	11035	1.06	10701	333
48	0.6554	145.168	38.4	11.7	663	10368	11031	1.06	10699	331
49	0.6691	144.716	37.9	12.0	651	10368	11019	1.06	10694	326
50	0.6833	145.033	38.3	12.2	655	10368	11023	1.06	10696	328
51	0.6966	144.770	38.0	12.5	648	10368	11016	1.06	10692	324
52	0.7103	144.613	37.8	12.7	643	10368	11011	1.06	10689	321
53	0.7227	144.963	38.2	12.9	648	10368	11016	1.06	10692	324
54	0.7374	145.105	38.3	13.2	610	10368	10978	1.06	10673	305
55	0.7493	145.550	38.8	13.4	616	10368	10984	1.06	10676	308
56	0.7628	146.212	39.4	13.7	627	10368	10995	1.06	10681	313
57	0.7755	146.615	39.8	13.9	632	10368	11000	1.06	10684	316
58	0.7896	146.194	39.4	14.2	620	10368	10988	1.06	10678	310
59	0.8022	146.833	40.1	14.4	630	10368	10998	1.06	10683	315
60	0.8164	146.956	40.2	14.7	629	10368	10997	1.06	10683	315
61	0.8299	147.722	41.0	14.9	641	10368	11009	1.06	10689	321
62	0.8419	147.885	41.1	15.1	642	10368	11010	1.06	10689	321
63	0.8560	147.096	40.3	15.4	623	10368	10991	1.06	10680	312
64	0.8698	147.427	40.7	15.6	627	10368	10995	1.06	10681	313
65	0.8840	147.630	40.9	15.9	628	10368	10996	1.06	10682	314
66	0.8978	147.566	40.8	16.1	623	10368	10991	1.06	10680	312
67	0.9032	147.490	40.7	16.2	621	10368	10989	1.06	10678	310
68	0.9047	148.175	41.4	16.3	633	10368	11001	1.06	10685	317
69	0.9071	148.750	42.0	16.3	644	10368	11012	1.06	10690	322

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
70	0.9116	149.101	42.3	16.4	650	10368	11018	1.06	10693	325
71	0.9174	148.836	42.1	16.5	643	10368	11011	1.06	10690	322
72	0.9215	149.001	42.2	16.6	645	10368	11013	1.06	10691	323
73	0.9265	149.373	42.6	16.7	651	10368	11019	1.06	10694	326
74	0.9323	149.001	42.2	16.8	643	10368	11011	1.06	10689	321
75	0.9384	148.877	42.1	16.9	639	10368	11007	1.06	10688	320
76	0.9465	148.703	41.9	17.0	634	10368	11002	1.06	10685	317
77	0.9566	148.033	41.3	17.2	619	10368	10987	1.06	10678	310
78	0.9662	148.462	41.7	17.4	625	10368	10993	1.06	10681	313
79	0.9786	148.423	41.7	17.6	621	10368	10989	1.06	10679	311
80	0.9916	148.136	41.4	17.8	613	10368	10981	1.06	10675	307
81	1.0077	148.283	41.5	18.1	612	10368	10980	1.06	10674	306
82	1.0229	148.820	42.1	18.4	619	10368	10987	1.06	10677	309
83	1.0383	149.469	42.7	18.7	627	10368	10995	1.06	10682	314
84	1.0524	149.101	42.3	18.9	617	10368	10985	1.06	10677	309
85	1.0652	149.919	43.1	19.2	630	10368	10998	1.06	10683	315
86	1.0733	149.568	42.8	19.3	621	10368	10989	1.06	10679	311
87	1.0799	149.788	43.0	19.4	624	10368	10992	1.06	10680	312
88	1.0865	150.006	43.2	19.6	626	10368	10994	1.06	10681	313
89	1.0916	149.445	42.7	19.7	615	10368	10983	1.06	10675	307
90	1.0953	150.310	43.5	19.7	630	10368	10998	1.06	10683	315
91	1.0967	150.464	43.7	19.8	632	10368	11000	1.06	10684	316

Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.			1224.760
Moisture content: Dry soil+tare, gms.			953.420
Moisture content: Tare, gms.			101.310
Moisture, %	32.8	32.8	31.8
Moist specimen weight, gms.	1131.8		
Diameter, in.	2.84	2.84	
Area, in.²	6.33	6.33	
Height, in.	5.66	5.66	
Net decrease in height, in.		0.00	
Wet density, pcf	120.4	120.4	
Dry density, pcf	90.6	90.6	
Void ratio	0.9114	0.9114	
Saturation, %	99.9	100.0	

Test Readings for Specimen No. 3

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Cell pressure = 105.00 psi (15120 psf)

Back pressure = 0.00 psi (0 psf)

Strain rate, in./min. = 0.055

Fail. Stress = 617 psf **at reading no.** 43

Ult. Stress = 489 psf **at reading no.** 85

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.0004	21.137	0.0	0.0	0	15120	15120	1.00	15120	0
1	0.0140	26.328	5.2	0.2	104	15120	15224	1.01	15172	52
2	0.0280	29.304	8.2	0.5	158	15120	15278	1.01	15199	79
3	0.0416	31.258	10.1	0.7	188	15120	15308	1.01	15214	94
4	0.0559	32.888	11.8	1.0	210	15120	15330	1.01	15225	105
5	0.0681	34.141	13.0	1.2	226	15120	15346	1.01	15233	113
6	0.0821	35.242	14.1	1.4	236	15120	15356	1.02	15238	118
7	0.0956	35.951	14.8	1.7	237	15120	15357	1.02	15239	119
8	0.1085	36.954	15.8	1.9	246	15120	15366	1.02	15243	123
9	0.1223	38.265	17.1	2.2	270	15120	15390	1.02	15255	135
10	0.1352	38.958	17.8	2.4	284	15120	15404	1.02	15262	142
11	0.1486	39.940	18.8	2.6	305	15120	15425	1.02	15272	152
12	0.1621	41.115	20.0	2.9	330	15120	15450	1.02	15285	165
13	0.1748	42.044	20.9	3.1	349	15120	15469	1.02	15295	175
14	0.1888	43.335	22.2	3.3	377	15120	15497	1.02	15308	188
15	0.2016	44.311	23.2	3.6	397	15120	15517	1.03	15318	198
16	0.2147	44.537	23.4	3.8	401	15120	15521	1.03	15320	200
17	0.2276	45.223	24.1	4.0	414	15120	15534	1.03	15327	207
18	0.2414	46.179	25.0	4.3	434	15120	15554	1.03	15337	217
19	0.2551	46.937	25.8	4.5	449	15120	15569	1.03	15344	224
20	0.2686	47.942	26.8	4.7	469	15120	15589	1.03	15355	235
21	0.2823	48.760	27.6	5.0	486	15120	15606	1.03	15363	243
22	0.2963	49.212	28.1	5.2	494	15120	15614	1.03	15367	247

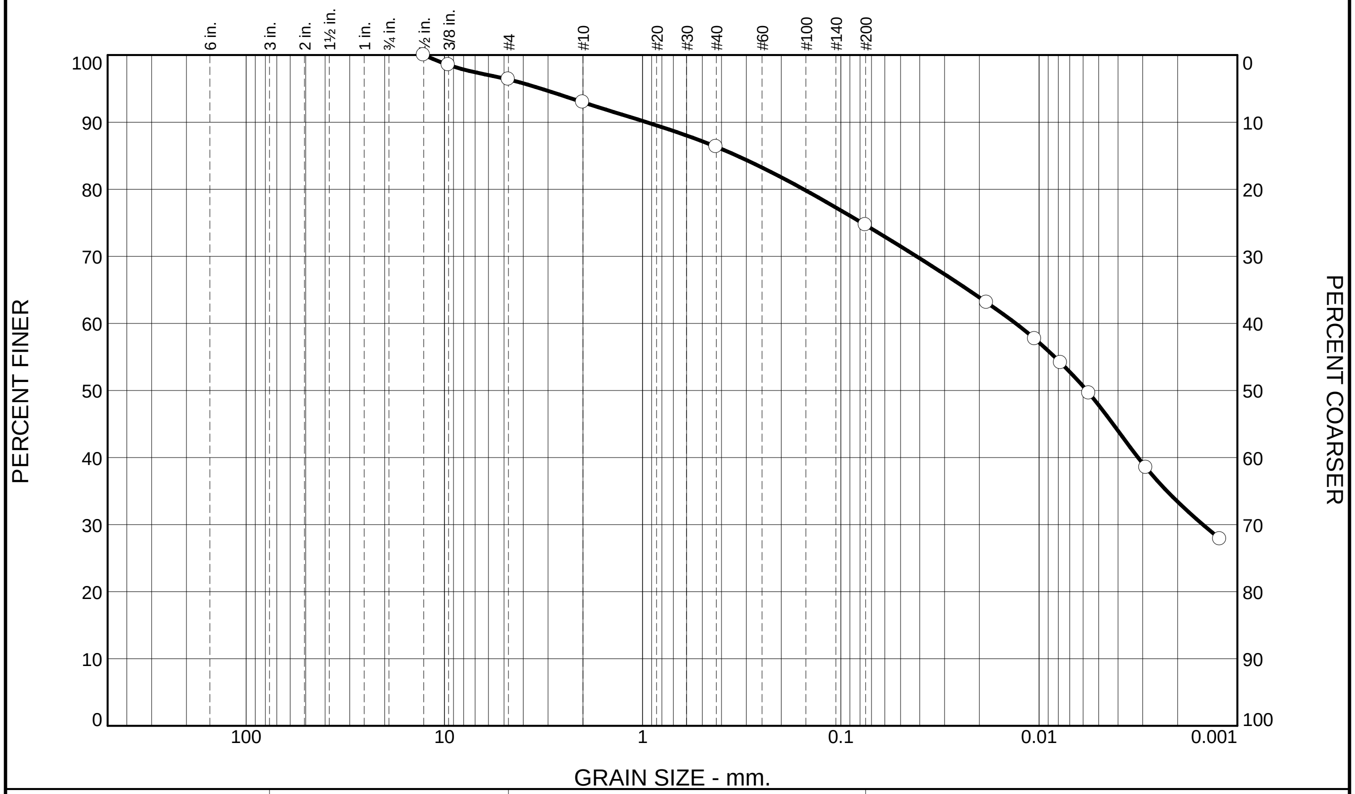
Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
23	0.3093	49.968	28.8	5.5	508	15120	15628	1.03	15374	254
24	0.3221	50.560	29.4	5.7	520	15120	15640	1.03	15380	260
25	0.3357	51.158	30.0	5.9	531	15120	15651	1.04	15385	265
26	0.3490	51.719	30.6	6.2	541	15120	15661	1.04	15391	271
27	0.3623	52.374	31.2	6.4	554	15120	15674	1.04	15397	277
28	0.3768	52.646	31.5	6.7	558	15120	15678	1.04	15399	279
29	0.3883	53.061	31.9	6.9	565	15120	15685	1.04	15402	282
30	0.4020	53.574	32.4	7.1	574	15120	15694	1.04	15407	287
31	0.4151	53.761	32.6	7.3	576	15120	15696	1.04	15408	288
32	0.4284	54.057	32.9	7.6	581	15120	15701	1.04	15410	290
33	0.4420	54.306	33.2	7.8	584	15120	15704	1.04	15412	292
34	0.4555	54.729	33.6	8.0	591	15120	15711	1.04	15416	296
35	0.4690	54.906	33.8	8.3	593	15120	15713	1.04	15417	297
36	0.4828	55.282	34.1	8.5	599	15120	15719	1.04	15419	299
37	0.4972	55.537	34.4	8.8	602	15120	15722	1.04	15421	301
38	0.5101	55.880	34.7	9.0	608	15120	15728	1.04	15424	304
39	0.5233	56.012	34.9	9.2	608	15120	15728	1.04	15424	304
40	0.5368	56.147	35.0	9.5	609	15120	15729	1.04	15425	305
41	0.5506	56.272	35.1	9.7	610	15120	15730	1.04	15425	305
42	0.5636	56.379	35.2	10.0	610	15120	15730	1.04	15425	305
43	0.5772	56.799	35.7	10.2	617	15120	15737	1.04	15428	308
44	0.5899	56.692	35.6	10.4	613	15120	15733	1.04	15426	306
45	0.6036	56.684	35.5	10.7	611	15120	15731	1.04	15425	305
46	0.6165	56.825	35.7	10.9	612	15120	15732	1.04	15426	306
47	0.6300	56.698	35.6	11.1	607	15120	15727	1.04	15424	304
48	0.6430	56.909	35.8	11.4	610	15120	15730	1.04	15425	305
49	0.6564	57.066	35.9	11.6	611	15120	15731	1.04	15426	306
50	0.6698	57.214	36.1	11.8	612	15120	15732	1.04	15426	306
51	0.6841	57.027	35.9	12.1	606	15120	15726	1.04	15423	303
52	0.6981	57.207	36.1	12.3	608	15120	15728	1.04	15424	304
53	0.7113	57.464	36.3	12.6	611	15120	15731	1.04	15425	305
54	0.7244	57.586	36.4	12.8	575	15120	15695	1.04	15407	287
55	0.7373	57.462	36.3	13.0	570	15120	15690	1.04	15405	285
56	0.7512	57.399	36.3	13.3	566	15120	15686	1.04	15403	283
57	0.7641	57.423	36.3	13.5	564	15120	15684	1.04	15402	282
58	0.7776	57.292	36.2	13.7	558	15120	15678	1.04	15399	279
59	0.7919	57.503	36.4	14.0	560	15120	15680	1.04	15400	280
60	0.8043	57.238	36.1	14.2	552	15120	15672	1.04	15396	276
61	0.8175	57.415	36.3	14.4	553	15120	15673	1.04	15397	277
62	0.8311	57.321	36.2	14.7	548	15120	15668	1.04	15394	274
63	0.8441	57.275	36.1	14.9	545	15120	15665	1.04	15393	273
64	0.8576	57.234	36.1	15.1	542	15120	15662	1.04	15391	271
65	0.8713	57.454	36.3	15.4	543	15120	15663	1.04	15392	272
66	0.8849	57.275	36.1	15.6	537	15120	15657	1.04	15389	269
67	0.8988	57.485	36.3	15.9	538	15120	15658	1.04	15389	269
68	0.9128	57.713	36.6	16.1	540	15120	15660	1.04	15390	270
69	0.9260	57.604	36.5	16.4	535	15120	15655	1.04	15388	268

Test Readings for Specimen No. 3

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
70	0.9386	57.610	36.5	16.6	533	15120	15653	1.04	15386	266
71	0.9520	57.657	36.5	16.8	531	15120	15651	1.04	15386	266
72	0.9650	57.604	36.5	17.0	528	15120	15648	1.03	15384	264
73	0.9788	57.253	36.1	17.3	518	15120	15638	1.03	15379	259
74	0.9919	57.214	36.1	17.5	515	15120	15635	1.03	15377	257
75	1.0054	57.277	36.1	17.8	513	15120	15633	1.03	15377	257
76	1.0188	57.337	36.2	18.0	512	15120	15632	1.03	15376	256
77	1.0318	57.265	36.1	18.2	508	15120	15628	1.03	15374	254
78	1.0452	57.238	36.1	18.5	505	15120	15625	1.03	15372	252
79	1.0583	57.399	36.3	18.7	505	15120	15625	1.03	15373	253
80	1.0713	57.602	36.5	18.9	507	15120	15627	1.03	15373	253
81	1.0832	57.376	36.2	19.1	500	15120	15620	1.03	15370	250
82	1.0925	57.331	36.2	19.3	497	15120	15617	1.03	15369	249
83	1.1003	57.462	36.3	19.4	498	15120	15618	1.03	15369	249
84	1.1084	57.524	36.4	19.6	498	15120	15618	1.03	15369	249
85	1.1194	57.158	36.0	19.8	489	15120	15609	1.03	15364	244

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	3.4	6.7	11.7	26.8	47.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	98.5		
#4	96.4		
#10	93.0		
#40	86.3		
#200	74.6		

* (no specification provided)

Material Description

lean clay with sand

Atterberg Limits

PL= 16 LL= 30 PI= 14

Coefficients

D_{90}= 0.9567 D_{85}= 0.3342 D_{60}= 0.0131
D_{50}= 0.0057 D_{30}= 0.0015 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(8)

Remarks

Moisture Content = 27.0%

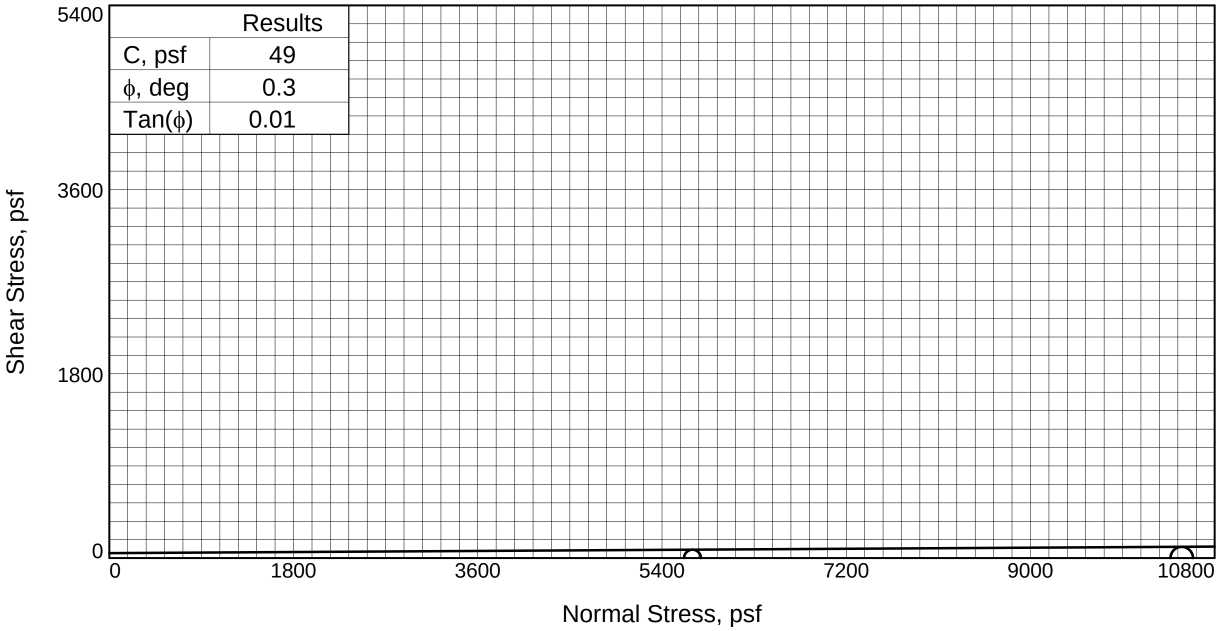
Source of Sample: B-03-03 **Depth:** 58.0'-60.0'
Sample Number: ST-14 **Date:** 8-6-21

DLZ

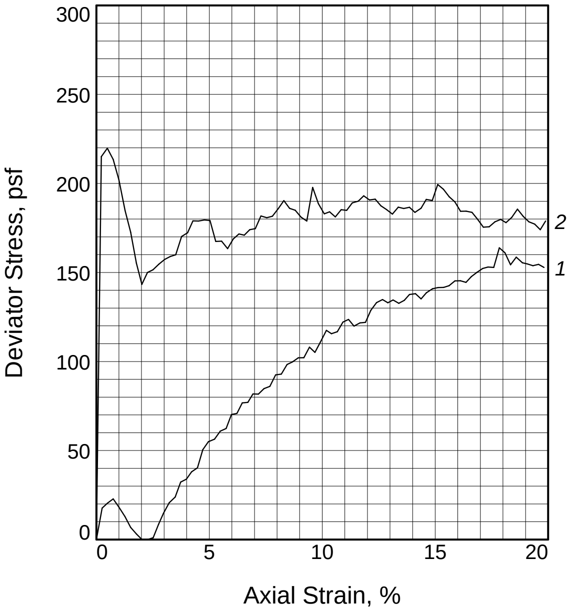
Client: Somat Engineering
Project: Fort St. DTE Main

Project No: 2121-4619.00 **Figure**

Tested By: KK **Checked By:** SR



Results	
C, psf	49
ϕ, deg	0.3
Tan(ϕ)	0.01



	Sample No.	1	2
Initial	Water Content, %	27.0	29.4
	Dry Density, pcf	100.6	97.6
	Saturation, %	103.9	105.2
	Void Ratio	0.7196	0.7726
	Diameter, in.	2.89	2.88
	Height, in.	5.42	5.32
At Test	Water Content, %	26.0	27.9
	Dry Density, pcf	100.6	97.6
	Saturation, %	100.0	100.0
	Void Ratio	0.7196	0.7726
	Diameter, in.	2.89	2.88
	Height, in.	5.42	5.32
	Strain rate, in./min.	0.055	0.055
	Back Pressure, psi	0.00	0.00
	Cell Pressure, psi	39.00	72.00
	Fail. Stress, psf	164	220
	Strain, %	17.8	0.5
	Ult. Stress, psf	153	179
	Strain, %	19.8	19.9
	σ_1 Failure, psf	5780	10588
	σ_3 Failure, psf	5616	10368

Type of Test:
Unconsolidated Undrained

Sample Type: Intact

Description: lean clay with sand

LL= 30 **PL=** 16 **PI=** 14

Assumed Specific Gravity= 2.77

Remarks:

Figure ________

Client: Somat Engineering

Project: Fort St. DTE Main

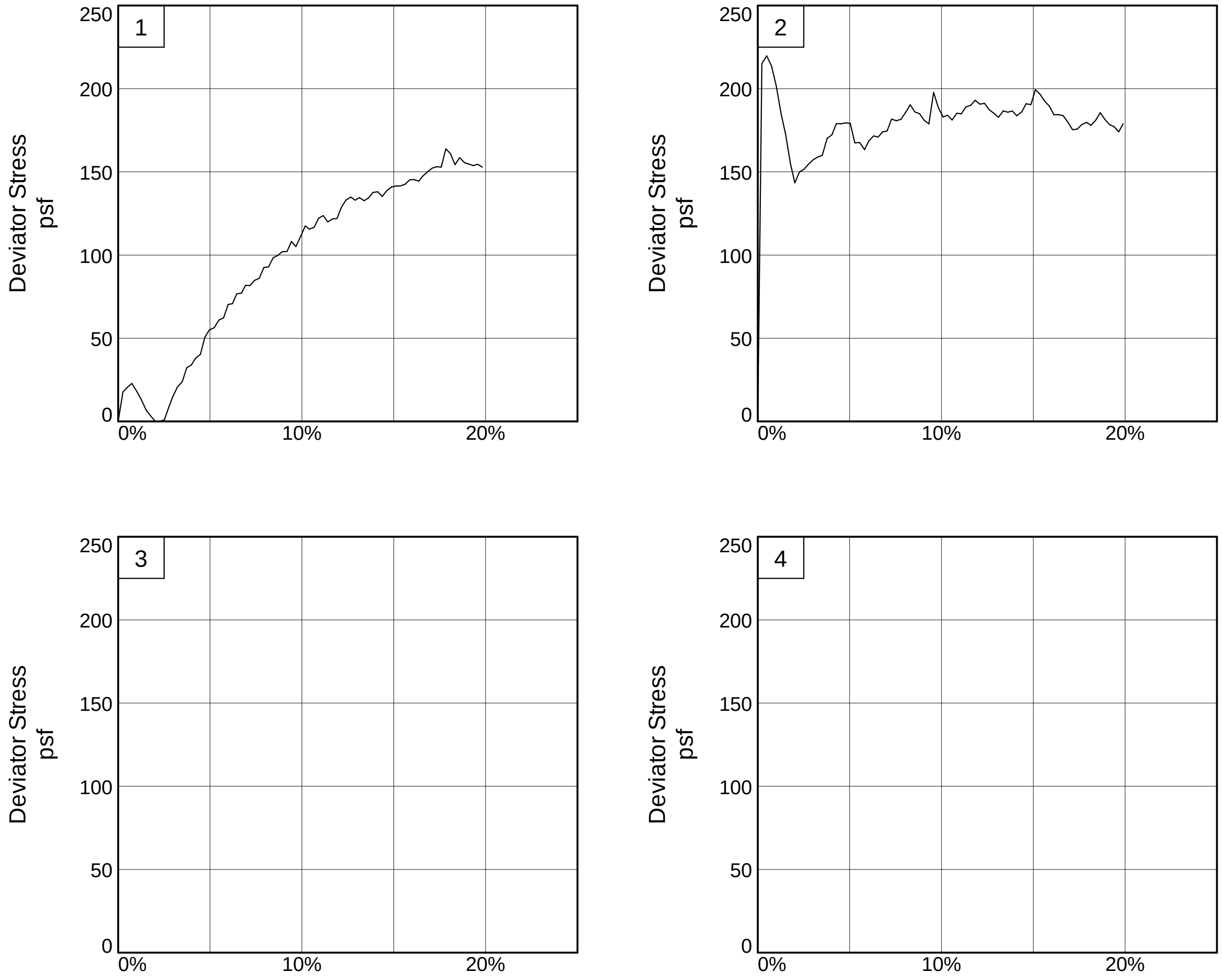
Source of Sample: B-03-03 **Depth:** 58.0'-60.0'

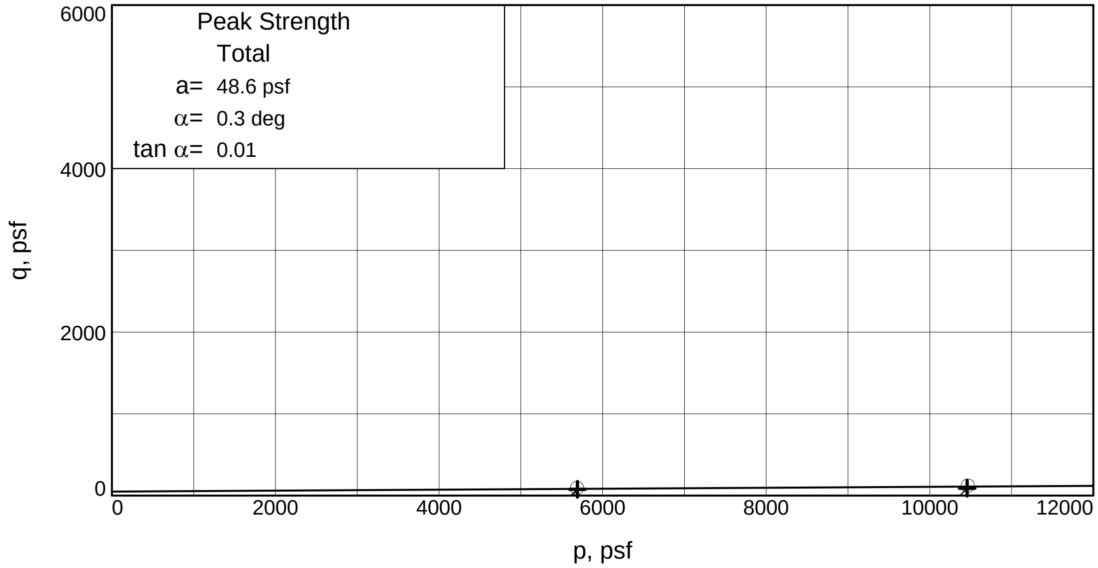
Sample Number: ST-14

Proj. No.: 2121-4619.00 **Date Sampled:** 8-6-21

DLZ

Tested By: WV **Checked By:** SR





Stress Paths: o indicates peak + indicates end

Client: Somat Engineering

Project: Fort St. DTE Main

Source of Sample: B-03-03 **Depth:** 58.0'-60.0' **Sample Number:** ST-14

Project No.: 2121-4619.00 **Figure** ________

DLZ, INC.

Tested By: WV **Checked By:** SR


Somat Engineering Fort St DTE Main
B-03-03, ST14, 58'-60'
UU
20210904
B-03-03
ST-14
58-60
2021/09/21 10:44

Unconsolidated Undrained (D2850)

Date :	9/21/2021 KS

Project		
Name	No.	Client
Fort St DTE Main	2021090A	Somat Engineering

Boring			
No.	Press	Sample	Depth
B-03-03	ST14	0	58'-60'

	Top	Bottom	Middle	
Diameter (in)	2.809	2.943	2.987	
	2.791	2.889	2.897	Avearage

	L1	L2	L3	Avearage
Length (in)	5.407	5.480	5.372	

Weight (g) =	1188.57	Weight Unit Wt. (pcf) =	

Confining Pressure (psi)	39	Sample No.	S1

	MOISTURE CONTENT	
	Before	After
Cont. No.		~~528~~ 528
Wet Wt. & Cont.		1272.69
Dry Wt. & Cont.		
Cont. Wt.		103.25
% Moisture		

DLZ

UU S1

FORMPACK3.xlsm

10/6/2021
5:24 PM

TRIAXIAL COMPRESSION TEST

Unconsolidated Undrained

Date: 8-6-21
Client: Somat Engineering
Project: Fort St. DTE Main
Project No.: 2121-4619.00
Location: B-03-03
Depth: 58.0'-60.0' **Sample Number:** ST-14
Description: lean clay with sand
Remarks:
Type of Sample: Intact
Assumed Specific Gravity=2.77 **LL=**30 **PL=**16 **PI=**14
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.			1272.690
Moisture content: Dry soil+tare, gms.			1039.150
Moisture content: Tare, gms.			103.250
Moisture, %	27.0	26.0	25.0
Moist specimen weight, gms.	1188.6		
Diameter, in.	2.89	2.89	
Area, in.²	6.54	6.54	
Height, in.	5.42	5.42	
Net decrease in height, in.		0.00	
Wet density, pcf	127.7	126.7	
Dry density, pcf	100.6	100.6	
Void ratio	0.7196	0.7196	
Saturation, %	103.9	100.0	

Test Readings for Specimen No. 1

Membrane modulus = 0.124105 kN/cm²
Membrane thickness = 0.02 cm
Filter paper coefficient = 0.001926 kN/cm
Filter paper coverage = 50%
Cell pressure = 39.00 psi (5616 psf)
Back pressure = 0.00 psi (0 psf)
Strain rate, in./min. = 0.055
Fail. Stress = 164 psf **at reading no.** 72
Ult. Stress = 153 psf **at reading no.** 80

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	0.0005	7.331	0.0	0.0	0	5616	5616	1.00	5616	0
1	0.0144	8.779	1.4	0.3	18	5616	5634	1.00	5625	9
2	0.0273	9.503	2.2	0.5	20	5616	5636	1.00	5626	10
3	0.0408	10.244	2.9	0.7	23	5616	5639	1.00	5627	11
4	0.0546	10.680	3.3	1.0	18	5616	5634	1.00	5625	9
5	0.0691	11.124	3.8	1.3	13	5616	5629	1.00	5622	6
6	0.0828	11.490	4.2	1.5	7	5616	5623	1.00	5619	3
7	0.0969	11.991	4.7	1.8	3	5616	5619	1.00	5618	2
8	0.1101	12.012	4.7	2.0	0	5616	5616	1.00	5616	0
9	0.1236	12.542	5.2	2.3	0	5616	5616	1.00	5616	0
10	0.1369	12.825	5.5	2.5	1	5616	5617	1.00	5617	1
11	0.1495	13.220	5.9	2.8	9	5616	5625	1.00	5620	4
12	0.1614	13.553	6.2	3.0	15	5616	5631	1.00	5623	7
13	0.1754	13.882	6.6	3.2	21	5616	5637	1.00	5626	10
14	0.1897	14.087	6.8	3.5	24	5616	5640	1.00	5628	12
15	0.2029	14.531	7.2	3.7	32	5616	5648	1.01	5632	16
16	0.2165	14.662	7.3	4.0	34	5616	5650	1.01	5633	17
17	0.2291	14.905	7.6	4.2	38	5616	5654	1.01	5635	19
18	0.2432	15.069	7.7	4.5	40	5616	5656	1.01	5636	20
19	0.2558	15.604	8.3	4.7	50	5616	5666	1.01	5641	25
20	0.2695	15.875	8.5	5.0	55	5616	5671	1.01	5643	27
21	0.2839	16.004	8.7	5.2	56	5616	5672	1.01	5644	28
22	0.2976	16.276	8.9	5.5	61	5616	5677	1.01	5646	30
23	0.3117	16.409	9.1	5.7	62	5616	5678	1.01	5647	31
24	0.3248	16.845	9.5	6.0	70	5616	5686	1.01	5651	35
25	0.3378	16.931	9.6	6.2	71	5616	5687	1.01	5651	35
26	0.3504	17.274	9.9	6.5	77	5616	5693	1.01	5654	38
27	0.3640	17.352	10.0	6.7	77	5616	5693	1.01	5655	39
28	0.3761	17.636	10.3	6.9	82	5616	5698	1.01	5657	41
29	0.3894	17.695	10.4	7.2	82	5616	5698	1.01	5657	41
30	0.4027	17.905	10.6	7.4	85	5616	5701	1.02	5658	42
31	0.4168	18.035	10.7	7.7	86	5616	5702	1.02	5659	43
32	0.4304	18.417	11.1	7.9	92	5616	5708	1.02	5662	46
33	0.4442	18.505	11.2	8.2	93	5616	5709	1.02	5662	46
34	0.4580	18.840	11.5	8.4	98	5616	5714	1.02	5665	49
35	0.4709	18.972	11.6	8.7	100	5616	5716	1.02	5666	50
36	0.4849	19.157	11.8	8.9	102	5616	5718	1.02	5667	51
37	0.4984	19.229	11.9	9.2	102	5616	5718	1.02	5667	51
38	0.5117	19.596	12.3	9.4	108	5616	5724	1.02	5670	54
39	0.5249	19.516	12.2	9.7	105	5616	5721	1.02	5669	53
40	0.5381	19.874	12.5	9.9	111	5616	5727	1.02	5671	55
41	0.5524	20.281	12.9	10.2	117	5616	5733	1.02	5675	59
42	0.5647	20.250	12.9	10.4	116	5616	5732	1.02	5674	58
43	0.5788	20.383	13.1	10.7	117	5616	5733	1.02	5674	58
44	0.5920	20.729	13.4	10.9	122	5616	5738	1.02	5677	61
45	0.6054	20.881	13.5	11.2	124	5616	5740	1.02	5678	62
46	0.6187	20.763	13.4	11.4	120	5616	5736	1.02	5676	60

Test Readings for Specimen No. 1

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
47	0.6331	20.934	13.6	11.7	122	5616	5738	1.02	5677	61
48	0.6461	21.022	13.7	11.9	122	5616	5738	1.02	5677	61
49	0.6591	21.440	14.1	12.2	129	5616	5745	1.02	5680	64
50	0.6727	21.744	14.4	12.4	133	5616	5749	1.02	5683	67
51	0.6870	21.916	14.6	12.7	135	5616	5751	1.02	5683	67
52	0.6999	21.894	14.6	12.9	133	5616	5749	1.02	5682	66
53	0.7123	22.050	14.7	13.1	135	5616	5751	1.02	5683	67
54	0.7263	22.033	14.7	13.4	133	5616	5749	1.02	5682	66
55	0.7393	22.198	14.9	13.6	134	5616	5750	1.02	5683	67
56	0.7518	22.446	15.1	13.9	138	5616	5754	1.02	5685	69
57	0.7660	22.555	15.2	14.1	138	5616	5754	1.02	5685	69
58	0.7797	22.484	15.2	14.4	135	5616	5751	1.02	5684	68
59	0.7924	22.742	15.4	14.6	139	5616	5755	1.02	5685	69
60	0.8069	22.952	15.6	14.9	141	5616	5757	1.03	5686	70
61	0.8203	23.069	15.7	15.1	141	5616	5757	1.03	5687	71
62	0.8336	23.157	15.8	15.4	142	5616	5758	1.03	5687	71
63	0.8469	23.295	16.0	15.6	143	5616	5759	1.03	5687	71
64	0.8608	23.527	16.2	15.9	145	5616	5761	1.03	5689	73
65	0.8740	23.614	16.3	16.1	145	5616	5761	1.03	5689	73
66	0.8875	23.653	16.3	16.4	144	5616	5760	1.03	5688	72
67	0.9002	23.910	16.6	16.6	148	5616	5764	1.03	5690	74
68	0.9137	24.131	16.8	16.8	150	5616	5766	1.03	5691	75
69	0.9273	24.339	17.0	17.1	152	5616	5768	1.03	5692	76
70	0.9402	24.471	17.1	17.3	153	5616	5769	1.03	5693	77
71	0.9538	24.549	17.2	17.6	153	5616	5769	1.03	5692	76
72	0.9673	25.249	17.9	17.8	164	5616	5780	1.03	5698	82
73	0.9808	25.186	17.9	18.1	161	5616	5777	1.03	5697	81
74	0.9943	24.908	17.6	18.3	154	5616	5770	1.03	5693	77
75	1.0079	25.237	17.9	18.6	159	5616	5775	1.03	5695	79
76	1.0226	25.165	17.8	18.9	155	5616	5771	1.03	5694	78
77	1.0348	25.212	17.9	19.1	155	5616	5771	1.03	5693	77
78	1.0481	25.253	17.9	19.3	154	5616	5770	1.03	5693	77
79	1.0613	25.389	18.1	19.6	155	5616	5771	1.03	5693	77
80	1.0745	25.385	18.1	19.8	153	5616	5769	1.03	5692	76

Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Moisture content: Moist soil+tare, gms.			1223.100
Moisture content: Dry soil+tare, gms.			984.280
Moisture content: Tare, gms.			99.590
Moisture, %	29.4	27.9	27.0
Moist specimen weight, gms.	1144.3		
Diameter, in.	2.88	2.88	
Area, in.²	6.50	6.50	
Height, in.	5.32	5.32	
Net decrease in height, in.		0.00	
Wet density, pcf	126.2	124.8	
Dry density, pcf	97.6	97.6	
Void ratio	0.7726	0.7726	
Saturation, %	105.2	100.0	

Test Readings for Specimen No. 2

Membrane modulus = 0.124105 kN/cm²

Membrane thickness = 0.02 cm

Filter paper coefficient = 0.001926 kN/cm

Filter paper coverage = 50%

Cell pressure = 72.00 psi (10368 psf)

Back pressure = 0.00 psi (0 psf)

Strain rate, in./min. = 0.055

Fail. Stress = 220 psf **at reading no.** 2

Ult. Stress = 179 psf **at reading no.** 79

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
0	-0.0005	18.950	0.0	0.0	0	10368	10368	1.00	10368	0
1	0.0113	29.226	10.3	0.2	215	10368	10583	1.02	10476	108
2	0.0254	30.130	11.2	0.5	220	10368	10588	1.02	10478	110
3	0.0393	30.528	11.6	0.7	214	10368	10582	1.02	10475	107
4	0.0528	30.668	11.7	1.0	202	10368	10570	1.02	10469	101
5	0.0670	30.588	11.6	1.3	185	10368	10553	1.02	10460	92
6	0.0802	30.683	11.7	1.5	173	10368	10541	1.02	10454	86
7	0.0938	30.565	11.6	1.8	155	10368	10523	1.01	10446	78
8	0.1066	30.619	11.7	2.0	143	10368	10511	1.01	10440	72
9	0.1199	30.956	12.0	2.3	150	10368	10518	1.01	10443	75
10	0.1328	31.057	12.1	2.5	152	10368	10520	1.01	10444	76
11	0.1464	31.235	12.3	2.8	155	10368	10523	1.01	10445	77
12	0.1603	31.392	12.4	3.0	157	10368	10525	1.02	10447	79
13	0.1734	31.500	12.5	3.3	159	10368	10527	1.02	10447	79
14	0.1863	31.577	12.6	3.5	160	10368	10528	1.02	10448	80
15	0.2002	32.092	13.1	3.8	170	10368	10538	1.02	10453	85
16	0.2142	32.226	13.3	4.0	172	10368	10540	1.02	10454	86
17	0.2270	32.575	13.6	4.3	179	10368	10547	1.02	10457	89
18	0.2401	32.608	13.7	4.5	179	10368	10547	1.02	10457	89
19	0.2538	32.670	13.7	4.8	179	10368	10547	1.02	10458	90
20	0.2670	32.694	13.7	5.0	179	10368	10547	1.02	10458	90
21	0.2806	32.887	13.9	5.3	167	10368	10535	1.02	10452	84
22	0.2944	32.966	14.0	5.5	168	10368	10536	1.02	10452	84

Test Readings for Specimen No. 2

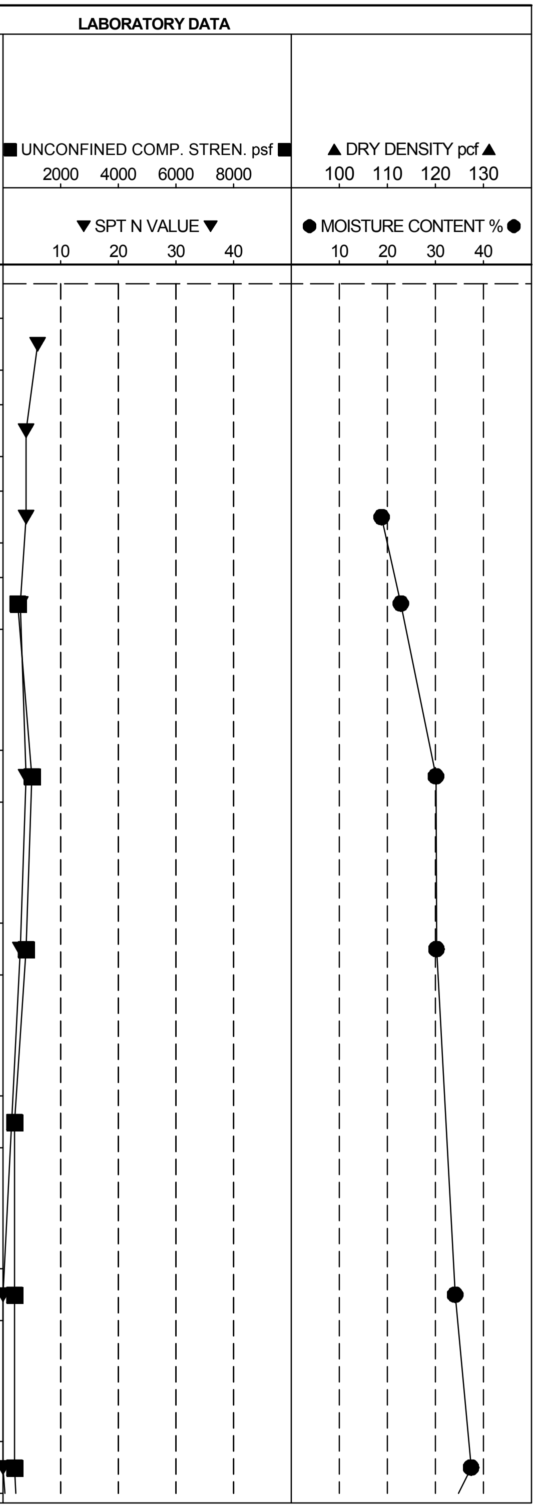
No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
23	0.3084	32.840	13.9	5.8	163	10368	10531	1.02	10450	82
24	0.3217	33.169	14.2	6.1	169	10368	10537	1.02	10452	84
25	0.3353	33.379	14.4	6.3	172	10368	10540	1.02	10454	86
26	0.3477	33.416	14.5	6.5	171	10368	10539	1.02	10453	85
27	0.3606	33.635	14.7	6.8	174	10368	10542	1.02	10455	87
28	0.3739	33.738	14.8	7.0	175	10368	10543	1.02	10455	87
29	0.3868	34.157	15.2	7.3	182	10368	10550	1.02	10459	91
30	0.4007	34.190	15.2	7.5	181	10368	10549	1.02	10458	90
31	0.4139	34.307	15.4	7.8	182	10368	10550	1.02	10459	91
32	0.4278	34.595	15.6	8.1	186	10368	10554	1.02	10461	93
33	0.4408	34.891	15.9	8.3	190	10368	10558	1.02	10463	95
34	0.4543	34.758	15.8	8.6	186	10368	10554	1.02	10461	93
35	0.4677	34.786	15.8	8.8	185	10368	10553	1.02	10460	92
36	0.4813	34.671	15.7	9.1	181	10368	10549	1.02	10459	91
37	0.4948	34.642	15.7	9.3	179	10368	10547	1.02	10457	89
38	0.5087	35.668	16.7	9.6	198	10368	10566	1.02	10467	99
39	0.5224	35.294	16.3	9.8	189	10368	10557	1.02	10462	94
40	0.5359	35.092	16.1	10.1	183	10368	10551	1.02	10459	91
41	0.5487	35.224	16.3	10.3	184	10368	10552	1.02	10460	92
42	0.5621	35.162	16.2	10.6	181	10368	10549	1.02	10459	91
43	0.5759	35.452	16.5	10.8	185	10368	10553	1.02	10461	93
44	0.5887	35.514	16.6	11.1	185	10368	10553	1.02	10460	92
45	0.6020	35.808	16.9	11.3	189	10368	10557	1.02	10463	95
46	0.6162	35.949	17.0	11.6	190	10368	10558	1.02	10463	95
47	0.6289	36.182	17.2	11.8	193	10368	10561	1.02	10465	97
48	0.6424	36.151	17.2	12.1	191	10368	10559	1.02	10463	95
49	0.6561	36.260	17.3	12.3	191	10368	10559	1.02	10464	96
50	0.6694	36.153	17.2	12.6	187	10368	10555	1.02	10462	94
51	0.6826	36.130	17.2	12.8	185	10368	10553	1.02	10461	93
52	0.6964	36.089	17.1	13.1	183	10368	10551	1.02	10459	91
53	0.7102	36.379	17.4	13.4	187	10368	10555	1.02	10461	93
54	0.7232	36.426	17.5	13.6	186	10368	10554	1.02	10461	93
55	0.7365	36.551	17.6	13.9	187	10368	10555	1.02	10461	93
56	0.7494	36.486	17.5	14.1	184	10368	10552	1.02	10460	92
57	0.7639	36.706	17.8	14.4	186	10368	10554	1.02	10461	93
58	0.7761	37.047	18.1	14.6	191	10368	10559	1.02	10463	95
59	0.7902	37.112	18.2	14.9	190	10368	10558	1.02	10463	95
60	0.8032	37.680	18.7	15.1	199	10368	10567	1.02	10468	100
61	0.8166	37.632	18.7	15.4	197	10368	10565	1.02	10466	98
62	0.8300	37.501	18.6	15.6	193	10368	10561	1.02	10464	96
63	0.8435	37.437	18.5	15.9	190	10368	10558	1.02	10463	95
64	0.8569	37.250	18.3	16.1	184	10368	10552	1.02	10460	92
65	0.8700	37.345	18.4	16.4	184	10368	10552	1.02	10460	92
66	0.8837	37.406	18.5	16.6	184	10368	10552	1.02	10460	92
67	0.8970	37.289	18.3	16.9	180	10368	10548	1.02	10458	90
68	0.9107	37.143	18.2	17.1	175	10368	10543	1.02	10456	88
69	0.9242	37.252	18.3	17.4	176	10368	10544	1.02	10456	88

Test Readings for Specimen No. 2

No.	Def. Dial in.	Load Dial	Load lbs.	Strain %	Deviator Stress psf	Minor Princ. Stress psf	Major Princ. Stress psf	1:3 Ratio	P psf	Q psf
70	0.9377	37.501	18.6	17.6	178	10368	10546	1.02	10457	89
71	0.9513	37.671	18.7	17.9	180	10368	10548	1.02	10458	90
72	0.9639	37.663	18.7	18.1	178	10368	10546	1.02	10457	89
73	0.9774	37.922	19.0	18.4	181	10368	10549	1.02	10458	90
74	0.9909	38.280	19.3	18.6	186	10368	10554	1.02	10461	93
75	1.0047	38.154	19.2	18.9	181	10368	10549	1.02	10459	91
76	1.0180	38.086	19.1	19.2	178	10368	10546	1.02	10457	89
77	1.0314	38.115	19.2	19.4	177	10368	10545	1.02	10457	89
78	1.0446	38.039	19.1	19.7	174	10368	10542	1.02	10455	87
79	1.0572	38.405	19.5	19.9	179	10368	10547	1.02	10457	89

DATE 1/31/2005 **LOG OF TEST BORING B-1**

ELEVATION ft MSL	LOG OF SOIL PROFILE	Depth	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	Ground Surface Elevation 585.01 ft								
584.01	12 inches of TOPSOIL	1.0							
580.01	FILL - Loose clayey fine to medium sand, trace gravel, frequent organic seams, brown/dark brown/black, moist (SC)	5.0	SS1	5-3-3	6	2.5			
			SS2	1-2-2	4	5.0			
577.01	FILL - Mixed silty fine sand and silty clay, trace gravel, dark brown (SM)(CL)	8.0	SS3	1-2-2	4	7.5		18.8	
570.51	FILL - Very soft silty clay, with sand, trace organics and grass pieces, black (CL) (A LOI test on SS5 indicated an organic content of 4.5%)	14.5	SS4	2-1-2	3	10.0	500*	22.8	
			SS5	2-2-2	4	15.0	1000*	30.1	
567.01	Soft SILTY CLAY, some sand, trace gravel, brown (CL)	18.0							
563.01	Soft SILTY CLAY, some sand, trace gravel, gray (CL)	22.0	SS6	1-1-2	3	20.0	800#	30.2	
558.01	Very soft SILTY CLAY, some sand, trace gravel, gray (CH)	27.0	VS7			25.0	400		
	Very soft to soft SILTY CLAY, some sand, trace gravel, gray (CL)		SS8	0-0-0	0	30.0	400#	34.1	
			SS9	0-0-0	0	35.0	400#	37.4	



BORING COORDINATES
E(x) Coordinate 13454786.1
N (y) Coordinate 290839.05

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS7, VS15, & VS18 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-31-05
Date Completed: 02-01-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering Inc.

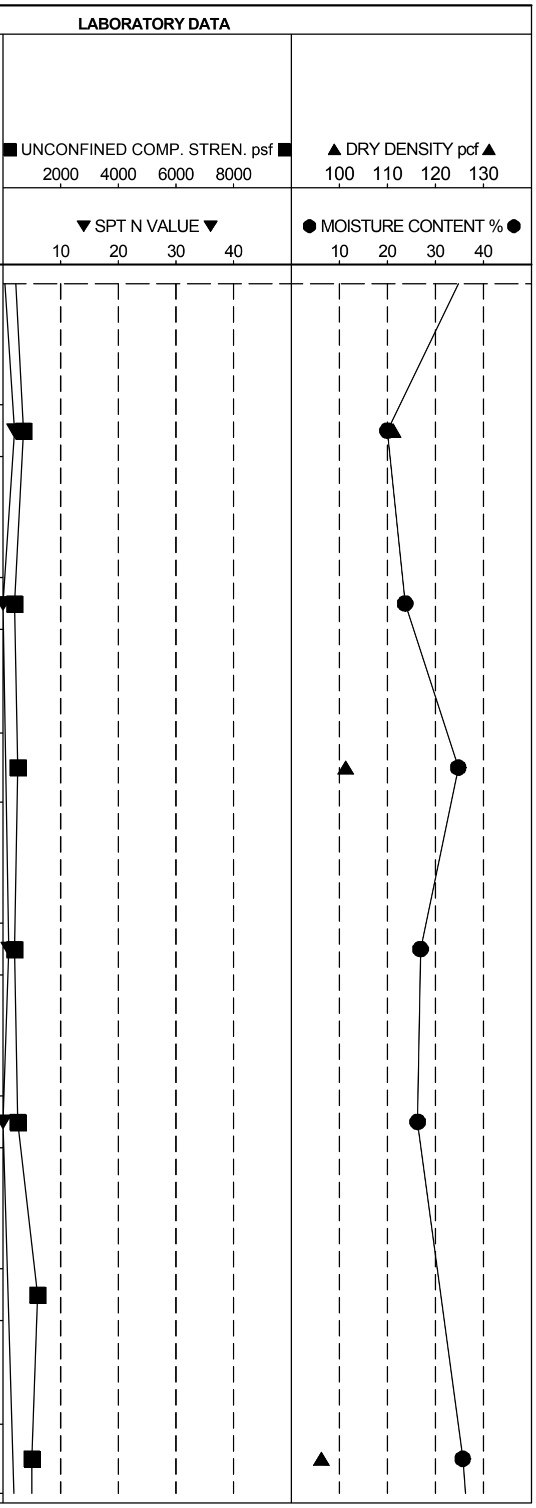
M-85 Bascule Bridge
Detroit, Michigan
JN-54049
CS-82071

PROJECT NO. G02161A **BORING NO.** B-1 **PAGE 1 of 3**

DATE 1/31/2005 **LOG OF TEST BORING B-1**

ELEVATION ft MSL	LOG OF SOIL PROFILE	Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	Ground Surface Elevation 585.01 ft		35							
	Very soft to soft SILTY CLAY, some sand, trace gravel, gray (CL)			SS10	0-0-2	2	40.0	700	20.0	111
			40							
				SS11	0-0-0	0	45.0	400#	23.7	
			45							
				ST12			50.0	500	34.8	101
			50							
				SS13	0-0-1	1	55.0	400#	26.9	
			55							
				SS14	0-0-0	0	60.0	500	26.3	
			60							
523.01		62.0								
	Medium SILTY CLAY, some sand, trace gravel, gray (CL)			VS15			65.0	1200		
			65							
				ST16			70.0	1000	35.7	96
			70							

LABORATORY DATA



BORING COORDINATES
E(x) Coordinate 13454786.1
N (y) Coordinate 290839.05

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS7, VS15, & VS18 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-31-05
Date Completed: 02-01-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

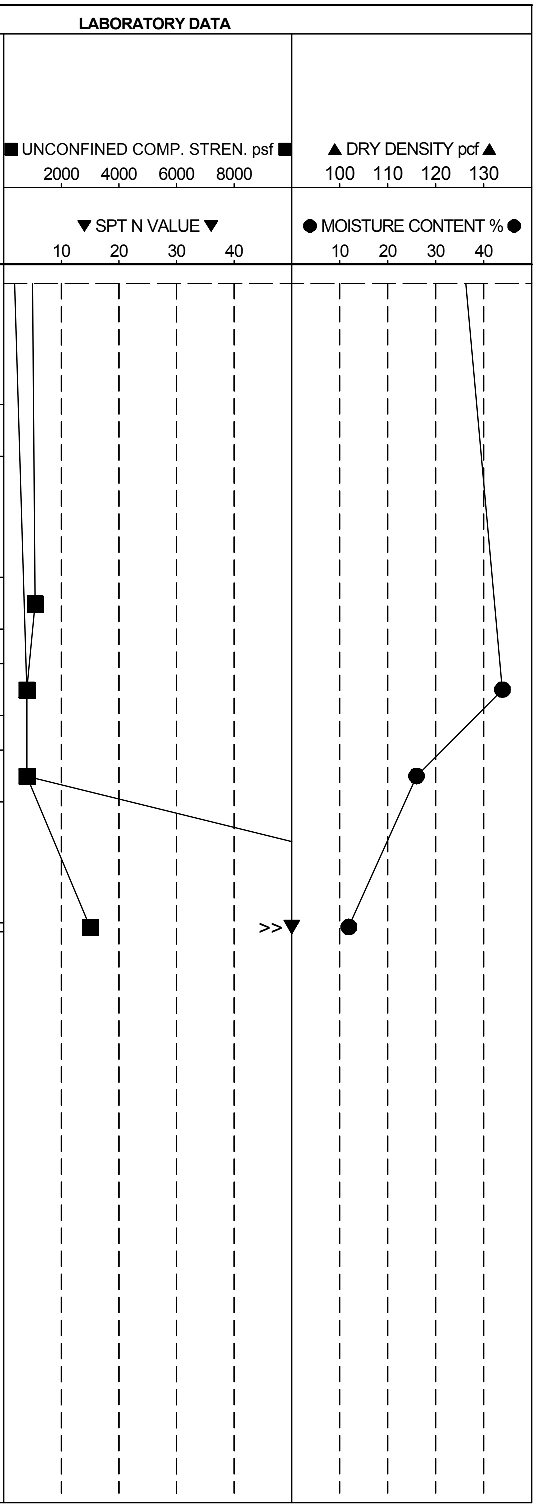
Somat Engineering Inc.

M-85 Bascule Bridge
Detroit, Michigan
JN-54049
CS-82071

PROJECT NO. G02161A **BORING NO.** B-1 **PAGE 2 of 3**

DATE 1/31/2005 **LOG OF TEST BORING B-1**

ELEVATION ft MSL	LOG OF SOIL PROFILE	Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	Ground Surface Elevation 585.01 ft		70							
	Medium SILTY CLAY, some sand, trace gravel, gray (CL)		75	NR17			75.0			
			80	VS18			80.0	1100		
504.01		81.0								
	Soft SILTY CLAY, some sand, trace gravel, gray (CL)			SS19	0-2-2	4	82.5	800#	43.9	
			85	SS20	0-1-3	4	85.0	800#	26.0	
500.01		85.0								
	Stiff SILTY CLAY, with sand, trace gravel, gray (CL) (Encountered obstruction while sampling SS21 - sampling terminated)			SS21	10/3"	10/3"	88.8	3000*	11.9	
495.01		90.0	90							
	End of Boring at 90 ft. (Boring terminated on possible bedrock)		95							
			100							
			105							



BORING COORDINATES
E(x) Coordinate 13454786.1
N (y) Coordinate 290839.05

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS7, VS15, & VS18 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-31-05
Date Completed: 02-01-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering Inc.

M-85 Bascule Bridge
Detroit, Michigan
JN-54049
CS-82071

PROJECT NO. G02161A **BORING NO.** B-1 **PAGE 3 of 3**

DATE 1/24/2005 **LOG OF TEST BORING B-2**

LOG OF SOIL PROFILE

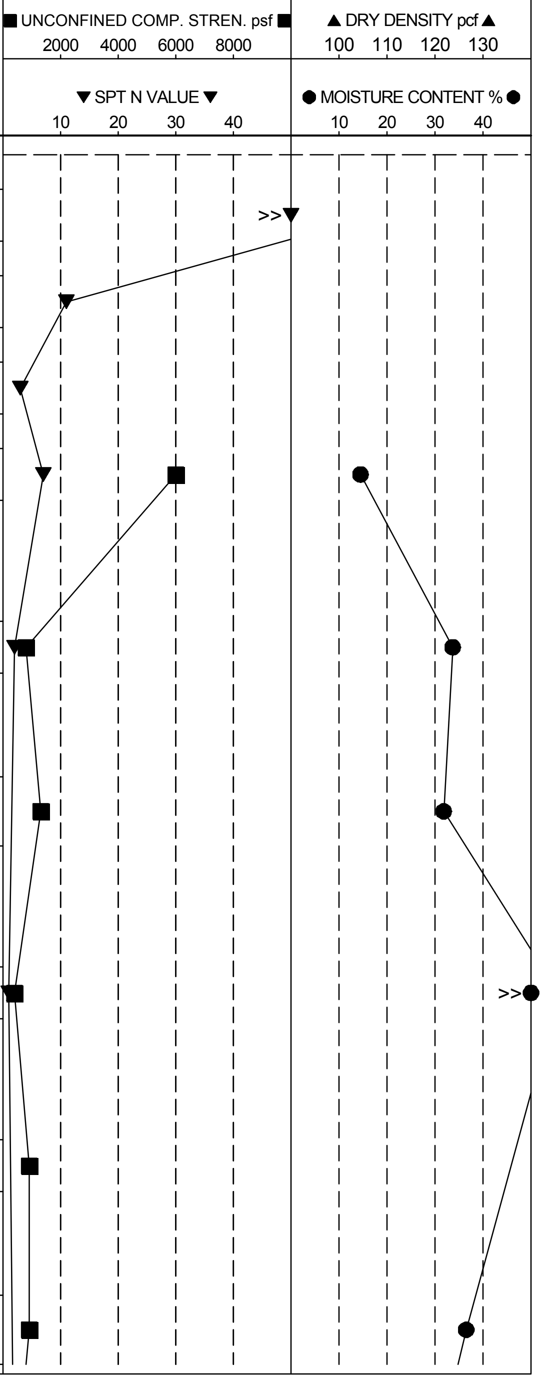
Ground Surface Elevation 582.87 ft

ELEVATION ft MSL	Description	Depth
582.45	5 inches of ASPHALTIC CEMENT CONCRETE	0.4
580.37	FILL - Mixed very dense sand, gravel, and slag, dark gray/black (SP)(SG)	2.5
576.37	FILL - Medium dense clayey fine to medium sand, trace silt and gravel, brown, moist (SC)	6.5
573.87	FILL - Very loose sandy silt, trace gravel and clay, trace slag/coal, black, moist (ML)	9.0
569.87	Very stiff SILTY CLAY, some sand, trace gravel, brown (CL)	13.0
560.87	Medium to soft SILTY CLAY, some sand, trace gravel, gray (CL)	22.0
555.87	Very soft SILTY CLAY, some sand, trace gravel, gray (CH)	27.0
	Very soft to soft SILTY CLAY, some sand, trace gravel, gray (CL)	

DEPTH (ft): 0, 5, 10, 15, 20, 25, 30, 35

FIELD DATA / **LABORATORY DATA**

SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
SS1	40-22-43	65	2.5			
SS2	16-5-6	11	5.0			
SS3	2-2-1	3	7.5			
SS4	1-3-4	7	10.0	6000*	14.5	
SS5	1-1-1	2	15.0	800#	33.7	
ST6			20.0	1300	31.8	
SS7	0-0-1	1	25.0	400#	55.7	
VS8			30.0	900		
ST9			35.0	900	36.5	



BORING COORDINATES
E(x) Coordinate 13454860.3
N (y) Coordinate 290819.89

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". A LOI test on SS3 indicated an organic content of 3.6%. Unconfined Compressive Strength values for VS8, VS11, & VS13 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-24-05
Date Completed: 01-24-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

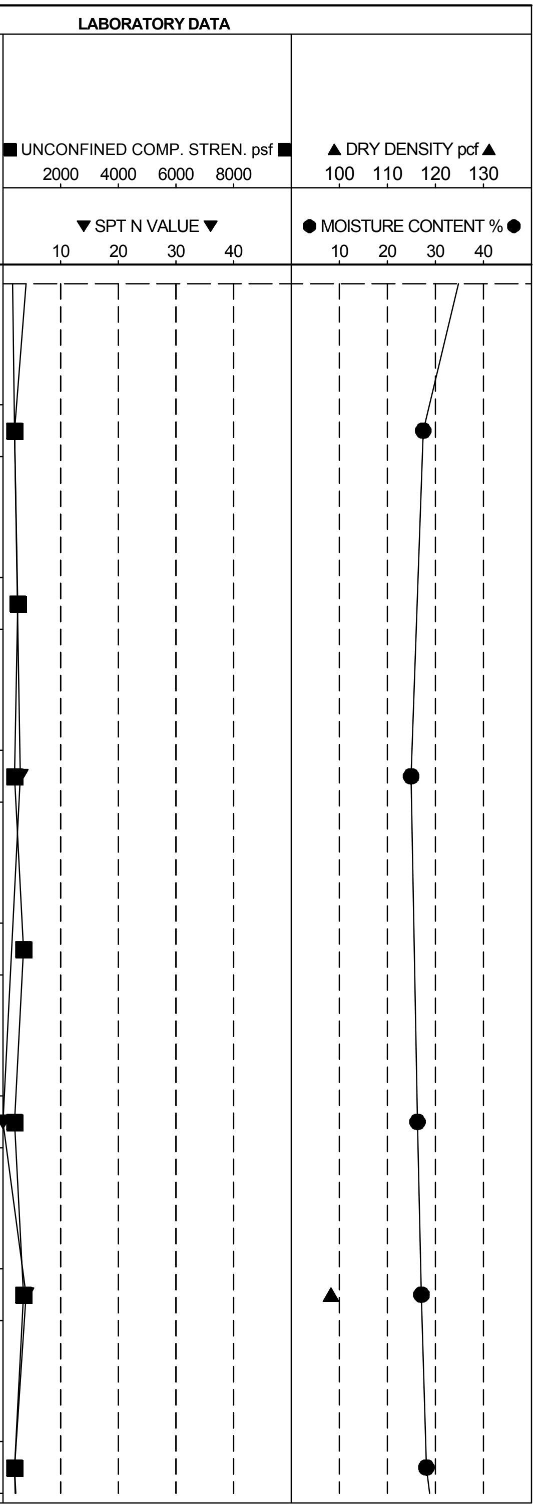
Somat Engineering Inc.

M-85 Bascule Bridge
Detroit, Michigan
JN-54049
CS-82071

PROJECT NO. G02161A **BORING NO.** B-2 **PAGE 1 of 3**

DATE 1/24/2005 **LOG OF TEST BORING B-2**

LOG OF SOIL PROFILE				FIELD DATA			LABORATORY DATA			
ELEVATION ft MSL		Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
		Ground Surface Elevation 582.87 ft								
	▧	Very soft to soft SILTY CLAY, some sand, trace gravel, gray (CL)	35							
				SS10	1-1-1	2	40.0	400#	27.5	
			40							
				VS11			45.0	500		
			45							
				SS12	0-1-2	3	50.0	400#	25.0	
			50							
				VS13			55.0	700		
			55							
				SS14	0-0-0	0	60.0	400#	26.3	
			60							
				SS15	0-2-2	4	65.0	700	27.1	98
			65							
				SS16	0-0-2	2	70.0	400#	28.1	
			70							



BORING COORDINATES
E(x) Coordinate 13454860.3
N (y) Coordinate 290819.89

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". A LOI test on SS3 indicated an organic content of 3.6%. Unconfined Compressive Strength values for VS8, VS11, & VS13 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-24-05
Date Completed: 01-24-05
Checked By: JSS
\# Torvane
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Somat Engineering Inc.

M-85 Bascule Bridge
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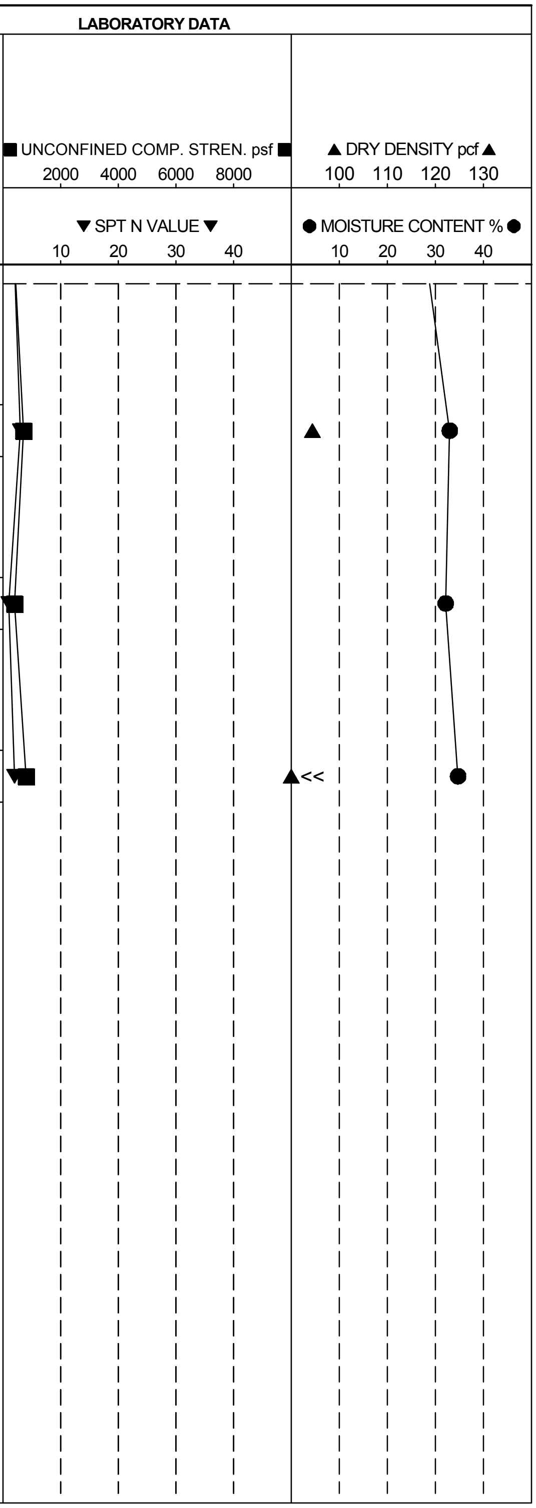
CS-82071

PROJECT NO. G02161A **BORING NO.** B-2 **PAGE 2 of 3**

DATE 1/24/2005 **LOG OF TEST BORING B-2**

LOG OF SOIL PROFILE				FIELD DATA			LABORATORY DATA			
ELEVATION ft MSL			Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
		Ground Surface Elevation 582.87 ft									
	▨			70							
	▨				SS17	0-1-2	3	75.0	700	33.0	94
	▨			75							
	▨	Very soft to soft SILTY CLAY, some sand, trace gravel, gray (CL)									
	▨				SS18	0-0-1	1	80.0	400#	32.2	
	▨			80							
	▨				SS19	0-0-2	2	85.0	800	34.7	89
	▨			85							
495.97	▨		86.9								
		End of Boring at 86.9 ft. (Boring terminated on possible bedrock)									
				90							
				95							
				100							
				105							



BORING COORDINATES
E(x) Coordinate 13454860.3
N (y) Coordinate 290819.89

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". A LOI test on SS3 indicated an organic content of 3.6%. Unconfined Compressive Strength values for VS8, VS11, & VS13 were calculated from the field vane shear test results.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-24-05
Date Completed: 01-24-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

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M-85 Bascule Bridge
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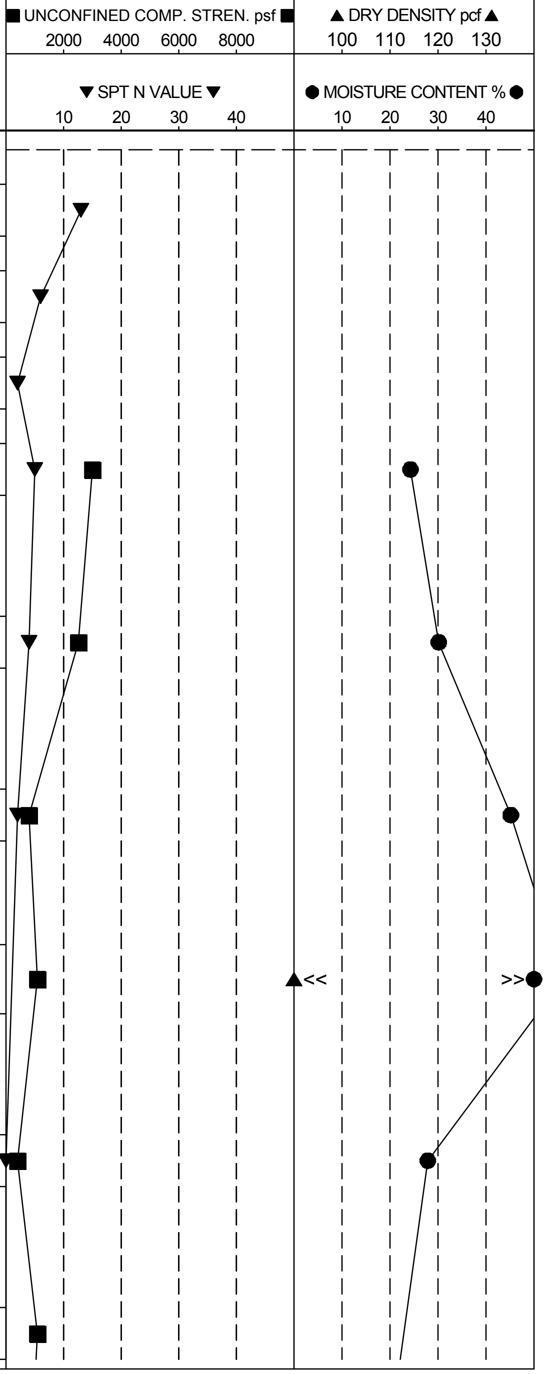
JN-54049
CS-82071

PROJECT NO. G02161A **BORING NO.** B-2 **PAGE 3 of 3**

DATE 1/20/2005 **LOG OF TEST BORING B-3**

LOG OF SOIL PROFILE				FIELD DATA			LABORATORY DATA			
ELEVATION ft MSL		Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	Ground Surface Elevation 583.26 ft		0							
582.76	6 inches of gravel FILL	0.5								
580.26	FILL - Medium dense silty fine to medium sand, trace gravel, brown, moist (SM)	3.0		SS1	10-7-6	13	2.5			
577.26	FILL - Loose silty fine sand, trace gravel, brown, moist (SM)	6.0	5	SS2	2-3-3	6	5.0			
575.26	FILL - Very loose clayey silt, trace gravel and organics, black, moist (ML)	8.0		SS3	1-1-1	2	7.5			
	(A LOI test on SS3 indicated an organic content of 3.0%.)									
566.76	Stiff SILTY CLAY, some sand, trace gravel, brown (CL)	16.5	10	SS4	2-2-3	5	10.0	3000*	24.3	
			15	SS5	1-2-2	4	15.0	2500*	30.1	
561.26	Soft SILTY CLAY, some sand, trace gravel, gray (CL)	22.0	20	SS6	0-1-1	2	20.0	800#	45.2	
556.26	Medium SILTY CLAY, some sand, trace gravel, gray (CH)	27.0	25	ST7			25.0	1100	56.0	69
	Medium to very soft SILTY CLAY, some sand, trace gravel, gray (CL)		30	SS8	0-0-0	0	30.0	400#	27.9	
			35	VS9			35.0	1100		



BORING COORDINATES
E(x) Coordinate 13454752.6
N (y) Coordinate 290745.1

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS9, VS12, & VS14 were calculated from the field vane shear test results. Not enough sample recovered in ST10 for strength test.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-20-05
Date Completed: 01-20-05
Checked By: JSS
\# Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering Inc.

M-85 Bascule Bridge
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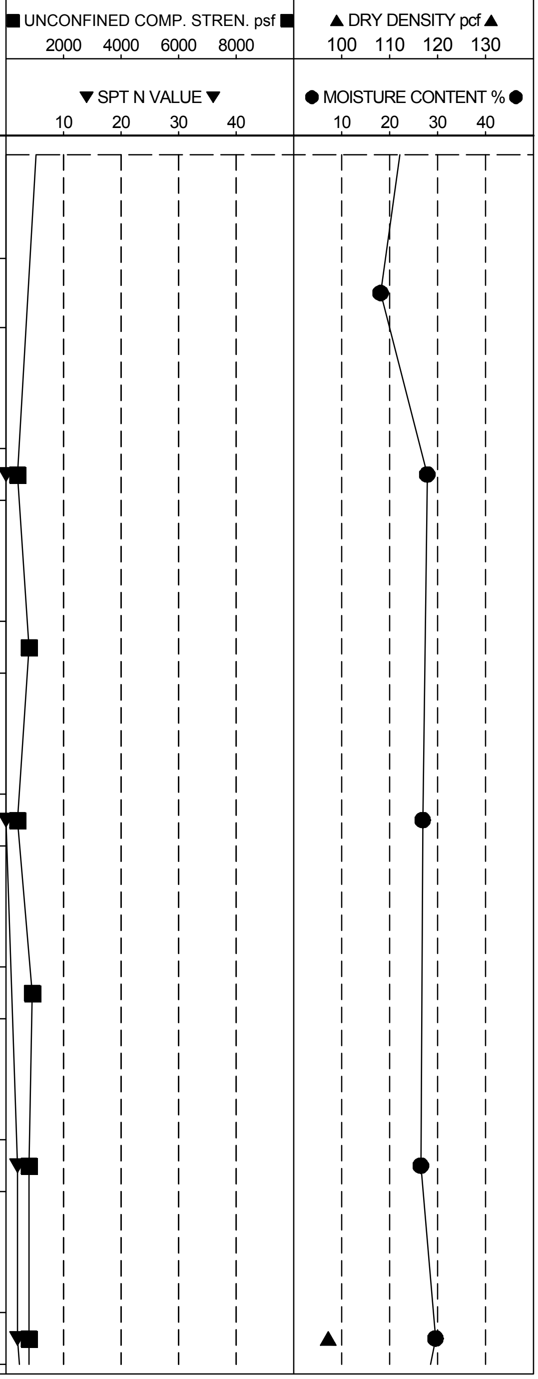
CS-82071

PROJECT NO. G02161A **BORING NO.** B-3 **PAGE 1 of 3**

DATE 1/20/2005 **LOG OF TEST BORING B-3**

LOG OF SOIL PROFILE			FIELD DATA			LABORATORY DATA			
ELEVATION ft MSL	Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
	Ground Surface Elevation 583.26 ft								
	Medium to very soft SILTY CLAY, some sand, trace gravel, gray (CL)	35							
		40	ST10			40.0		18.1	
		45	SS11	0-0-0	0	45.0	400#	27.8	
		50	VS12			50.0	800		
		55	SS13	0-0-0	0	55.0	400#	26.9	
		60	VS14			60.0	900		
		65	SS15	0-1-1	2	65.0	800#	26.5	
		70	SS16	0-0-2	2	70.0	800	29.6	97



BORING COORDINATES
E(x) Coordinate 13454752.6
N (y) Coordinate 290745.1
GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A
Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS9, VS12, & VS14 were calculated from the field vane shear test results. Not enough sample recovered in ST10 for strength test.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
Hammer Type: automatic
Backfilled With: Grout
Date Started: 01-20-05
Date Completed: 01-20-05
Checked By: JSS
Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering Inc.

M-85 Bascule Bridge
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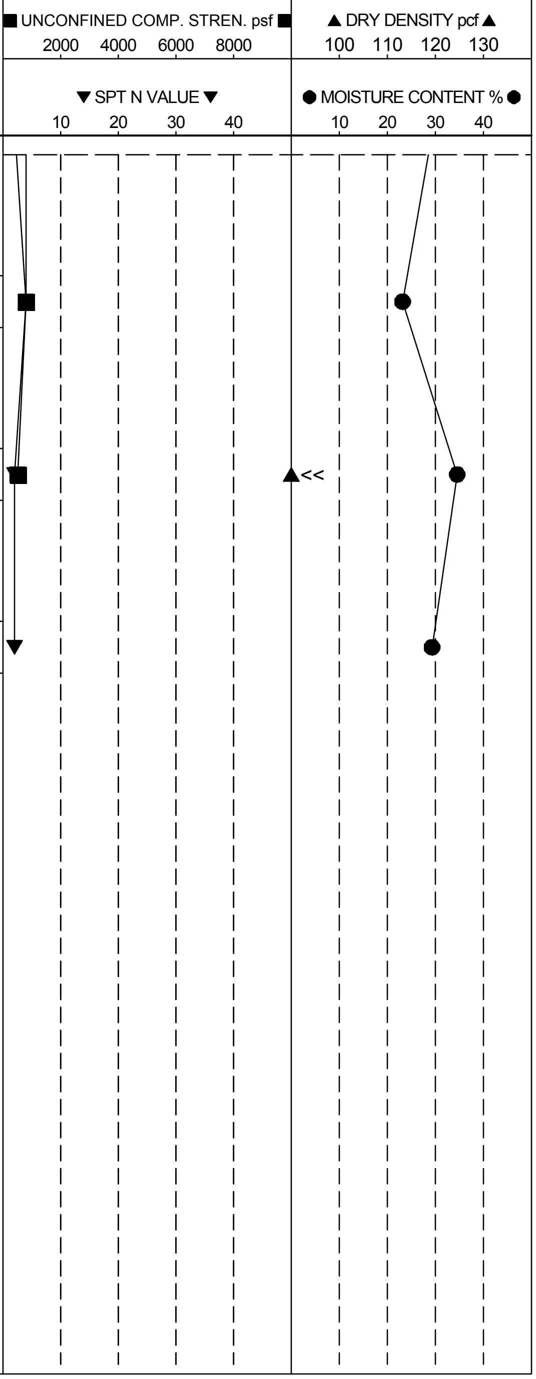
PROJECT NO. G02161A **BORING NO.** B-3 **PAGE 2 of 3**

DATE 1/20/2005 **LOG OF TEST BORING B-3**

	LOG OF SOIL PROFILE				FIELD DATA			LABORATORY DATA			
ELEVATION ft MSL			Depth	DEPTH (ft)	SAMPLE NO.	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)
		Ground Surface Elevation 583.26 ft									
	▨	Medium to very soft SILTY CLAY, some sand, trace gravel, gray (CL)		70							
	▨				SS17	0-2-2	4	75.0	800#	23.2	
	▨			75							
	▨				SS18	1-1-1	2	80.0	500	34.5	88
	▨			80							
	▨				SS19	0-1-1	2	85.0	<>#	29.3	
	▨			85							
494.76	▨		88.5								
		End of Boring at 88.5 ft. (Boring terminated on possible bedrock)		90							
				95							
				100							
				105							



BORING COORDINATES
E(x) Coordinate 13454752.6
N (y) Coordinate 290745.1

GROUNDWATER READINGS
First Encountered: none
Upon Completion: N/A

Remarks:
"0" blow count indicates "weight of hammer". Unconfined Compressive Strength values for VS9, VS12, & VS14 were calculated from the field vane shear test results. Not enough sample recovered in ST10 for strength test.

Driller: J. Blank
Drill Rig: CME 75
Engineer on Rig: A. Ogunlade
Drilling Method: 4 1/2 inch HSA/WR
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Backfilled With: Grout
Date Started: 01-20-05
Date Completed: 01-20-05
Checked By: JSS
Torvane
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M-85 Bascule Bridge
Detroit, Michigan
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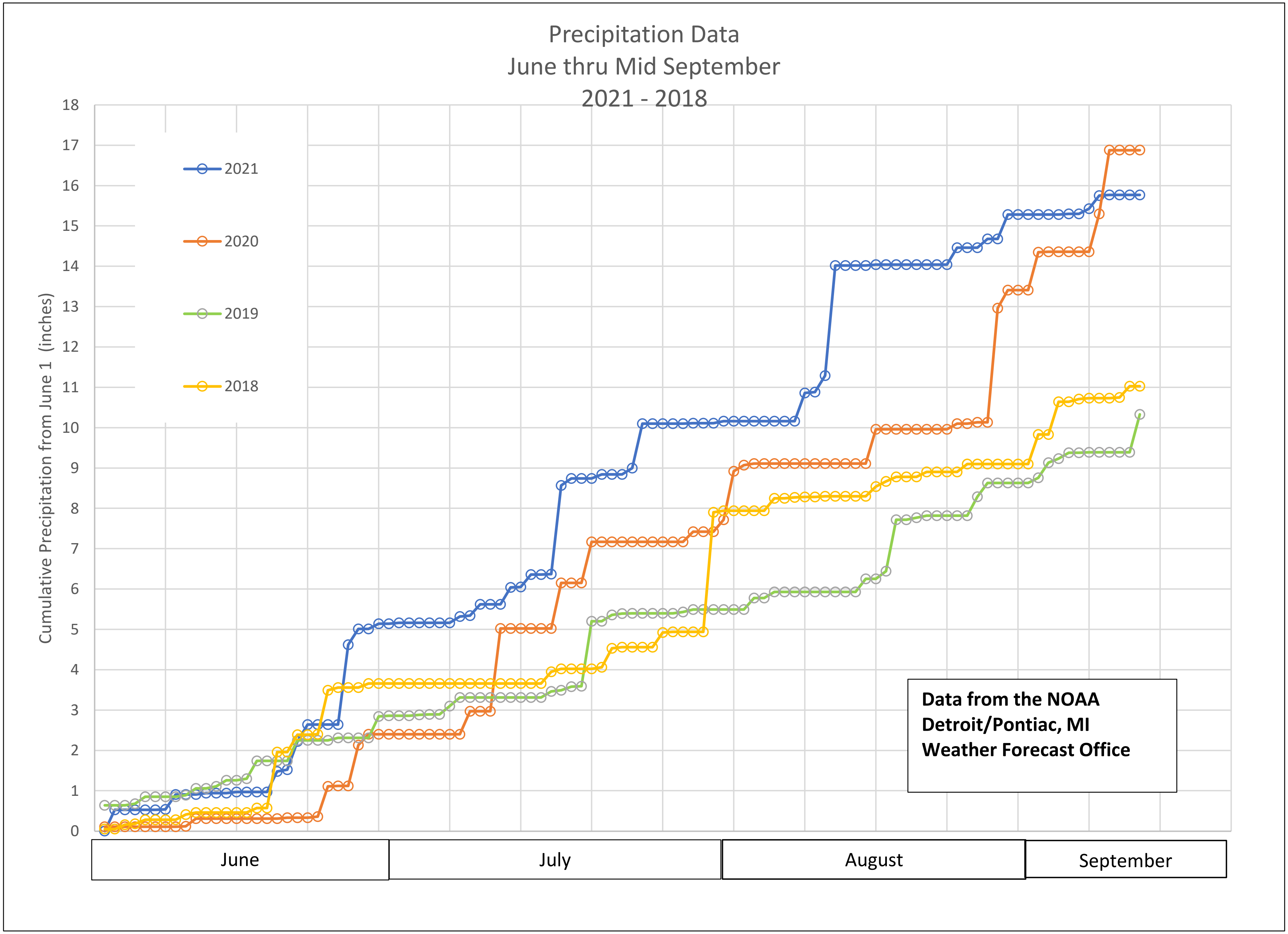
PROJECT NO. G02161A **BORING NO.** B-3 **PAGE 3 of 3**

APPENDIX G

DAILY PRECIPITATION TOTALS



Data from the NOAA
Detroit/Pontiac, MI
Weather Forecast Office

Daily Precipitation Totals per Year
June 1 to September 11

From NOAA Detroit/Pontiac Weather Station

	Daily Precipitation (in)			
Date	2021	2020	2019	2018
June 1	0	0.11	0.64	0.05
June 2	0.53	T	T	0
June 3	0	0	0	0.11
June 4	0	T	0.04	0.02
June 5	0	0	0.17	0.1
June 6	0	0	0	0
June 7	0.01	0	0	0
June 8	0.37	0	0	0
June 9	T	0.01	0.04	0.13
June 10	0	0.19	0.17	0.05
June 11	0.03	T	0	0
June 12	0	0	0.05	0
June 13	T	0	0.15	0
June 14	0.03	0	0	0
June 15	0	0	0.04	0
June 16	0	0	0.44	0.11
June 17	0	0	T	0
June 18	0.51	0	0	1.39
June 19	0.04	0.02	T	T
June 20	0.7	0	0.51	0.43
June 21	0.42	T	0	0
June 22	0	0.03	0	0.01
June 23	T	0.75	T	1.09
June 24	T	0.01	0.06	0.07
June 25	1.98	0	0	0
June 26	0.39	1.01	0	0
June 27	T	0.27	T	0.1
June 28	0.13	0	0.53	0
June 29	T	0	0.02	0
June 30	0.02	0	0	0
July 1	T	0	0	0
July 2	0	0	0.02	0
July 3	T	0	0.01	0
July 4	0	0	T	T
July 5	0	0	0.21	T
July 6	0.16	T	0.21	0
July 7	0.02	0.57	T	0
July 8	0.28	T	0	0
July 9	0	0	0	0
July 10	0	2.05	0	0
July 11	0.42	0	0	0
July 12	0.01	0	0	0
July 13	0.31	0	0	0
July 14	T	0	0	0
July 15	0.01	0	0.15	0.29
July 16	2.2	1.13	0.03	0.07
July 17	0.17	0	0.09	0
July 18	0	0	0.01	0
July 19	0	1.02	1.61	0
July 20	0.1	0	T	0.04
July 21	0	0	0.16	0.47
July 22	0	T	0.03	0.03
July 23	0.16	0	0.01	T
July 24	1.1	0	0	T
July 25	0	0	0	0
July 26	0	0	0	0.36
July 27	0	T	0	0.02
July 28	0	0	0.03	T
July 29	0.01	0.25	0.06	0
July 30	0	0	0	0
July 31	0	0	0	2.96
August 1	0.05	0.3	0	0.04
August 2	0	1.2	0	0
August 3	0	0.15	0	0
August 4	0	0.04	0.29	0
August 5	0	0	0	0
August 6	T	0	0.15	0.31
August 7	T	0	0	T
August 8	T	0	0	0.02
August 9	0.7	0	0	0.01
August 10	0.02	0	0	0
August 11	0.41	0	0	0.02
August 12	2.73	0	T	T
August 13	0	0	T	0
August 14	0	T	0	0
August 15	0	T	0.32	0
August 16	0.02	0.85	0	0.24
August 17	T	0	0.19	0.13
August 18	0	0	1.28	0.11
August 19	T	0	0	0
August 20	0	0	0.05	T
August 21	0	0	0.05	0.12
August 22	0	0	0	T
August 23	0	0	0	0
August 24	0.42	0.14	0	0
August 25	T	0	0	0.2
August 26	0	0.03	0.47	0
August 27	0.22	0	0.34	0
August 28	0	2.83	T	0
August 29	0.6	0.45	T	T
August 30	0	0	T	0
August 31	0	0	0	0
September 1	0	0.94	0.13	0.73
September 2	0	0.01	0.37	0
September 3	0	0	0.1	0.81
September 4	0.02	0	0.15	0
September 5	T	0	0	0.07
September 6	0.13	T	0.01	0.02
September 7	0.32	0.94	0	T
September 8	0.02	1.58	0	0
September 9	T	T	T	0.02
September 10	0	T	0	0.28
September 11	0	T	0.94	0

APPENDIX H

GEO PROFESSIONAL BUSINESS ASSOCIATION (GBA) MESSAGE

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

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