

Geotechnical Report

# Appendix G

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## 42nd Avenue Upgrade

### Lake Otis Parkway to Florina Street

MOA PM&E Project No. 18-06

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February 2020



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# **Geotechnical Investigation**

## **42<sup>nd</sup> Avenue Upgrade**

### **Lake Otis Parkway to Florina Street**

### **(MOA PM&E Project No. 18-06)**

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A handwritten signature in black ink, appearing to read "M. Harrison", written over a horizontal line.

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**February 2020**  
**CRW Project Number 10142.00**

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## 1. Introduction and Project Description

CRW Engineering Group, LLC (CRW) is pleased to present this geotechnical investigation and design recommendations report to support the upgrades to East 42<sup>nd</sup> Avenue (42<sup>nd</sup> Avenue) in Anchorage, Alaska. A project vicinity map is shown in Figure 1. The project is being managed by the Municipality of Anchorage (MOA) Project Management and Engineering (PM&E) Department and the Anchorage Water and Wastewater Utility (AWWU) and has been assigned MOA PM&E project number 18-06. The project consists of upgrading approximately 4,350 linear feet of roadway along 42<sup>nd</sup> Avenue between Lake Otis Parkway and Florina Street. Improvements are expected to include a new roadway structural section, pavement, drainage improvements, pedestrian facilities, street lights, 3,000 linear feet of water main replacement, and landscaping. The project alignment is shown on Figures 2 through 7.

The scope of work included:

- Review of historical geotechnical investigations within and near the project area.
- Performing a geotechnical field investigation which included advancing 24 boreholes along the project alignment and soil sampling. It also included advancing 1 penetrometer.
- Installation of 15 piezometer wells for groundwater level monitoring.
- Overseeing index laboratory testing of recovered soil samples including moisture content, grain size distribution including hydrometer, and Atterberg Limits.
- Analysis of field observations and testing results.
- Preparing the geotechnical report to provide recommendations for the project.

## 2. Existing Conditions

42<sup>nd</sup> Avenue lies south of the University of Alaska (UAA) and Providence Hospital Medical district and has a west-to-east orientation. The roadway supports a variety of uses including: businesses, a park, single-family, multi-family, and high-density multi-family housing.

42<sup>nd</sup> Avenue is characterized as a local street and does not currently have pedestrian facilities except for a separated pathway located on the north side of 42<sup>nd</sup> Avenue within Folker Park, see Figures 3 and 4. The existing two-lane roadway surface width varies from approximately 26-36 feet wide, with no curb and gutter except between Dale Street and Florina Street, see Figures 6 and 7. 42<sup>nd</sup> Avenue shows significant pavement distress along the alignment including transverse and longitudinal asphalt cracks and potholes. The road shoulders along the project area are not paved and contain potholes. Pavement patches were present in multiple areas of the alignment, notably in areas with buried utilities.

Surface water runoff is currently conveyed through a discontinuous piped storm drain network. The eastern half of the roadway flows north to outfalls along Dale Street (Figure 6) and Piper Street (Figure 5), see Figures 6 and 7. At Wright Street (Figure 4) and Folker Street (Figure 6), storm drainage flows south to the Alaska Department of Transportation and Public Facilities (ADOT&PF) Tudor Road storm drain system before it returns back to 42<sup>nd</sup> Avenue along Laurel Street (Figure 2). The system flows across Lake Otis Parkway and ultimately to the headwaters of Fish Creek. There are no treatment structures along the route.

### 3. Subsurface Investigation

CRW's geotechnical investigation consisted of drilling and sampling 24 boreholes (BH-01 through BH-24) and performing one penetrometer test (P-1) from May 3<sup>rd</sup> to May 7<sup>th</sup>, 2019 at the locations shown in Figures 2 through 7. Borehole locations were selected by CRW following the guidelines presented in the 2007 MOA PM&E Design Criteria Manual (DCM) Section 1.7 – Soil Investigation Standards in addition to the 2018 Design and Construction Practices Manual (DCPM) from AWWU. The soil boring locations were approved by PM&E and AWWU prior to performing the field investigations.

Initial boring locations were submitted to local utilities for gaining acceptable clearance from their facilities and were adjusted for traffic control safety and utility proximity prior to drilling. Select site investigation photographs can be found in Appendix C.

#### 3.1 Subsurface Drilling

Drilling services were provided by Discovery Drilling Inc. (Discovery) of Anchorage, Alaska, using a truck-mounted CME-75 drill rig equipped with a nominal 8-inch outer diameter (O.D.) hollow-stem auger. When drilling through the asphalt pavement, an approximately 12-inch diameter hole was cut in the pavement with a saw tooth bit prior to advancing the borehole.

Traffic control was contracted by Discovery and provided by Northern Dame Construction of Wasilla, AK. Traffic control was performed in accordance with the requirements of the MOA approved traffic control plan.

A CRW engineer supervised the field exploration program, recovered soil samples, and managed field operations. All borings were advanced to depths of 16.5 to 17 feet BGS, with the exception of BH-24 that was advanced to 41 feet BGS. BH-24 (Figure 3) was advanced in the Providence facility parking lot north of 42<sup>nd</sup> Avenue to assess subsurface conditions for potential retaining wall design.

#### 3.2 Sample Collection

Soil samples were obtained by advancing an oversized split-spoon sampler into the soil beyond the bottom of the auger or by collecting cuttings from the auger. Samples were collected using a 3-inch outer diameter (O.D.) split-spoon sampler as a modified Standard Penetration Test (SPT). The sampler was advanced 18 to 24 inches, counted in 6-inch intervals, using a 340-pound automatic hammer. The number of blows required to drive the sampler each 6-inch interval is reported on the borehole logs. The blow counts shown on the borehole logs are field values that have not been corrected for overburden, sampler size, hammer energy, rod length, or other factors.

Split-spoon samples were collected at approximately 2.5-foot intervals in the top 10 feet and every 5 feet thereafter. A surface grab sample just below the asphalt was also collected. Recovered samples were visually classified in the field before being individually sealed in double plastic bags and transported to the soils laboratory for additional testing. Field visual classifications were verified per laboratory testing. Soil characteristics, such as classification, consistency, moisture, and color were noted for each sample recovered. Classification was performed following the Unified Soil Classification System (USCS) according to ASTM D2487/D2488. Frost classifications of the soil were described according to the MOA Design Criteria Manual (DCM) standards.

### **3.3 Borehole Completion and Piezometer Well Installation**

All boreholes were backfilled with cuttings brought to the ground surface during drilling. In select borings (BH-01 thru 07, BH-09, BH-11, BH-13, BH-15, BH-17, BH-19, BH-21, and BH-24), a 1-inch PVC piezometer well was installed for groundwater level monitoring. The PVC pipe was hand-slotted the last 10 feet and was installed over the length of each boring. After the piezometer was installed, the annular space around the PVC was backfilled with cuttings. A 7-inch flush mount cover was installed at the surface with the annulus filled with pea gravel. A cold patch asphalt was placed around the flush mount to match the existing pavement surface where required. If no piezometer well was installed, the boring was backfilled with cuttings and a cold patch asphalt was placed at the surface to match the existing pavement where required.

### **3.4 Groundwater Monitoring**

Groundwater levels were noted during drilling. Additional groundwater level measurements occurred in May 2019, approximately two weeks after completion of drilling. Groundwater measurements will be collected again in the fall. Groundwater levels observed during drilling and measurements after drilling are presented on the borehole logs, in Appendix A, and in this report in Table 1.

### **3.5 PID Field Testing**

Soil samples were tested with a Photo Ionization Detector (PID) to estimate the presence of volatile organic compounds (VOC) after being placed into a polyurethane bags during sampling. The PID was calibrated at the beginning of each field day with 100-parts per million (ppm) isobutylene calibration gas. The PID used was equipped with a 10.2-eV lamp. Prior to screening, each sample was shaken or agitated for 15 seconds to assist volatilization. After vapor development, the PID sampling probe was inserted to about one-half the headspace depth and the highest measurement was recorded, which was normally between 2 and 5 seconds after probe insertion. Care was taken when inserting the sampling probe into the bag to avoid uptake of any moisture or soil particles. The field PID readings are presented on the borehole logs in Appendix A.

### **3.6 Contaminated Soils Disposal**

No contaminated soils were encountered during the field investigation therefore no special handling due to potential contamination by petroleum hydrocarbon compounds or other potentially hazardous materials was required.

### **3.7 Drive Penetrometer**

One drive penetrometer test was performed by advancing the NWJ drill rods using the 340-pound automatic hammer with blows counted per foot as the drill rod was advanced. The test was performed to aid in predicting pile driving behavior and provide some correlation to the Standard Penetration Test (SPT) for potential retaining wall options.

#### **4. Laboratory Testing and Results**

Soil laboratory tests to evaluate index properties of recovered samples were performed by the Alaska Testlab (ATL) in their Anchorage facility. The laboratory testing program consisted of soil index tests to determine the water content, grain-size distribution including hydrometer, No. 200 Wash, and Atterberg Limits.

The laboratory tests were performed in accordance with the test methods of ASTM International. In total, 159 samples were submitted for testing. All samples were tested for their water content per ASTM D2216.

Twenty-six samples were selected for grain-size distribution testing in accordance with ASTM D6913 and D422. The hydrometer test was completed on ten samples to determine frost classification.

Eighteen samples were washed through the No. 200 mesh sieve in accordance with ASTM D1140.

Nine samples were tested for their Atterberg Limits in accordance with ASTM D4318.

One sample was tested for its organic content in accordance with ASTM D2974.

Results of the laboratory testing are presented in Appendix B. Laboratory results are included on the borehole logs in Appendix A.

## 5. Historical Geotechnical Investigations

CRW consulted the on-line MOA Soil Boring map to evaluate historic borings along 42<sup>nd</sup> Avenue. A brief discussion of the historic investigation and their findings are below. Historical logs and locations are included in Appendix D.

### 5.1 Municipality of Anchorage Construction Division

Test holes were completed by the MOA from 1976 through 1984 along 42<sup>nd</sup> Avenue between Lake Otis Parkway and Florina Street.

Materials encountered from Lake Otis Parkway to Folker Street consisted generally of sand and gravel with varying fines content. Layers of sandy silt to silty sand and gravel were observed at 2 to 4 feet below ground surface (BGS). The borings were completed to depths of 6 to 9.5 feet BGS. Groundwater was encountered ranging from 7.5 to 8 feet BGS in select borings and was not observed in other borings.

Materials encountered from Folker Street to Piper Street consisted of well graded gravel with sand and silt. The borings were completed from 9 to 9.5 feet BGS. Groundwater was encountered in one boring at a depth of 7 feet BGS and not observed in the other borings.

Materials encountered from Piper Street to Florina Street consisted of well to poorly graded sand and gravel with silt. The borings were completed from 7 to 10 feet BGS. Groundwater was encountered in all but one boring and was observed to be from 7 to 9 feet BGS.

### 5.2 AWWU Lake Otis Parkway Water Rehabilitation, 36<sup>th</sup> to 42<sup>nd</sup> Avenue

DOWL completed eleven borings along Lake Otis Parkway from 36<sup>th</sup> Avenue to 42<sup>nd</sup> Avenue in addition to reviewing historical geotechnical information along Lake Otis Parkway (DOWL, 2016).

Materials encountered at the intersection of Lake Otis Parkway and 42<sup>nd</sup> Avenue (TB-7 which was closest to our project) consisted of 8 inches of asphalt pavement overlaying sand and gravel fill with varying fines content. A peat layer was encountered below the fill at a depth of 8 feet that extended to 10.3 feet. Below the peat was silty sand that transitioned to a poorly graded sand with silt and gravel.

Groundwater was encountered during drilling at depths ranging from 3 to 15 feet BGS. Groundwater readings collected in October 2016 recorded depths ranging from 2.2 to 9.8 feet BGS.

### 5.3 AWWU 43<sup>rd</sup> Avenue from Dale to Piper Street

Shannon and Wilson (S&W) completed four geotechnical borings in the vicinity of 43<sup>rd</sup> Avenue and Thorne Place (S&W, 2017).

Materials encountered consisted of 2 to 4 feet of silty sand with gravel or gravel with sand which was identified as likely fill. S&W stated there was uncertainty on the geologic contact interface between the fill and native sands due to similarity between the two materials. The asphalt thickness was observed to be 1.5 to 2.5 inches thick. Below the sandy soils (i.e. fill and native sands) were alternating layers of sands with silt and gravel and gravel contaminating various amounts of silt and sand.

Groundwater was encountered during drilling at depths ranging from 7.5 and 12 feet BGS. Groundwater readings collected in September 2017 recorded depths ranging from 7 to 12.2 feet BGS.

## 6. Site Conditions

### 6.1 Geology

The geology for the project area was determined from the Simplified Geologic Map of Central and East Anchorage, Alaska, as mapped by R.A. Combellick with the Alaska Division of Geologic and Geophysical Surveys (DGGS) in 1999 in addition to the 1972 map by Schmoll and Dobrovolsky (Combellick, 1999; Schmoll and Dobrovolsky, 1972). The geology of the project area consists primarily of Holocene alluvium which is made up of loose gravel and sand with some silt. A portion of the project, from approximately Laurel Street (Figure 2) to Folker Street (Figure 3), is mapped as a glacial drift with a composition ranging from diamicton to well-sorted sand and gravel and locally including silt and clay with little or no sand and gravel. Geologic conditions in the boreholes agreed with the general geology though variations between borings was noted.

### 6.2 Pavement Thickness and General Soil Lithology

The pavement thickness, where encountered, was 2 inches based on measurements of recovered samples.

The subsurface conditions within the existing road prism where borings occurred generally consisted of a 2 to 8 foot thick layer of granular fill underlain by coarse grained material. The granular fill classification mixed between well to poorly graded sand and gravel with varying fines content. The moisture content ranged between 2 and 27 percent and the average was approximately 7 percent. The fines content ranged between 4 and 39 percent and the average was approximately 15 percent. The frost susceptibility was determined to vary from F2 to F4 frost classification.

The coarse grained materials below the granular fill ranged from clean, poorly to well-graded sand and gravel with low fines content to silty sand and gravel in select borings. In borings BH-01, 02, 04, 05, and 17 a moist to wet, gray, silt ranging in thickness from 2 to 3 feet was observed within 10 feet below the surface.

Below the coarse grained material from BH-07 thru BH-22 (Figures 3 thru 7), was a moist to wet, gray, silt that undulated along the project alignment. This silt was encountered in depths as shallow as 7.5 feet BGS but was as deep as 15 feet BGS.

The encountered subsurface conditions generally agreed with the historic geotechnical investigation findings. Detailed subsurface conditions can be found on the borehole logs in Appendix A. It should be noted that subsurface conditions outside the existing road prism could vary from the borehole logs.

### 6.3 Drive Penetrometer Results

One drive penetrometer, P-01, was completed on the north side of 42<sup>nd</sup> Avenue just east of Hickory Place (Figure 3). The penetrometer was advanced to 22 feet BGS as noted with single digit blows per foot measured in the top 12 feet and steadily increased with depth until reaching 200 blows per foot (practical refusal). The results of the drive penetrometer are presented in Appendix A.

### 6.4 PID Field Testing Results

Standard practice in the MOA is to consider soil samples with PID readings of 20 parts per million (ppm) or higher potentially contaminated. Only one sample, at a depth of 5 feet BGS in BH-08, initially had a PID reading above this threshold at 20.4 ppm however subsequent readings of the sample after the field



investigation showed a decreased PID reading. It is CRW's opinion that this sample was influenced from drilling materials which resulted in a false positive PID reading therefore no analytical testing was performed on the potentially contaminated soil. Samples were disposed of as previously stated.

## 6.5 Groundwater Conditions

Groundwater, if observed, is recorded on the borehole logs. Table 1 provides a summary of the groundwater levels at the time of drilling and subsequent measurements. All depths are relative to the existing roadway surface.

**Table 1 – Summary of Groundwater Levels**

Borehole	Groundwater Levels While Drilling (feet)	Groundwater Levels on 05/29/2019 (feet)	Groundwater Levels on 09/26/2019 (feet)
BH-01	5.0	5.2	5.7
BH-02	5.3	5.3	5.4
BH-03	10.0	5.9	6.1
BH-04	7.5	10.5	10.7
BH-05	Not Observed	13.4	14.8
BH-06	Not Observed	Not Encountered	Not Encountered
BH-07	5.0	8.8	8.7
BH-08	Not Observed	No Piezometer Installed	No Piezometer Installed
BH-09	7.0	6.2	6.5
BH-10	6.0	No Piezometer Installed	No Piezometer Installed
BH-11	7.0	7.7	8.2
BH-12	7.5	No Piezometer Installed	No Piezometer Installed
BH-13	7.5	7.8	8.2
BH-14	7.5	No Piezometer Installed	No Piezometer Installed
BH-15	8.0	5.6	6.1
BH-16	5.0	No Piezometer Installed	No Piezometer Installed
BH-17	5.0	5.2	5.6
BH-18	5.0	No Piezometer Installed	No Piezometer Installed
BH-19	7.5	6.0	6.4
BH-20	7.5	No Piezometer Installed	No Piezometer Installed
BH-21	Not Observed	5.8	6.2
BH-22	Not Observed	No Piezometer Installed	No Piezometer Installed
BH-23	5.0	No Piezometer Installed	No Piezometer Installed
BH-24	15.0	25.4	29.3

## 6.6 Contaminated Site Review

Soil samples were tested using a PID during the field investigation per MOA and AWWU requirements with results previously discussed in this report and values provided on the borehole logs. In addition, CRW consulted the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program (CSP) on-line database for nearby recorded contaminated sites.

A review of the CSP database revealed three sites within 500 feet of the project as follows:

1. Tudor Car Wash  
2621 East Tudor Road  
Hazard ID 23,712  
Located 390 feet south of 42<sup>nd</sup> Avenue  
Status: Cleanup Complete  
Discussion: Previously removed underground storage tanks and piping. Petroleum impacted soil and groundwater discovered during tank removal. Soil and groundwater downgradient meets the ADEC most stringent cleanup levels. Levels of benzene in soil and groundwater upgradient do not presently meet the ADEC most stringent cleanup levels.
2. Residence  
4010 Piper Street  
Hazard ID 25,612  
Located 430 feet north of 42<sup>nd</sup> Avenue  
Status: Cleanup Complete  
Discussion: Previously removed heating oil underground storage tanks. Phase II investigation discovered tetrachloroethylene (PCE) contamination in one boring. ADEC reviewed the environmental records in 2011 and determined concentrations of PCE do not pose an unacceptable risk to human health or the environment.
3. Piper Mobile Home Park  
4222 Piper Street  
Hazard ID 4,510  
Located 60 feet south of 42<sup>nd</sup> Avenue  
Status: Cleanup Complete – Institutional Controls  
Discussion: Petroleum contamination discovered during assessment activities in 2007. Subsequent studies determined diesel range organics (DRO) above cleanup level in one sample. ADEC is working to contact the property owner as of Feb 2019 and respond to previous correspondence to decommission the onsite monitoring wells.

## 7. Geotechnical Engineering Recommendations

CRW has developed the following recommendations based on our understanding of the project scope and considering the data obtained during our geotechnical investigation.

### 7.1 Site Preparation

All pavement and pathways, existing fill, existing curbs and gutters, trees, stumps, and all other deleterious material should be cleared. Exposed subgrade at the bottoms of excavations should be scarified a minimum of 6 inches, moisture conditioned, and compacted to 95 percent of the maximum Proctor density as determined from ASTM D1557. If the subgrade cannot be moisture conditioned, we recommend the contractor overexcavate the subgrade a minimum of 1 foot and replace with non-frost susceptible (NFS) material.

### 7.2 Utility Excavation

Any excavations for utilities should follow proper local, state, and federal requirements, including Occupational Safety and Health Administration (OSHA) standards. The soil and groundwater conditions for utility excavations will vary.

The contractor is responsible for trench stability, worker safety, and regulation compliance as he will be present on a day to day basis and can adjust efforts to obtain the needed stability. Surface runoff entering the excavation could present challenges and should be accounted for during construction. We anticipate excavations to use benching/sloping or shielding. If trench shoring, like cantilever or braced excavations, is utilized, additional recommendations for lateral earth pressures can be provided.

Utility excavations above the water table may stand relatively steeply initially but fail suddenly without warning. As the in-situ soils dry, they will tend to ravel and slough to their natural angle of repose, which we estimate to be between 1.5 to 1.8H:1V (horizontal to vertical). Below the water table, or if surface water is allowed to enter the trench, in-situ soils may slough, soften, squeeze, slump over time or due to disturbance, to slopes of 2 to 2.5H:1V or flatter.

Inspection of utility line subgrade should follow AWWU DCPM requirements and standards.

Additionally, the sequencing of excavation for the utility line and the excavation for the roadway should be considered by the designers and the contractor. Should the roadway construction occur prior to utility installation, poor performance of the roadway may occur due to dissimilar material in the utility trench compared to the roadway structural section as well as damage and repair to any insulation and/or geotextile.

### 7.3 Dewatering and Radius of Influence

Subsurface conditions have relatively shallow groundwater relative to the anticipated water main replacement excavation based on measurements taken at the time of drilling and during subsequent readings. Excavations for the water main replacement are anticipated to be 12 feet BGS and groundwater levels were measured between 5 to 14.8 feet BGS (excluding BH-24). Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences, such as existing swales. We recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impacts on the construction procedures, if necessary. We recommend the ground around any excavation be

contoured to direct surface water away from the excavation and to minimize surface water or runoff from entering the excavation.

Based on the observed groundwater and anticipated excavation depths, dewatering will likely be required. Dewatering methods include open pumping, wellpoints, deep wells, ejector wells, cutoff methods, or some combination. Considering the geologic conditions we do not recommend open pumping, ejector wells, or cutoff methods due to the amounts of anticipated groundwater, depth to dense/hard layers, and cost. We recommend wellpoints or deep wells be considered for construction dewatering. Depending on spacing and size, wellpoints may be either standard 1.5 to 2 inch diameter or larger, 6 inch diameter suction wells (Powers et al., 2007).

We recommend construction dewatering be the responsibility of the contractor. We recommend the contractor submit a dewatering plan for approval as part of the submittal process. The dewatering plan should show anticipated wellpoint/well layout and spacing including diameters, wellscreens, filters, and location of pumps, discharge point(s).

Permits from the Alaska Department of Natural Resources, and potentially other local and state agencies will be necessary for construction dewatering.

For preliminary planning, we have estimated pumping rates for the waterline excavation based on assumed dewatering effective width of 10 feet and drawdown of 7 feet. We estimated hydraulic conductivity from empirical and literature values based on the encountered soils ranging from 5 to 250 FT/day with an average value of 100 FT/day with higher flows in the gravels and lower flows in the silty sands. We note there is tremendous uncertainty in conductivity estimates using empirical/literature values as they are affected by soil type, excavation/dewatering methods, and seasonal groundwater fluctuations, and will vary during construction.

We estimate an initial required pumping rate of 1 to 21 gallons per minute per linear foot (GPM/FT) which decrease to steady-state pumping rates of 0.5 to 12 GPM/FT during dewatering efforts. We estimate the radius of influence of the cone of depression from dewatering to vary from 60 to 400 FT (measured from the center of the trench). These estimates do not consider the effect of “tailwater” from water flowing into the excavation due to the high permeability of bedding material.

Dewatering activities should consider the potential for settlement when buildings and other infrastructure are within the radius of influence. When the water table is lowered compressible soils can consolidate, due to an increase of the effective weight of overlying soils. Consolidation has the potential to impact development adjacent to the project area. While construction and dewatering are anticipated to be of short duration and impacts minimal, considerations should be made as to whether monitoring of settlement is required. CRW’s geotechnical engineer will work closely with the designers to evaluate the magnitude of settlement and tolerable settlement values will be determined considering input from MOA, CRW designers, and Stakeholders during detailed design.

If dewatering produces intolerable settlements the designers should perform pre- and post-condition surveys of the buildings and other infrastructure to evaluate if dewatering activities resulted in damage. In addition, survey points should be placed at and around building and other infrastructure locations to verify settlement due to dewatering. If settlement is observed during monitoring the contractor should reevaluate the dewatering technique to reduce the potential for continued settlement.

## **7.4 Frost Depth and Permafrost**

Seasonal frost was not observed in the borings at the time of drilling.

Typical design frost depths are estimated between 8 and 11 feet BGS in Anchorage and are common for relatively dry granular soils. It should be noted that seasonal fluctuations of snow cover, temperatures, infiltration/evaporation, groundwater table, and other climatic effects will have an impact on the design frost depth therefore any calculated value should only be considered a reasonably estimated design value as deeper frost penetrations are possible. In addition, the presence of groundwater within the upper 11 feet will also affect the frost depth in addition to the potential for ice lensing and heaving.

We have estimated design frost depths based on the modified Berggren equation using the commercially available Microsoft DOS program Berg2 as discussed in the next section of this report.

Permafrost was not encountered in the boreholes and is not expected at the project site.

## **7.5 Recommended Road Structural Sections**

CRW has developed a recommended road structural section based on the current MOA DCM as outlined in Chapter 1 Streets, Section 1.10 Road Structural Fill Design. The structural section design uses the goal of reducing the freezing and thawing impacts to a specified percentage.

The DCM recommends two methods for frost considerations in the structural section design: the Complete Protection Method and the Limited Subgrade Frost Penetration Method.

The Complete Protection Method involves the removal of all frost susceptible subgrade soils beneath the roadway to the calculated frost penetration depth. These soils are replaced with non-frost susceptible fill. This method may be used regardless of the frost susceptibility of the subgrade soils. Board insulation may also be used in the subbase of the structural section to reduce the required depth of classified fill and backfill. The Complete Protection Method would require excavation and replacement of frost susceptible soils down to depths of 8 to 10 feet, excluding insulation, which is not economical and therefore is not recommended.

The Limited Subgrade Frost Penetration Method attempts to restrict roadway surface movements to levels that will not adversely affect road surface life or quality. The method permits frost penetration into a frost susceptible subgrade equal to a maximum of 10 percent of the structural section design thickness.

The frost depth was analyzed using the commercially available MSDOS computer program Berg2 written by Braley and Connor (Braley and Connor, 1989) as approved in the DCM. The analysis calculates the estimated total frost penetration depth and determines the recommended structural section. For our analysis, we used the program default climate parameters for Anchorage and assumed conservative surface freeze/thaw n-factors based on local practice and published values. Soil layers were assigned in the program with estimated dry unit weights of the soil and average or anticipated water contents. Soil thermal parameters were calculated from the equations built into the Berg2 program (see Braley and Connor for further discussion).

### **7.5.1 Recommended Structural Section – Limited Subgrade Frost Protection Method**

In general, 42<sup>nd</sup> Avenue contains frost susceptible subgrade with a F2 to F4 frost classification within 8 feet of the ground surface. Based on this, we recommend an insulated structural section using the Limited Subgrade Frost Penetration for the entire project alignment. We have developed a recommended structural section based on the Berg2 analysis, and have evaluated 2 and 3 inches of insulation. We have evaluated these insulation thickness to consider the potential savings of fill below the insulation by comparing 1 inch of insulation compared to fill amount. We do note that 4 inches of insulation is likely more economical than 3 inches and also provides better thermal protection and improved road performance. The insulation for the structural section in this analysis assumed a minimum R-value of R-

4.5 per inch. Our recommended structural sections are presented in Table 2 and Table 3. A typical insulated section is presented in Figure 8 for 2 inches of insulation.

**Table 2 – Recommended Structural Section – 2 inches Insulation**

Layer	Minimum Thickness, inches
Asphalt Pavement	2
Leveling Course	2
MOA Type II-A	16
Insulation	2
MOA Type II	24
Geotextile	N/A
Subgrade	N/A
Total Thickness	46

**Table 3 – Recommended Structural Section – 3 inches Insulation**

Layer	Minimum Thickness, inches
Asphalt Pavement	2
Leveling Course	2
MOA Type II-A	16
Insulation	3
MOA Type II	15
Geotextile	N/A
Subgrade	N/A
Total Thickness	38

See Appendix E for Berg2 analysis and detailed results. Note that the recommended structural section considers only minimum thicknesses.

## 7.6 Rigid Insulation

We recommend that rigid board insulation for the road structural section have a minimum compressive strength of 60 pounds per square inch (psi) and a maximum water absorption of 0.3 percent by volume in accordance with the current version of Municipality of Anchorage Standard Specifications (MASS). We recommend the insulation have a minimum R-value of R-4.5 per inch. We recommend a minimum of 12 inches of loose fill be placed over the insulation to protect from wheel loads during construction and to prevent frost formation in the form of differential icing.

Board insulation installation should be extended a minimum of 4 feet beyond the back of the curb when no pathway/sidewalk is present. Extending the insulation 4 feet will reduce the risk of the curb heaving up or “curb rolling”. The potential for curb rolling decreases as the distance the insulation extends beyond the back of curb increases. The 4-foot layout has protected the curb well on past projects especially where the curbs need to be protected due to the flat longitudinal roadway grades like those on 42<sup>nd</sup> Avenue. The insulation should extend 1 foot minimum beyond the back of the sidewalk/pathway but will not perform

as well as the curb. However, to increase the performance of the sidewalk/pathway, the owner could consider extending the insulation 4 feet as well. Additionally, insulation below separated pathways that are separated by 4 feet or more could be reduced to R-4.5 per inch to save cost but will not perform as well.

Transitions between insulated and non-insulated sections should involve the extension of insulation out from the roadway section 8 to 12 feet with the thickness reduced in these areas to minimize the possibility of differential heave. The insulation can be tapered from an R-value of 9 to an R-value of 4.5 in the transition zone. The subgrade in transitions should be graded (tapered) at a 10H:1V (horizontal to vertical) slope if construction distances permit. We recommend the transitions not be steeper than 5H:1V.

## 7.7 Geotextiles

We recommend that a geotextile be used at the base of the structural section along the entire project alignment. The use of a geotextile reduces the effects of thaw weakening, prevents fines migration, and increases lateral drainage at the base of the structural section. If soil layers near the top of the water table are looser the geotextile will provide additional stabilization.

We recommend a non-woven geotextile that meets MOA specifications similar to Class 2, Type A should be used. The geotextile should be placed on top of the excavated subgrade soils prior to placement of classified fill. The geotextile should be extended up the sides of excavations.

Typical installation involves placing the geotextile transverse to the centerline in order to avoid large overlaps. Fabric joints should be overlapped according to manufacturers recommendations. Fabric joints may require sewing together depending on subgrade conditions.

## 7.8 Subdrains

Based on the groundwater level measurements along the project alignment, subdrains are not required.

## 7.9 Reuse of Material

Fill and native material that meets the classification for MOA Type II and Type II-A fill can be reused as classified fill in the roadway structural section. It is anticipated that the majority of existing fill and native soils along 42<sup>nd</sup> Avenue contain frost susceptible material and will not meet MOA Type II and Type II-A classification.

Fill and native material that meets the classification for bedding/backfill material can be reused in utility trenches.

The amount and quality of reuse of material will vary depending on factors including lateral extent of deposits, transitional lithology, groundwater conditions and control during construction, and mixing of excavated materials. Higher fines content soils were encountered near the ground surface along the west side of the project which could make granular soils difficult to compact if mixed and water content increases. We recommend native material excavated for reuse be visually inspected for fines content and if the material becomes wet will require storage to be dried for reuse. This effort may be less efficient and cost more than complete removal and replacement with imported materials.



### 7.10 Soil Corrosivity Evaluation

Based on the AWWU DCPM Water Pipe Selection Diagram and the absence of contaminated soils, we anticipate the waterline to be constructed of polyvinyl chloride (PVC) material therefore no corrosion evaluation is required.

### 7.11 Utility Recommendations

All utilities should be bedded, backfilled, and compacted per AWWU DCPM and PVC pipe installation manual as AWWU has more stringent requirements than the manufacturer. The satisfactory performance of piped utilities is highly dependent upon the quality of soil below and along the sides of the pipe. Considering the presence of groundwater, AWWU bedding material Chip E may be required to allow groundwater to flow down the bedding. Chip E material would need to be analyzed to meet ASTM D2321.

AWWU standard is to adequately bury utilities to protect from freezing. If inadequate burial depths cannot be achieved as design proceeds, alternate methods such as insulation, active freeze protection like heat tape, or some combination are recommended. Recommendations on insulation for utility protection can be provided on request.

### 7.12 Retaining Wall Recommendations

A retaining wall is anticipated to be constructed on the north side of 42<sup>nd</sup> Avenue just east of Hickory Place. Based on the current project alignment and planned upgrades, the retaining wall is estimated to have a maximum height of 5 to 7 feet with the higher portions on the west end and decreasing in height moving east.

It is uncertain at this time what type of retaining wall will be used however several types of retaining walls may be appropriate as listed below. Other options for slope reinforcement like micropiles, soil nailing, or Spiralnails are available however these methods require specialty contractors and are likely more expensive than a retaining structure.

- Cast-in-Place (CIP) Concrete Wall (cantilever or counterfort)
- Modular Gravity Walls (Bin or Gabion)
- Mechanically Stabilized Earth (MSE)
- Sheet pile wall
- Soldier pile with lagging wall

The design will need to consider the existing topography, native soil strength and stiffness, adjacent structures, and neighboring businesses and residences in the selection of the retaining wall. In addition, new retaining walls could increase loading of the new or existing utilities. Long term maintenance of utilities should also be considered in the selection of the future retaining wall.

Walls like CIP Concrete, Modular Gravity, and MSE will require over-excavation into the existing slope along 42<sup>nd</sup> Avenue to construct, depending on the required geometry, which could be problematic for slope stability or to the existing infrastructure at the top of the slope. Sheet pile and soldier pile walls wouldn't require as much excavation however they typically require larger construction equipment and commonly create disturbances like noise and ground vibration due to pile driving activities. It should be noted that the drive penetrometer encountered refusal at a depth of 22 feet therefore if sheet pile or soldier pile are selected, pre-drilling may be required beyond this depth. Additional retaining wall specific recommendations will be provided once a wall is selected.



We recommend backfill immediately behind the retaining wall be clean, free draining granular soils that are NFS like MOA Type II. We recommend a minimum of 4 feet of backfill between the back of the retaining wall and the native soil to minimize frost heaving forces. Alternately insulation could be used in lieu of NFS backfill to reduce frost penetration.

We recommend proper drainage of surface water and runoff unless the retaining wall is designed for groundwater hydrostatic forces. The ground at the top of the wall should be capped to be relatively impermeable and graded to channel water flow away from the wall face. It is important to prevent surface water from infiltrating into the backfill and adding additional loading to the wall. We recommend the retaining wall, depending on type, include weep holes. In addition, we recommend horizontal drains be installed at the base behind the walls to collect and drain water away from the wall.

We recommend the following soil parameters for the native soils and NFS backfill soils for the retaining wall design.

**Table 4 – Retaining Wall Soil Parameters**

Soil Type	Total Unit Weight (pcf)	Friction Angle, $\phi'$ (°)	Cohesion, $c'$ (psf)	Undrained shear strength (psf)
Native Silts with sand	120	28	0	1,250
Granular NFS Backfill	135	36	0	-

Backfill materials behind the retaining walls should be placed in relatively thin lifts of six inches and compacted to a minimum of 95 percent of the Modified Proctor maximum dry density in accordance with ASTM D1557. We recommend compaction equipment be selected to ensure no damage to the wall during construction. Compaction verification of the backfill by a qualified inspector is also recommended.

## 8. Limitations and Closure

The information submitted in this report is based on our interpretation of data from the field geotechnical investigation performed for this project. The conclusions contained in this report are based on site conditions as they were observed on the drilling dates indicated. It is presumed that the exploratory borings are representative of the subsurface conditions throughout the site. Effort was made to obtain information representative of existing conditions at the site. If, however, subsurface conditions are found to differ, we should be notified immediately to review these recommendations in light of additional information.

If there is substantial lapse of time between the submittal of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse. Unanticipated soil conditions are commonly encountered and cannot fully be determined by collecting discrete samples or advancing borings. The client and contractor should be aware of this risk and account for contingency accordingly.

This report was prepared by CRW for use on this project only, and may not be used in any manner that would constitute a detriment to CRW. CRW is not responsible for conclusions, opinions, or recommendations made by others based on data presented in this report.

## 9. References

Braley, W.A. and Connor, B., 1989. Berg2 Micro-Computer Estimation of Freeze and Thaw Depths and Thaw Consolidation. A report prepared for the State of Alaska Department of Transportation and Public Facilities Statewide Research, June, 1989.

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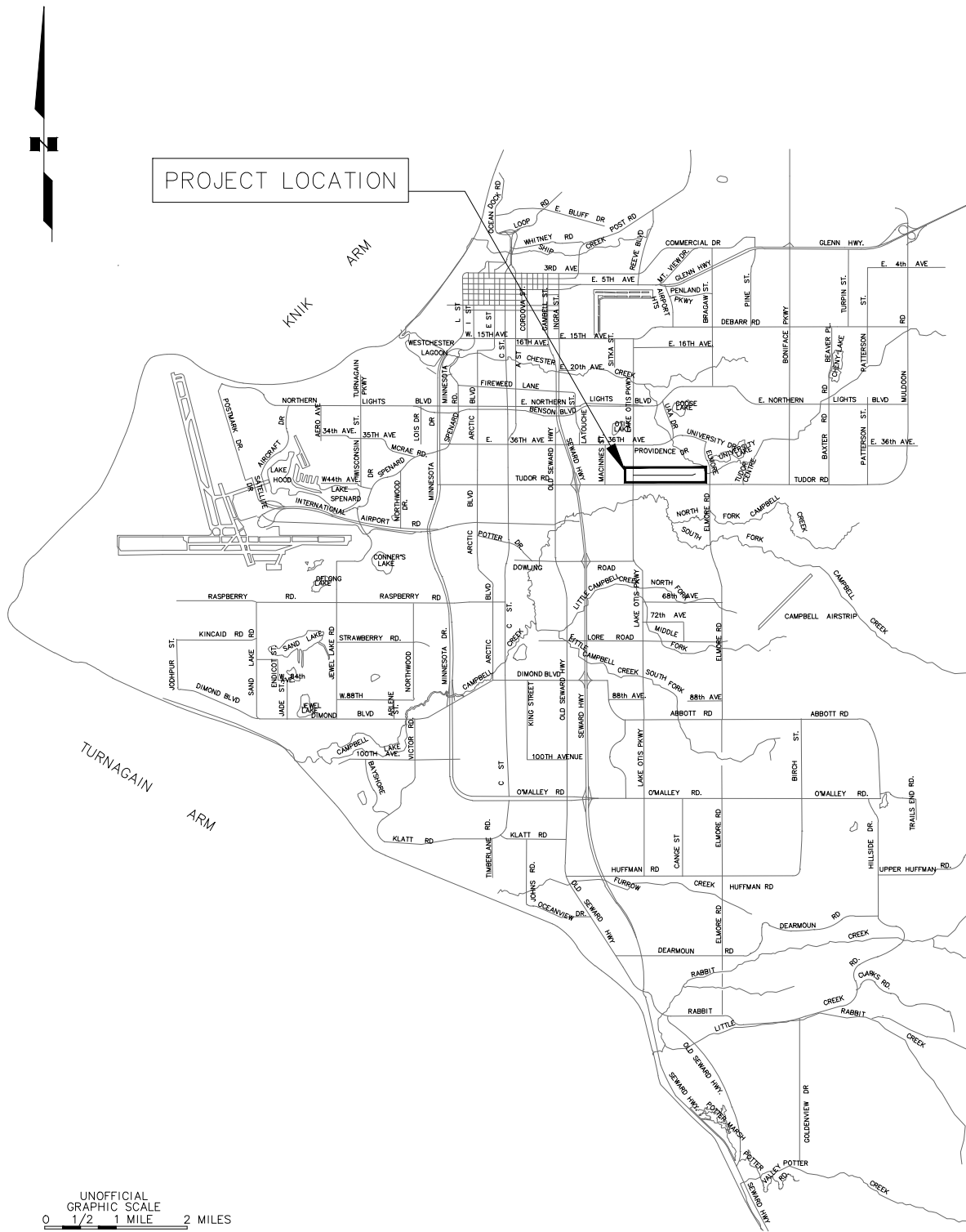
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## Figures

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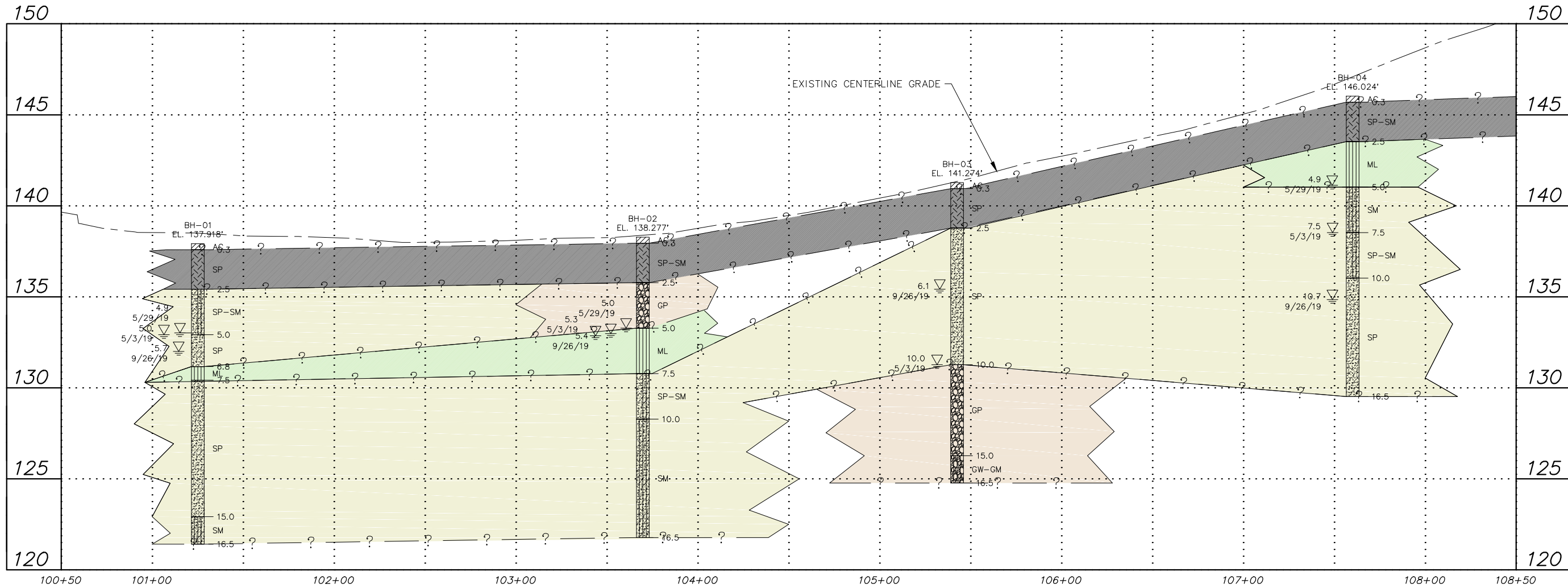
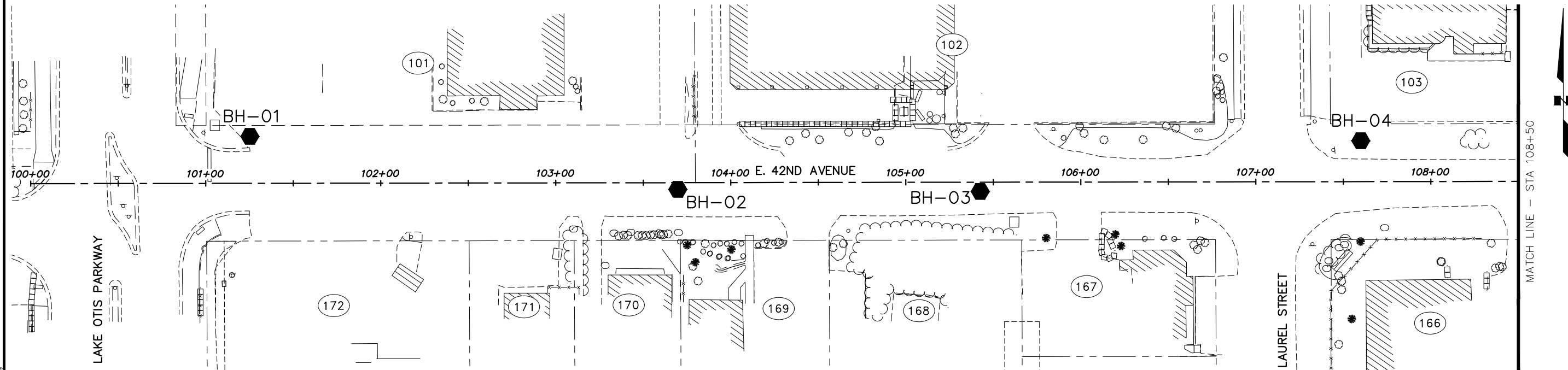


3940 ARCTIC BLVD, SUITE 300  
ANCHORAGE, ALASKA 99503  
PHONE: (907) 562-3252  
#AEC0882-AK

VICINITY MAP  
42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET  
ANCHORAGE, ALASKA

Project: 18-06  
Drawn By: CRW  
Scale: NTS  
Date: FEB 2020  
Figure: 1

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00\_CADD\02 Figures\06\_Geotechnical\10142.00 Soil Boring Plan & Profile\_w\_hatching\_v2.dwg



**LEGEND**

**BH-X**  
● BOREHOLE LOCATION AND NUMBER

■ FILL  
■ GRAVEL  
■ SAND  
■ SILT

- NOTES:**
1. GENERALIZED GEOLOGIC CONTACTS, INCLUDING EXTENTS OF FILL AND GROUNDWATER DEPTHS, ARE INTERPOLATED OR GRAPHICAL AND ESTIMATED BASED ON BOREHOLE DATA. ACTUAL CONDITIONS WILL VARY.
  2. GROUNDWATER LEVELS SHOWN AT TIME OF INVESTIGATION AND SUBSEQUENT READINGS WILL CHANGE WITH SEASON AND PRECIPITATION.
  3. SOILS CLASSIFIED ACCORDING TO UNIFIED SOIL CLASSIFICATION SYSTEM (USCS).
  4. FOR INFORMATIONAL USE ONLY. NOT FOR QUANTITIES OR FOR CONSTRUCTION.



PROJECT: **18-06**  
STATUS: **FINAL**

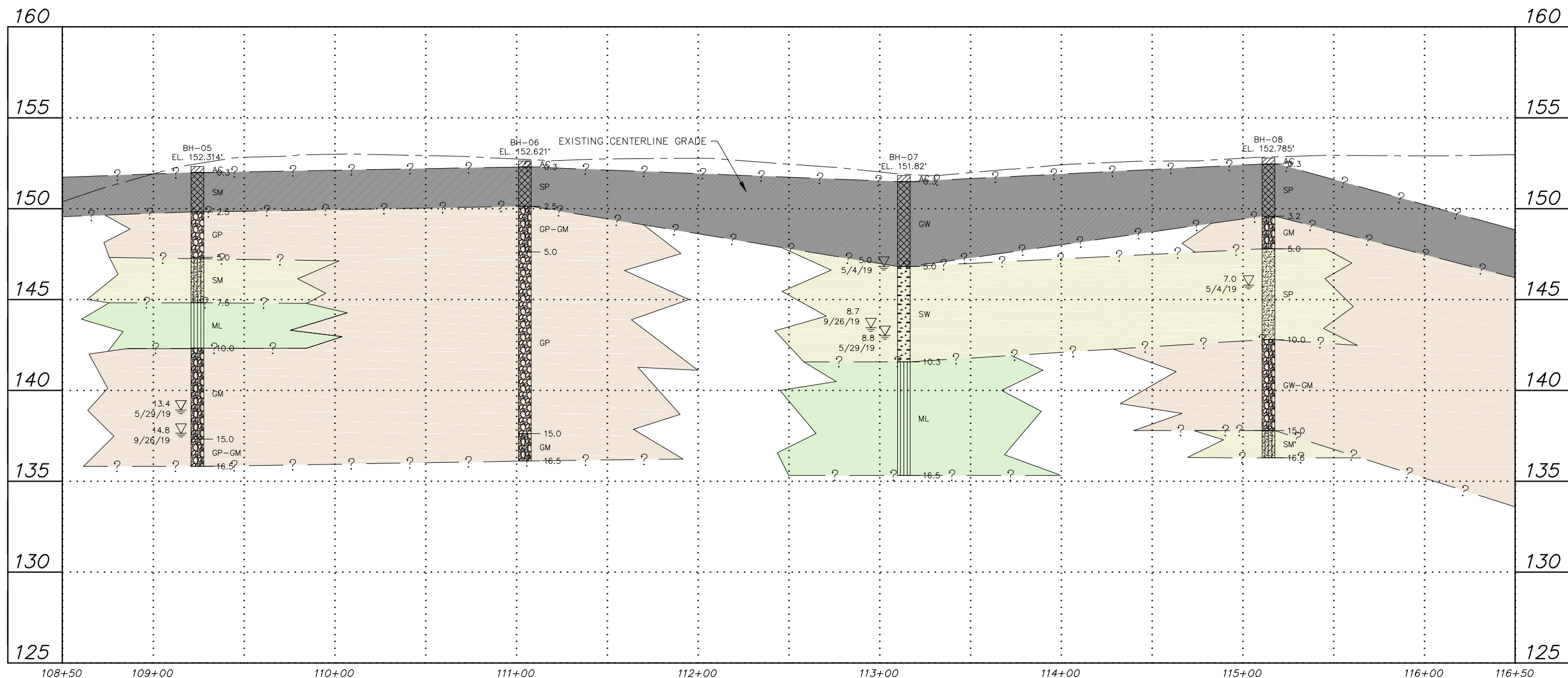
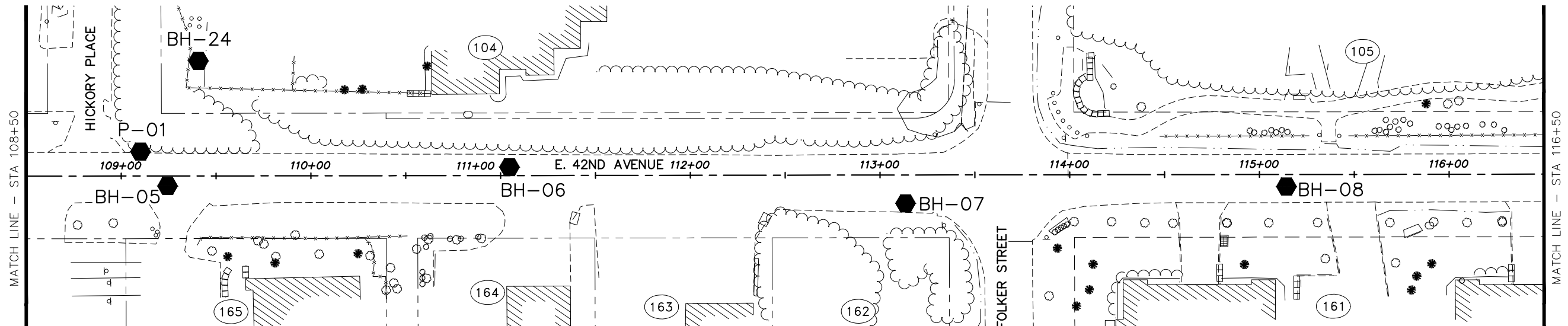


42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET

**BOREHOLE PLAN & PROFILE**

DATE	FEB 2020
SCALE	GRAPHIC
FIGURE	2

File: J:\JobsData\10142.00\_42nd Avenue Upgrade\00\_CADD\02\_Figures\06\_Geotechnical\10142.00\_Soil Boring Plan & Profile\_w\_hatching\_v2.dwg



**LEGEND**

**BH-X/P-X**  
BOREHOLE/PENETROMETER  
LOCATION AND NUMBER

FILL  
 GRAVEL  
 SAND  
 SILT

- NOTES:**
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  4. FOR INFORMATIONAL USE ONLY. NOT FOR QUANTITIES OR FOR CONSTRUCTION.
  5. BH-24 NOT SHOWN FOR CLARITY.



PROJECT: **18-06**  
STATUS: **FINAL**

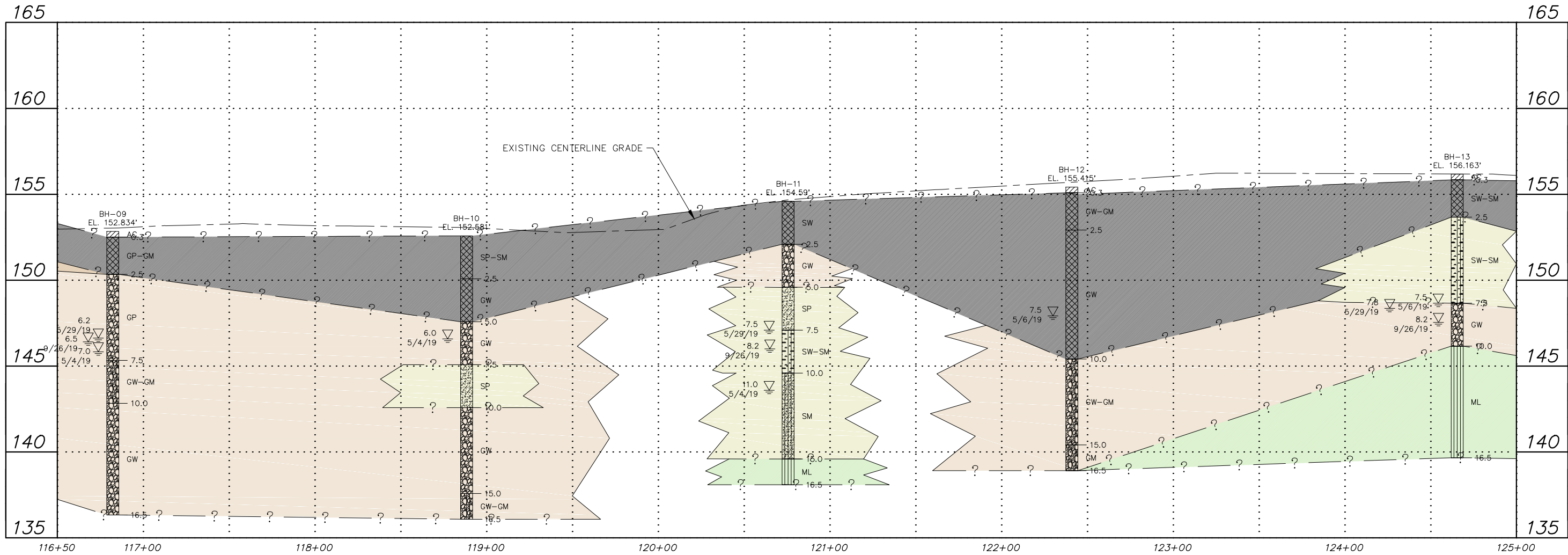
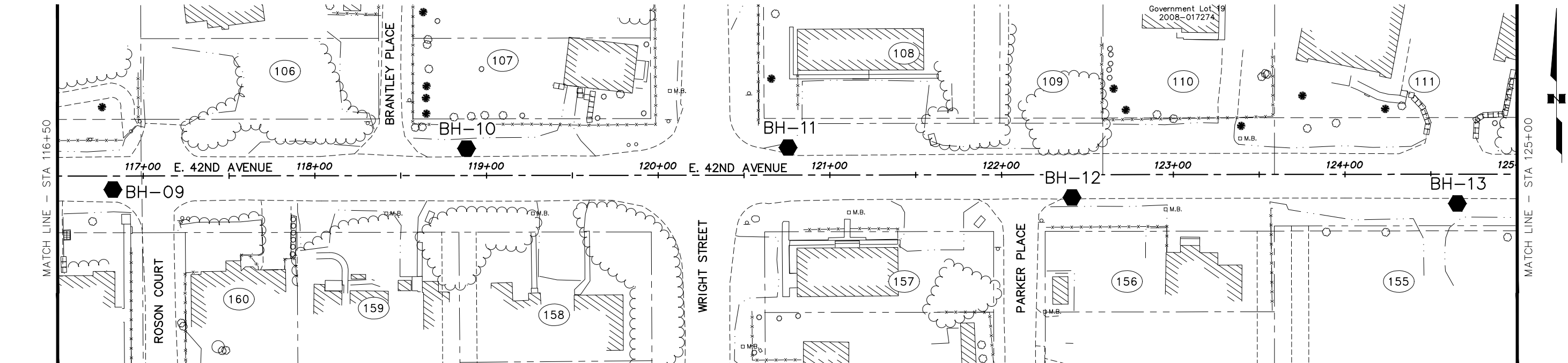


42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET  
**BOREHOLE PLAN & PROFILE**

DATE	FEB 2020
SCALE	GRAPHIC
FIGURE	3



File: J:\JobsData\10142.00 42nd Avenue Upgrade\00\_CADD\02 Figures\06\_Geotechnical\10142.00 Soil Boring Plan & Profile\_w\_hatching\_v2.dwg



**LEGEND**

**BH-X**

● BOREHOLE LOCATION AND NUMBER

■ FILL

■ GRAVEL

■ SAND

■ SILT

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PROJECT: **18-06**

STATUS: **FINAL**



42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET

**BOREHOLE PLAN & PROFILE**

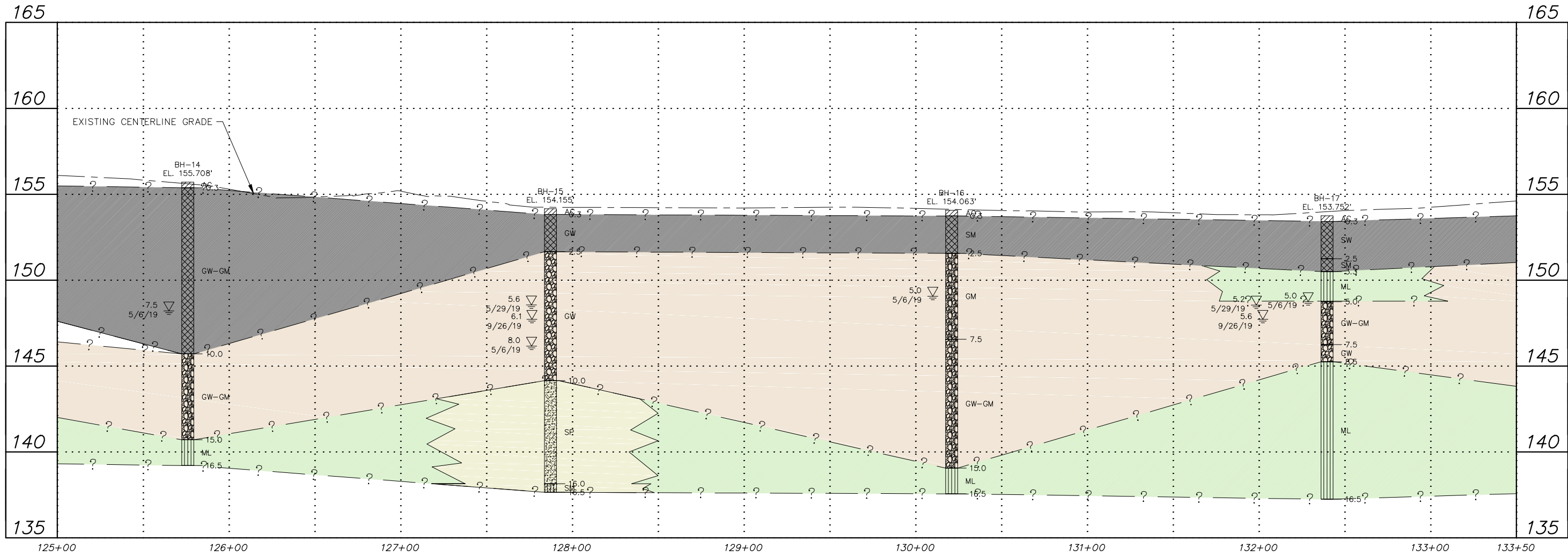
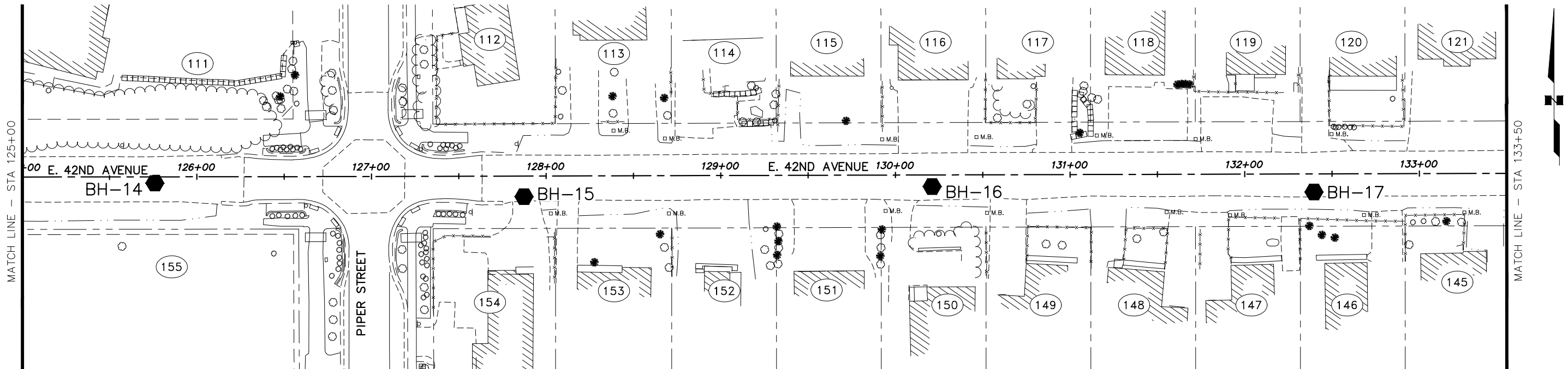
DATE  
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SCALE  
**GRAPHIC**

FIGURE  
**4**



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**LEGEND**

**BH-X**  
● BOREHOLE LOCATION AND NUMBER

█ FILL  
█ GRAVEL  
█ SAND  
█ SILT

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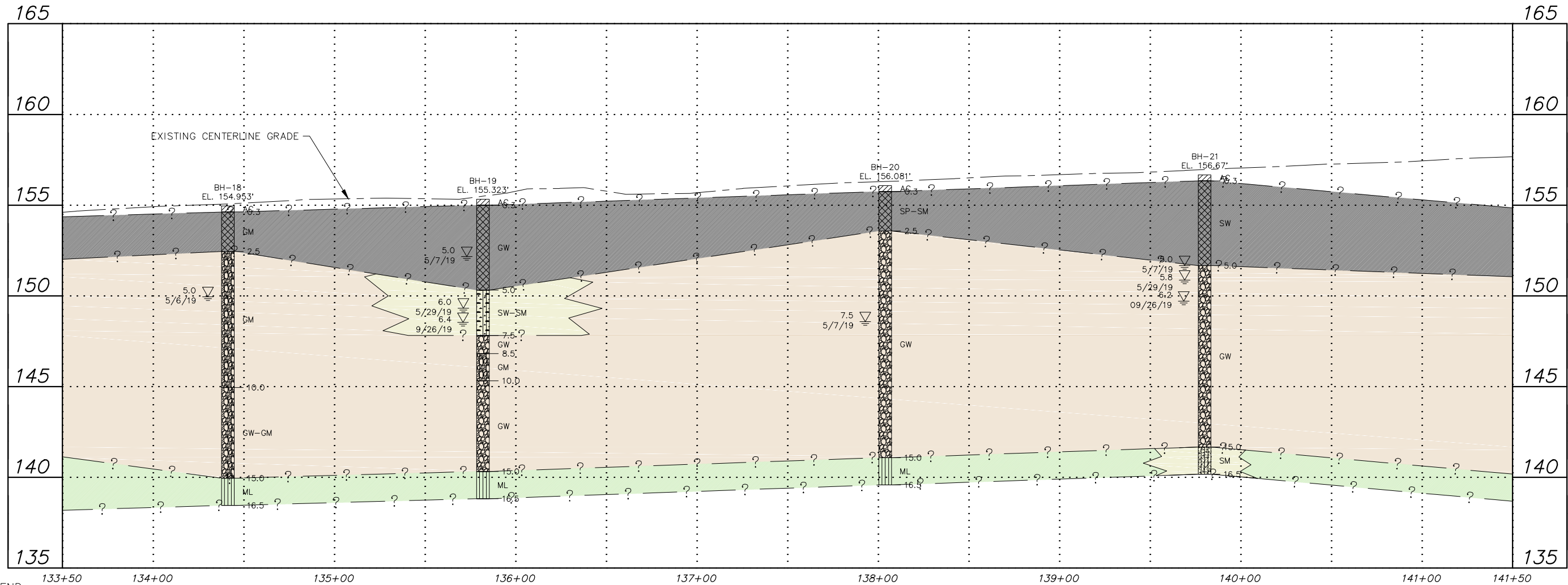
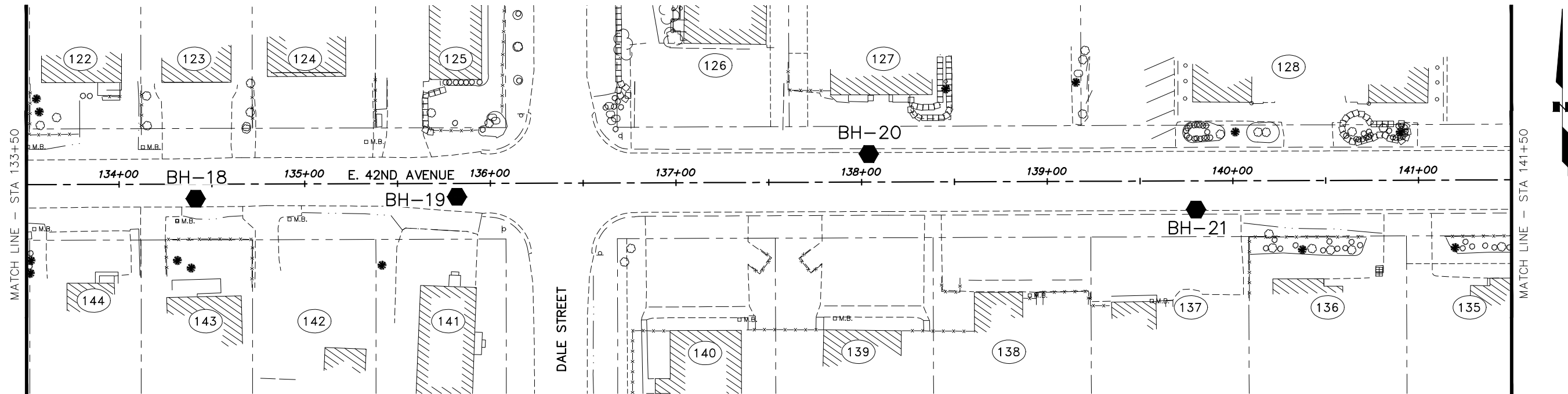
PROJECT: 18-06  
STATUS: FINAL



42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET  
**BOREHOLE PLAN & PROFILE**

DATE	FEB 2020
SCALE	GRAPHIC
FIGURE	5

File: J:\JobsData\10142.00 42nd Avenue Upgrade\00\_CADD\02 Figures\06\_Geotechnical\10142.00 Soil Boring Plan & Profile\_w\_hatching\_v2.dwg



- NOTES:
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PROJECT: 18-06

STATUS: FINAL



42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET

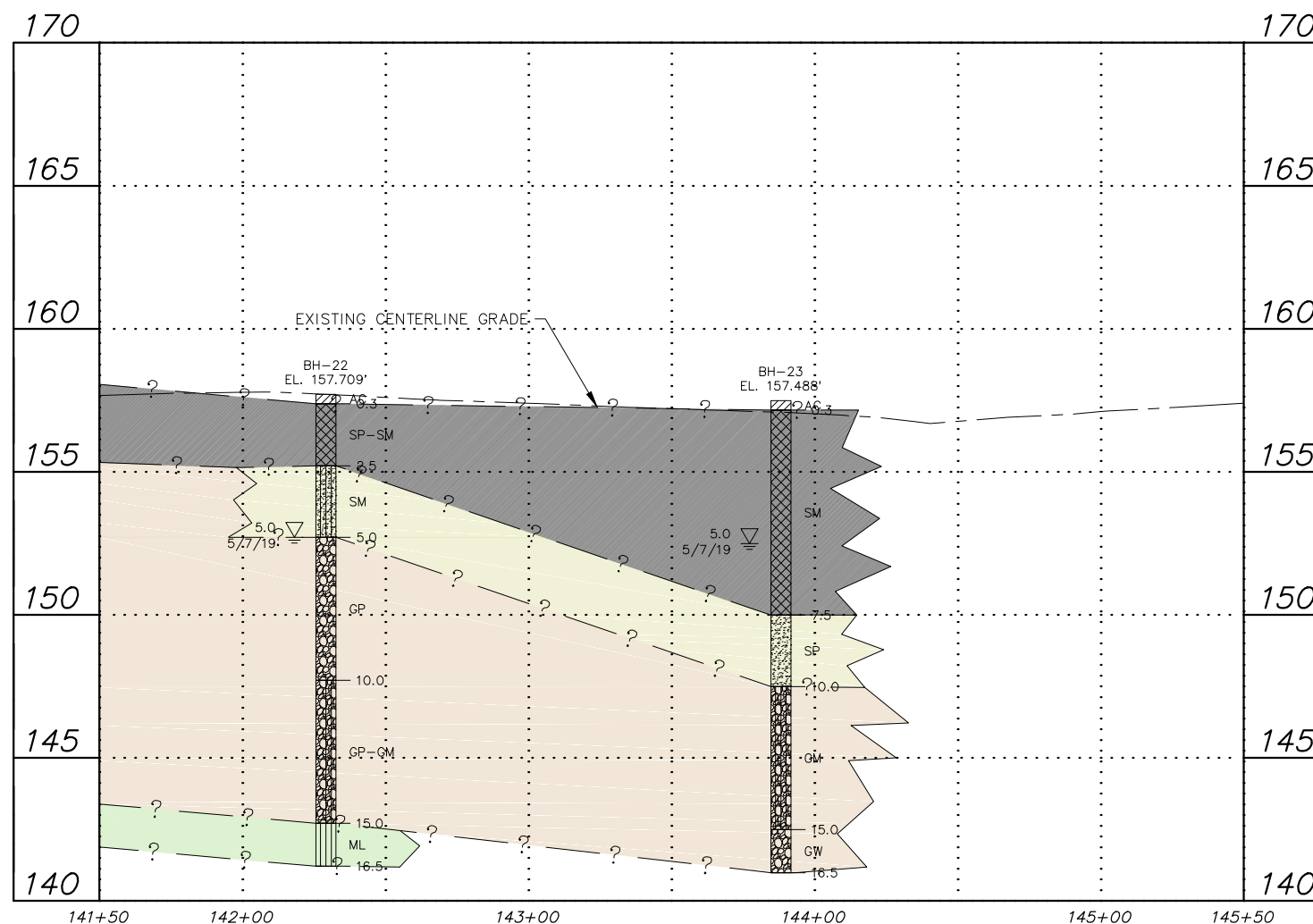
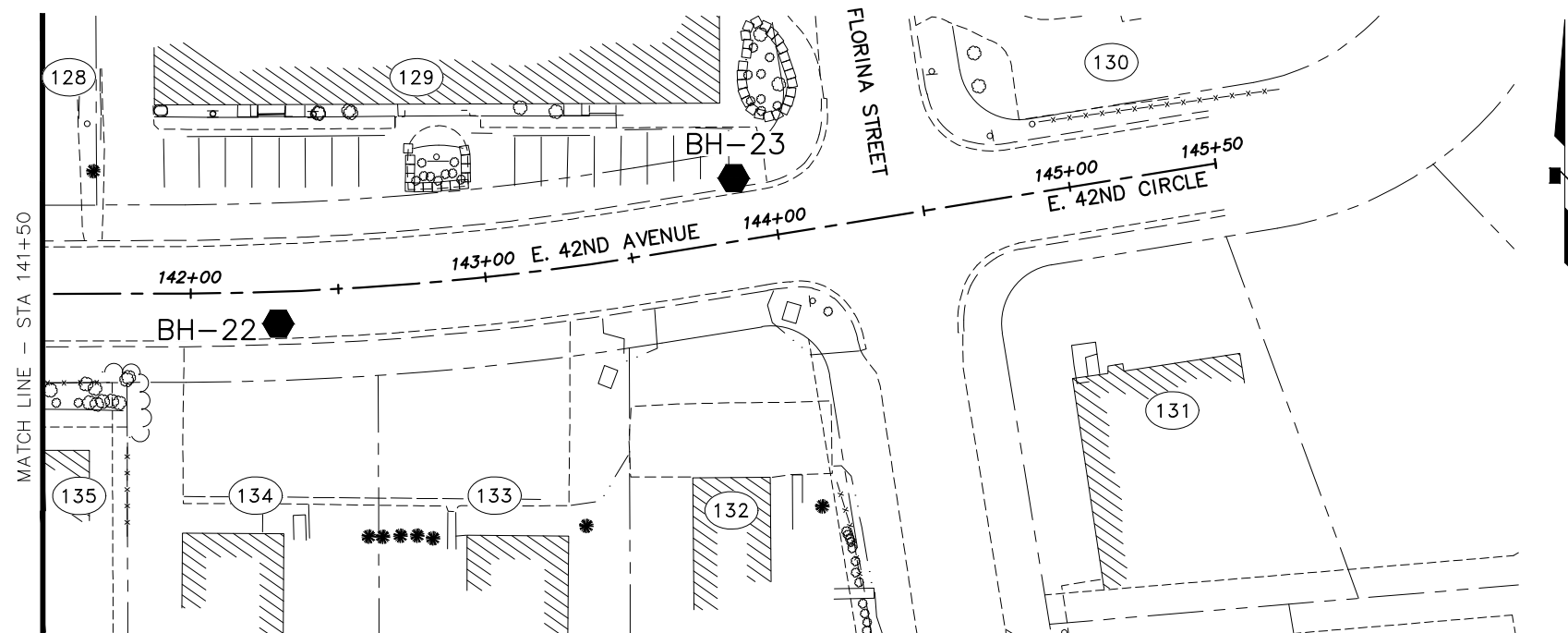
**BOREHOLE PLAN & PROFILE**

DATE  
**FEB 2020**

SCALE  
**GRAPHIC**

FIGURE  
**6**

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PROJECT: 18-06

STATUS: FINAL



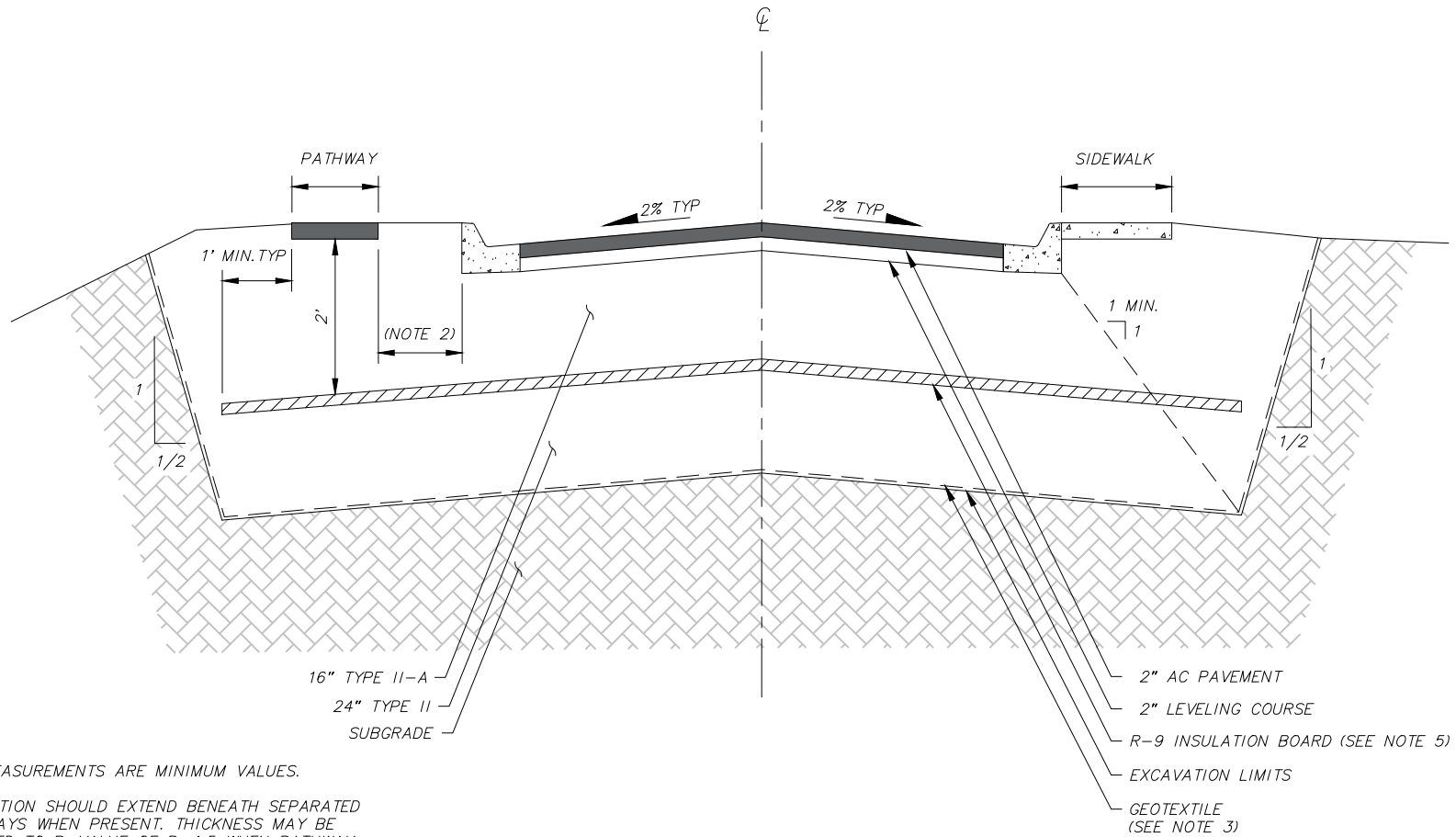
42ND AVENUE UPGRADE  
LAKE OTIS PARKWAY TO FLORINA STREET

**BOREHOLE PLAN & PROFILE**

DATE  
**FEB 2020**

SCALE  
**GRAPHIC**

FIGURE  
**7**



**NOTES:**

1. ALL MEASUREMENTS ARE MINIMUM VALUES.
2. INSULATION SHOULD EXTEND BENEATH SEPARATED PATHWAYS WHEN PRESENT. THICKNESS MAY BE REDUCED TO R-VALUE OF R-4.5 WHEN PATHWAY IS SEPARATED BY 4 FEET OR MORE.
3. GEOTEXTILE SHALL MEET MASS SECTION 20.25 CLASS 2, TYPE A, NON-WOVEN FABRIC WHEN SPECIFIED.
4. EXTEND INSULATION A MINIMUM OF 4 FEET BEYOND THE BACK OF CURB WHEN NO PATHWAY OR SIDEWALK ARE PRESENT.
5. INSULATION MIN. 60 PSI, ABSORPTION 0.30% MAX. BY VOLUME PER MASS.



42ND AVEUNE UPGRADE  
TYPICAL INSULATED SECTION  
WITHOUT EDGE SUBDRAINS  
LAKE OTIS PARKWAY TO FLORINA STREET

Project:	18-06
Drawn By:	CRW
Scale:	NTS
Date:	FEB 2020
Figure:	8

# **Appendix A**

## **Borehole and Penetrometer Logs**

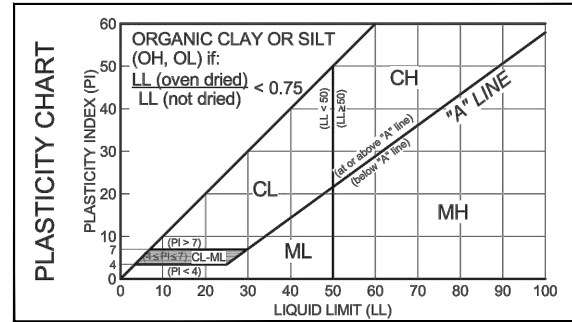
Included in this section:

- 1) Borehole Log Legend
- 2) Borehole Logs (BH-01 thru BH-24)
- 3) Drive Penetrometer Log



# UNIFIED SOIL CLASSIFICATION (ASTM D 2487)

GROUP SYMBOL	SOIL GROUP NAMES & LEGEND		
GW	WELL-GRADED GRAVEL		If soil contains $\geq 15\%$ sand, add "with sand"
GP	POORLY GRADED GRAVEL		
GM	SILTY GRAVEL		
GC	CLAYEY GRAVEL		
SW	WELL-GRADED SAND		If soil contains $\geq 15\%$ gravel, add "with gravel"
SP	POORLY GRADED SAND		
SM	SILTY SAND		
SC	CLAYEY SAND		
CL	LEAN CLAY		If soil contains coarse-grained soil from 15% to 29%, add "with sand" or "with gravel" for whichever type is prominent, or for $\geq 30\%$ , add "sandy" or "gravelly"
ML	SILT		
OL	ORGANIC CLAY OR SILT		
CH	FAT CLAY		
MH	ELASTIC SILT		
OH	ORGANIC CLAY OR SILT		
PT	PEAT		



## COMPONENT DEFINITIONS BY GRADATION

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 IN.
COBBLES	3 IN. TO 12 IN.
GRAVEL	3 IN. TO NO. 4 (4.76 mm)
COARSE GRAVEL	3 IN. TO 3/4 IN.
FINE GRAVEL	3/4 IN. TO NO. 4 (4.76 mm)
SAND	NO. 4 (4.76 mm) TO NO. 200 (0.074 mm)
COARSE SAND	NO. 4 (4.76 mm) TO NO. 10 (2.0 mm)
MEDIUM SAND	NO. 10 (2.0 mm) TO NO. 40 (0.42 mm)
FINE SAND	NO. 40 (0.42 mm) TO NO. 200 (0.074 mm)
SILT AND CLAY	SMALLER THAN NO. 200 (0.074 mm)
SILT	0.074 mm TO 0.005 mm
CLAY	LESS THAN 0.005 mm

Gravels or sands with 5% to 12% fines require dual symbols (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) and add "with clay" or "with silt" to group name. If fines classify as CL-ML for GM or SM, use dual symbol GC-GM or SC-SM.  
 Optional Abbreviations: Lower case "s" after USCS group symbol denotes either "sandy" or "with sand" and "g" denotes either "gravelly" or "with gravel."

## RELATIVE DENSITY / CONSISTENCY ESTIMATE USING STANDARD PENETRATION TEST (SPT) VALUES (FROM TERZAGHI & PECK 1996)

COHESIONLESS SOILS <sup>(a)</sup>		COHESIVE SOILS <sup>(b)</sup>	
RELATIVE DENSITY	N <sub>60</sub> (BLOWS/FOOT) <sup>(c)</sup>	CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TSF) <sup>(d)</sup>
VERY LOOSE	0 - 4	VERY SOFT	0 - 0.25
LOOSE	4 - 10	SOFT	0.25 - 0.50
MED DENSE	10 - 30	MEDIUM	0.50 - 1.0
DENSE	30 - 50	STIFF	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	2.0 - 4.0
		HARD	OVER 4.0

- (a) Soils consisting of gravel, sand and silt, either separately or in combination possessing no characteristics of plasticity, and exhibiting drained behavior.  
 (b) Soils possessing the characteristics of plasticity, and exhibiting undrained behavior.  
 (c) Refer to ASTM D 1586-99 for a definition of N.  
 (d) Undrained shear strength,  $s_u = 1/2$  unconfined compression strength,  $U_c$ . Note that Torvane measures  $s_u$  and Pocket Penetrometer measures  $U_c$ .

## SAMPLER ABBREVIATIONS

SS	SPT Sampler (2 in. OD, 140 lb hammer)	C	Core (Rock)
SSO	Oversize Spit Spoon (2.5 in. OD, 140 lb typ.)	TW	Thin Wall (Shelby Tube)
HD	Heavy Duty Split Spoon (3 in. OD, 300/340 lb typ.)	MS	Modified Shelby
BD	Bulk Drive (4 in. OD, 300/340 lb hammer typ.)	GP	Geoprobe
CA	Continuous Core (Soil in Hollow-Stem Auger)	AR	Air Rotary Cuttings
G	Grab Sample from surface / testpit	AG	Auger Cuttings

## LABORATORY TEST ABBREVIATIONS

Consol	Consolidation	PM	Modified Proctor	TXCD	Consolidated Drained Triaxial
Dd	Dry Density	PP	Pocket Penetrometer	TXCU	Consolidated Undrained Triaxial
MA	Sieve and Hydrometer Analysis	MC	Moisture Content	TXUU	Unconsolidated Undrained Triaxial
NP	Non-plastic	SA	Sieve Analysis	LL	Liquid Limit
OLI	Organic Loss	SpG	Specific Gravity	PL	Plastic Limit
P200	Percent Fines (Silt & Clay)	TS	Thaw Consolidation	VS	Vane Shear
PID	Photoionization Detector	TV	Torvane	$\Omega$	Soil Resistivity

## DESCRIPTIVE TERMINOLOGY FOR PERCENTAGES (ASTM D 2488)

DESCRIPTIVE TERMS	RANGE OF PROPORTION
TRACE	0 - 5%
FEW	5 - 10%
LITTLE	10 - 25%
SOME	30 - 45%
MOSTLY	50 - 100%

## CRITERIA FOR DESCRIBING MOISTURE CONDITION (ASTM D 2488)

DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL IS BELOW WATER TABLE



SOIL CLASSIFICATION / LEGEND

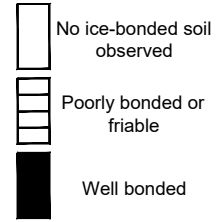
FIGURE A-1

FILE NAME: M:\Engineering References\Tech\_Geotechnical Reports\Geotech.dwg

## FROZEN SOIL CLASSIFICATION (ASTM D 4083)

1. DESCRIBE SOIL INDEPENDENT OF FROZEN STATE	CLASSIFY SOIL BY THE UNIFIED SOIL CLASSIFICATION SYSTEM			
2. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF FROZEN SOIL	MAJOR GROUP		SUBGROUP	
	DESCRIPTION	DESIGNATION	DESCRIPTION	DESIGNATION
	Segregated ice not visible by eye	N	Poorly bonded or friable	N <sub>f</sub>
			Well bonded	No excess ice
				Excess ice
	Segregated ice visible by eye (ice less than 25 mm thick)	V	Individual ice crystals or inclusions	V <sub>x</sub>
			Ice coatings on particles	V <sub>c</sub>
			Random or irregularly oriented ice formations	V <sub>r</sub>
			Stratified or distinctly oriented ice formations	V <sub>s</sub>
			Uniformly distributed ice	V <sub>u</sub>
3. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF SUBSTANTIAL ICE STRATA	Ice greater than 25 mm thick	ICE	Ice with soil inclusions	ICE+soil type
			Ice without soil inclusions	ICE

## ICE BONDING SYMBOLS



## DEFINITIONS

**Candled Ice** is ice which has rotted or otherwise formed into long columnar crystals, very loosely bonded together.

**Clear Ice** is transparent and contains only a moderate number of air bubbles.

**Cloudy Ice** is translucent, but essentially sound and non-pervious.

**Friable** denotes a condition in which material is easily broken up under light to moderate pressure.

**Granular Ice** is composed of coarse, more or less equidimensional, ice crystals weakly bonded together.

**Ice Coatings on particles** are discernible layers of ice found on or below the larger soil particles in a frozen soil mass. They are sometimes associated with hoarfrost crystals, which have grown into voids produced by the freezing action.

**Ice Crystal** is a very small individual ice particle visible in the face of a soil mass. Crystals may be present alone or in a combination with other ice formations.

## FROST DESIGN SOIL CLASSIFICATION<sup>(1)</sup>

FROST GROUP <sup>(2)</sup>	GENERAL SOIL TYPE	% FINER THAN 0.02 mm BY WEIGHT	TYPICAL USCS SOIL CLASS
NFS <sup>(3)</sup>	(a) Gravels Crushed stone Crushed rock	0 - 1.5	GW, GP
	(b) Sands	0 - 3	SW, SP
PFS <sup>(4)</sup> [MOA NFS] [MOA F2]	(a) Gravels Crushed stone Crushed rock	1.5 - 3	GW, GP
	(b) Sands	3 - 10	SW, SP
S1 [MOA F1]	Gravelly soils	3 - 6	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
S1 [MOA F2]	Sandy soils	3 - 6	SW, SP, SW-SM, SP-SM, SW-SC, SP-SC
F1 <sup>(5)</sup>	Gravelly soils	6 - 10	GM, GC, GM-GC, GW-GM, GP-GM, GW-GC, GP-GC
F2 <sup>(5)</sup>	(a) Gravelly soils	10 - 20	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
	(b) Sands	6 - 15	SM, SW-SM, SP-SM, SC, SW-SC, SP-SC, SM-SC
F3 <sup>(5)</sup>	(a) Gravelly soils	10 - 20	GM, GC, GM-GC
	(b) Sands, except very fine silty sands	6 - 15	SM, SC, SM-SC
	(c) Clays, PI>12	--	CL, CH
F4 <sup>(5)</sup>	(a) Silts	--	ML, MH, ML-CL
	(b) Very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI<12	--	CL, ML-CL
	(d) Varved clays or other fine-grained banded sediments	--	CL or CH layered with ML, MH, ML-CL, SM, SC, or SM-SC

**Ice Lenses** are lenticular ice formations in soil occurring essentially parallel to each other, generally normal to the direction of heat loss and commonly in repeated layers.

**Ice Segregation** is the growth of ice as distinct lenses, layers, veins and masses in soils, commonly but not always oriented normal to direction of heat loss.

**Massive Ice** is a large mass of ice, typically nearly pure and relatively homogeneous.

**Poorly-Bonded** signifies that the soil particles are weakly held together by the ice and that the frozen soil consequently has poor resistance to chipping or breaking.

**Porous Ice** contains numerous void, usually interconnected and usually resulting from melting at air bubbles or along crystal interfaces from presence of salt or other materials in the water, or from the freezing of saturated snow. Though porous, the mass retains its structural unity.

**Thaw-Stable** frozen soils do not, on thawing, show loss of strength below normal, long-time thawed values nor produce detrimental settlement.

**Thaw-Unstable** frozen soils show on thawing, significant loss of strength below normal, long-time thawed values and/or significant settlement, as a direct result of the melting of the excess ice in the soil.

**Well-Bonded** signifies that the soil particles are strongly held together by the ice and that the frozen soil possesses relatively high resistance to chipping or breaking.

- (1) From the U.S. Army Corps of Engineers (USACE), EM 1110-3-138, "Pavement Criteria for Seasonal Frost Conditions", April 1984  
 (2) USACE frost groups directly correspond to frost groups in Municipality of Anchorage (MOA) Design Criteria Manual (DCM).  
 (3) Non-frost susceptible  
 (4) Possibly frost susceptible, requires lab test for void ratio to determine frost design classification.  
 (5) Consistent with MOA Definition.



## FROZEN SOIL CLASSIFICATION / LEGEND

FIGURE A-2



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/3/19

COMPLETED 5/3/19

GROUND ELEVATION 137.918 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.00 ft / Elev 132.92 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 5.70 ft / Elev 132.22 ft

CRW LOG - CRW\_DATA\TEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 6%		AC	0.2	ASPHALT CONCRETE, (AC) black	PID = 0.4	
						SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL]		
							2.5			
	HD 2	50	9-8-6-10 (14)	MC = 6%		SP- SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) gray, moist	PID = 0.7	Piezometer
5							5.0			
	HD 3A	100		MC = 43%		SP	5.7	POORLY GRADED SAND WITH GRAVEL, (SP) gray, wet	PID = 0	
	HD 3B	75	0-3-3-1 (6)	PP = 2.5 tsf MC = 51% PP		ML		SILT, (ML) brown, wet	PID = 0	1-in. sch. 40. PVC
							7.5			
	HD 4	83	4-6-10-8 (16)	MC = 17%		SP		POORLY GRADED SAND WITH GRAVEL, (SP) gray, wet	PID = 0	
10							10.0			
	HD 5	83	4-10-11-15 (21)	MC = 12%		SP		POORLY GRADED SAND, (SP) gray, wet	PID = 0	
										1-in. sch. 40. PVC slotted
15							15.0			
	HD 6A	67	11-13-20 (33)	MC = 16% Fines = 23% P200		SM	16.0	SILTY SAND, (SM) 23% fines, gray, wet	PID = 1.3	
	HD 6B	100		MC = 12%		SM	16.5	SILTY SAND, (SM) gray, wet	PID = 0.3	





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PAGE 1 OF 1

CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/3/19

COMPLETED 5/3/19

GROUND ELEVATION 138.277 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.30 ft / Elev 132.98 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 5.40 ft / Elev 132.88 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 5% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 138.1	PID = 0.4	
						SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 39% gravel, 49% sand, 12% fines, brown, moist, [FILL], Frost Class: MOA F2 135.8		
	HD 2	75	10-6-5-4 (11)	MC = 3%		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist	PID = 0.6	← Piezometer
5								5.0 SANDY SILT, (ML) gray, wet 133.3	PID = 0.6	
	HD 3	67	6-3-3-4 (6)	MC = 16%		ML				← 1-in. sch. 40. PVC
								7.5 POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) gray, wet 130.8	PID = 0.2	
	HD 4	83	2-2-2-4 (4)	MC = 13%		SP-SM				
10								10.0 SILTY SAND, (SM) brown, wet 128.3	PID = 0.3	
	HD 5	100	2-11-16 (27)	MC = 18%		SM				← 1-in. sch. 40. PVC slotted
								15.0 SILTY SAND, (SM) 5% gravel, 82% sand, 13% fines, brown, wet 123.3	PID = 0.2	
15								16.5 121.8		
	HD 6	100	12-15-24 (39)	MC = 16% Fines = 13% SA		SM				



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/3/19

COMPLETED 5/3/19

GROUND ELEVATION 141.274 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 10.00 ft / Elev 131.27 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 6.10 ft / Elev 135.17 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 6%		AC		0.2 ASPHALT CONCRETE, (AC) black	141.1	PID = 1.5
						SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL]		
							2.5		138.8	
	HD 2	89	24-9-10 (19)	MC = 3%		SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist		PID = 0.6
5							5.0		136.3	
	HD 3	67	9-4-3 (7)	MC = 5%		SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist		PID = 1.4
							7.5		133.8	
	HD 4	33	8-6-8 (14)	MC = 4%		SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist		PID = 0.8
10							10.0		131.3	
	HD 5	33	5-4-5 (9)	MC = 12%		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, wet		PID = 0.6
							15.0		126.3	
15										
	HD 6	33	12-13-15 (28)	MC = 10%		GW- GM		WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) gray, wet		PID = 0
							16.5		124.8	

Piezometer

1-in. sch. 40.  
PVC

1-in. sch. 40.  
PVC slotted



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/3/19

COMPLETED 5/3/19

GROUND ELEVATION 146.024 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 138.52 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 10.70 ft / Elev 135.32 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 10%		AC		0.2 ASPHALT CONCRETE, (AC) black 145.9	PID = 0	
						SP-SM		2.5 POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) brown, moist, [FILL] 143.5		
	HD 2A	100		MC = 39%		ML		3.3 SILT, (ML) brown light, moist 142.8	PID = 0	
	HD 2B	60	4-4-3-2 (7)	MC = 17%		ML		SILT WITH GRAVEL, (ML) brown dark, moist		
5								5.0 SILTY SAND, (SM) 26% fines, brown, moist 141.0	PID = 0.1	
	HD 3	75	1-1-6-9 (7)	MC = 17% Fines = 26% P200		SM				
								7.5 ▽ POORLY GRADED SAND WITH SILT, (SP-SM) 7% gravel, 86% sand, 7% fines, brown, wet 138.5	PID = 2.2	
	HD 4	75	12-19-14-29 (33)	MC = 8% SA		SP-SM				
10								10.0 POORLY GRADED SAND WITH GRAVEL, (SP) brown, wet 136.0	PID = 0	
	HD 5	75	15-15-17-21 (32)	MC = 12%		SP				
								15.0 POORLY GRADED SAND WITH GRAVEL, (SP) gray, wet 131.0	PID = 0	
15								16.5 129.5		
	HD 6	100	11-15-21 (36)	MC = 14%		SP				

Piezometer

1-in. sch. 40. PVC

1-in. sch. 40. PVC slotted



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PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 152.314 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING --- Not observed

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▼ AFTER DRILLING 14.80 ft / Elev 137.51 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 6% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 152.2	PID = 0.2	
						SM		SILTY SAND WITH GRAVEL, (SM) 21% gravel, 50% sand, 29% fines, brown, moist, [FILL], Frost Class: MOA F3 149.8		
	HD 2	33	2-1-1-2 (2)	MC = 5%		GP		2.5 POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist 149.8	PID = 0.1	← Piezometer
5										
	HD 3	33	1-1-1-2 (2)	MC = 6% SA		SM		5.0 SILTY SAND WITH GRAVEL, (SM) 26% gravel, 50% sand, 24% fines, brown, moist 147.3	PID = 1.8	← 1-in. sch. 40. PVC
	HD 4	50	1-5-8-9 (13)	MC = 5% AL		ML		7.5 GRAVELLY SILT, (ML) brown, moist, non plastic 144.8	PID = 0.9	
10										
	HD 5	75	10-13-14- 14 (27)	MC = 2% Fines = 14% P200		GM		10.0 SILTY GRAVEL, (GM) 14% fines, gray, moist 142.3	PID = 0.6	← 1-in. sch. 40. PVC slotted
15										
	HD 6	75	27-31-21- 23 (52)	MC = 7%		GP- GM		15.0 ▼ POORLY GRADED GRAVEL WITH SILT, (GP-GM) gray, moist 137.3	PID = 0	
								17.0 135.3		



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PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 152.621 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING --- Not observed








LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING --- Not encountered

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 3%		AC		0.2 ASPHALT CONCRETE, (AC) black 152.5	PID = 0.5	
						SP		POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL]		
								2.5 150.1		
	HD 2	75	32-13-12-11 (25)	MC = 4% Fines = 8% SA		GP- GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 53% gravel, 39% sand, 8% fines, brown, moist	PID = 1.3	Piezometer
5								5.0 147.6		
	HD 3	75	6-8-9-8 (17)	MC = 2%		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist	PID = 2.7	
								7.5 145.1		1-in. sch. 40. PVC
	HD 4	75	9-12-13-14 (25)	MC = 3%		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist	PID = 0.7	
10								10.0 142.6		
	HD 5	75	11-13-11-10 (24)	MC = 6%		GP		POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist	PID = 1.6	
								15.0 137.6		1-in. sch. 40. PVC slotted
15								16.5 136.1		
	HD 6	100	45-41-26 (67)	MC = 6% Fines = 12% P200		GM		SILTY GRAVEL, (GM) 12% fines, brown, moist	PID = 1.3	



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 151.82 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.00 ft / Elev 146.82 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 8.70 ft / Elev 143.12 ft

CRW LOG - CRW\_DATA\TEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 2% MA		AC	0.2	ASPHALT CONCRETE, (AC) black	PID = 0	
						GW		WELL GRADED GRAVEL WITH SAND, (GW) 73% gravel, 23% sand, 4% fines, brown, moist, [FILL], Frost Class: MOA NFS		
	HD 2	67	6-5-4-5 (9)	MC = 3% Fines = 4%		GW	2.5	WELL GRADED GRAVEL WITH SAND, (GW) brown, moist, [FILL]	PID = 0.4	← Piezometer
5							5.0	▽ WELL GRADED SAND WITH GRAVEL, (SW) brown, wet	PID = 0	
	HD 3	67	4-2-4-2 (6)	MC = 5%		SW				← 1-in. sch. 40. PVC
	HD 4	94	2-2-2 (4)	MC = 4%		SW	7.5	WELL GRADED SAND WITH GRAVEL, (SW) brown, wet	PID = 0.2	
10							10.0	▽		
	HD 5A	100	3-14-23 (37)	MC = 10%		SW	10.0	WELL GRADED SAND WITH GRAVEL, (SW) brown, wet	PID = 0	
	HD 5B	44		PP = 4.5 tsf MC = 9% PP			10.5	SILT, (ML) gray, wet	PID = 0	← 1-in. sch. 40. PVC slotted
						ML				
15							15.0	SILT, (ML) gray, wet, non plastic	PID = 0	
	HD 6	100	18-22-20 (42)	MC = 9% AL		ML	16.5			



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 152.785 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING --- Not Observed








LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 8%		AC		0.2 ASPHALT CONCRETE, (AC) black 152.6 POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL]	PID = 4.1
						SP			
	HD 2A	100	10-11-16-17 (27)	MC = 2%		SP		2.5 POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL] 150.3 3.2 POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist, [FILL] 149.6	PID = 0.7
	HD 2B	50		MC = 12% AL		GM		SILTY GRAVEL, (GM) brown, moist, non plastic	PID = 5.4
5									
	HD 3	75	18-17-18-24 (35)	MC = 4%		SP		5.0 POORLY GRADED SAND WITH GRAVEL, (SP) brown, moist 147.8	PID = 20.4
	HD 4	50	38-24-25-22 (49)	MC = 8%		SP		7.5 POORLY GRADED SAND WITH GRAVEL, (SP) brown, wet 145.3	PID = 3.1
10									
	HD 5	75	14-17-15-15 (32)	MC = 8% Fines = 8% P200		GW-GM		10.0 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 8% fines, brown, wet 142.8	PID = 0.7
15									
	HD 6	100	12-20-20 (40)	MC = 8% Fines = 18% SA		SM		15.0 SILTY SAND WITH GRAVEL, (SM) 34% gravel, 48% sand, 18% fines, brown, wet 137.8 16.5 136.3	PID = 0.6



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 152.834 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.00 ft / Elev 145.83 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 6.50 ft / Elev 146.33 ft

CRW LOG - CRW\_DATATEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	150		MC = 4% Fines = 7% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 152.7	PID = 2.2	
						GP-GM		2.5 POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 53% gravel, 40% sand, 7% fines, brown, moist, [FILL], Frost Class: MOA F1 150.3		
	HD 2	67	24-20-19- 22 (39)	MC = 3% Fines = 5% P200		GP		5.0 POORLY GRADED GRAVEL WITH SAND, (GP) 5% fines, brown, moist 147.8	PID = 5.4	← Piezometer
5										
	HD 3	75	28-13-8-14 (21)	MC = 5%		GP		7.5 POORLY GRADED GRAVEL WITH SAND, (GP) brown, moist 145.3	PID = 3.2	← 1-in. sch. 40. PVC
	HD 4	75	7-9-9-12 (18)	MC = 13% Fines = 6% SA		GW-GM		10.0 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 52% gravel, 42% sand, 6% fines, brown, wet 142.8	PID = 0.6	
10										
	HD 5	100	11-11-13 (24)	MC = 8%		GW		15.0 WELL GRADED GRAVEL WITH SAND, (GW) brown, wet 137.8	PID = 3.2	← 1-in. sch. 40. PVC slotted
15										
	HD 6	67	38-23-31 (54)	MC = 12%		GW		16.5 WELL GRADED GRAVEL WITH SAND, (GW) brown, wet 136.3	PID = 1.6	





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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/4/19

COMPLETED 5/4/19

GROUND ELEVATION 152.581 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 6.00 ft / Elev 146.58 ft

LOGGED BY MCH

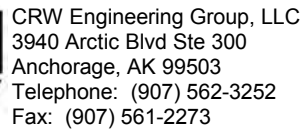
CHECKED BY SMH

AT END OF DRILLING ---

NOTES No asphalt or organic mat.

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 4%		SP- SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) brown, moist, [FILL]	PID = 1
	HD 2	33	7-2-2-2 (4)	MC = 5% SA		GW		2.5 --- 150.1 WELL GRADED GRAVEL WITH SAND, (GW) 53% gravel, 44% sand, 3% fines, brown, moist, [FILL]	PID = 0.7
5									
	HD 3	29	1-1-2-1 (3)	MC = 6%		GW		5.0 --- 147.6 WELL GRADED GRAVEL, (GW) gray, moist ▽	PID = 1.8
	HD 4	29	1-4-3-3 (7)	MC = 11%		SP		7.5 --- 145.1 POORLY GRADED SAND WITH GRAVEL, (SP) brown, wet	PID = 2.3
10									
	HD 5	46	4-4-5-5 (9)	MC = 12%		GW		10.0 --- 142.6 WELL GRADED GRAVEL WITH SAND, (GW) brown, moist	PID = 0.6
15									
	HD 6	46	29-20-25- 24 (45)	MC = 8% Fines = 7% P200		GW- GM		15.0 --- 137.6 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 7% fines, gray, moist	PID = 1.3
								17.0 --- 135.6	



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**▽ AFTER DRILLING** 8.20 ft / Elev 146.39 ft

CRW LOG - CRW DATATEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/6/19

COMPLETED 5/6/19

GROUND ELEVATION 155.415 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 147.92 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 7% Fines = 11% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 155.3 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 50% gravel, 39% sand, 11% fines, brown, moist, [FILL], Frost Class: MOA F2	PID = 1.2
	HD 2	67	13-8-7-5 (15)	MC = 6%		GW		2.5 WELL GRADED GRAVEL WITH SAND, (GW) brown, moist, [FILL] 152.9	PID = 3.4
5	HD 3	75	13-9-8-10 (17)	MC = 4%		GW		5.0 WELL GRADED GRAVEL WITH SAND, (GW) brown, moist, [FILL] 150.4	PID = 3.1
	HD 4	75	13-12-14- 17 (26)	MC = 8%		GW		7.5 ▽ WELL GRADED GRAVEL WITH SAND, (GW) brown, wet, [FILL] 147.9	PID = 2.6
10	HD 5	75	7-7-6-11 (13)	MC = 10%		GW-GM		10.0 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) brown, wet 145.4	PID = 0.3
15	HD 6	100	9-23-24 (47)	MC = 8% Fines = 48% P200		GM		15.0 SILTY GRAVEL, (GM) 48% fines, brown, wet 140.4	PID = 0.4
								16.5 138.9	



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/6/19

COMPLETED 5/6/19

GROUND ELEVATION 156.163 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 148.66 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 8.20 ft / Elev 147.96 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 5%		AC		0.2 ASPHALT CONCRETE, (AC) black	PID = 1	
						SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL, (SW-SM) brown, moist, [FILL]		
								156.0		
								2.5		
	HD 2	67	17-15-20- 23 (35)	MC = 5%		SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL, (SW-SM) brown, moist	PID = 0.5	← Piezometer
								153.7		
5								5.0		
	HD 3	75	46-17-15- 13 (32)	MC = 5% Fines = 7% SA		SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL, (SW-SM) 40% gravel, 53% sand, 7% fines, brown, moist	PID = 0.8	← 1-in. sch. 40. PVC
								151.2		
								7.5		
	HD 4	75	11-11-13- 13 (24)	MC = 10%		GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, wet	PID = 1.4	
								148.7		
10								10.0		
	HD 5	83	16-5-6-5 (11)	PP = 4.5 tsf MC = 10% LL = 17 PL = 15 AL, PP		ML		SILT WITH GRAVEL, (ML) gray, wet	PID = 0.3	← 1-in. sch. 40. PVC slotted
								146.2		
								15.0		
	HD 6	67	11-11-30 (41)	PP = 4.5 tsf MC = 12% PP		ML		SILT WITH GRAVEL, (ML) gray, wet	PID = 1	
								141.2		
15								16.5		
								139.7		



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/6/19

COMPLETED 5/6/19

GROUND ELEVATION 155.708 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 148.21 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 4% Fines = 7% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 155.5 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 62% gravel, 31% sand, 7% fines, brown, moist, [FILL], Frost Class: MOA F1	PID = 12.9
						GW- GM			
	HD 2	67	8-12-9-11 (21)	MC = 3%		GW- GM		2.5 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) brown, moist, [FILL] 153.2	PID = 0.1
5									
	HD 3	75	15-13-19- 21 (32)	MC = 3%		GW- GM		5.0 WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) brown, moist to wet, [FILL] 150.7	PID = 0.3
	HD 4	75	32-9-10-9 (19)	MC = 11% Fines = 4% SA		GW		7.5 WELL GRADED GRAVEL WITH SAND, (GW) 71% gravel, 25% sand, 4% fines, brown, wet, [FILL] 148.2	PID = 0
10									
	HD 5	75	3-5-8-5 (13)	MC = 12%		GW- GM		10.0 WELL GRADED GRAVEL WITH SILT, (GW-GM) brown, wet 145.7	PID = 0.1
15									
	HD 6	100	13-10-14 (24)	MC = 10% Fines = 51% P200		ML		15.0 SILT WITH GRAVEL, (ML) 51% fines, gray, wet, non plastic 140.7	PID = 0.1
								16.5 139.2	



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**▽ AFTER DRILLING** 6.10 ft / Elev 148.06 ft

CRW LOG - CRW DATATEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ



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PAGE 1 OF 1

CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/6/19

COMPLETED 5/6/19

GROUND ELEVATION 154.063 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.00 ft / Elev 149.06 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 19% Fines = 39% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 153.9 SILTY SAND WITH GRAVEL, (SM) 24% gravel, 37% sand, 39% fines, brown, moist, [FILL], Frost Class: MOA F4	PID = 0.1
						SM			
	HD 2	67	3-5-9-14 (14)	MC = 16% Fines = 48% P200		GM		2.5 SILTY GRAVEL, (GM) 48% fines, gray, moist 151.6	PID = 0
5									
	HD 3	100	8-15-12 (27)	MC = 16% Fines = 2% AL		GM		5.0 ▽ SILTY GRAVEL, (GM) gray, wet, non plastic 149.1	PID = 0.5
	HD 4	75	6-9-8-9 (17)	MC = 5% P200		GW		7.5 WELL GRADED GRAVEL, (GW) 2% fines, brown, wet 146.6	PID = 0.6
10									
	HD 5	75	10-9-10-8 (19)	MC = 10%		GW-GM		10.0 WELL GRADED GRAVEL WITH SILT, (GW-GM) gray, wet 144.1	PID = 0.1
15									
	HD 6	100	36-18-22 (40)	MC = 11%		ML		15.0 SILT WITH GRAVEL, (ML) gray, wet 139.1	PID = 0.6
								16.5 137.6	



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**PROJECT NAME** 42nd Avenue Upgrade

**PROJECT LOCATION** Anchorage, AK

**GROUND ELEVATION** 153.752 ft

**GROUND WATER LEVELS:**

▽ **AT TIME OF DRILLING** 5.00 ft / Elev 148.75 ft

AT END OF DRILLING ---

**▽ AFTER DRILLING** 5.60 ft / Elev 148.15 ft

CRW LOG - CRW DATATEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ





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PAGE 1 OF 1

CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/6/19

COMPLETED 5/6/19

GROUND ELEVATION 154.953 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.00 ft / Elev 149.95 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 5% Fines = 15% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 154.8 SILTY GRAVEL WITH SAND, (GM) 50% gravel, 35% sand, 15% fines, brown, moist, [FILL], Frost Class: MOA F1	PID = 2.6
						GM		2.5 152.5	
	HD 2	67	11-9-7-10 (16)	MC = 4%		GM		SILTY GRAVEL WITH SAND, (GM) brown, moist	PID = 3.2
5								5.0 ▽ 150.0	
	HD 3	75	8-15-16-14 (31)	MC = 5%		GM		SILTY GRAVEL WITH SAND, (GM) brown, wet	PID = 4.5
								7.5 147.5	
	HD 4	58	29-17-10-7 (27)	MC = 11%		GM		SILTY GRAVEL WITH SAND, (GM) gray, wet	PID = 1
10								10.0 145.0	
	HD 5	75	8-5-5-6 (10)	MC = 15% SA		GW-GM		WELL GRADED GRAVEL WITH SILT AND SAND, (GW-GM) 49% gravel, 45% sand, 6% fines, brown, wet	PID = 0.3
								15.0 140.0	
15								15.0 140.0	
	HD 6	100	25-28-34 (62)	MC = 10% AL		ML		GRAVELLY SILT, (ML) gray, wet, non plastic	PID = 0
								16.5 138.5	



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/7/19

COMPLETED 5/7/19

GROUND ELEVATION 155.323 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 147.82 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▽ AFTER DRILLING 6.40 ft / Elev 148.92 ft

CRW LOG - CRW\_DATA\TEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 3%		AC		0.2 ASPHALT CONCRETE, (AC) black 155.2	PID = 0.5	
						GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, moist, [FILL]		
								2.5 152.8	PID = 1.1	
	HD 2	50	35-16-24-29 (40)	MC = 4%		GW		WELL GRADED GRAVEL, (GW) brown, moist, [FILL]		Piezometer
5								5.0 150.3	PID = 0.6	
	HD 3	67	10-19-50 (69)	MC = 4%		SW-SM		WELL GRADED SAND WITH SILT AND GRAVEL, (SW-SM) gray, moist		1-in. sch. 40. PVC
								7.5 147.8	PID = 0.8	
	HD 4A	75	18-15-18-14 (33)	MC = 12%		GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, moist		
	HD 4B	75		MC = 6% Fines = 21% P200		GM		SILTY GRAVEL, (GM) 21% fines, gray, wet	PID = 1	
10								10.0 145.3	PID = 1	
	HD 5	75	10-10-9-9 (19)	MC = 12%		GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, wet		1-in. sch. 40. PVC slotted
								15.0 140.3	PID = 0.2	
15	HD 6	100	41-15-15 (30)	MC = 8% AL		ML		SILT WITH GRAVEL, (ML) gray, wet, non plastic		
								16.5 138.8		



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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/7/19

COMPLETED 5/7/19

GROUND ELEVATION 156.081 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 7.50 ft / Elev 148.58 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 4% Fines = 9% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 155.9 POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 45% gravel, 54% sand, 9% fines, brown, moist, [FILL], Frost Class: MOA F1	PID = 0.1
						SP- SM			
	HD 2	17	4-6-9-9 (15)	MC = 5%		GW		2.5 WELL GRADED GRAVEL WITH SAND, (GW) brown, moist 153.6	PID = 0.7
5									
	HD 3	50		MC = 6%		GW		5.0 WELL GRADED GRAVEL WITH SAND, (GW) brown, wet 151.1 Blowcounts not recorded	PID = 0.2
	HD 4	75	5-3-6-7 (9)	MC = 11% Fines = 3% SA		GW		7.5 ▽ WELL GRADED GRAVEL WITH SAND, (GW) 65% gravel, 32% sand, 3% fines, brown, wet 148.6	PID = 1.1
10									
	HD 5	75	20-15-19- 15 (34)	MC = 9%		GW		10.0 WELL GRADED GRAVEL WITH SAND, (GW) gray, wet 146.1	PID = 0
15									
	HD 6	100	13-20-28 (48)	PP = 4.5 tsf MC = 10% PP		ML		15.0 SANDY SILT WITH GRAVEL, (ML) gray, wet 141.1	PID = 0.2
								16.5 139.6	



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# BOREHOLE BH-21

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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/7/19

COMPLETED 5/7/19

GROUND ELEVATION 156.67 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING --- Not Observed

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

▼ AFTER DRILLING 6.20 ft / Elev 150.47 ft

CRW LOG - CRW\_DATA\TEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 8%		AC		0.2 ASPHALT CONCRETE, (AC) black 156.5	PID = 0	
						SW		WELL GRADED SAND WITH GRAVEL, (SW) brown, moist, [FILL]		
								2.5 154.2		
	HD 2	50	9-4-6-4 (10)	MC = 7%		SW		WELL GRADED SAND WITH GRAVEL, (SW) brown, moist, [FILL]	PID = 0.7	← Piezometer
5								5.0 151.7		
	HD 3	75	5-8-9-3 (17)	MC = 12%		GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, wet	PID = 0	← 1-in. sch. 40. PVC
								7.5 149.2		
	HD 4	75	6-10-11-8 (21)	MC = 10%		GW		WELL GRADED GRAVEL WITH SAND, (GW) brown, wet	PID = 0	
10								10.0 146.7		
	HD 5	75	17-11-11-4 (22)	MC = 9%		GW		WELL GRADED GRAVEL WITH SAND, (GW) gray, wet	PID = 0	← 1-in. sch. 40. PVC slotted
								15.0 141.7		
15								15.0 141.7		
	HD 6	75	3-4-34-29 (38)	MC = 12% Fines = 15% P200		SM		SILTY SAND, (SM) 15% fines, gray, wet	PID = 0.2	
								17.0 139.7		



CRW Engineering Group, LLC  
3940 Arctic Blvd Ste 300  
Anchorage, AK 99503  
Telephone: (907) 562-3252  
Fax: (907) 561-2273

# BOREHOLE BH-22

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CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/7/19

COMPLETED 5/7/19

GROUND ELEVATION 157.709 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

AT TIME OF DRILLING --- Not Observed

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 3% Fines = 10% MA		AC		0.2 ASPHALT CONCRETE, (AC) black 157.5 POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 45% gravel, 45% sand, 10% fines, brown, moist, [FILL], Frost Class: MOA F2	PID = 0.3
						SP- SM		2.5 155.2	
	HD 2	50	47-14-12- 15 (26)	MC = 4%		SM		SILTY SAND WITH GRAVEL, (SM) gray, moist	PID = 1.1
5									
	HD 3	75	15-13-13- 11 (26)	MC = 6% Fines = 5% SA		GP		5.0 POORLY GRADED GRAVEL WITH SAND, (GP) 55% 152.7 gravel, 40% sand, 5% fines, gray, wet	PID = 0.3
	HD 4	50	11-15-23- 19 (38)	MC = 14%		GP		7.5 POORLY GRADED GRAVEL WITH SAND, (GP) gray, 150.2 wet	PID = 0.1
10									
	HD 5	75	15-13-13- 14 (26)	MC = 11%		GP- GM		10.0 POORLY GRADED GRAVEL WITH SILT AND SAND, 147.7 (GP-GM) gray, wet	PID = 0.1
15									
	HD 6	100	46-14-21 (35)	MC = 11%		ML		15.0 SANDY SILT WITH GRAVEL, (ML) gray, wet 142.7	PID = 0
								16.5 141.2	



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# BOREHOLE BH-23

PAGE 1 OF 1

CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DATE STARTED 5/7/19

COMPLETED 5/7/19

GROUND ELEVATION 157.488 ft

DRILLING CONTRACTOR Discovery Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Hollow-Stem Auger

▽ AT TIME OF DRILLING 5.00 ft / Elev 152.49 ft

LOGGED BY DMB

CHECKED BY SMH

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data
0									
	G 1	100		MC = 27% Fines = 20% SA		AC		0.2 ASPHALT CONCRETE, (AC) black 157.3 SILTY SAND WITH GRAVEL, (SM) 35% gravel, 45% sand, 20% fines, brown, moist, [FILL]	PID = 0
						SM			
	HD 2	50	6-7-9-8 (16)	MC = 8% Fines = 14% P200		SM		2.5 SILTY SAND WITH GRAVEL, (SM) 14% fines, gray, moist, [FILL] 155.0	PID = 0
5									
	HD 3	75	5-9-8-11 (17)	MC = 9% Fines = 32% P200		SM		5.0 ▽ SILTY SAND WITH GRAVEL, (SM) 32% fines, gray, moist, [FILL] 152.5	PID = 0
	HD 4	75	7-9-12-15 (21)	MC = 19%		SP		7.5 POORLY GRADED SAND WITH GRAVEL, (SP) gray, moist 150.0	PID = 0.2
10									
	HD 5	75	10-14-14- 14 (28)	MC = 12%		GM		10.0 SILTY GRAVEL WITH SAND, (GM) gray, wet 147.5	PID = 0
15									
	HD 6	100	21-22-16 (38)	MC = 10%		GW		15.0 WELL GRADED GRAVEL, (GW) gray, wet 142.5	PID = 0
								16.5 141.0	



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# BOREHOLE BH-24

PAGE 1 OF 2

**CLIENT** Municipality of Anchorage

**PROJECT NAME** 42nd Avenue Upgrade

**PROJECT NUMBER** MOA PM&E Project No. 18-06

**PROJECT LOCATION** Anchorage, AK

**DATE STARTED** 5/7/19 **COMPLETED** 5/7/19

**GROUND ELEVATION** 167.784 ft

**DRILLING CONTRACTOR** Discovery Drilling, Inc.

**GROUND WATER LEVELS:**

**DRILLING METHOD** Hollow-Stem Auger

▽ **AT TIME OF DRILLING** 15.00 ft / Elev 152.78 ft

**LOGGED BY** DMB **CHECKED BY** SMH

**AT END OF DRILLING** ---

**NOTES**

▽ **AFTER DRILLING** 29.30 ft / Elev 138.48 ft

CRW LOG - CRW\_DATA\TEMPLATE.GDT - 1/22/20 07:25 - 10142.00 42ND AVE.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
0										
	G 1	100		MC = 11% OLI		GC		CLAYEY GRAVEL, (GC) gray, moist, low plasticity, 0.3% organics, 97.7% ash	PID = 0	
						GC				
	HD 2	67	0-0-1-2 (1)	MC = 15%		GC		CLAYEY GRAVEL, (GC) brown, moist	PID = 2.8	
5										
	HD 3	50	2-3-6-6 (9)	MC = 12%		GC		CLAYEY GRAVEL, (GC) brown, moist	PID = 0.7	
	HD 4	75	4-4-3-4 (7)	PP = 4.5 tsf MC = 15% PP		ML		SILT WITH GRAVEL, (ML) gray, moist	PID = 0.4	
10										
	HD 5	75	3-3-3-4 (6)	MC = 13%		ML		SILT WITH GRAVEL, (ML) gray, moist	PID = 0	
15										
	HD 6	75	3-4-2-4 (6)	MC = 20% Fines = 71% P200		ML		SILT WITH SAND, (ML) 71% fines, gray, wet	PID = 0	
20										

← Piezometer

(Continued Next Page)



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# BOREHOLE BH-24

PAGE 2 OF 2

CLIENT Municipality of Anchorage

PROJECT NAME 42nd Avenue Upgrade

PROJECT NUMBER MOA PM&E Project No. 18-06

PROJECT LOCATION Anchorage, AK

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	ICE BOND	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Environmental Data	WELL DIAGRAM
20										
	HD 7	83	2-4-3-4 (7)	MC = 18%				GRAVELLY SILT WITH SAND, (ML) gray, wet	PID = 0	
					ML					
25										
	HD 8	75	8-14-15-17 (29)	MC = 7%				GRAVELLY SILT WITH SAND, (ML) gray, wet	PID = 0.7	
					ML					
30										
	HD 9	75	15-14-19- 27 (33)	MC = 10%				GRAVELLY SILT WITH SAND, (ML) gray, wet	PID = 2.7	
					ML					
35										
	HD 10	100	8-38-50 (88)	MC = 8%				SILTY SAND WITH GRAVEL, (SM) gray, wet	PID = 4	
					SM					
40										
	HD 11	83	19-52	MC = 6% Fines = 29% SA				SILTY SAND WITH GRAVEL, (SM) 32% gravel, 39% sand, 29% fines, gray, wet	PID = 0.6	
					SM					

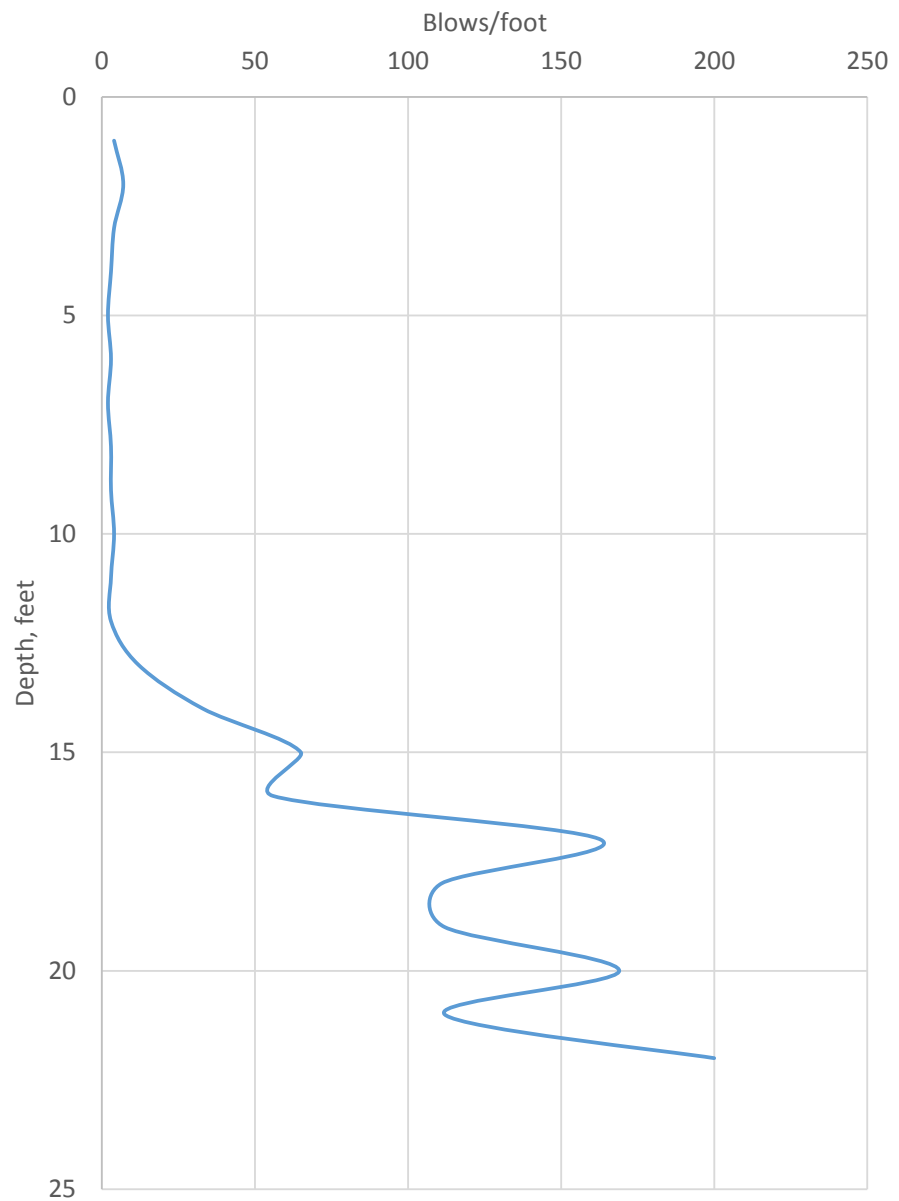
1-in. sch. 40.  
PVC

1-in. sch. 40.  
PVC slotted



**42nd Ave Upgrade Drive Penetrometer, P-01**

Depth, feet	Blows/foot
1	4
2	7
3	4
4	3
5	2
6	3
7	2
8	3
9	3
10	4
11	3
12	3
13	12
14	33
15	65
16	56
17	163
18	111
19	112
20	169
21	112
22	200



# **Appendix B**

## **Laboratory Results**

Included in this section:

- 1) Laboratory Results from Alaska Testlab



# Testing Report Summary

Date Sample Recv'd 5/28/2019

Client CRW Engineering  
 Project 42nd Ave Upgrade  
 Location BH-01 to BH-24

W.O. # 517  
 Lab # 470

All results will be posted to the website for your access and convenience. Samples will be kept for 30 days before being disposed. Please contact us if you would like the remaining material returned.

## Test Performed

### Moisture Content, ASTM D2216

Sample ID	Results (%)	Sample ID	Results (%)
BH-01 Sample 1	6	BH-13 Sample 1	5
BH-01 Sample 2	6	BH-13 Sample 2	5
BH-01 Sample 3	43	BH-13 Sample 3	5
BH-01 Sample 3B	51	BH-13 Sample 4	10
BH-01 Sample 4	17	BH-13 Sample 5	10
BH-01 Sample 5	12	BH-13 Sample 6	12
BH-01 Sample 6	16	BH-14 Sample 1	4
BH-01 Sample 6A	12	BH-14 Sample 2	3
BH-02 Sample 1	5	BH-14 Sample 3	3
BH-02 Sample 2	3	BH-14 Sample 4	11
BH-02 Sample 3	16	BH-14 Sample 5	12
BH-02 Sample 4	13	BH-14 Sample 6	10
BH-02 Sample 5	18	BH-15 Sample 1	2
BH-02 Sample 6	16	BH-15 Sample 2	4
BH-03 Sample 1	6	BH-15 Sample 3	8
BH-03 Sample 2	3	BH-15 Sample 4	11
BH-03 Sample 3	5	BH-15 Sample 5	18
BH-03 Sample 4	4	BH-15 Sample 6	14
BH-03 Sample 5	12	BH-15 Sample 6A	10
BH-03 Sample 6	10	BH-16 Sample 1	19
BH-04 Sample 1	10	BH-16 Sample 2	16
BH-04 Sample 2A	39	BH-16 Sample 3	16
BH-04 Sample 2B	17	BH-16 Sample 4	5
BH-04 Sample 3	17	BH-16 Sample 5	10
BH-04 Sample 4	8	BH-16 Sample 6	11
BH-04 Sample 5	12	BH-17 Sample 1	13
BH-04 Sample 6	14	BH-17 Sample 2A	5
BH-05 Sample 1	6	BH-17 Sample 2B	8
BH-05 Sample 2	5	BH-17 Sample 3	15
BH-05 Sample 3	6	BH-17 Sample 4A	10
BH-05 Sample 4	5	BH-17 Sample 4B	9
BH-05 Sample 5	2	BH-17 Sample 5	7
BH-05 Sample 6	7	BH-17 Sample 6	18
BH-06 Sample 1	3	BH-18 Sample 1	5
BH-06 Sample 2	4	BH-18 Sample 2	4
BH-06 Sample 3	2	BH-18 Sample 3	5
BH-06 Sample 4	3	BH-18 Sample 4	11
BH-06 Sample 5	6	BH-18 Sample 5	15
BH-06 Sample 6	6	BH-18 Sample 6	10

Client	CRW Engineering
Project	42nd Ave Upgrade
Location	BH-01 to BH-24

W.O. #	517
Lab #	470

BH-07 Sample 1	2	BH-19 Sample 1	3
BH-07 Sample 2	3	BH-19 Sample 2	4
BH-07 Sample 3	5	BH-19 Sample 3	4
BH-07 Sample 4	4	BH-19 Sample 4A	12
BH-07 Sample 5A	10	BH-19 Sample 4B	6
BH-07 Sample 5B	9	BH-19 Sample 5	12
BH-07 Sample 6	6	BH-19 Sample 6	8
BH-08 Sample 1	8	BH-20 Sample 1	4
BH-08 Sample 2A	2	BH-20 Sample 2	5
BH-08 Sample 2B	12	BH-20 Sample 3	6
BH-08 Sample 3	4	BH-20 Sample 4	11
BH-08 Sample 4	8	BH-20 Sample 5	9
BH-08 Sample 5	8	BH-20 Sample 6	10
BH-08 Sample 6	8	BH-21 Sample 1	8
BH-09 Sample 1	4	BH-21 Sample 2	7
BH-09 Sample 2	3	BH-21 Sample 3	12
BH-09 Sample 3	5	BH-21 Sample 4	10
BH-09 Sample 4	13	BH-21 Sample 5	9
BH-09 Sample 5	8	BH-21 Sample 6	12
BH-09 Sample 6	12	BH-22 Sample 1	3
BH-10 Sample 1	4	BH-22 Sample 2	4
BH-10 Sample 2	5	BH-22 Sample 3	6
BH-10 Sample 3	6	BH-22 Sample 4	14
BH-10 Sample 4	11	BH-22 Sample 5	11
BH-10 Sample 5	12	BH-22 Sample 6	11
BH-10 Sample 6	8	BH-23 Sample 1	27
BH-11 Sample 1	6	BH-23 Sample 2	8
BH-11 Sample 2	8	BH-23 Sample 3	9
BH-11 Sample 3	5	BH-23 Sample 4	19
BH-11 Sample 4	10	BH-23 Sample 5	12
BH-11 Sample 5	12	BH-23 Sample 6	10
BH-11 Sample 6A	11	BH-24 Sample 1	11
BH-11 Sample 6B	7	BH-24 Sample 2	15
BH-12 Sample 1	7	BH-24 Sample 3	12
BH-12 Sample 2	6	BH-24 Sample 4	15
BH-12 Sample 3	4	BH-24 Sample 5	13
BH-12 Sample 4	8	BH-24 Sample 6	20
BH-12 Sample 5	10	BH-24 Sample 7	18
BH-12 Sample 6	8	BH-24 Sample 8	7
		BH-24 Sample 9	10
		BH-24 Sample 10	8
		BH-24 Sample 11	6

If you have questions regarding this summary report or the test procedures, please contact us.

*Oscar*

Oscar Lage  
Laboratory Supervisor



## Testing Report Summary

		Date Sample Recv'd	5/28/2019
Client	CRW Engineering	W.O. #	517
Project	42nd Ave Upgrade	Lab #	See Below
Location	See Below		

All results will be posted to the website for your access and convenience. Samples will be kept for 30 days before being disposed. Please contact us if you would like the remaining material returned.

Sample ID	Test Performed	Test Method	% Passing #200
BH-01 Sample 6A	Standard Test Methods for Determining the Amount of Material Finer than 75- $\mu$ m (No. 200) Sieve in Soils by Washing	ASTM D1140	23
BH-04 Sample 3			26
BH-05 Sample 5			14
BH-06 Sample 6			12
BH-08 Sample 5			8
BH-09 Sample 2			5
BH-10 Sample 6			7
BH-11 Sample 5			29
BH-12 Sample 6			48
BH-14 Sample 6			51
BH-15 Sample 6B			39
BH-16 Sample 2			48
BH-16 Sample 4			2
BH-19 Sample 4B			21
BH-21 Sample 6			15
BH-23 Sample 2			14
BH-23 Sample 3			32
BH-24 Sample 6			71

Sample ID	Test Performed	Test Method	Results		
BH-05 S4 (ATL#478)	Plasticity Index	ASTM D4318	Liquid Limit	NP	ML
BH-08 S 2B (ATL#483)			Plastic Limit	NP	
			Plasticity Index	NP	
			Liquid Limit	NP	ML
BH-07 S6 (ATL#483)			Plastic Limit	NP	
			Plasticity Index	NP	
			Liquid Limit	NP	ML
BH-13 S5 (ATL#497)			Plastic Limit	NP	
			Plasticity Index	NP	
			Liquid Limit	17	ML
Plastic Limit			15		
Plasticity Index			2		

		Date Sample Recv'd	5/28/2019
Client	CRW Engineering	W.O. #	517
Project	42nd Ave Upgrade	Lab #	See Below
Location	See Below		

BH-14 S6 (ATL#500)	Plasticity Index	ASTM D4318	Liquid Limit	NP	ML		
			Plastic Limit	NP			
			Plasticity Index	NP			
BH-14 S6 (ATL#500)					Liquid Limit	NP	ML
					Plastic Limit	NP	
					Plasticity Index	NP	
BH-16 S3 (ATL#504)					Liquid Limit	NP	ML
					Plastic Limit	NP	
					Plasticity Index	NP	
BH-17 S5 (ATL#507)					Liquid Limit	NP	ML
					Plastic Limit	NP	
					Plasticity Index	NP	
BH-18 S6 (ATL#510)					Liquid Limit	NP	ML
					Plastic Limit	NP	
					Plasticity Index	NP	
BH-19 S6 (ATL#512)					Liquid Limit	NP	ML
					Plastic Limit	NP	
					Plasticity Index	NP	

Sample ID	Test Performed	Test Method	Results	
BH-24 S2 (ATL#535)	Moisture, Ash & Organic Matter of Peat Materials	ASTM D2974	% Organics (by weight)	0.3
			% Ash	97.7

If you have questions regarding this summary report or the test procedures, please contact us.

*oscar*

Oscar Lage  
Laboratory Supervisor



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-02 Sample 1

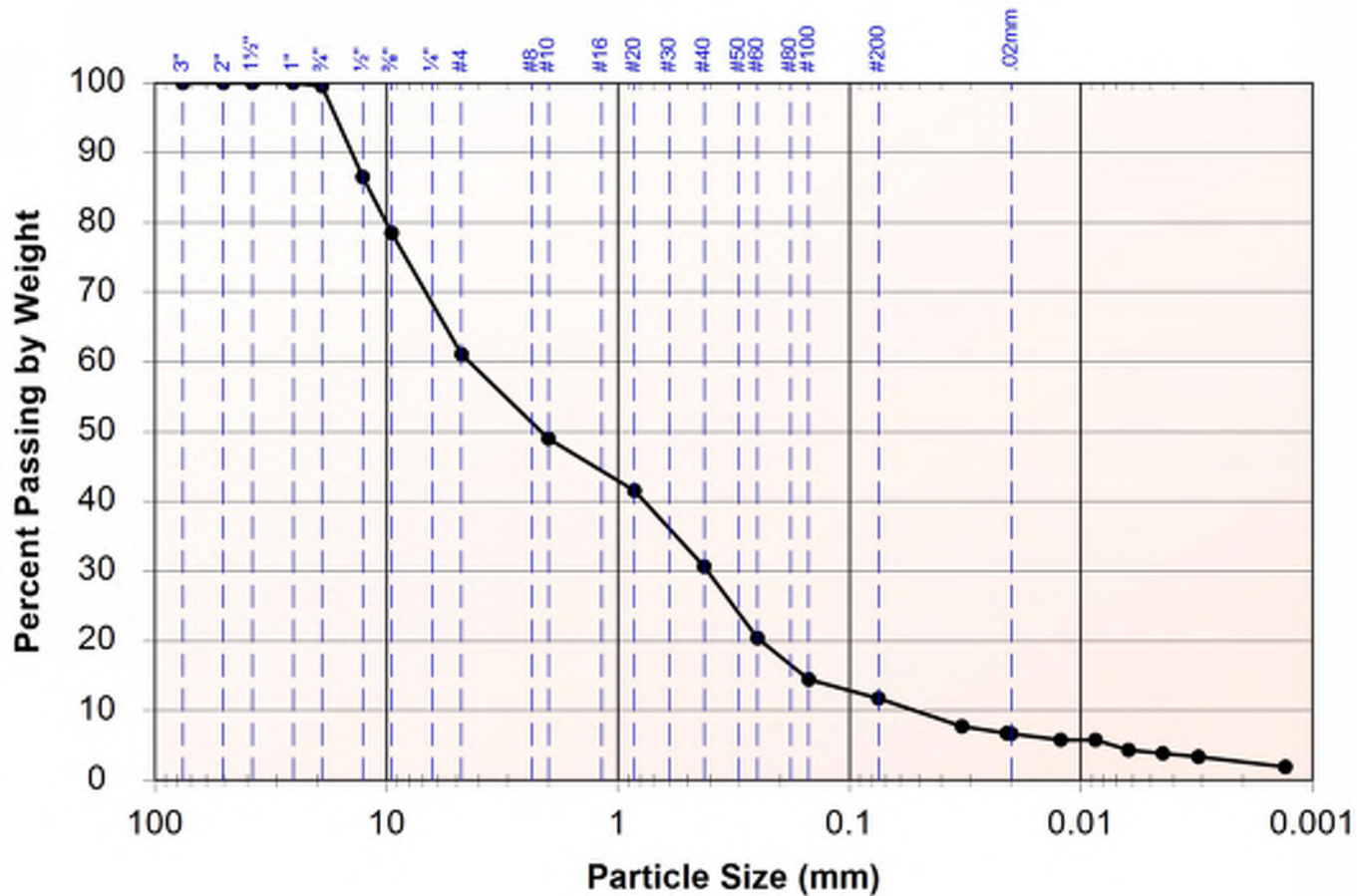
Lab Number 2019-472

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Sand with Silt and Gravel, SP-SM

Frost Classification: F2



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	100%	
1"	100%	
3/4"	100%	
1/2"	87%	
3/8"	78%	
#4	61%	
#10	49%	
Total Weight of Sample 1431.2g		
#20	42%	
#40	31%	
#60	20%	
#100	14%	
#200	11.8%	
Total Weight of Fine Fraction 86.84g		
0.02 mm	6.7%	



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-02 Sample 6

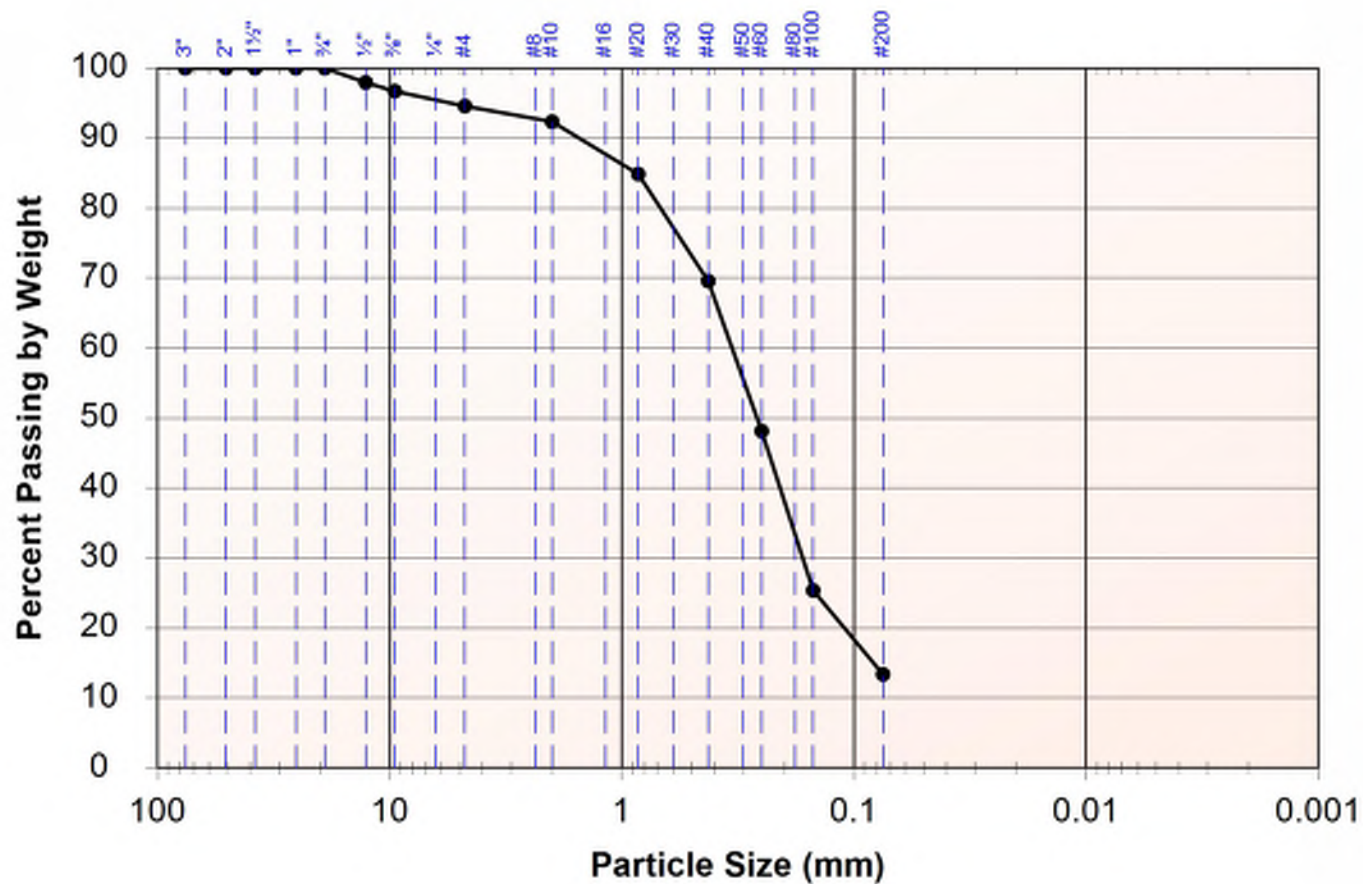
Lab Number 2019-473

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Silty Sand, SM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	100%	
¾"	100%	
½"	98%	
⅜"	97%	
#4	95%	
Total Weight of Sample 2614.6g		
#10	92%	
#20	85%	
#40	70%	
#60	48%	
#100	25%	
#200	13.4%	
Total Weight of Fine Fraction 639.0g		





Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-4 Sample 4

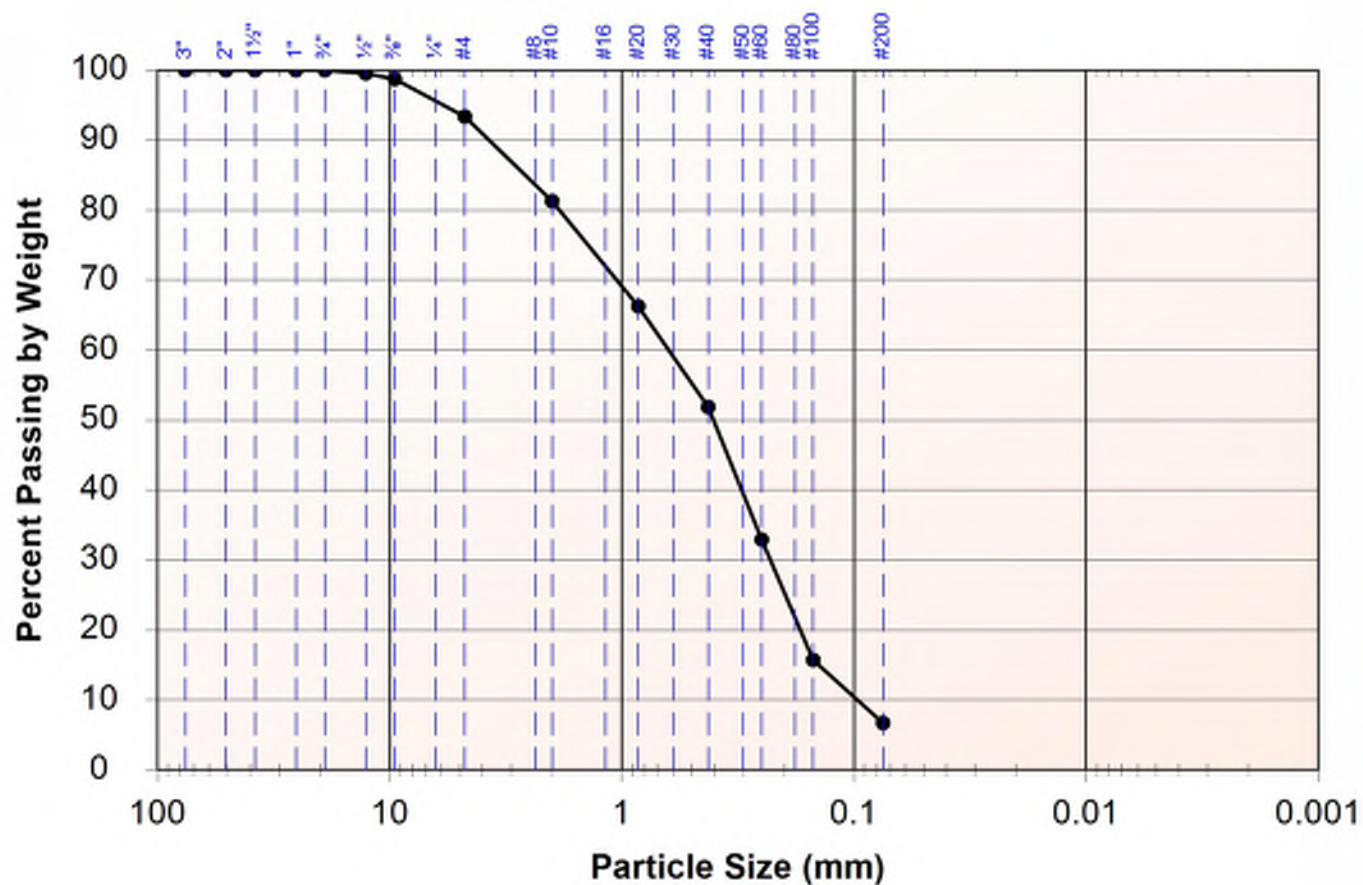
Lab Number 2019-475

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Sand with Silt, SP-SM

Frost Classification: Not Measured



Size	Passing	Specification
------	---------	---------------

3"	100%	
2"	100%	
1½"	100%	
1"	100%	
¾"	100%	
½"	100%	
⅜"	100%	
⅛"	100%	
#4	93%	

Total Weight of Sample 1636.3g

#10	81%	
#20	66%	
#40	52%	
#60	33%	
#100	16%	
#200	6.7%	

Total Weight of Fine Fraction 352.6g



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-05 Sample 1

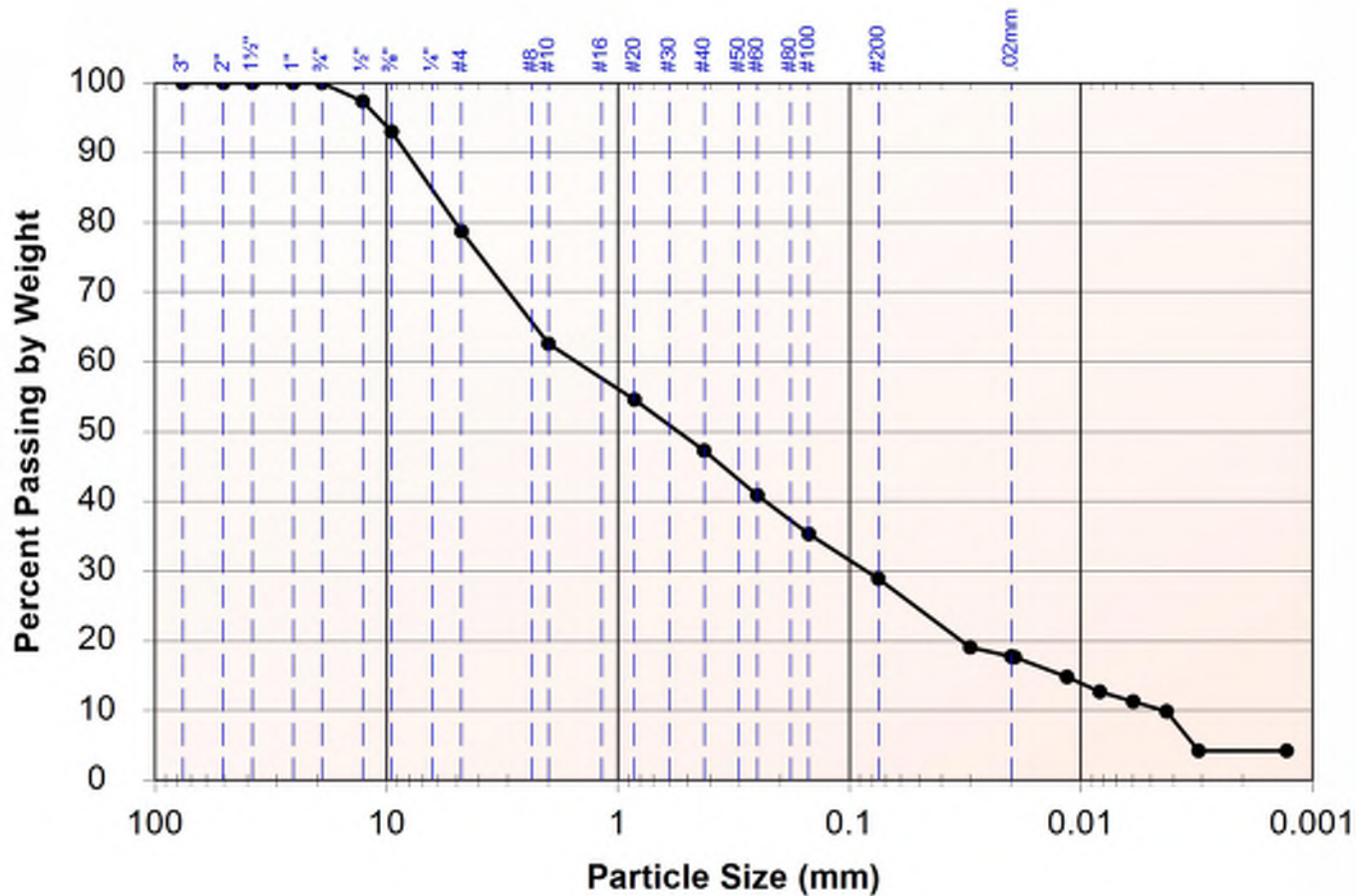
Lab Number 2019-476

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: F3



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	100%	
1"	100%	
3/4"	100%	
1/2"	97%	
3/8"	93%	
#4	79%	
#10	63%	
Total Weight of Sample 2243.9g		
#20	55%	
#40	47%	
#60	41%	
#100	35%	
#200	28.9%	
Total Weight of Fine Fraction 78g		
0.02 mm	17.8%	



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-05 Sample 3

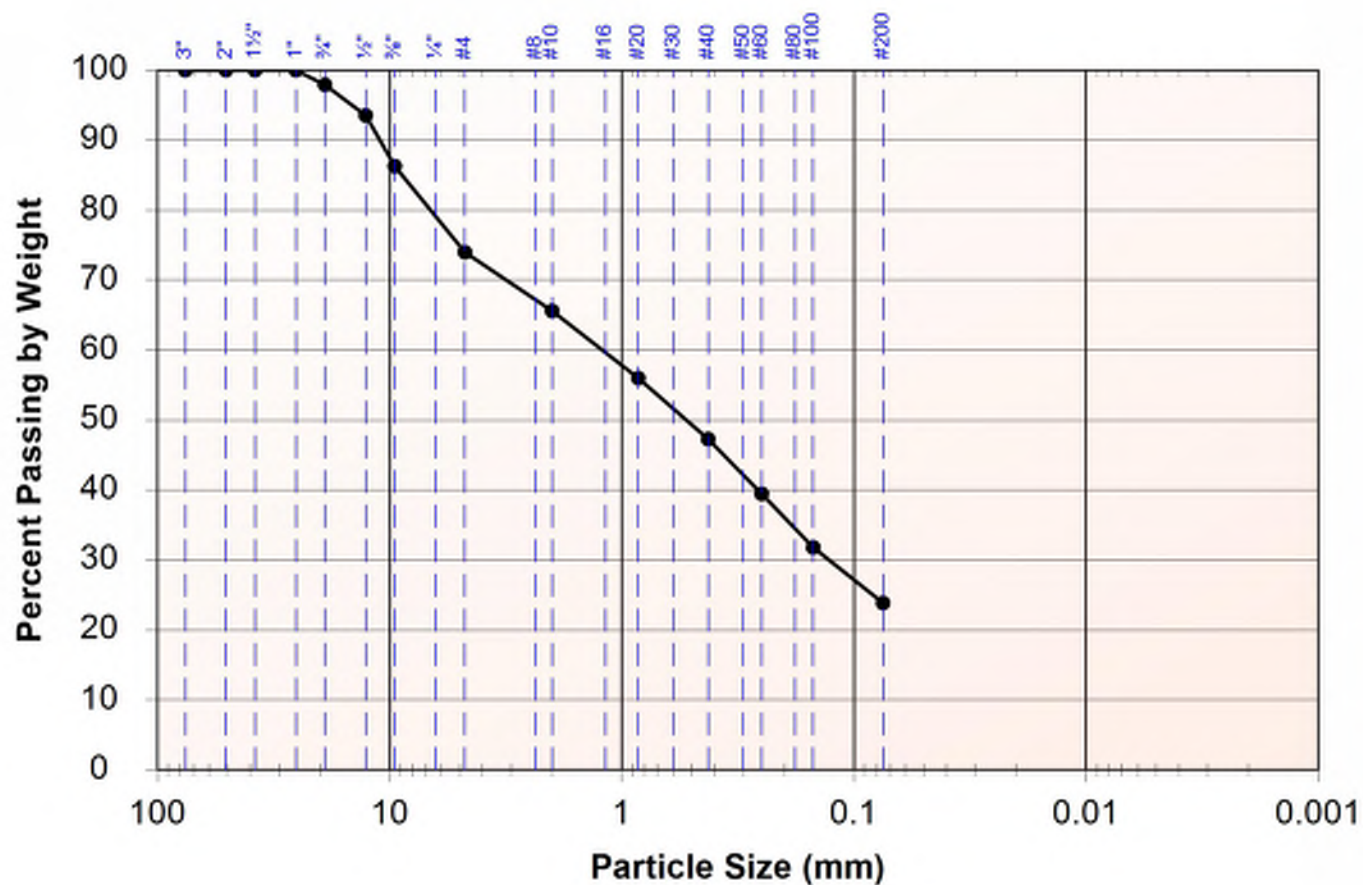
Lab Number 2019-477

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: Not Measured



Size	Passing	Specification
------	---------	---------------

3"	100%	
2"	100%	
1½"	100%	
1"	100%	
¾"	98%	
½"	94%	
⅜"	86%	
#4	74%	

Total Weight of Sample 830.4g

#10	66%
#20	56%
#40	47%
#60	39%
#100	32%
#200	23.9%

Total Weight of Fine Fraction 614.5g



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-06 Sample 2

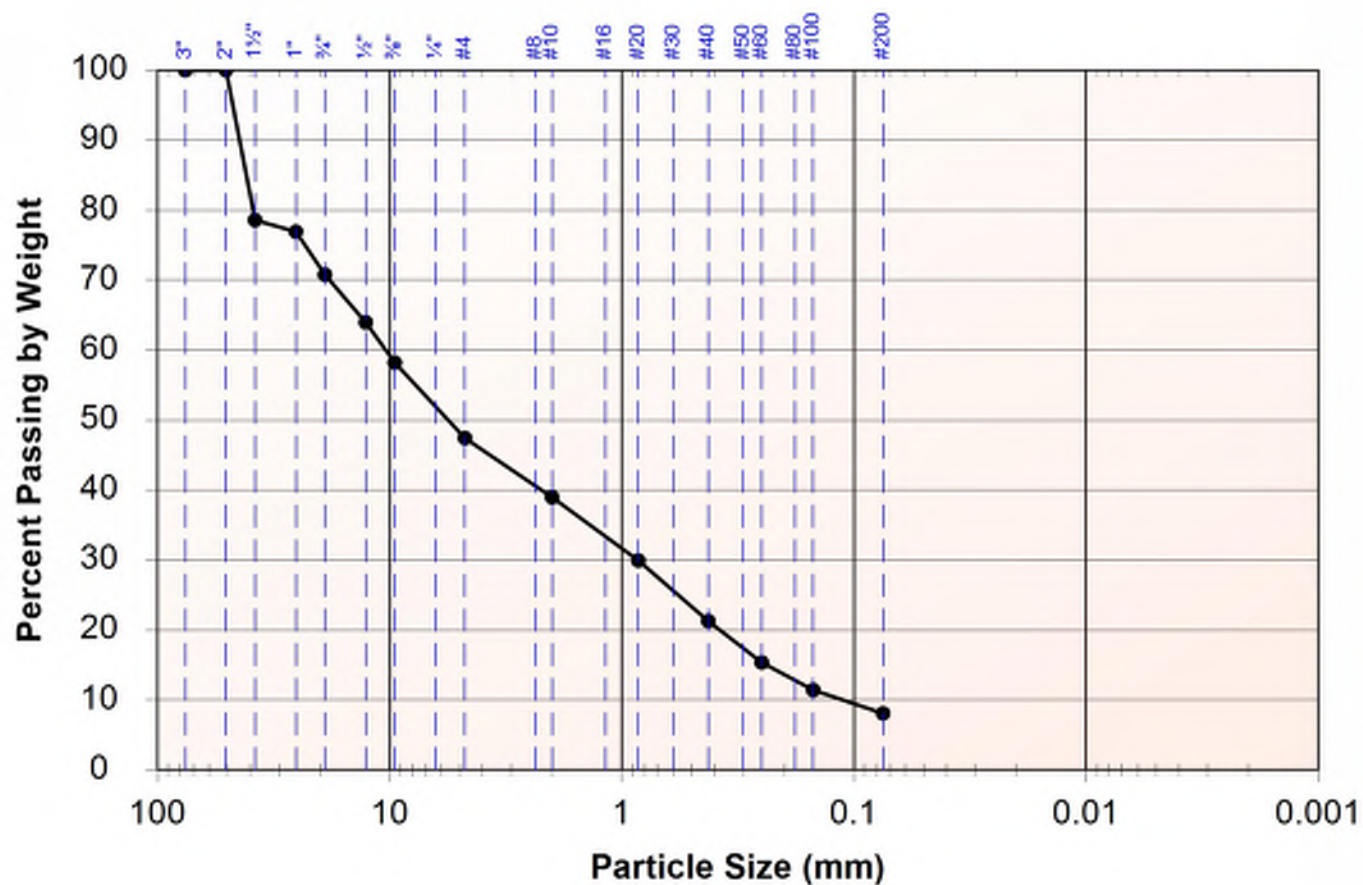
Lab Number 2019-480

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Gravel with Silt and Sand, GP-GM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	79%	
1"	77%	
3/4"	71%	
1/2"	64%	
3/8"	58%	
#4	47%	
Total Weight of Sample 1936.8g		
#10	39%	
#20	30%	
#40	21%	
#60	15%	
#100	11%	
#200	8.1%	
Total Weight of Fine Fraction 410.2g		





Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-07 Sample 1

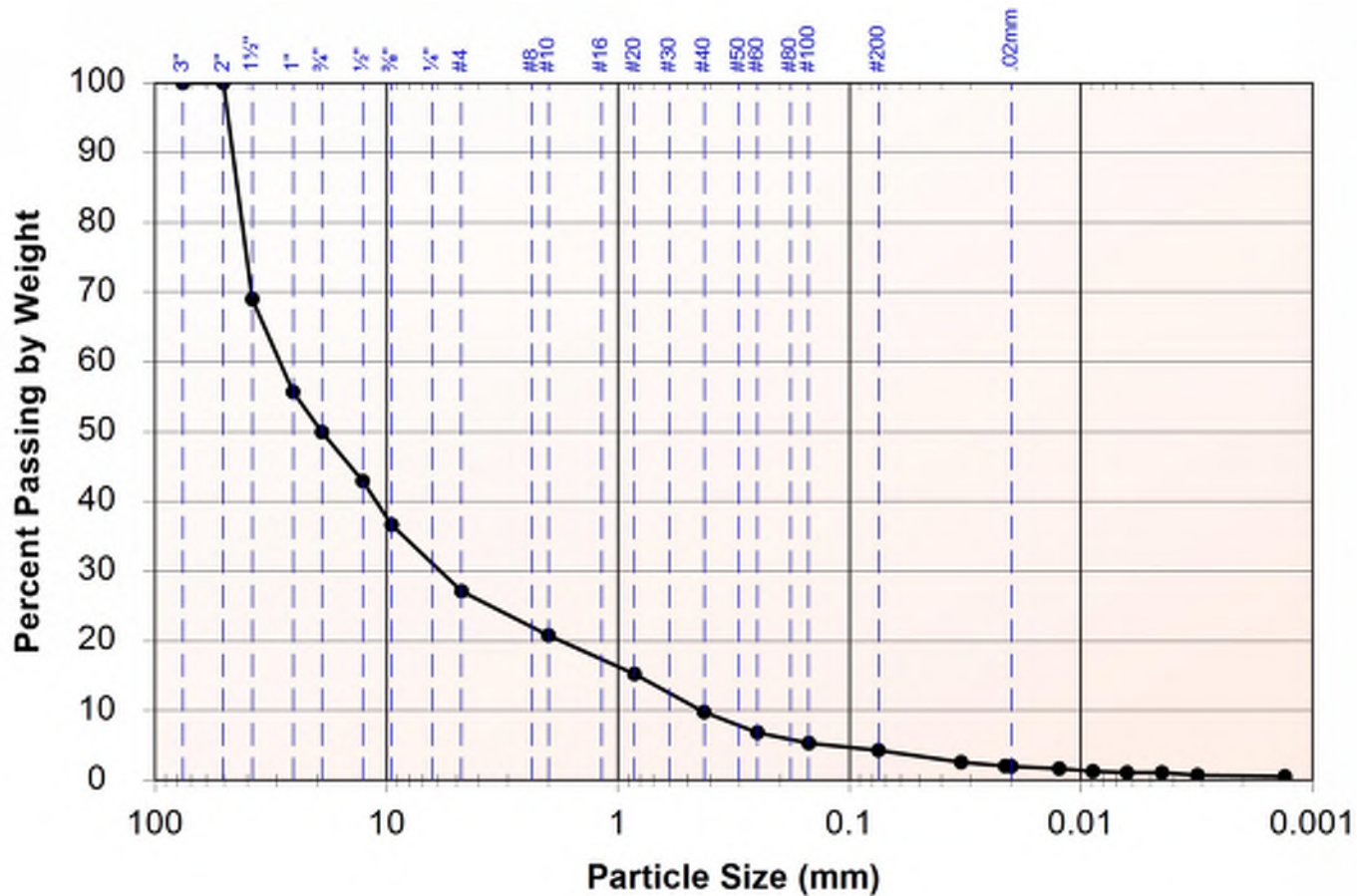
Lab Number 2019-482

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Sand, GW

Frost Classification: NFS



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	69%	
1"	56%	
¾"	50%	
½"	43%	
⅜"	37%	
#4	27%	
#10	21%	
Total Weight of Sample 2510.9g		
#20	15%	
#40	10%	
#60	7%	
#100	5%	
#200	4.3%	
Total Weight of Fine Fraction 82.6g		
0.02 mm	2.0%	



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-08 Sample 6

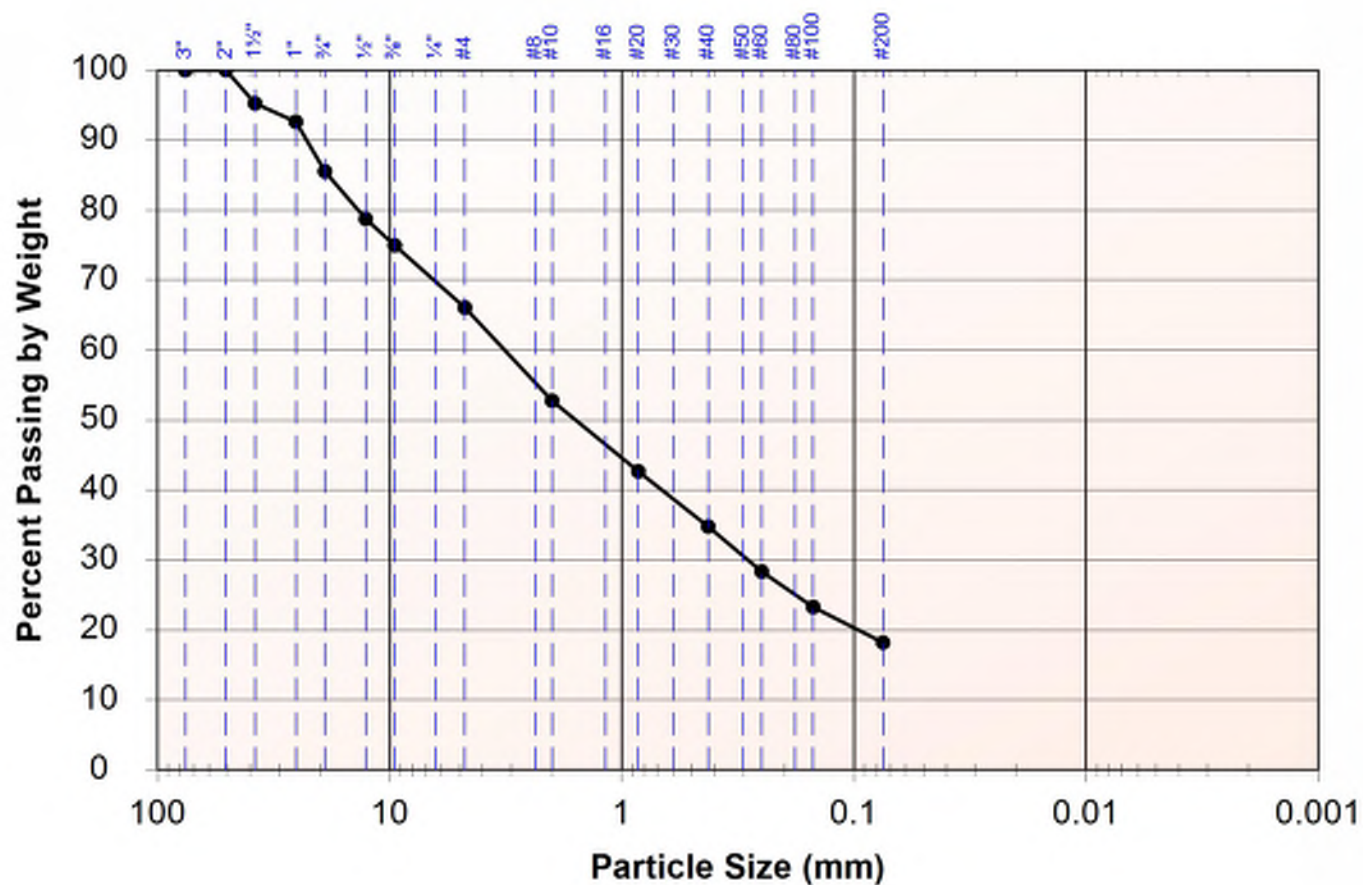
Lab Number 2019-486

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	95%	
1"	93%	
3/4"	86%	
1/2"	79%	
3/8"	75%	
#4	66%	
Total Weight of Sample 2187.5g		
#10	53%	
#20	43%	
#40	35%	
#60	28%	
#100	23%	
#200	18.2%	
Total Weight of Fine Fraction 380.3g		



**Client:** CRW Engineering Group, LLC  
**Project:** 42nd Ave Upgrade  
**Work Order:** 517

## Particle Size Distribution

ASTM D422

**Location:** BH-09 Sample 1

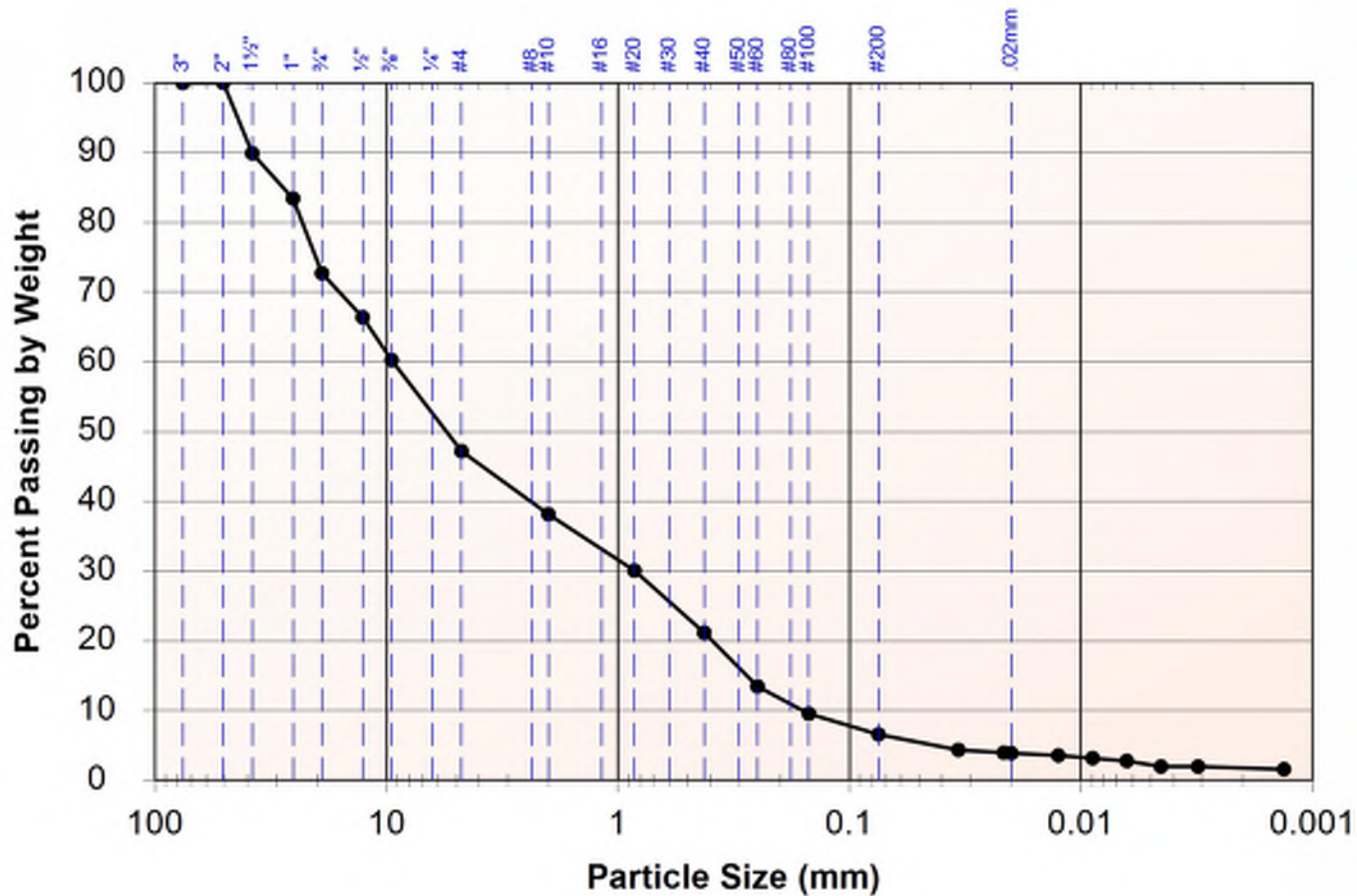
**Lab Number** 2019-487

**Received** 5/28/2019

**Reported** 6/21/2019

**Engineering Classification:** Poorly Graded Gravel with Silt and Sand, GP-GM

**Frost Classification:** S1



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	90%	
1"	83%	
3/4"	73%	
1/2"	66%	
3/8"	60%	
#4	47%	
#10	38%	
Total Weight of Sample 2078.1g		
#20	30%	
#40	21%	
#60	13%	
#100	10%	
#200	6.6%	
Total Weight of Fine Fraction 342.8g		
0.02 mm	3.9%	



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-9 Sample 4

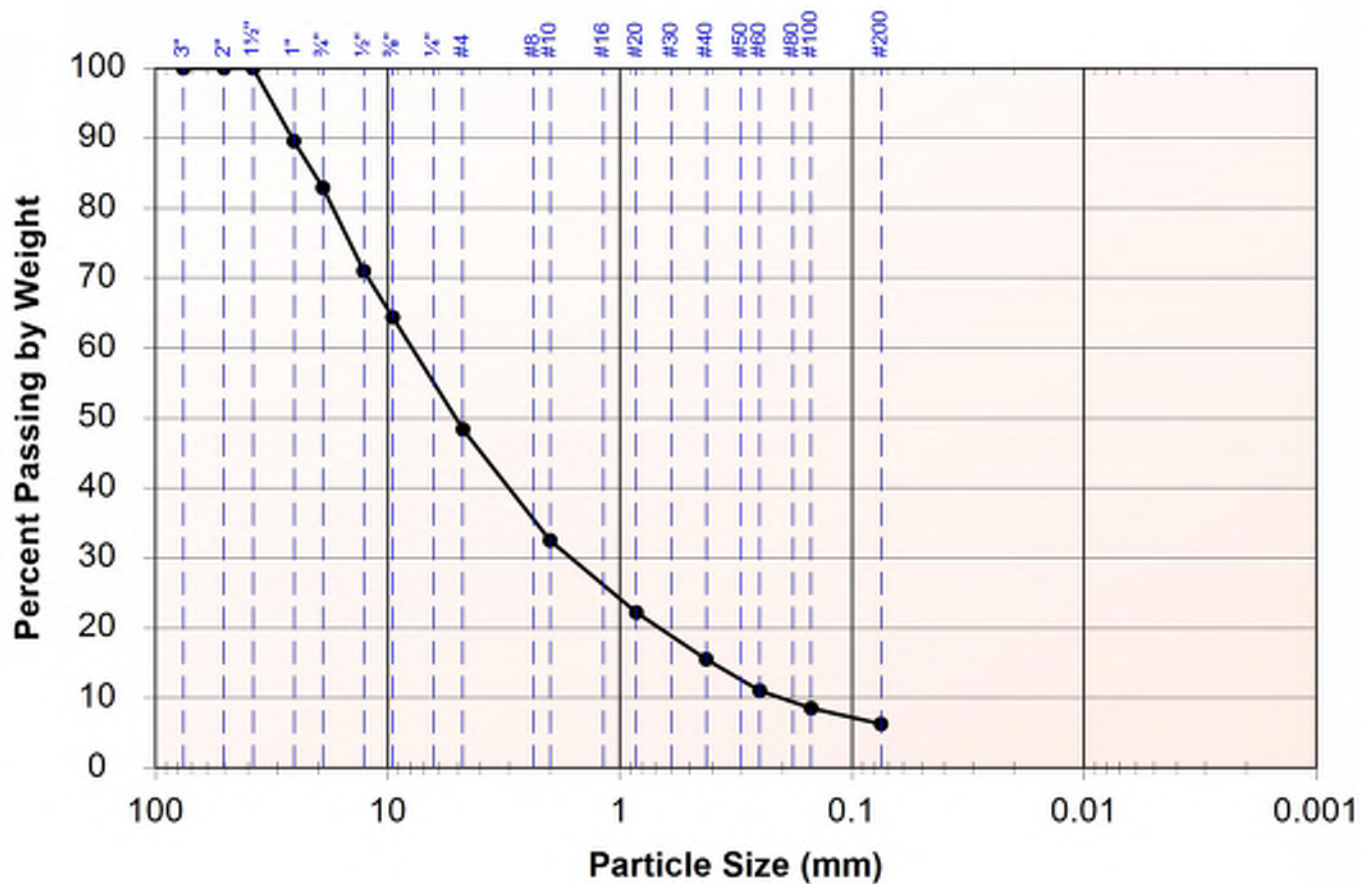
Lab Number 2019-489

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Silt and Sand, GW-GM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	100%	
1"	90%	
3/4"	83%	
1/2"	71%	
3/8"	64%	
#4	48%	
Total Weight of Sample 2247.8g		
#10	33%	
#20	22%	
#40	16%	
#60	11%	
#100	9%	
#200	6.3%	
Total Weight of Fine Fraction 310.1g		





**Client:** CRW Engineering Group, LLC  
**Project:** 42nd Ave Upgrade  
**Work Order:** 517

## Particle Size Distribution

ASTM D422

**Location:** BH-10 Sample 2

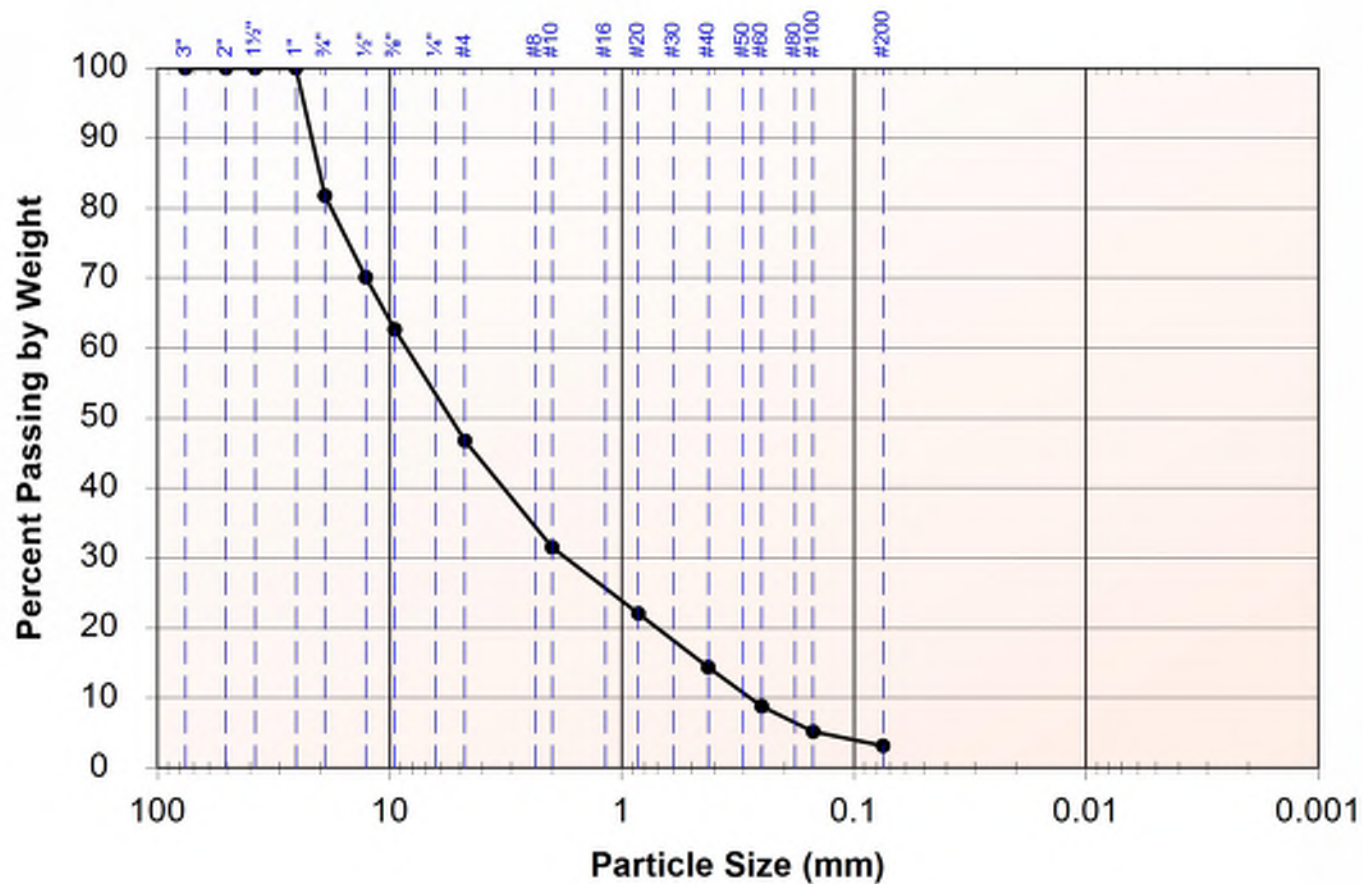
**Lab Number** 2019-490

**Received** 5/28/2019

**Reported** 6/21/2019

**Engineering Classification:** Well Graded Gravel with Sand, GW

**Frost Classification:** Not Measured





Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-11 Sample 3

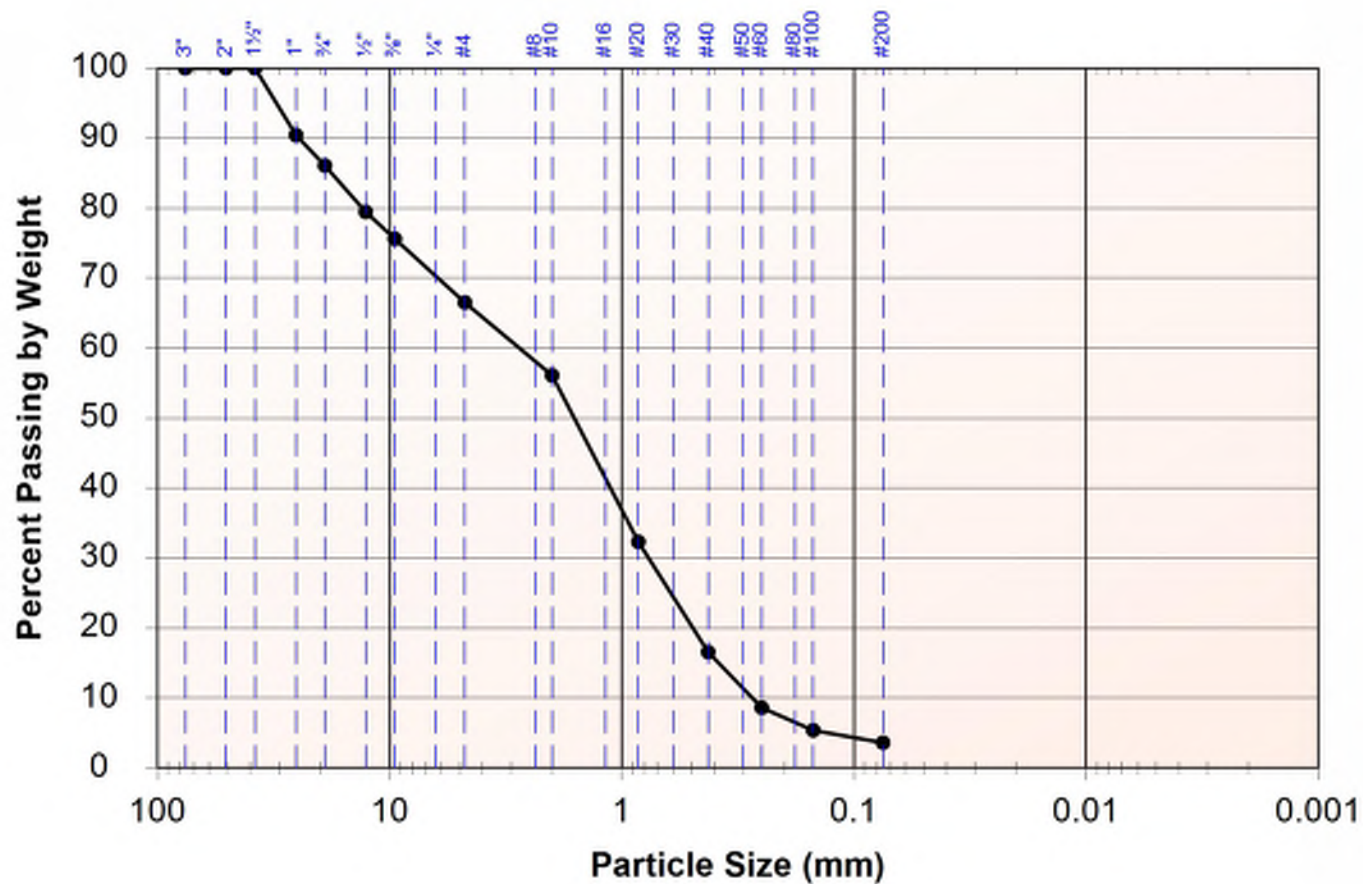
Lab Number 2019-492

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Sand with Gravel, SP

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	90%	
¾"	86%	
½"	79%	
⅜"	76%	
#4	67%	
Total Weight of Sample 2510.4g		
#10	56%	
#20	32%	
#40	17%	
#60	9%	
#100	5%	
#200	3.6%	
Total Weight of Fine Fraction 322.7g		



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: Bh-12 Sample 1

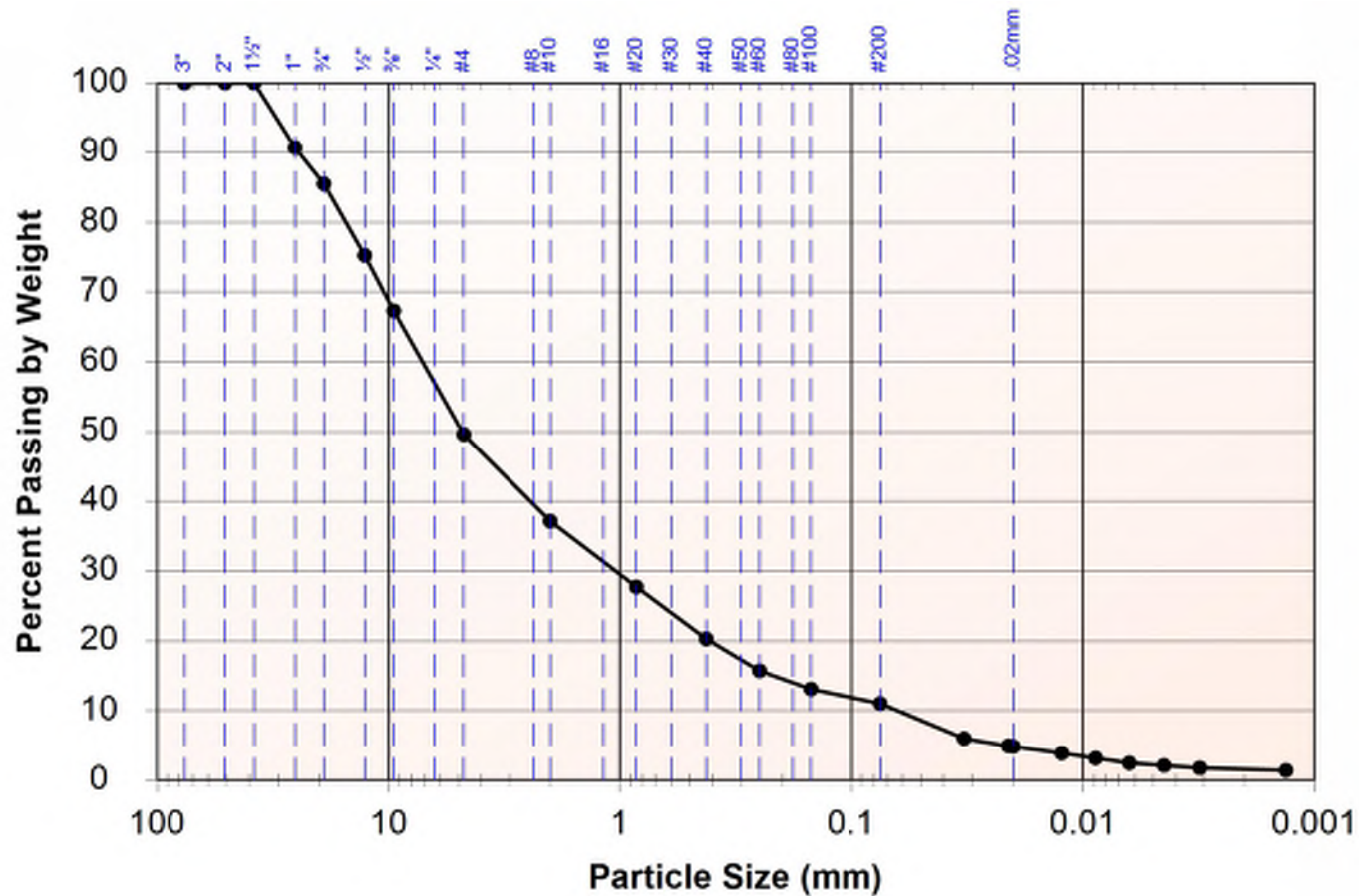
Lab Number 2019-494

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Silt and Sand, GW-GM

Frost Classification: S1





Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-13 Sample 3

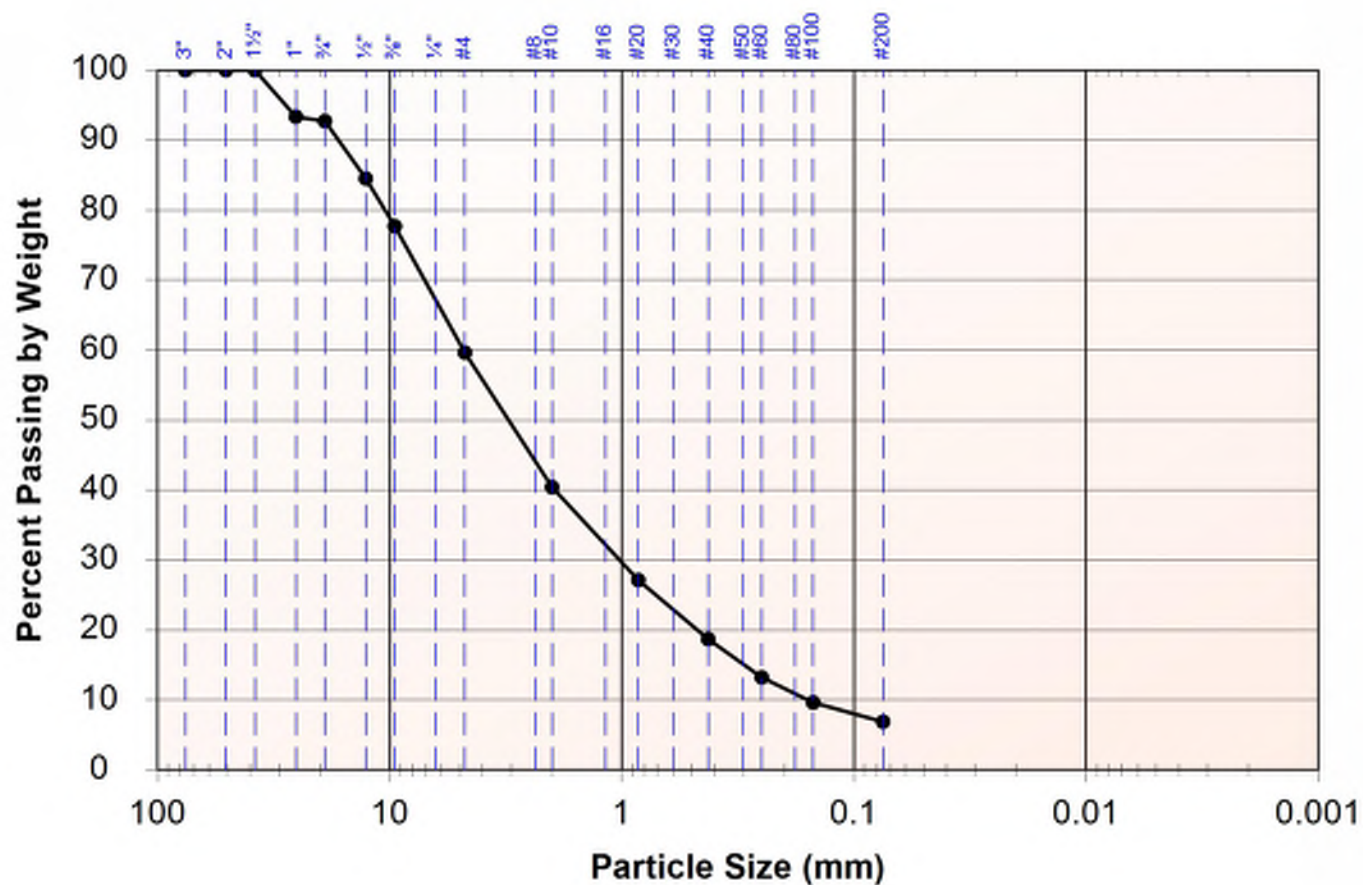
Lab Number 2019-496

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Well Graded Sand with Silt and Gravel, SW-SM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	93%	
¾"	93%	
½"	85%	
⅜"	78%	
#4	60%	
Total Weight of Sample 1629.1g		
#10	40%	
#20	27%	
#40	19%	
#60	13%	
#100	10%	
#200	6.9%	
Total Weight of Fine Fraction 374.4g		





Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-14 Sample 1

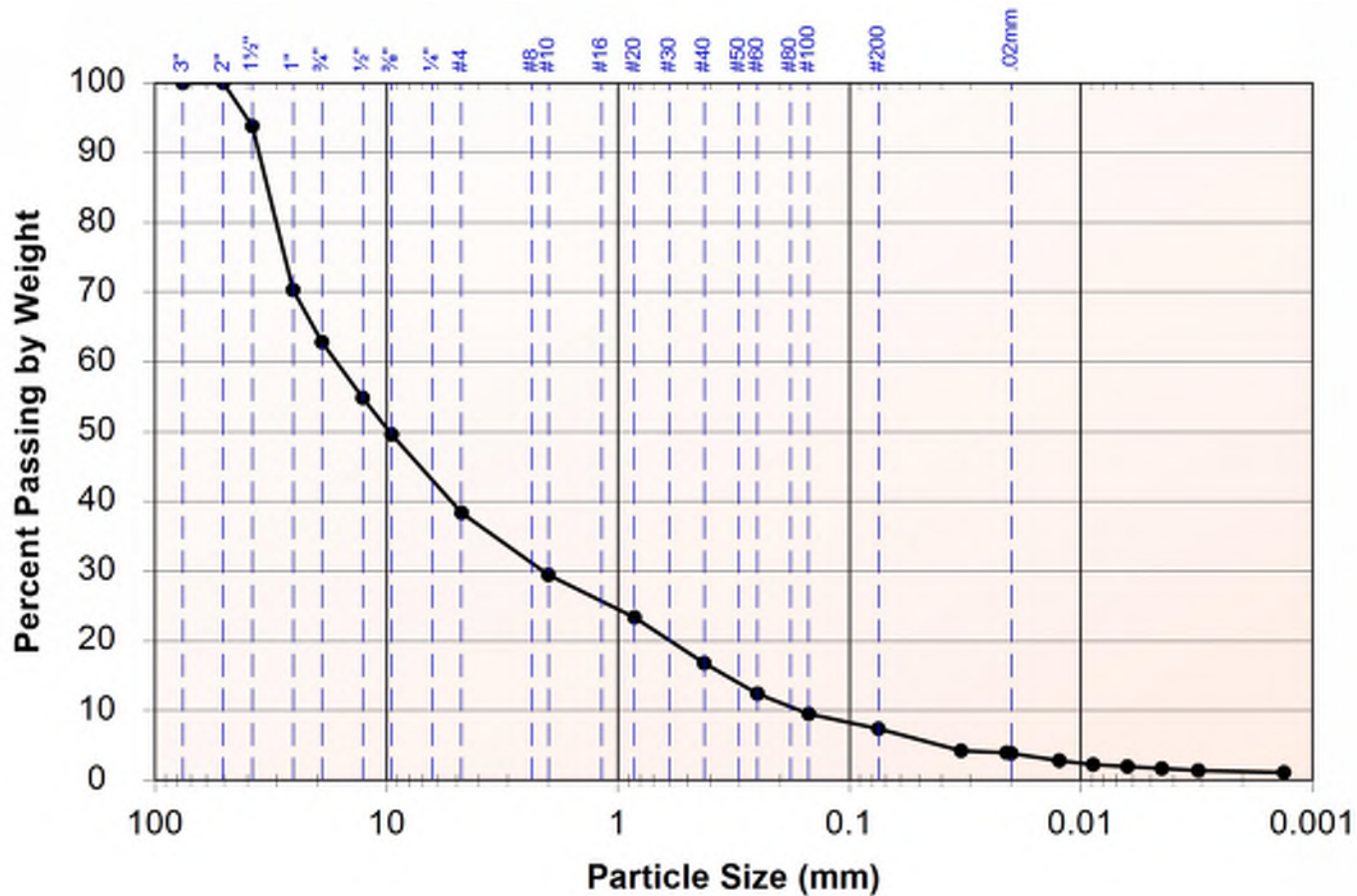
Lab Number 2019-498

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Silt and Sand, GW-GM

Frost Classification: S1



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	94%	
1"	70%	
3/4"	63%	
1/2"	55%	
3/8"	50%	
#4	38%	
#10	29%	
Total Weight of Sample 2070.8g		
#20	23%	
#40	17%	
#60	12%	
#100	10%	
#200	7.4%	
Total Weight of Fine Fraction 83.2g		
0.02 mm	3.9%	



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-14 Sample 4

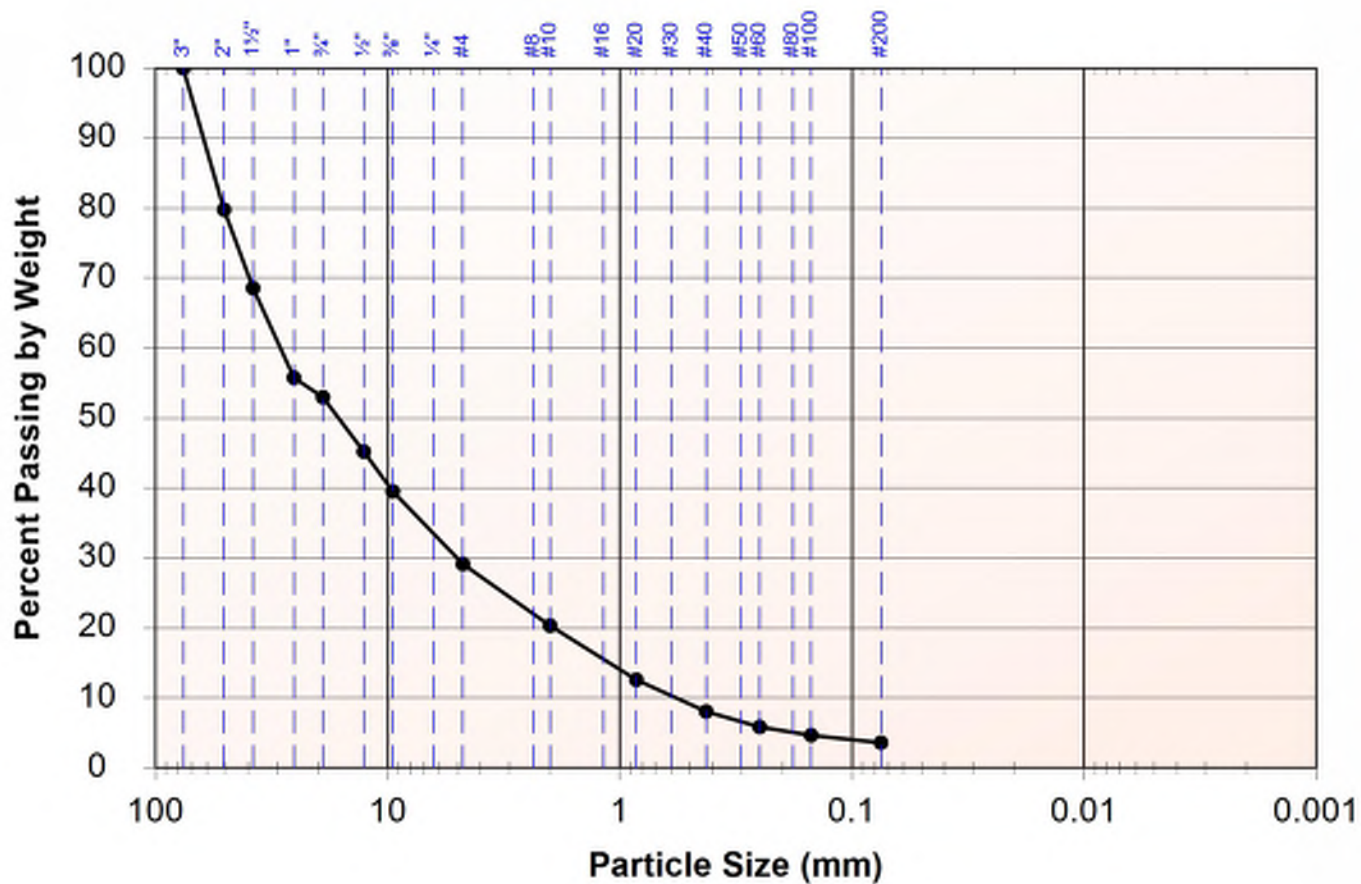
Lab Number 2019-499

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Sand, GW

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	80%	
1 1/2"	69%	
1"	56%	
3/4"	53%	
1/2"	45%	
3/8"	40%	
#4	29%	
Total Weight of Sample 1108g		
#10	20%	
#20	13%	
#40	8%	
#60	6%	
#100	5%	
#200	3.6%	
Total Weight of Fine Fraction 323.6g		



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-16 Sample 1

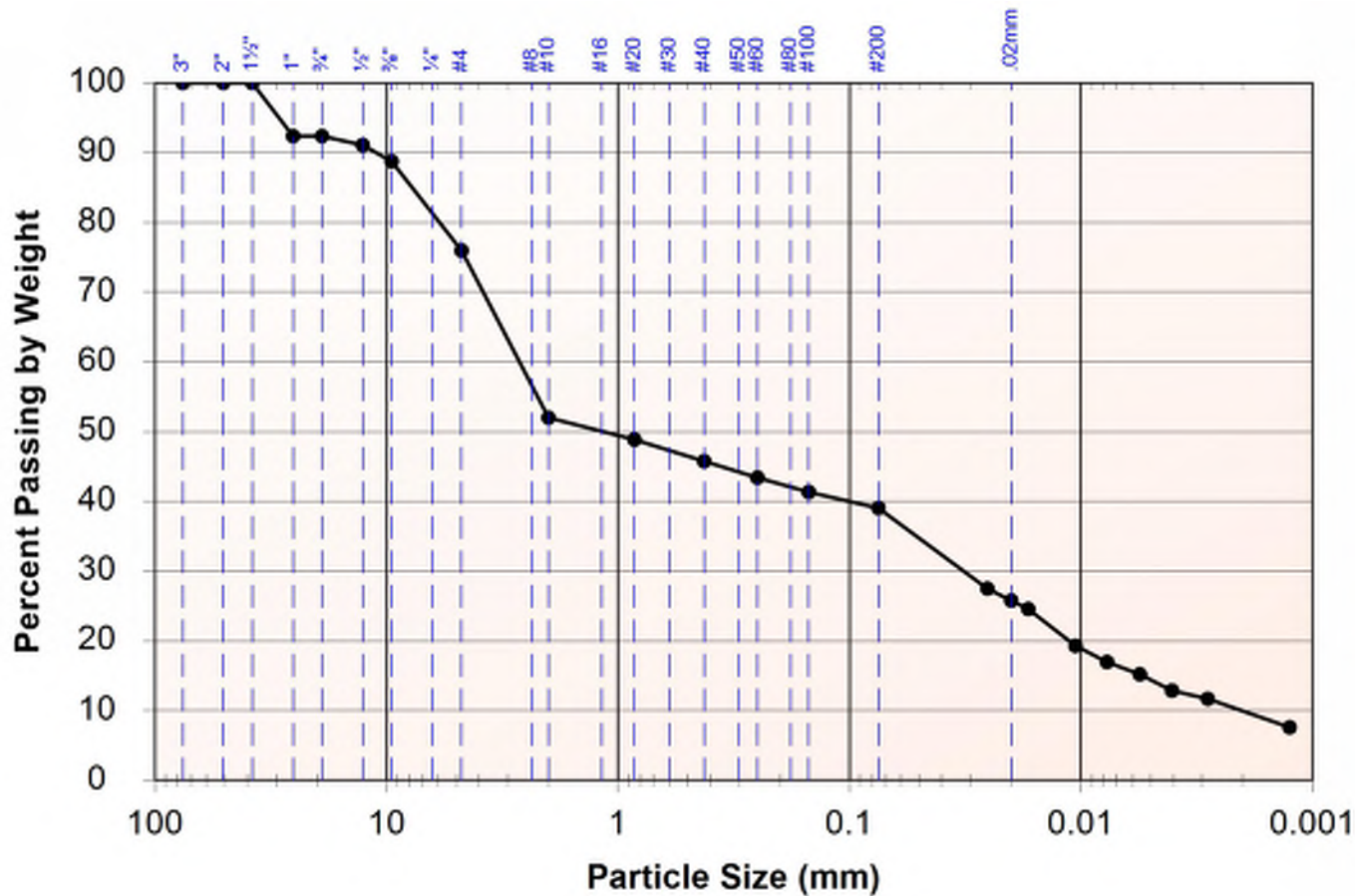
Lab Number 2019-502

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: F4



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	100%	
1"	92%	
3/4"	92%	
1/2"	91%	
3/8"	89%	
#4	76%	
#10	52%	
Total Weight of Sample 1881.4g		
#20	49%	
#40	46%	
#60	43%	
#100	41%	
#200	39.0%	
Total Weight of Fine Fraction 85.8g		
0.02 mm	25.8%	



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-17 Sample 3

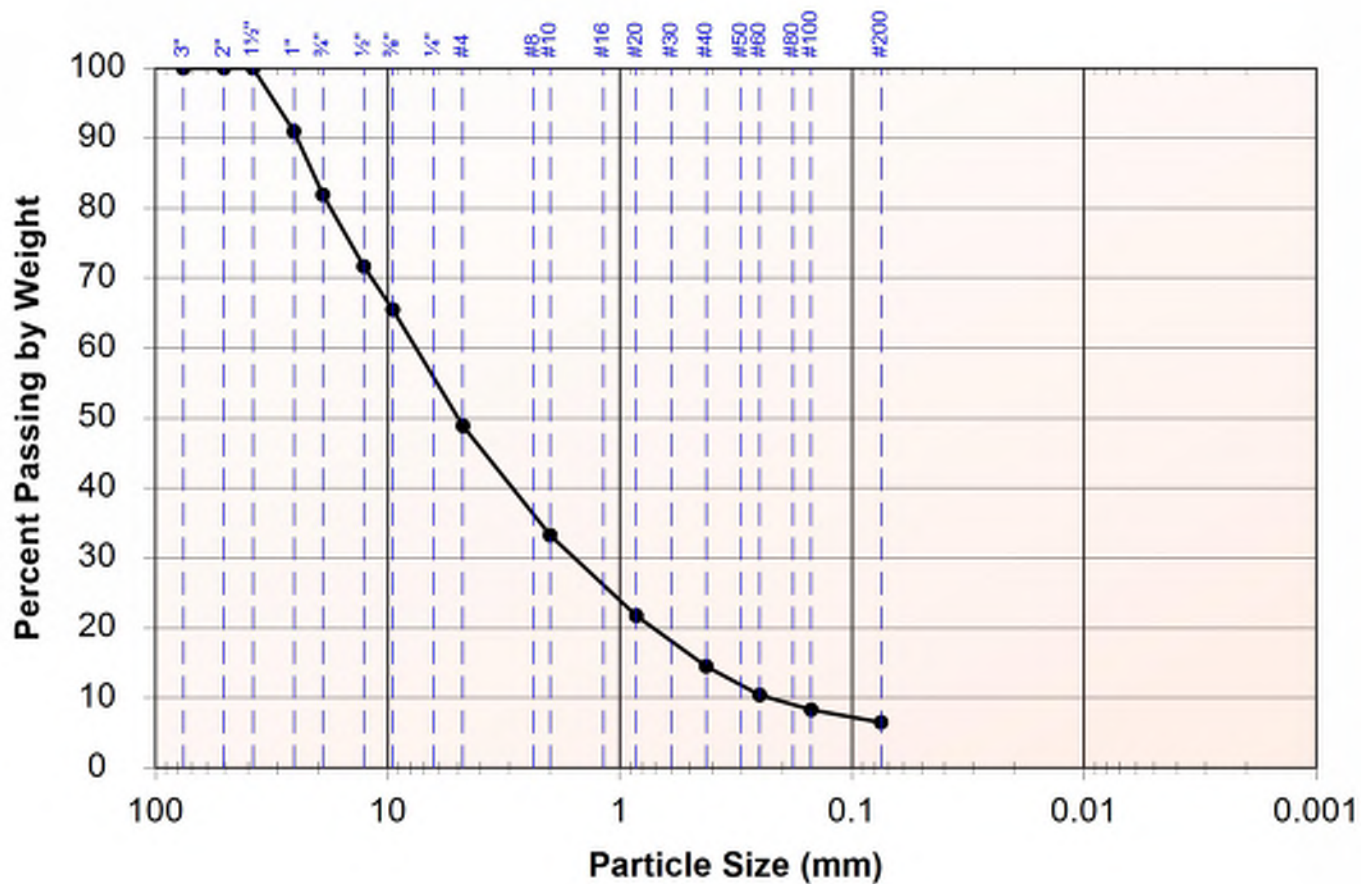
Lab Number 2019-506

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Silt and Sand, GW-GM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	91%	
¾"	82%	
½"	72%	
⅜"	66%	
#4	49%	
Total Weight of Sample 2250.9g		
#10	33%	
#20	22%	
#40	15%	
#60	10%	
#100	8%	
#200	6.5%	
Total Weight of Fine Fraction 519.5g		





Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-18 Sample 1

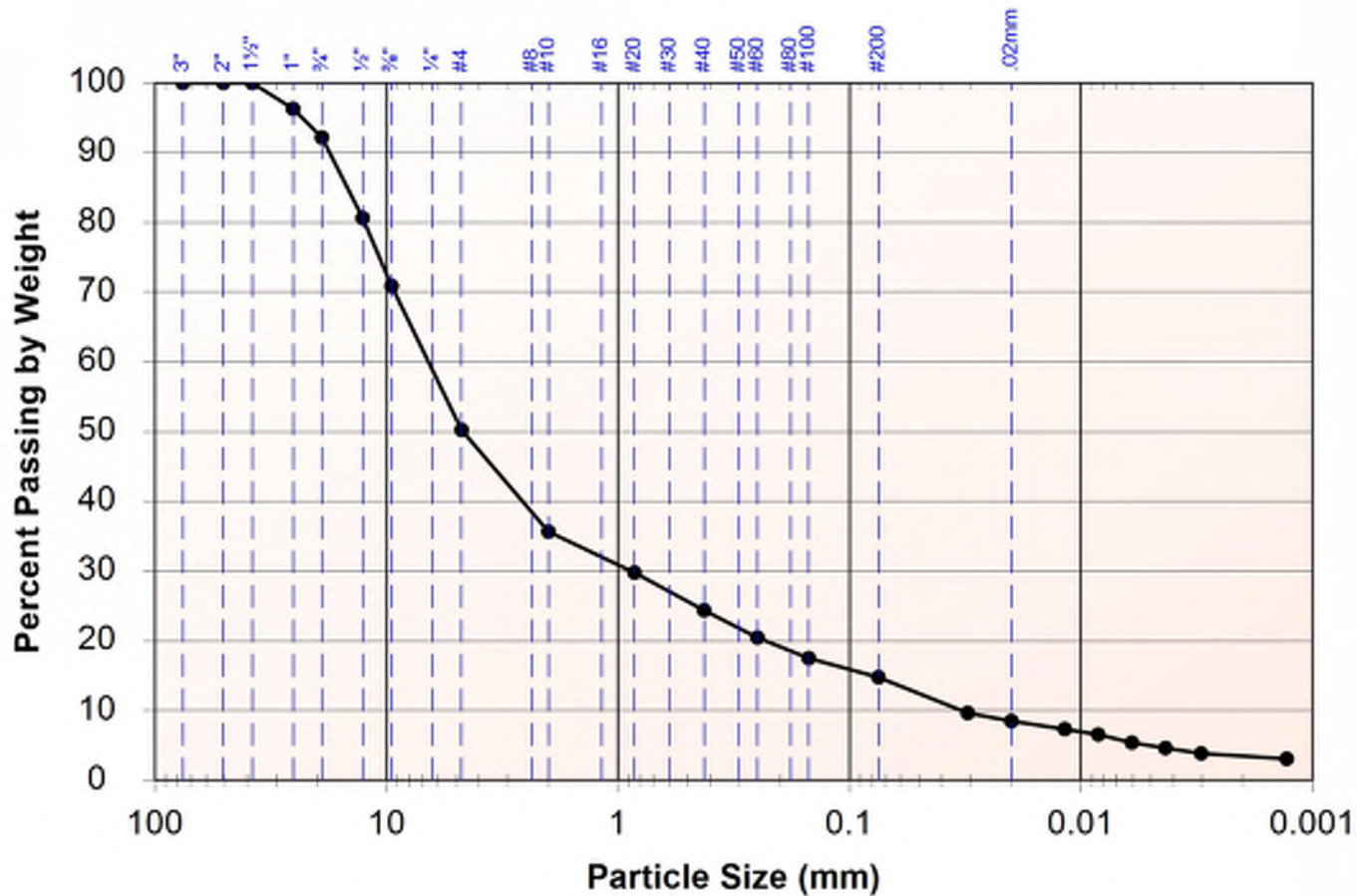
Lab Number 2019-508

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Silty Gravel with Sand, GM

Frost Classification: F1



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	96%	
¾"	92%	
½"	81%	
⅜"	71%	
#4	50%	
#10	36%	
Total Weight of Sample 2696.4g		
#20	30%	
#40	24%	
#60	20%	
#100	18%	
#200	14.8%	
Total Weight of Fine Fraction 78.4g		
0.02 mm	8.5%	



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-18 Sample 5

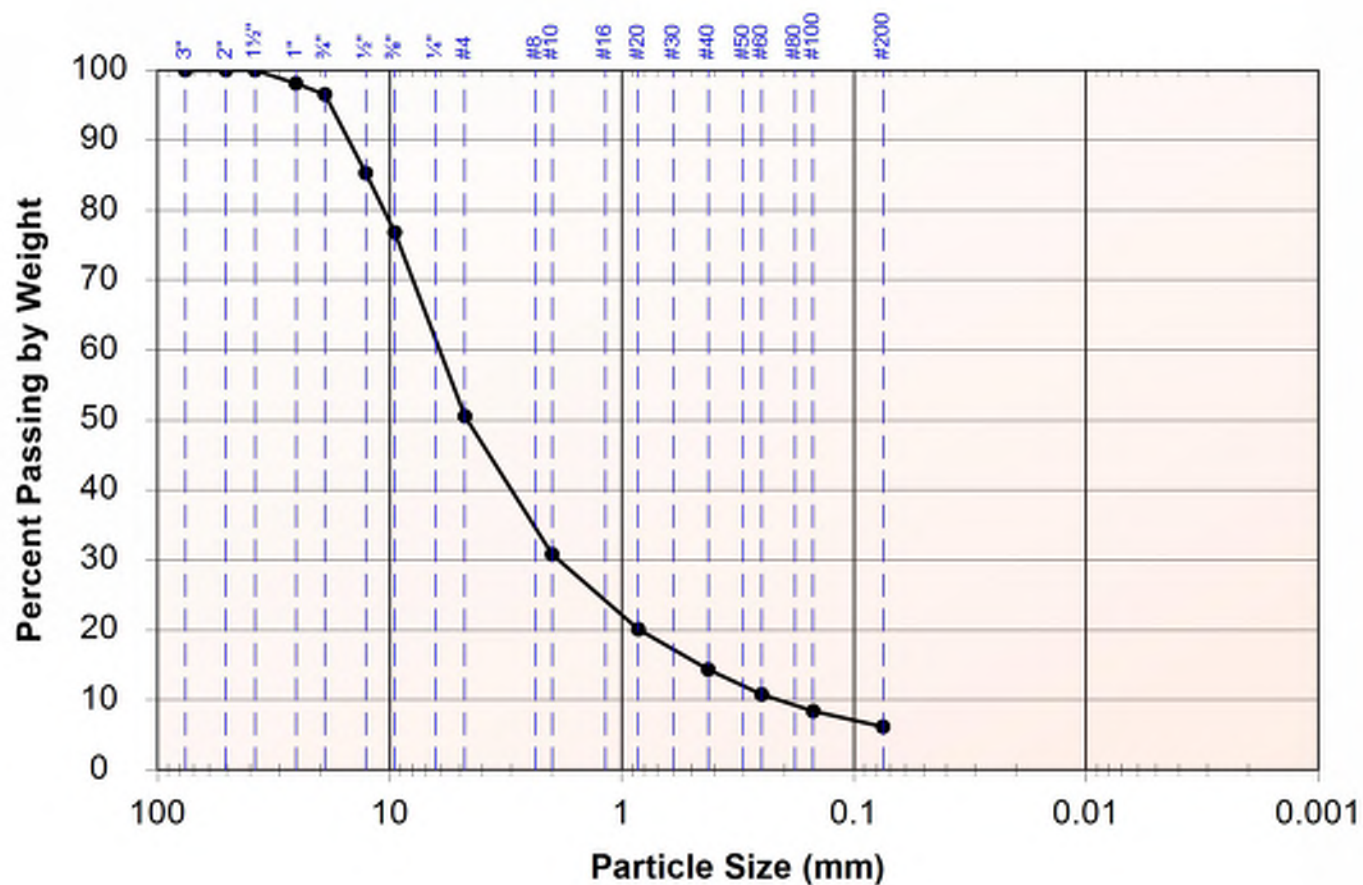
Lab Number 2019-509

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Well Graded Gravel with Silt and Sand, GW-GM

Frost Classification: Not Measured



Size	Passing	Specification
------	---------	---------------

3"	100%	
----	------	--

2"	100%	
----	------	--

1 1/2"	100%	
--------	------	--

1"	98%	
----	-----	--

3/4"	97%	
------	-----	--

1/2"	85%	
------	-----	--

3/8"	77%	
------	-----	--

#4	51%	
----	-----	--

Total Weight of Sample 1731.8g		
--------------------------------	--	--

#10	31%	
-----	-----	--

#20	20%	
-----	-----	--

#40	14%	
-----	-----	--

#60	11%	
-----	-----	--

#100	8%	
------	----	--

#200	6.2%	
------	------	--

Total Weight of Fine Fraction 432.2g		
--------------------------------------	--	--



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-20 Sample 1

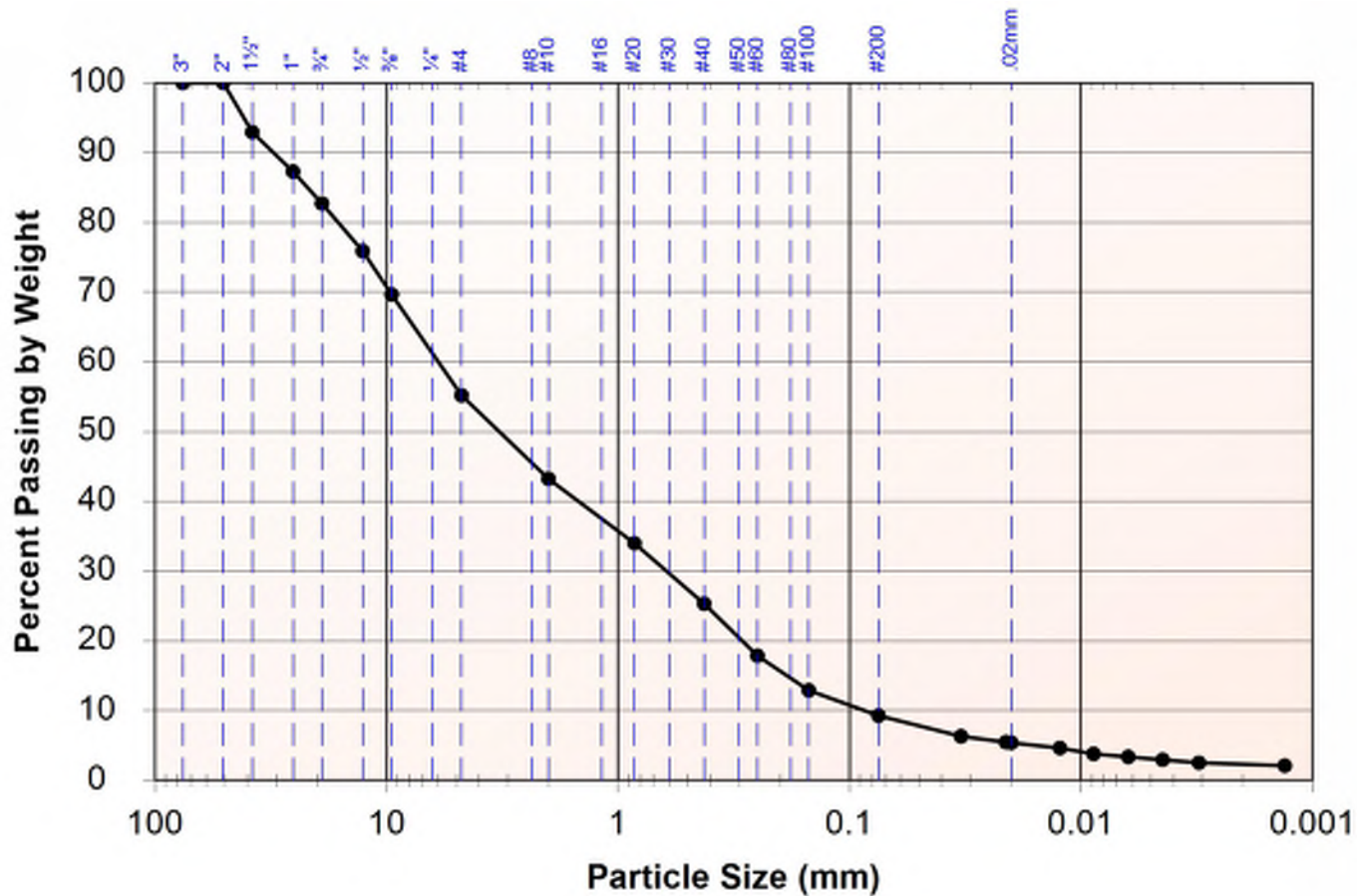
Lab Number 2019-513

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Sand with Silt and Gravel, SP-SM

Frost Classification: S2



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	93%	
1"	87%	
3/4"	83%	
1/2"	76%	
3/8"	70%	
#4	55%	
#10	43%	
Total Weight of Sample 1983.9g		
#20	34%	
#40	25%	
#60	18%	
#100	13%	
#200	9.3%	
Total Weight of Fine Fraction 464.4g		
0.02 mm	5.4%	



**Client:** CRW Engineering Group, LLC  
**Project:** 42nd Ave Upgrade  
**Work Order:** 517

## Particle Size Distribution

ASTM D422

**Location:** BH-20 Sample 4

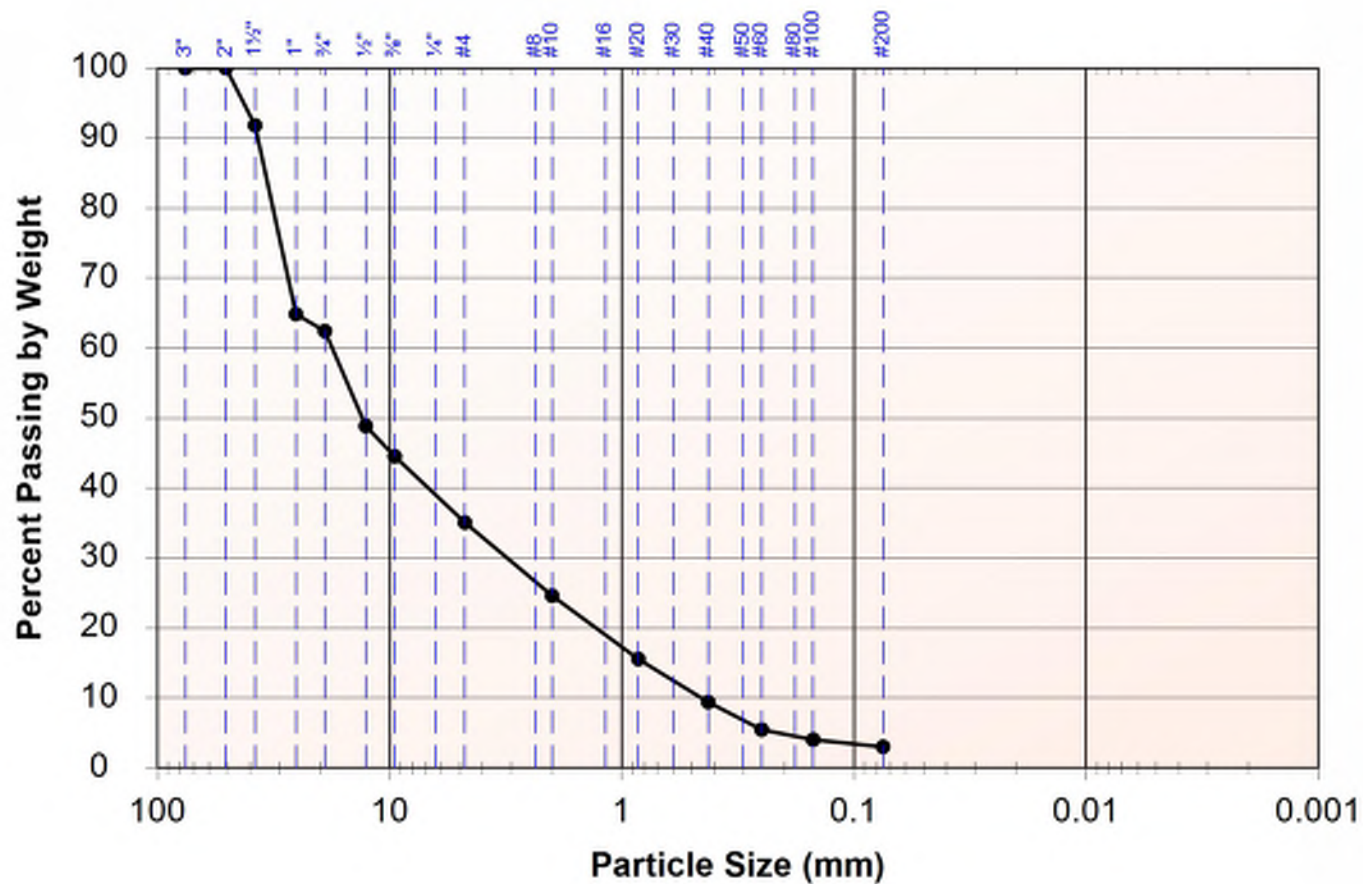
**Lab Number** 2019-514

**Received** 6/21/2019

**Reported** 6/21/2019

**Engineering Classification:** Well Graded Gravel with Sand, GW

**Frost Classification:** Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	92%	
1"	65%	
¾"	62%	
½"	49%	
⅜"	45%	
#4	35%	
Total Weight of Sample 1397.4g		
#10	25%	
#20	16%	
#40	9%	
#60	5%	
#100	4%	
#200	3.0%	
Total Weight of Fine Fraction 490.5g		





Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-22 Sample 1

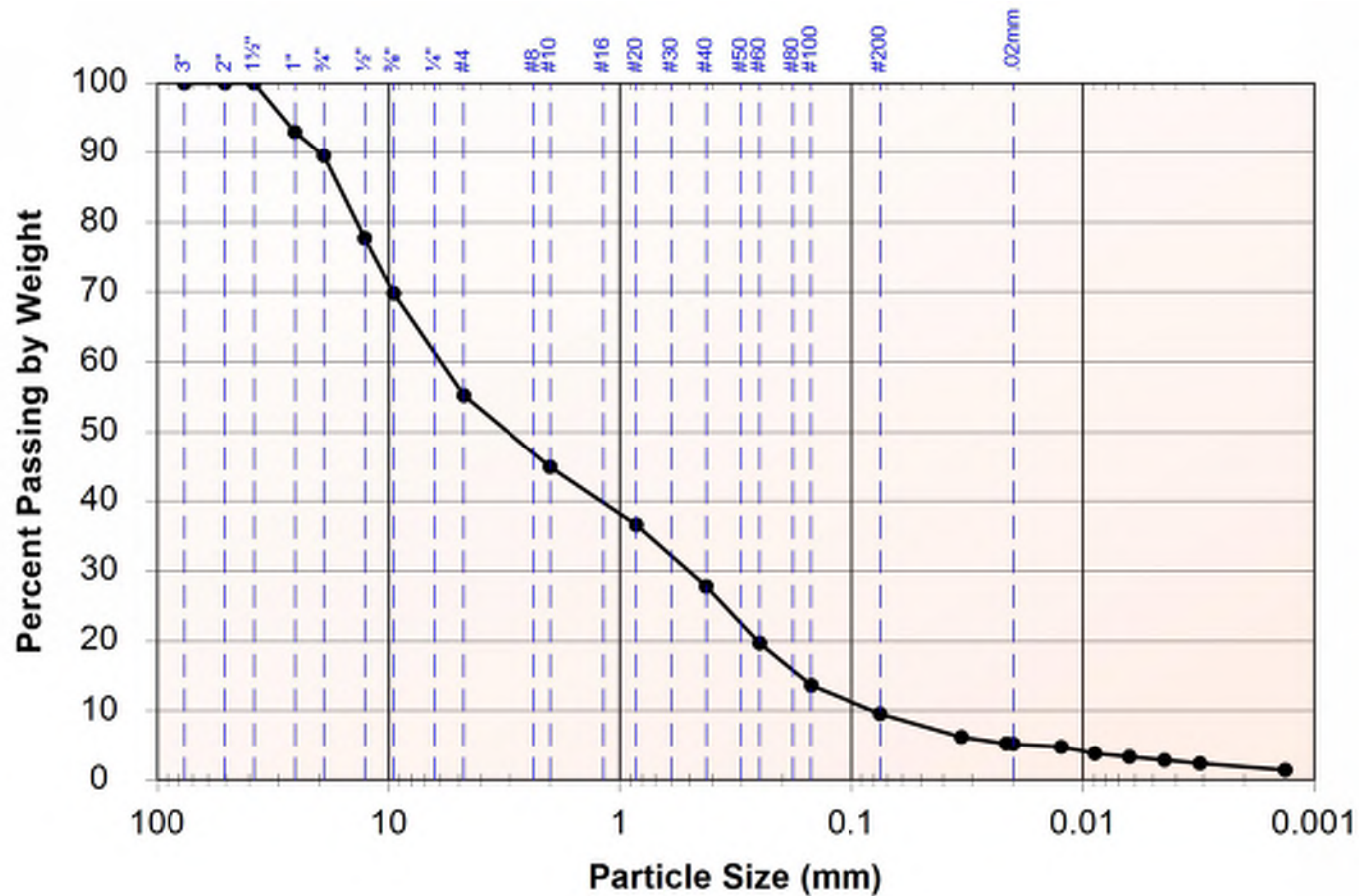
Lab Number 2019-516

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Sand with Silt and Gravel, SP-SM

Frost Classification: S2



Size	Passing	Specification
3"	100%	
2"	100%	
1 1/2"	100%	
1"	93%	
3/4"	90%	
1/2"	78%	
3/8"	70%	
#4	55%	
#10	45%	
Total Weight of Sample 3060.3g		
#20	37%	
#40	28%	
#60	20%	
#100	14%	
#200	9.6%	
Total Weight of Fine Fraction 370.6g		
0.02 mm	5.2%	



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-22 Sample 3

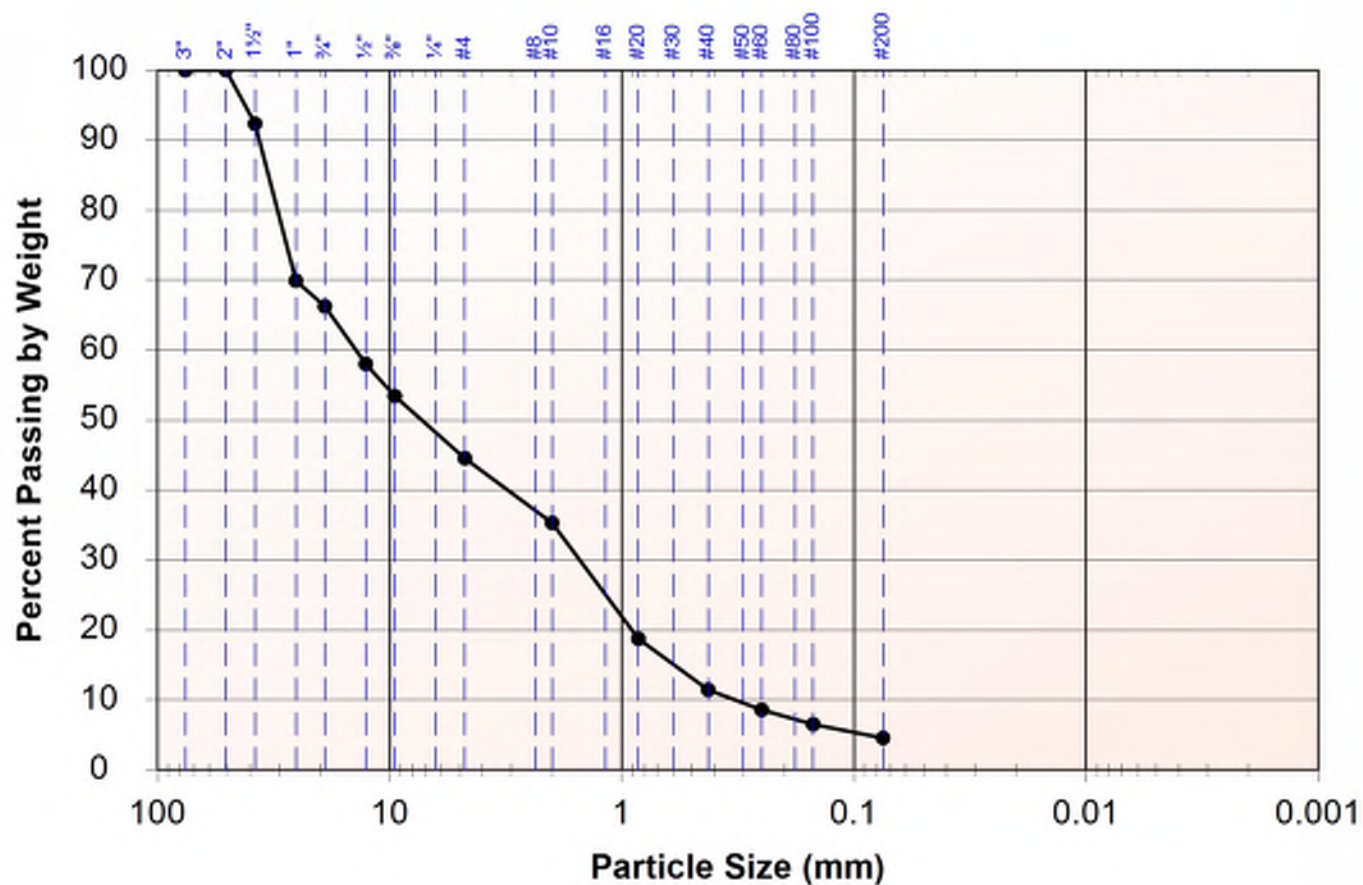
Lab Number 2019-517

Received 6/21/2019

Reported 6/21/2019

Engineering Classification: Poorly Graded Gravel with Sand, GP

Frost Classification: Not Measured



Size	Passing	Specification
------	---------	---------------

3"	100%	
----	------	--

2"	100%	
----	------	--

1 1/2"	92%	
--------	-----	--

1"	70%	
----	-----	--

3/4"	66%	
------	-----	--

1/2"	58%	
------	-----	--

3/8"	53%	
------	-----	--

#4	45%	
----	-----	--

Total Weight of Sample 1515.6g		
--------------------------------	--	--

#10	35%	
-----	-----	--

#20	19%	
-----	-----	--

#40	11%	
-----	-----	--

#60	9%	
-----	----	--

#100	7%	
------	----	--

#200	4.6%	
------	------	--

Total Weight of Fine Fraction 674.7g		
--------------------------------------	--	--



Client: CRW Engineering Group, LLC  
Project: 42nd Ave Upgrade  
Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-23 Sample 1

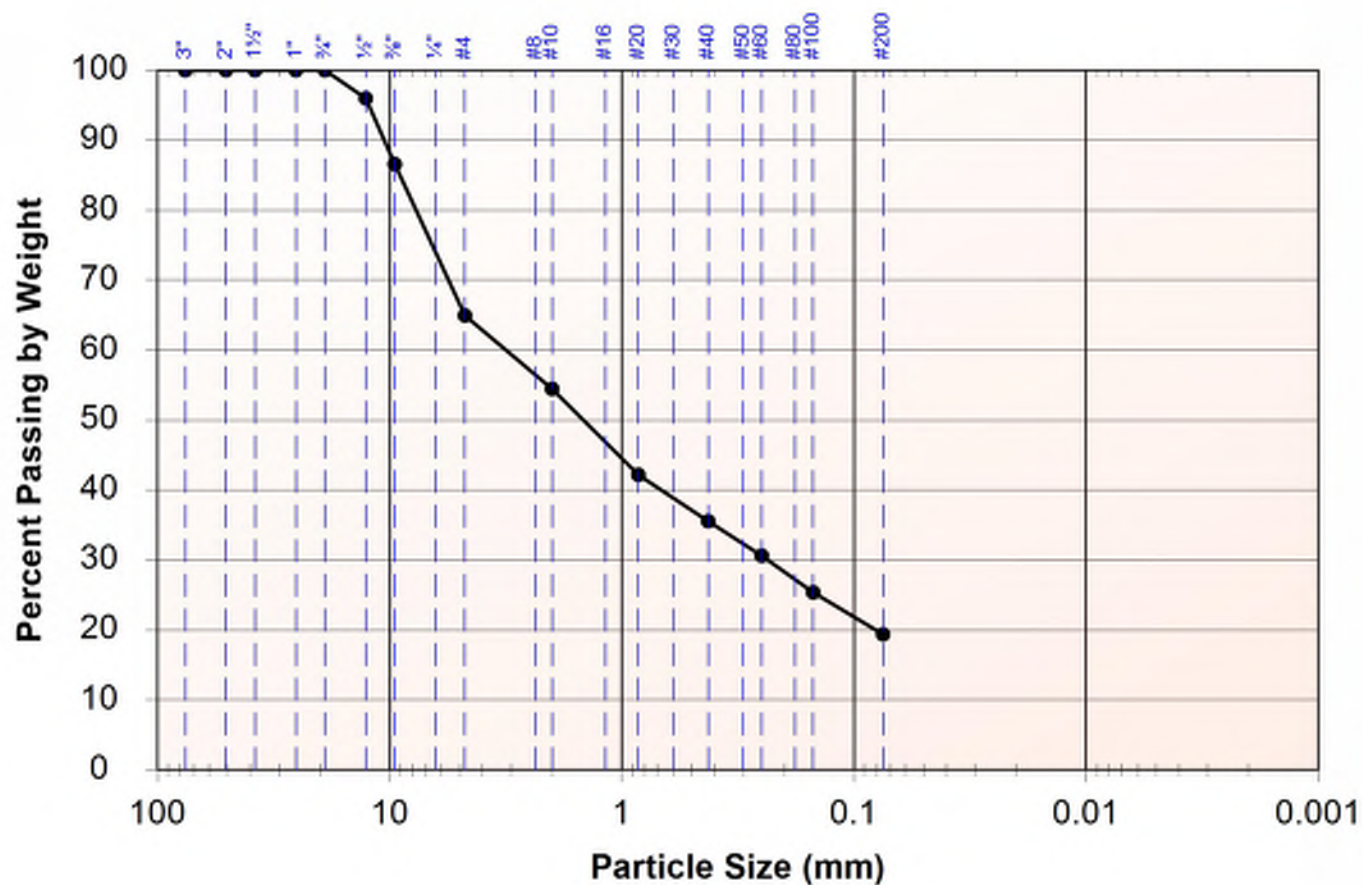
Lab Number 2019-518

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: Not Measured



Size	Passing	Specification
------	---------	---------------

3"	100%	
----	------	--

2"	100%	
----	------	--

1 1/2"	100%	
--------	------	--

1"	100%	
----	------	--

3/4"	100%	
------	------	--

1/2"	96%	
------	-----	--

3/8"	87%	
------	-----	--

#4	65%	
----	-----	--

Total Weight of Sample 1924.8g		
--------------------------------	--	--

#10	54%	
-----	-----	--

#20	42%	
-----	-----	--

#40	36%	
-----	-----	--

#60	31%	
-----	-----	--

#100	25%	
------	-----	--

#200	19.4%	
------	-------	--

Total Weight of Fine Fraction 447.6g		
--------------------------------------	--	--



Client: CRW Engineering Group, LLC  
 Project: 42nd Ave Upgrade  
 Work Order: 517

## Particle Size Distribution

ASTM D422

Location: BH-24 Sample 11

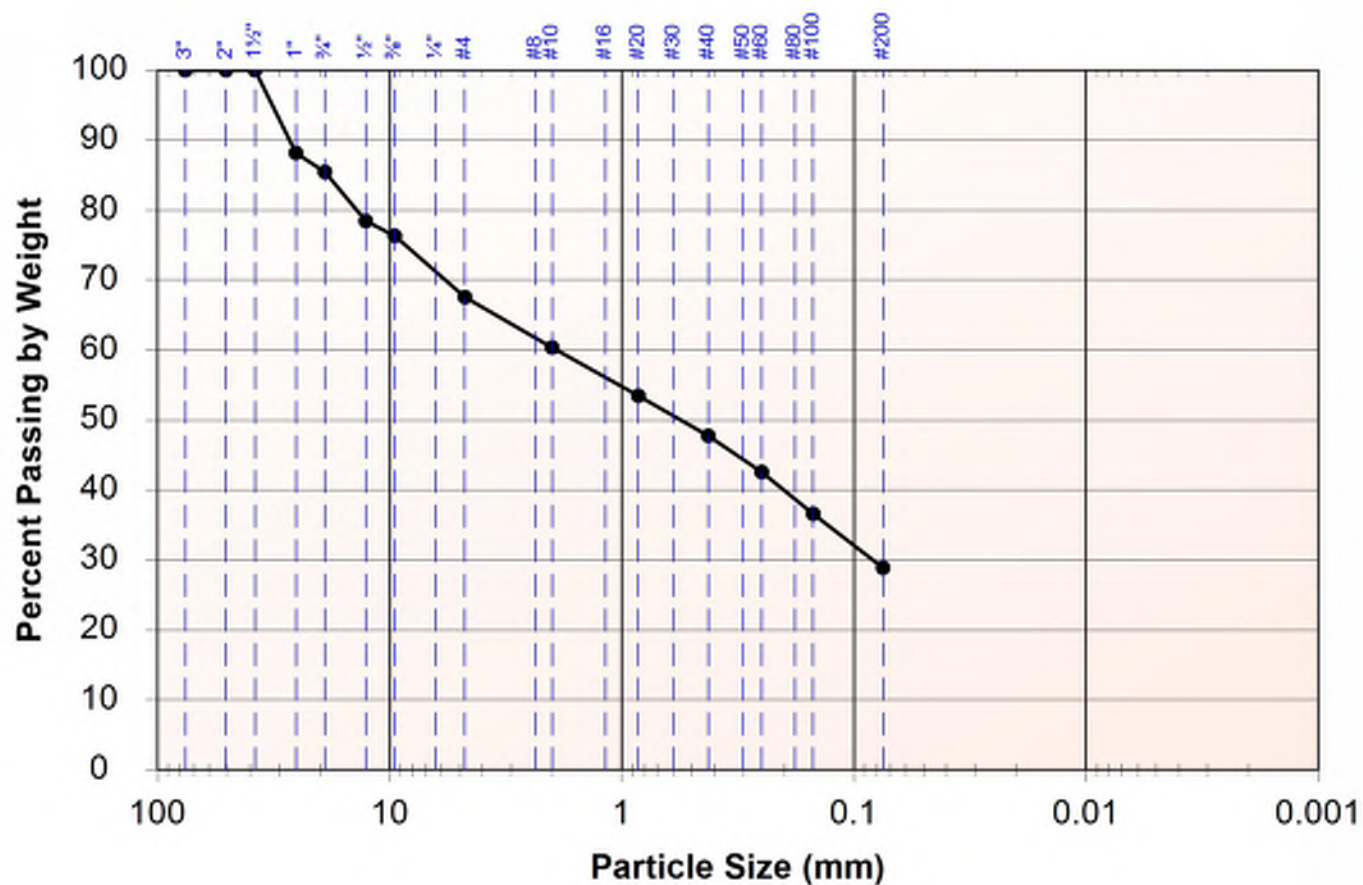
Lab Number 2019-523

Received 5/28/2019

Reported 6/21/2019

Engineering Classification: Silty Sand with Gravel, SM

Frost Classification: Not Measured



Size	Passing	Specification
3"	100%	
2"	100%	
1½"	100%	
1"	88%	
¾"	85%	
½"	78%	
⅜"	76%	
#4	68%	
Total Weight of Sample 1290g		
#10	60%	
#20	53%	
#40	48%	
#60	43%	
#100	37%	
#200	28.9%	
Total Weight of Fine Fraction 455.0g		



# **Appendix C**

## **Site Investigation Photos**

Included in this section:

- 1) Select Site Investigation Photos

<div><b>42<sup>nd</sup> Avenue Upgrade, Anchorage, AK</b> <b>Site Investigation Photos</b></div>	
Photo	Description
	Drilling BH-04.
	Setting up on BH-11.

<div><b>42<sup>nd</sup> Avenue Upgrade, Anchorage, AK</b> <b>Site Investigation Photos</b></div>	
Photo	Description
	Drilling BH-17.
	Completed BH-01.

<div>42<sup>nd</sup> Avenue Upgrade, Anchorage, AK Site Investigation Photos</div>	
Photo	Description
	Completed BH-16.
	May 2019 water level measurements on 42 <sup>nd</sup> Avenue.

# **Appendix D**

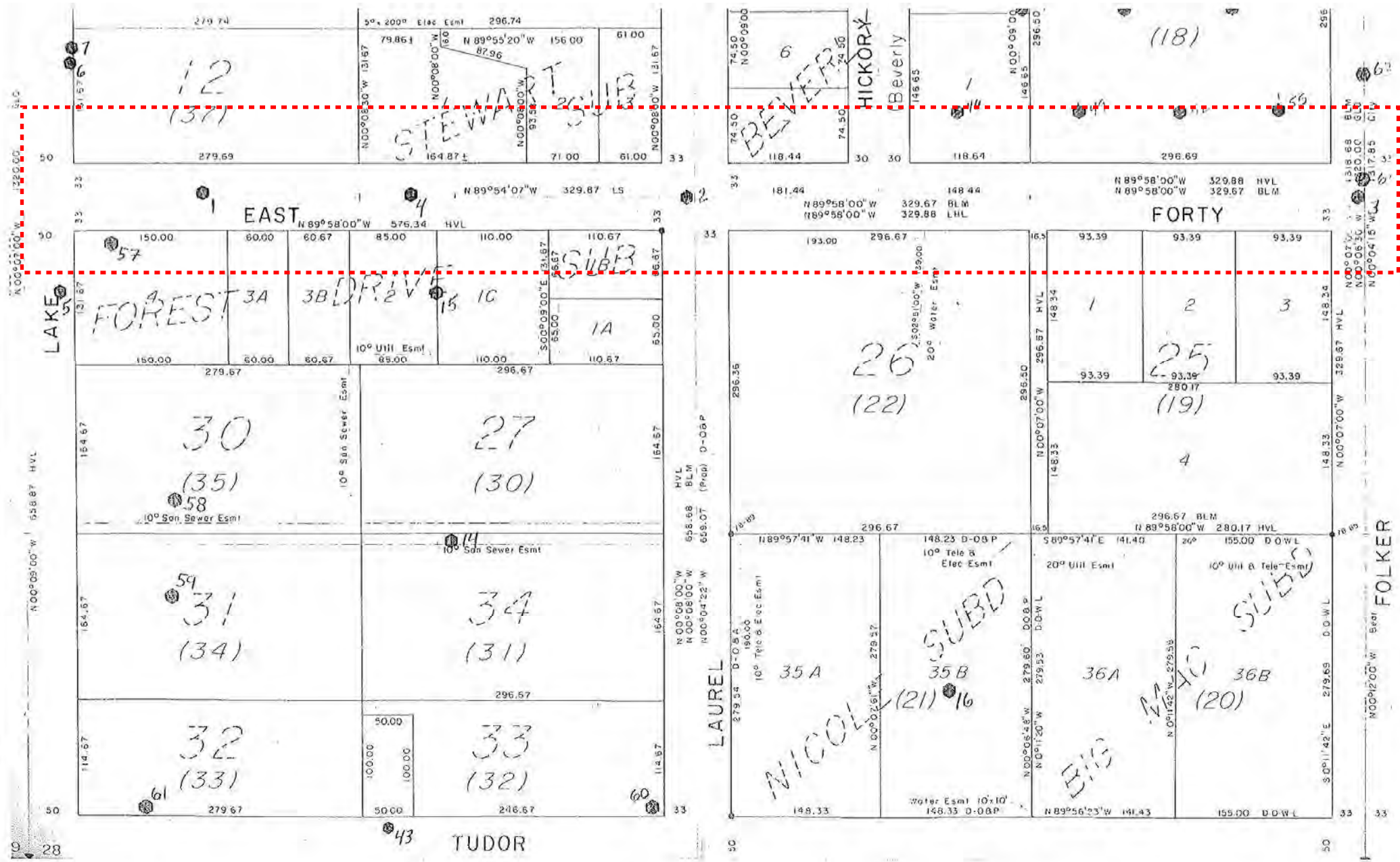
## **Historic Geotechnical Data**

Included in this section:

- 1) Historic Borehole Logs for 42<sup>nd</sup> Ave

**42<sup>nd</sup> Avenue**

**Lake Otis Parkway to Folker Street**





MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

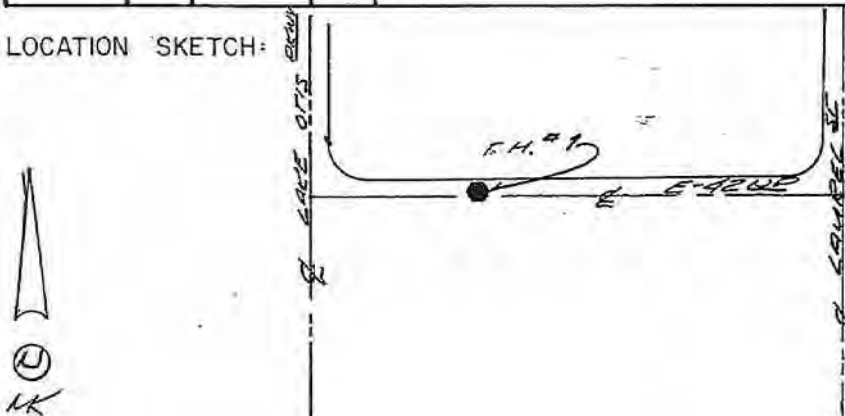
SOILS LOG

LOCATION 4<sup>th</sup> NORTH OF THE 2 OF E 42ND AVE / 175<sup>th</sup> ST  
EAST OF THE 2 OF LAKE OTIS  
COMMENTS ALL TEST CLASSIFICATION BASE ON 0.075MM  
% = 50% OF THE - # 200%

HOLE NO. #1  
DATE 6/9/76  
BY M.E. PRUEGG  
DEPTH 9.5 FT.  
WATER TABLE 7.5

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1		
2	SW-SM 1-A	GR. GULY-SAND w/ SM. SILT / - # 200 = 6% / (46%) (48%) (6%) MOIST = 9.9% / MED. DENSE / NP / LIES TO F-2
3		
4	ML 1-B	GR. SANDY-SILT w/ TRACE OF GRAVEL / - # 200 = 60 (35%) (60%) (5%) MOIST = 25% / FROZEN / NP / F-4
5		
6	GM 1-C	GR. SILTY-SANDY-GRAVEL / - # 200 = 31% / (31%) (32%) (37%) MOIST = 19.9% / MED. DENSE / NP / F-4
7		
8		
9	SW-SM 1-D	RED. WELL GRADED SAND w/ SM. SILT / (93%) (7%) - # 200 = 7.0 / MOIST = 15% / NP / LIES TO F-2 (BORDERLINE)
10		

LOCATION SKETCH:



GRID  
1734-C



# MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

## SOILS LOG

LOCATION 9 OF E. 46<sup>TH</sup> AVE. 1/4<sup>TH</sup> WEST OF CORNER OF  
LAUREL<sup>ST</sup>

COMMENTS ACCEPTED REFUSAL AT -6<sup>FT</sup> DUE  
TO COARSE MATERIAL / ALL FROST CLASSIFICATION  
BASED ON DEN<sup>ITY</sup> = 30% OF -<sup>500</sup>%

HOLE NO. #2

DATE 6/9/76

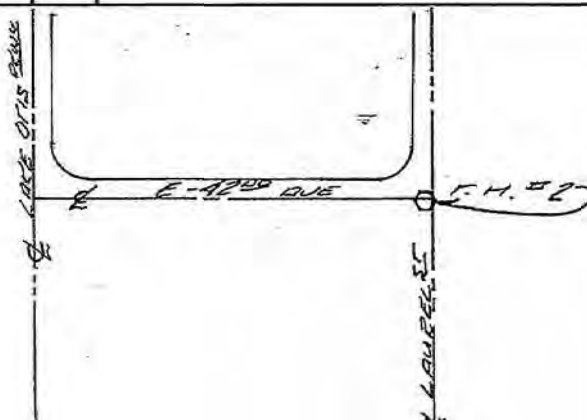
BY M. E. KRUEGER

DEPTH 6<sup>FT</sup>

WATER TABLE None

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1		
2		
3		
4	GP 2-A	(37%) (60%) REL. SANDY - GRAVEL w/ COLL. CORBLE / - <sup>200</sup> = 3% / MOIST = 4% / NP / N.E.S. / DENSE
5		
6		
7		
8		
9		
10		

LOCATION SKETCH:



Grid  
1734C

MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

SOILS LOG

LOCATION S. OF E. 42ND AVE. / 4th WEST OF FOLKERS ST

HOLE NO. 53 3

DATE 6/19/76

BY M.E. KRUEGER

COMMENTS ALLEGED REFUSE AT -8ft DUE

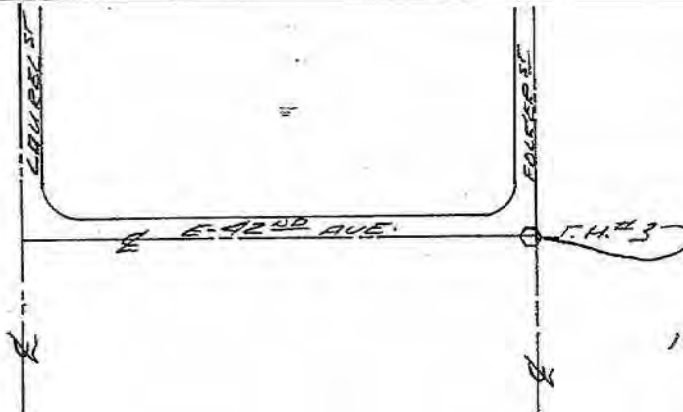
DEPTH 8ft

TO COARSE MATERIAL / ALL FROST CLASSIFICATION  
BASE ON .02mm % = 50% OF - #200

WATER TABLE N/A

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1		
2		
3		
4		
5		
6	GP 3-A	REL. <sup>(40%)</sup> SANDY-GRAVEL w/ <sup>(59%)</sup> OLL. CORBLE / - #200 = 1. % / MOIST = 3. % / NP / N.E.S. DENSE
7		
8		
9		
10		

LOCATION SKETCH:



1734-C

MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

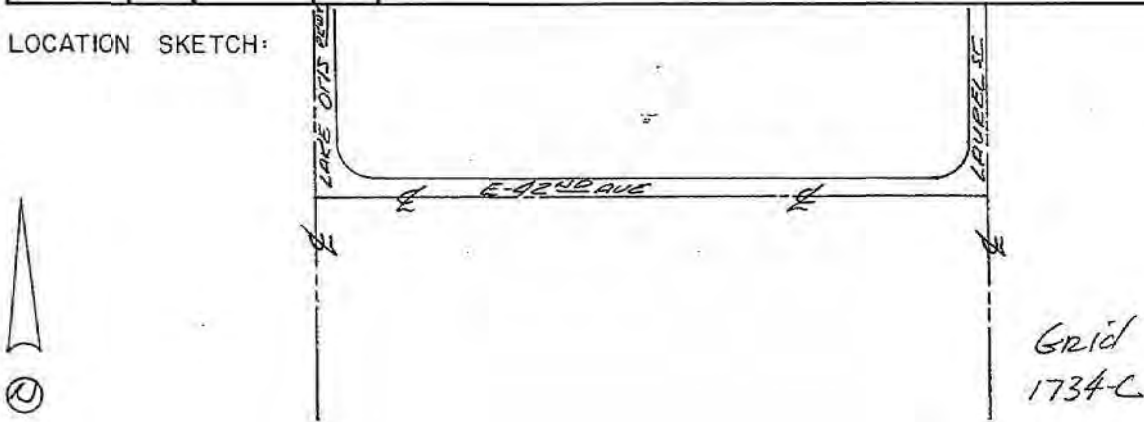
## SOILS LOG

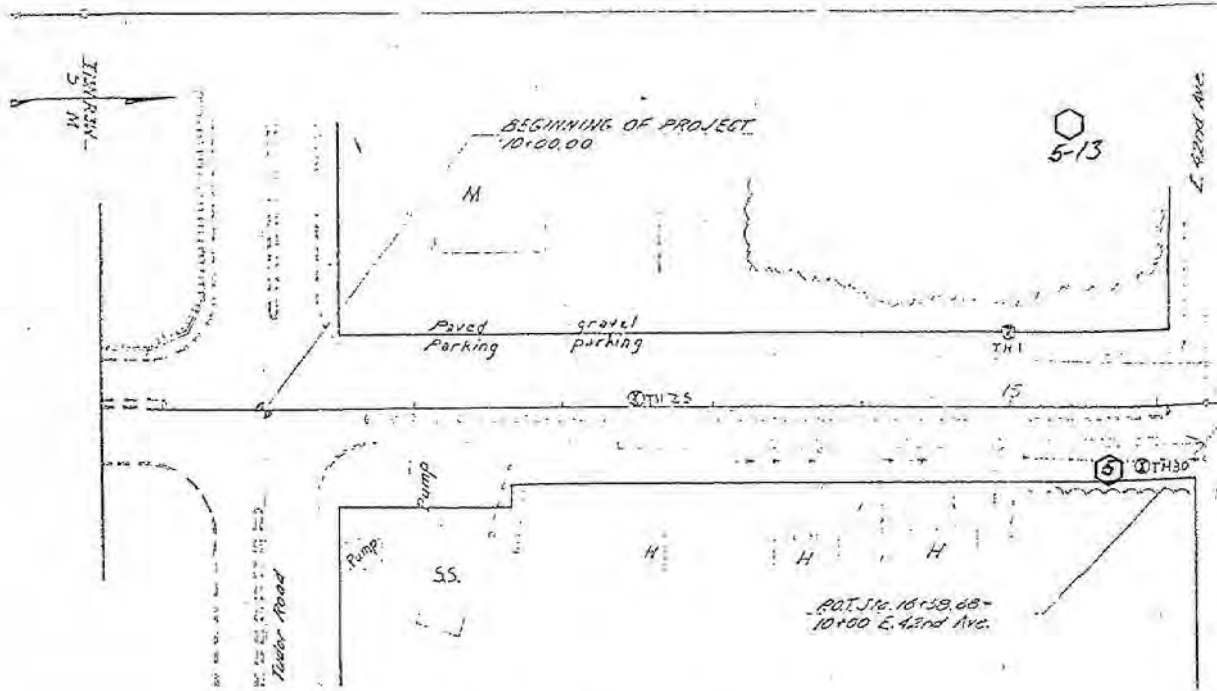
LOCATION # OF E-42ND / 2.75' WEST OF THE # OF  
LAUREL ST / 420' EAST OF THE # OF LAUREL ST  
COMMENTS ALL FROST CLASSIFICATION BASED ON  
0.02 MIN. = 50% OF THE - #200

HOLE NO. #7  
DATE 6/9/76  
BY M. E. KRUEGER  
DEPTH 9.5' FT  
WATER TABLE 8' FT

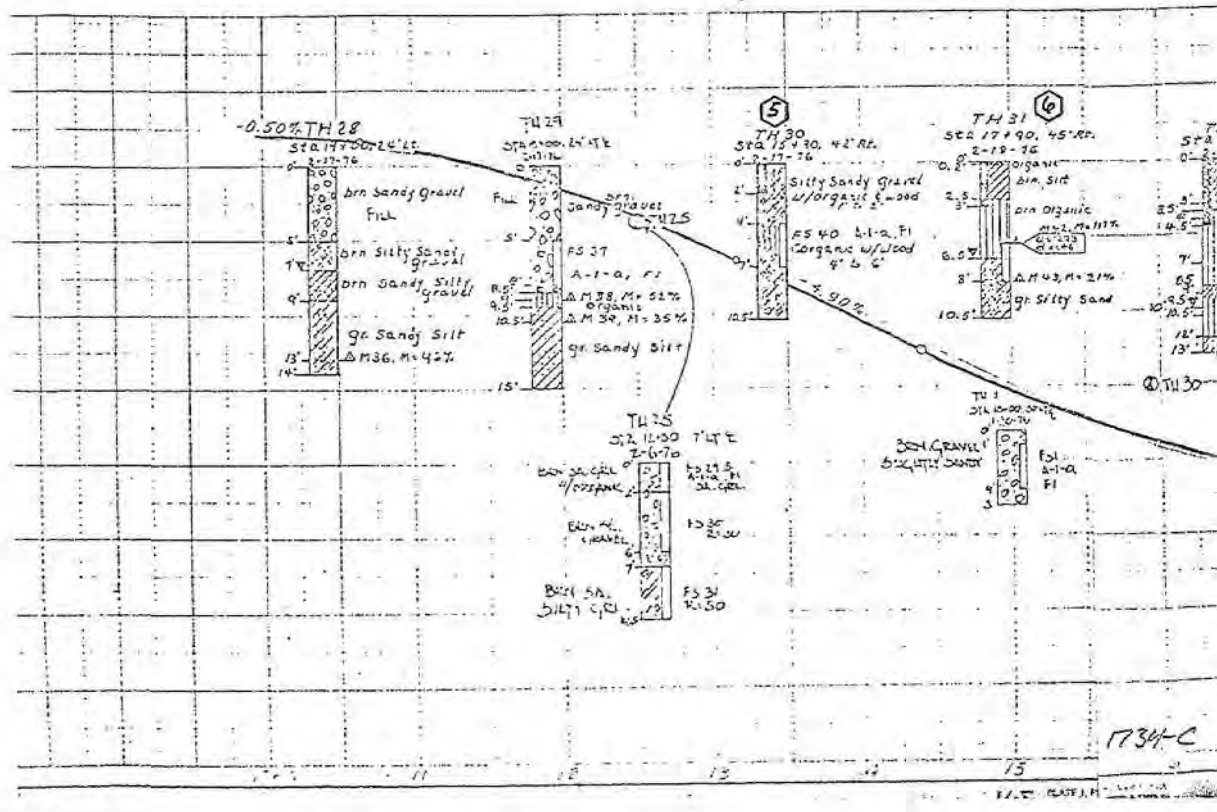
DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1	GM	7-A BRN. SILTY - SANDY - GRAVEL w/ A TRACE OF ORGANIC (25%) (30%) (47%) - #200 = 23% / MOIST. = 14.1% / NP / F-2 / MED. DENSE
2		
3		
4	SM	7-B BRN. GULY - SILTY - SAND / (15%) (47%) (40%) - #200 = 47% / MOIST. = 14.1% NP / F-4 / MED. DENSE
5		
6		
7		
8		
9	SM	7-C BRN. SILTY - GULY - SAND / (15%) (14%) (25%) - #200 = 13% / MOIST. = 16% NP / F-2 / LOW DENSITY
10		

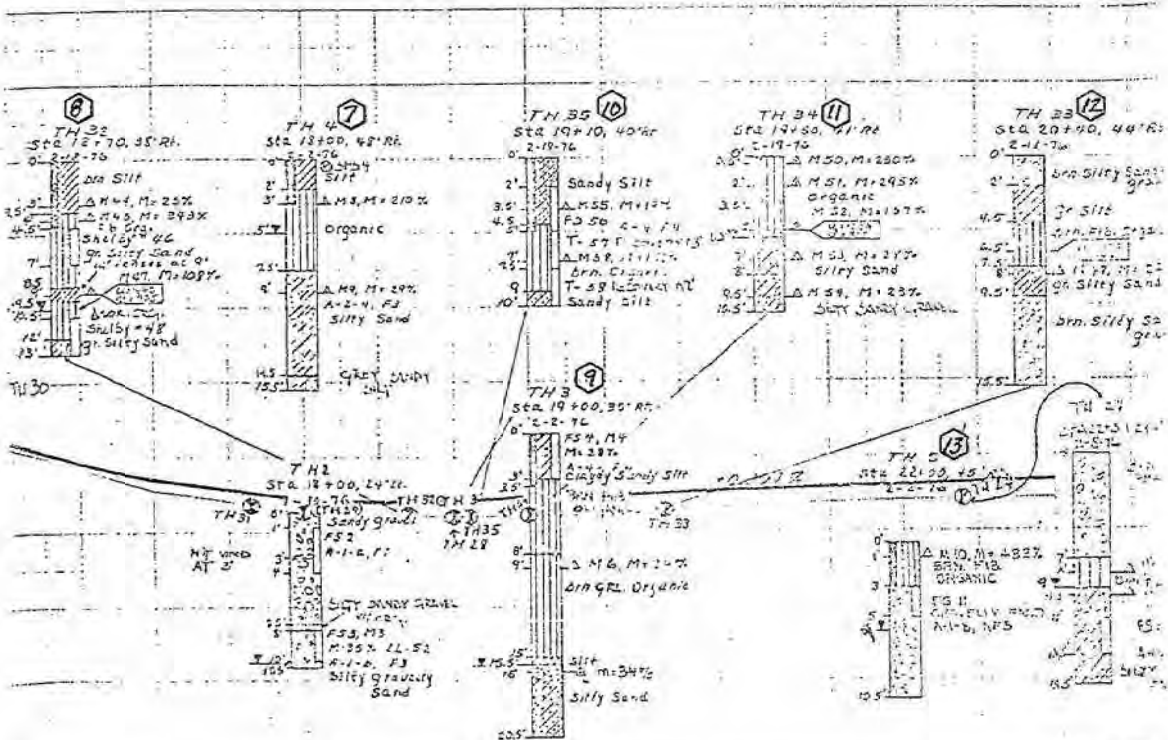
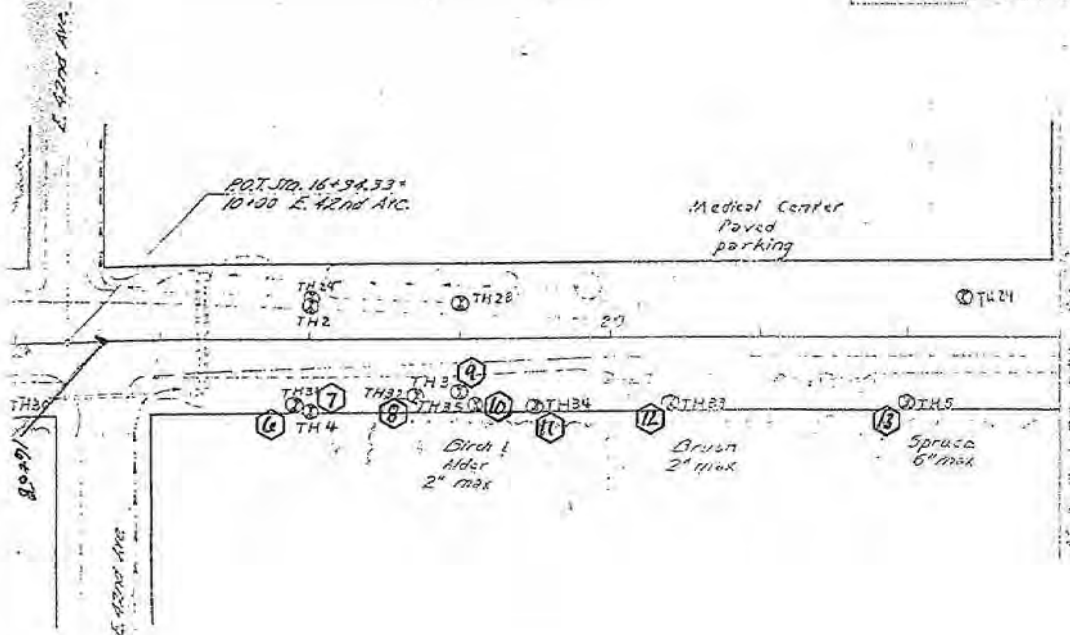
LOCATION SKETCH:





State of Alaska DOT  
 Lokoris Parkway





Performed For S. G. Heflin Date Performed 19 January 1970  
Legal Description: Lot        Block        Subdivision FOREST DRIVE SUBDIVISION  
This Form Reports a: Soils Log X Percolation Test       

Depth Feet	Soil Characteristics	Location Sketch
1	Silt topsoil - ML	
2		
3	Glacial Till, consisting of	
4	Silty gravel GM	
5		
6		
7		
8		
9		
10		
11		
12		

Was Ground Water Encountered? No

If Yes, At What Depth       

Slope       

Reading	Date	Gross Time	Net Time	Depth To H <sub>2</sub> O	Net Drop

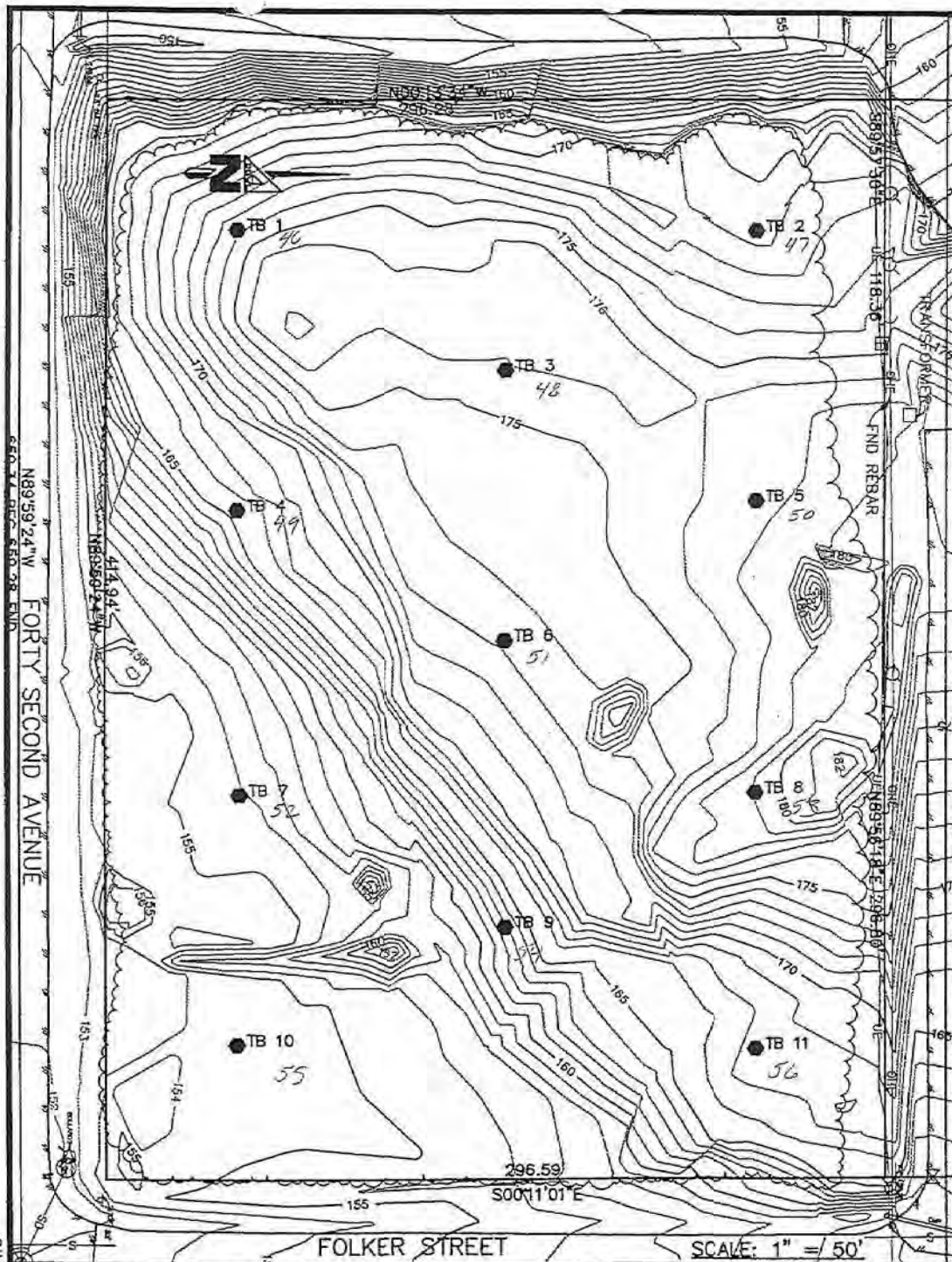
Percolation Rate 1"        Minute  
Proposed Installation: Seepage Pit        Drain Field         
Depth Of Inlet        Depth To Bottom Of Pit Or Trench         
COMMENTS: Seepage area required: 225 square feet  
per hour - based on soil conditions to depth of  
each lot listed above

Test Performed By: Alaska Geological Consultants

Data Certified By: J. P. M. Jensen  
Date: 1-19-70

RECEIVED  
JAN 28 1970  
1734c





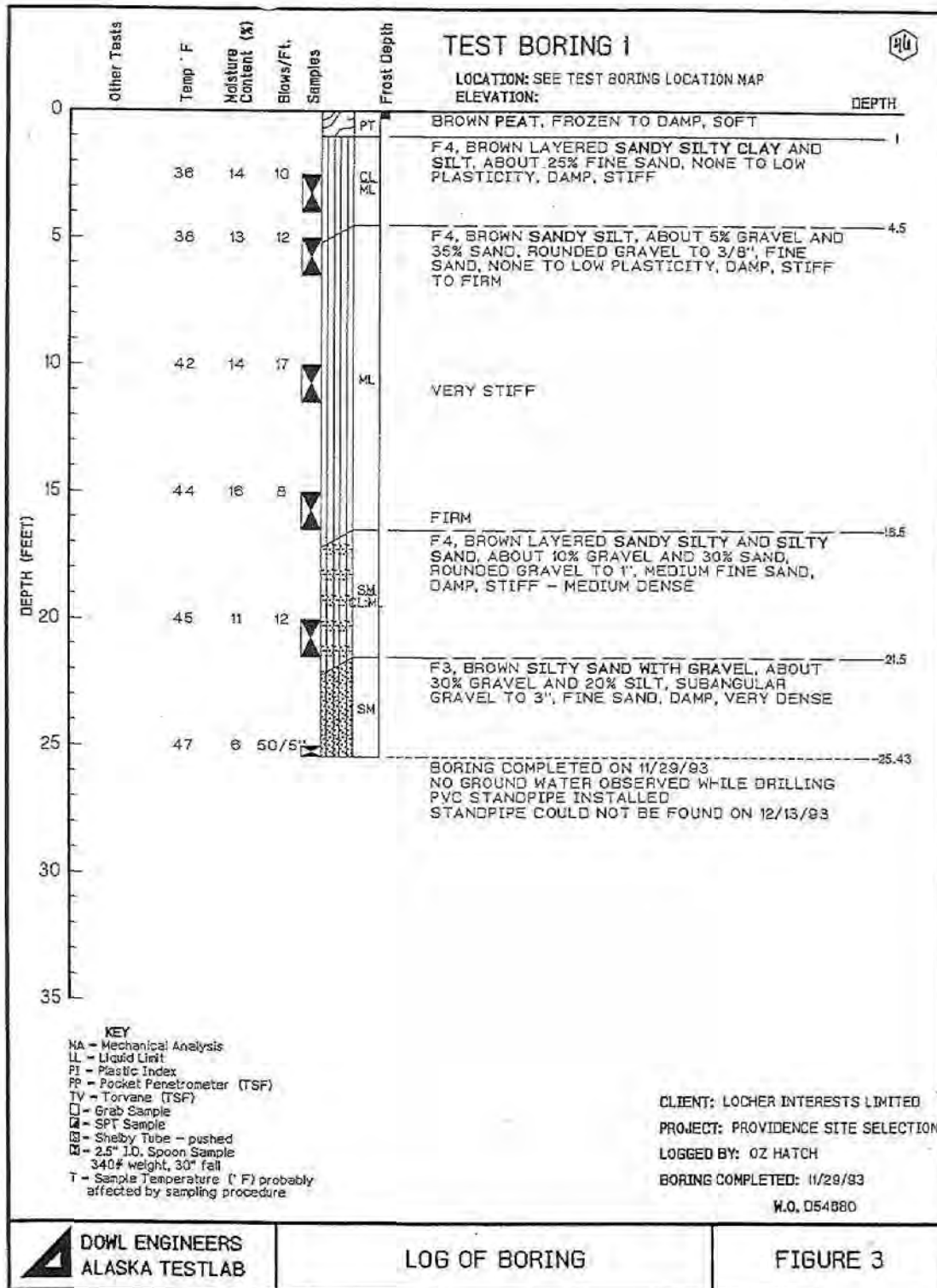
D54680  
GRID 1734  
ETBLADY.DWG

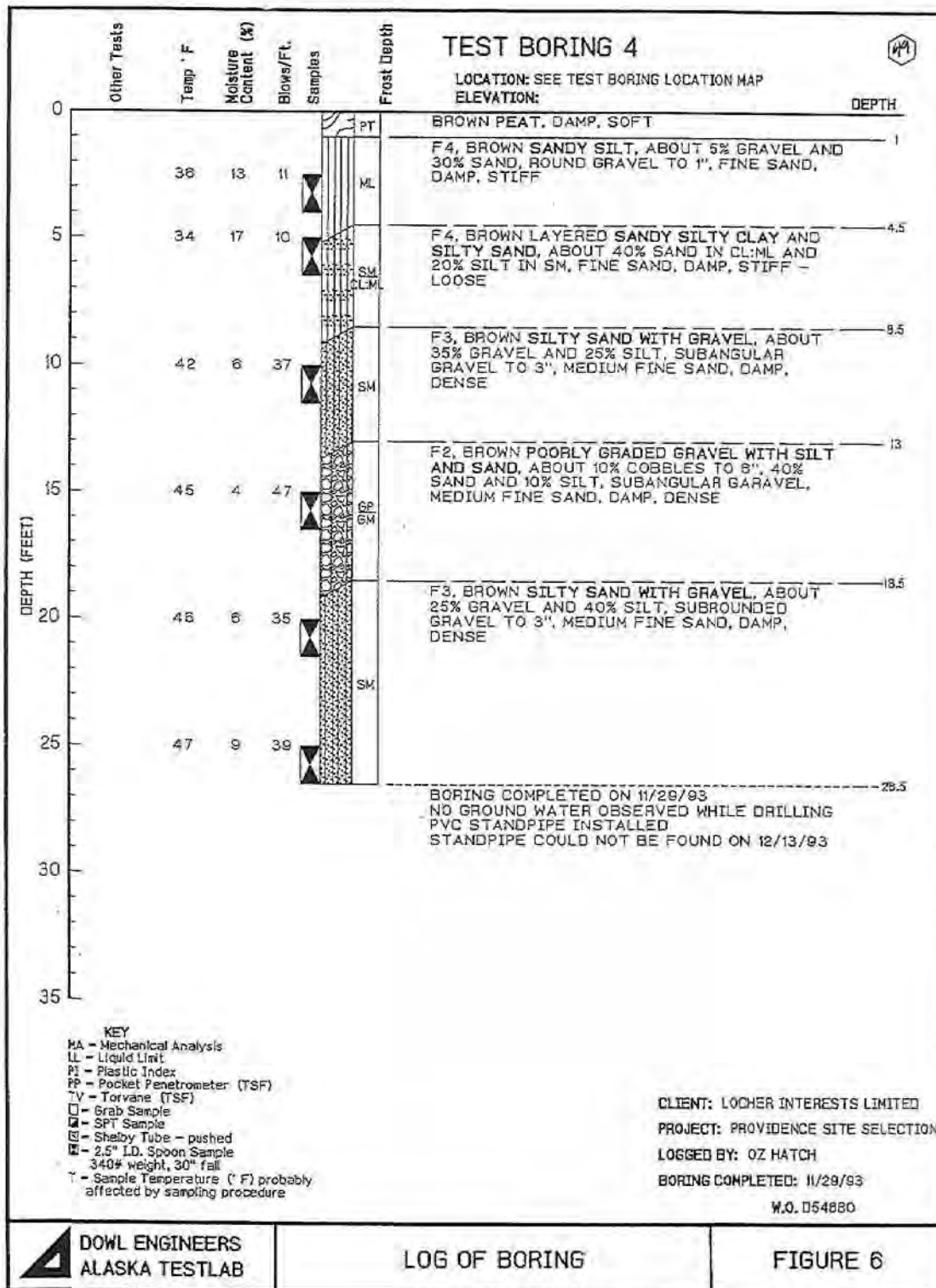
**DOWL**  
ENGINEERS

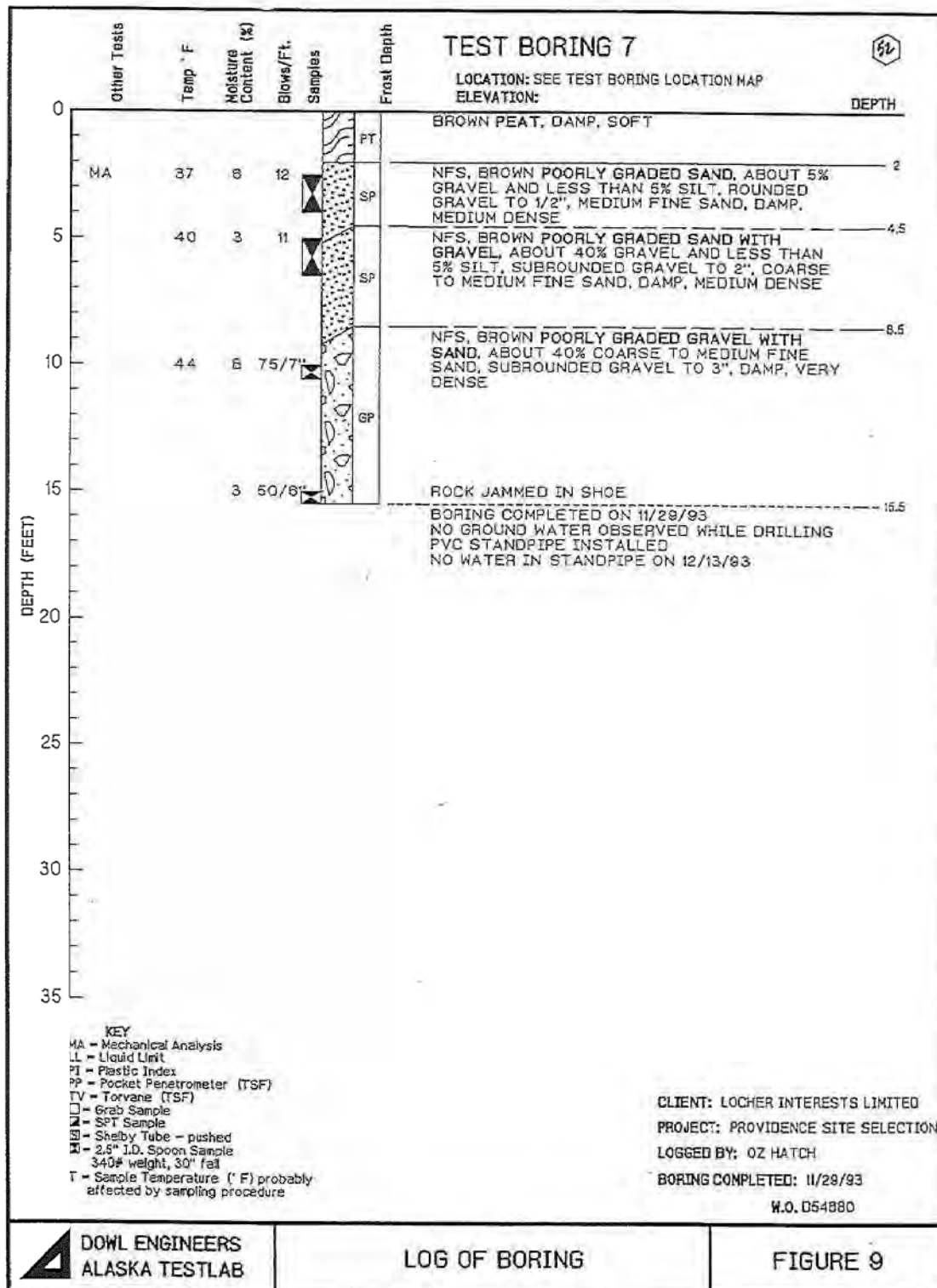
TEST BORING  
LOCATION MAP

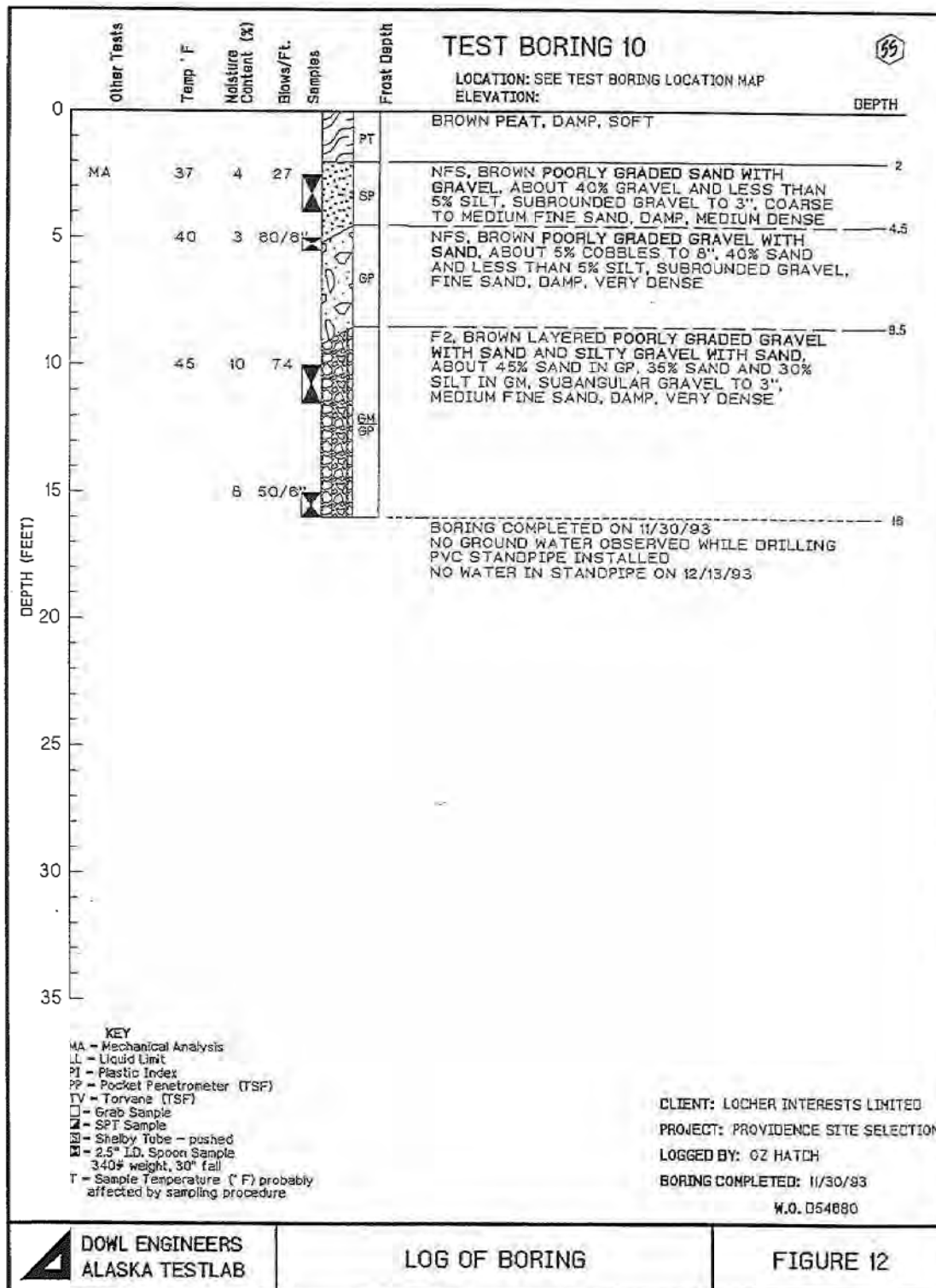
FIGURE 2



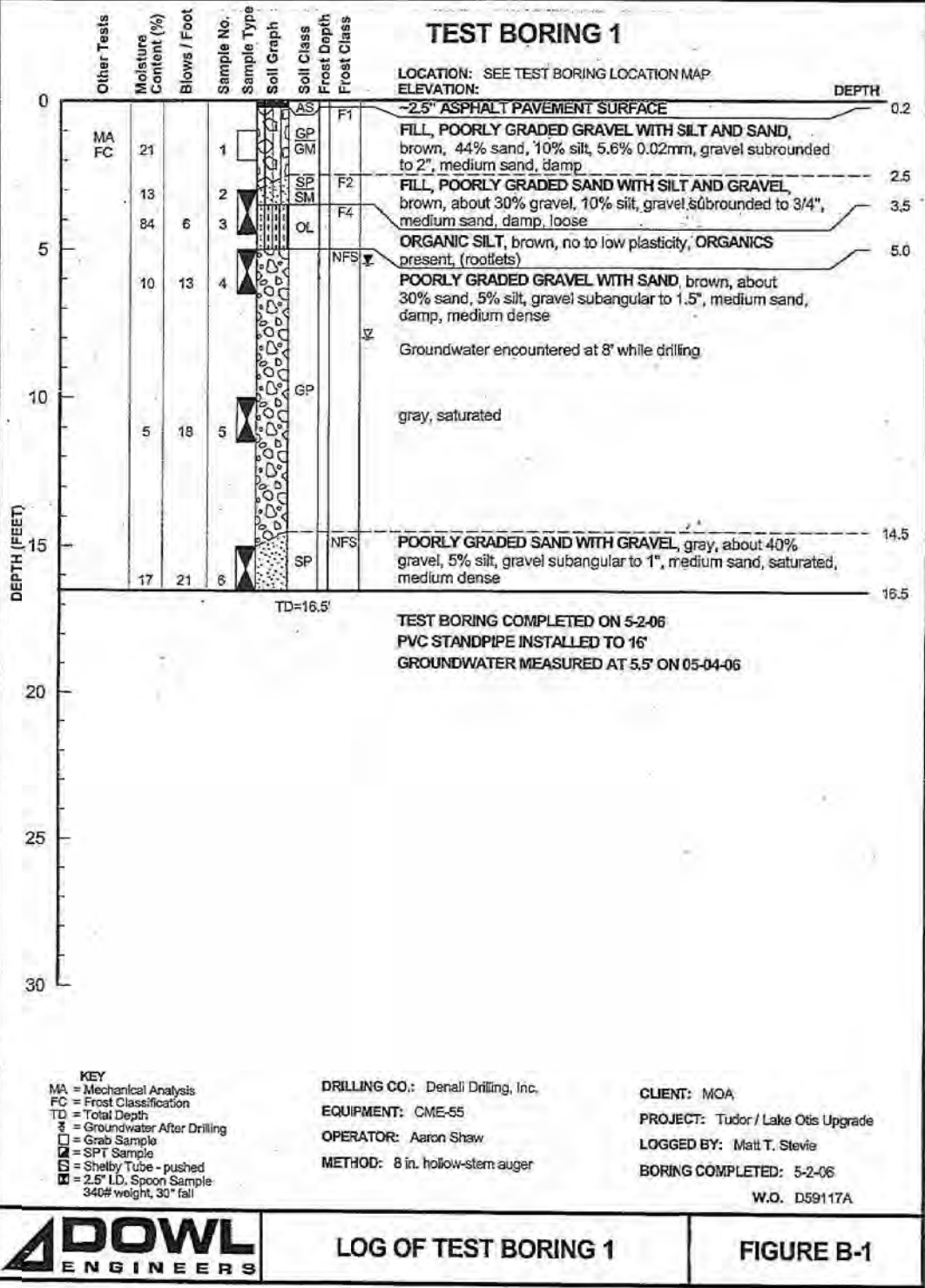








# TEST BORING 1

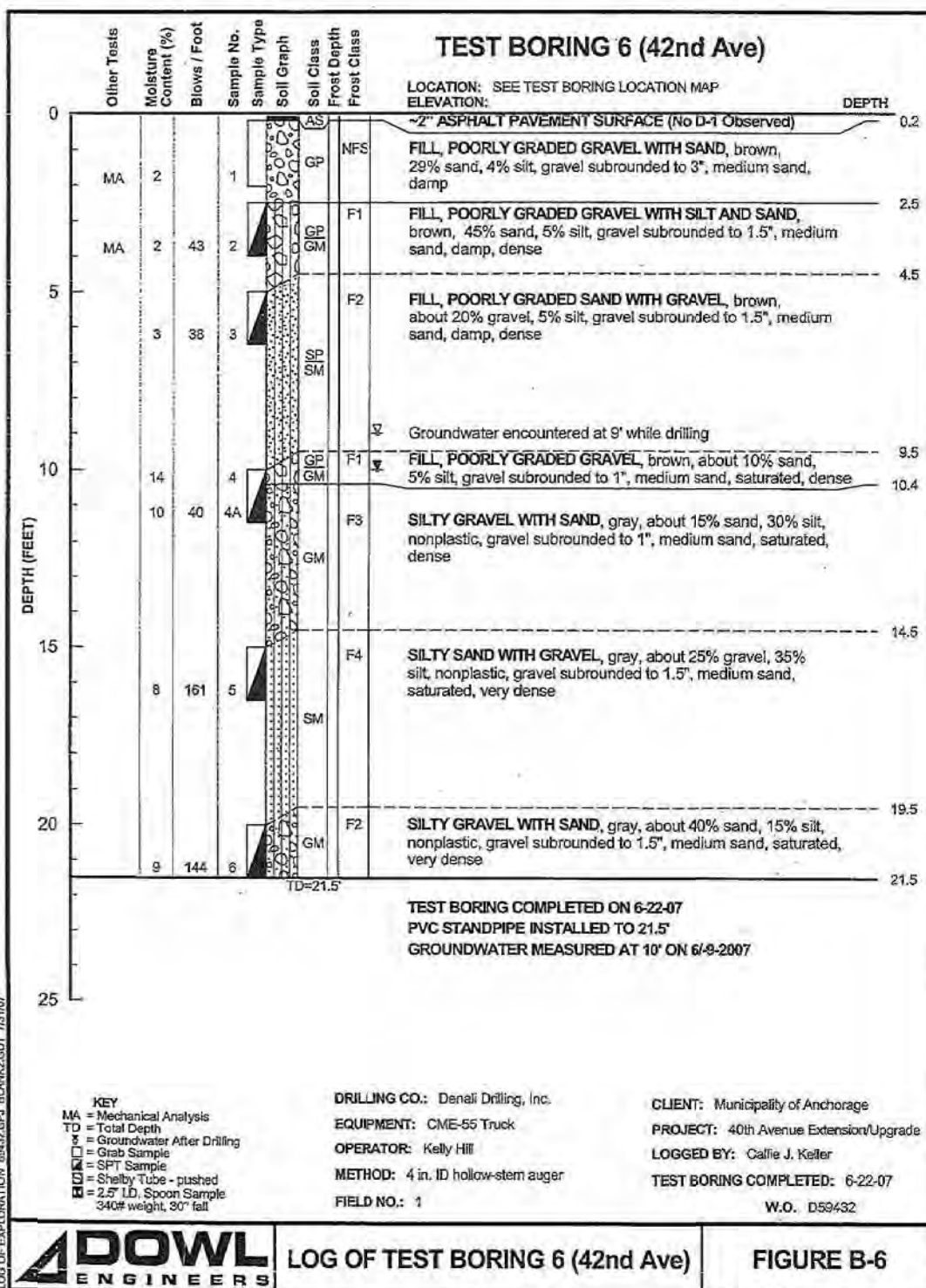


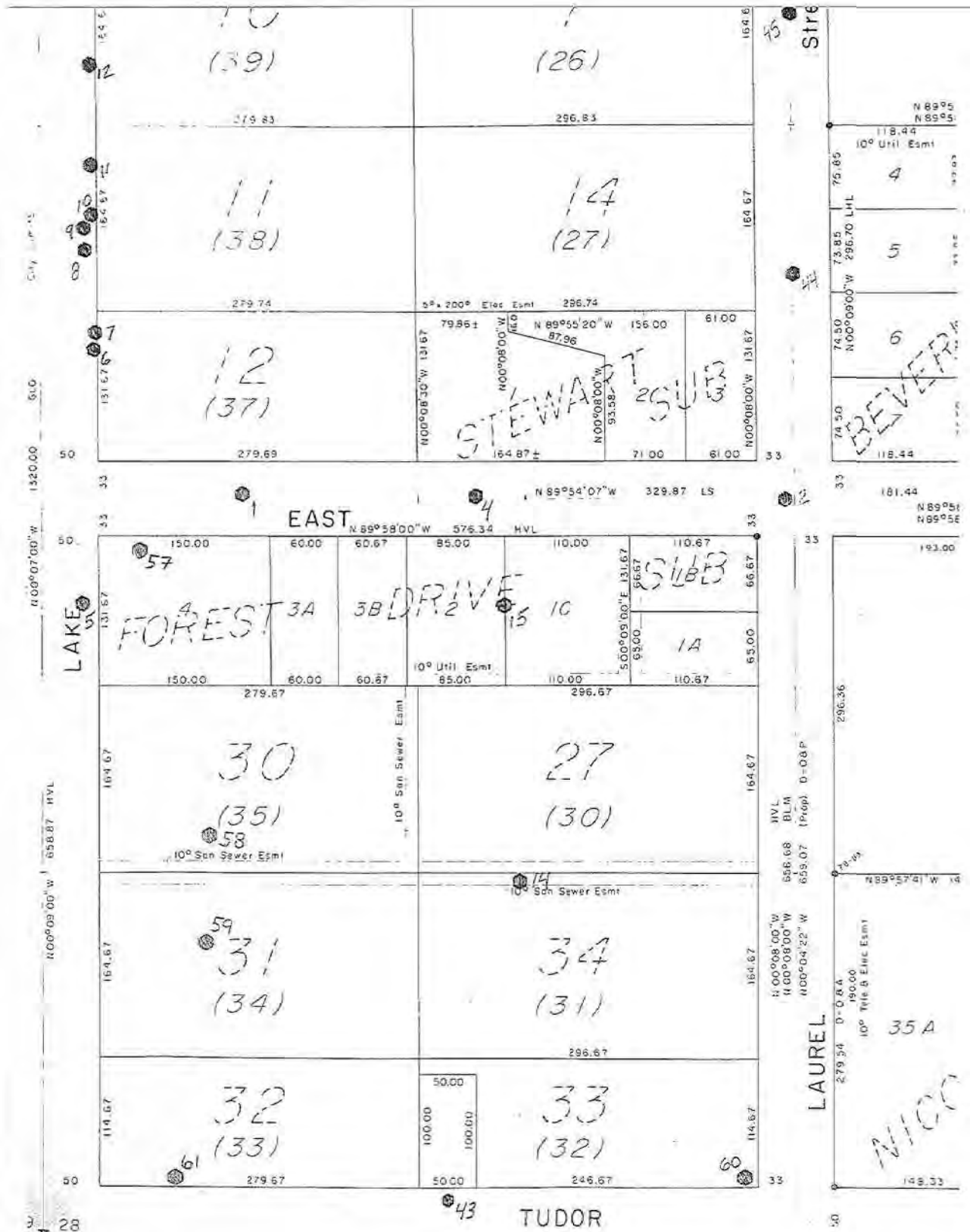
LOG OF EXPLORATION 59117A.GPJ BLANK2.GDT 2/14/07



LOG OF TEST BORING 1

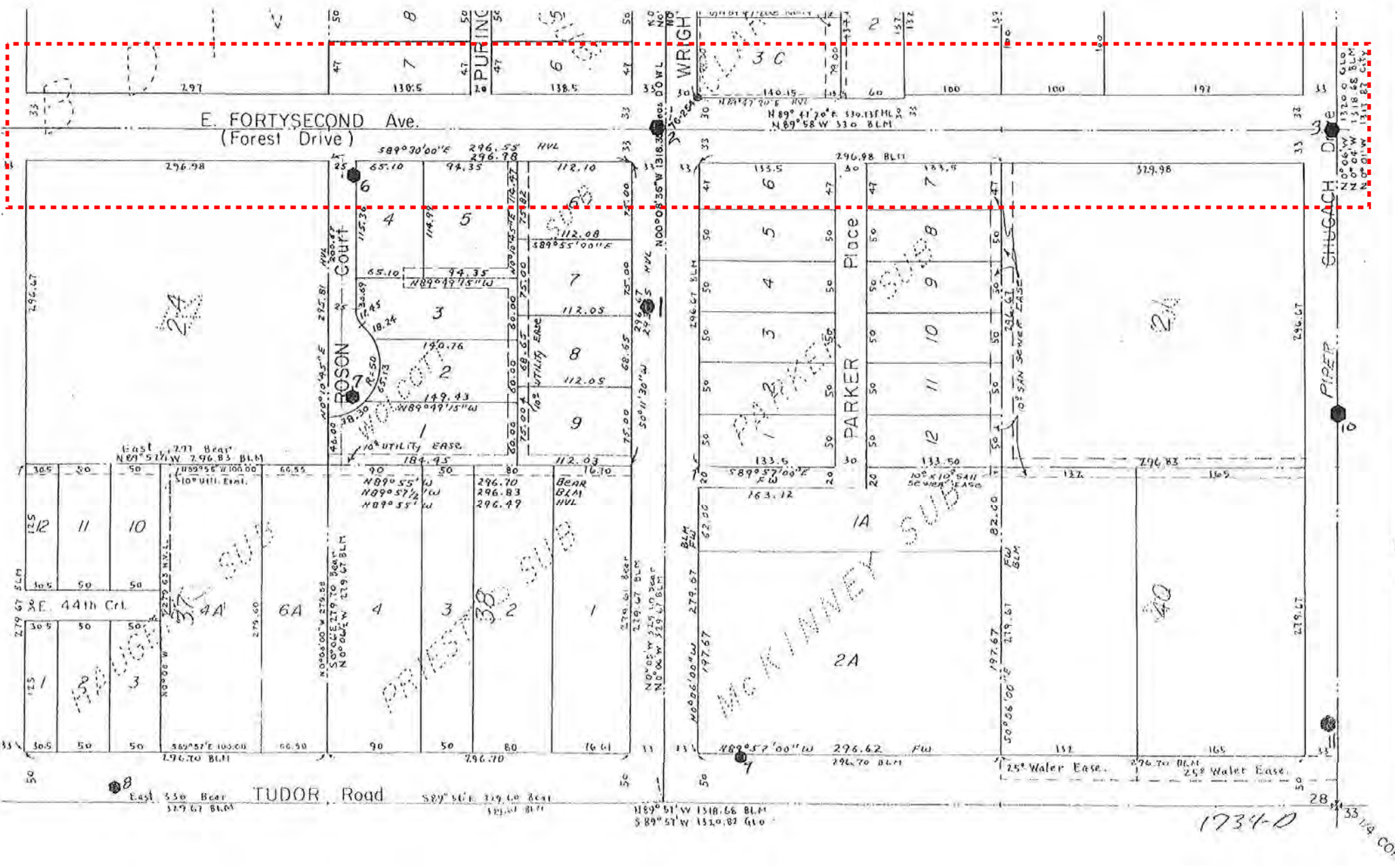
FIGURE B-1







**42<sup>nd</sup> Avenue**  
**Folker Street to Piper Street**



MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

2

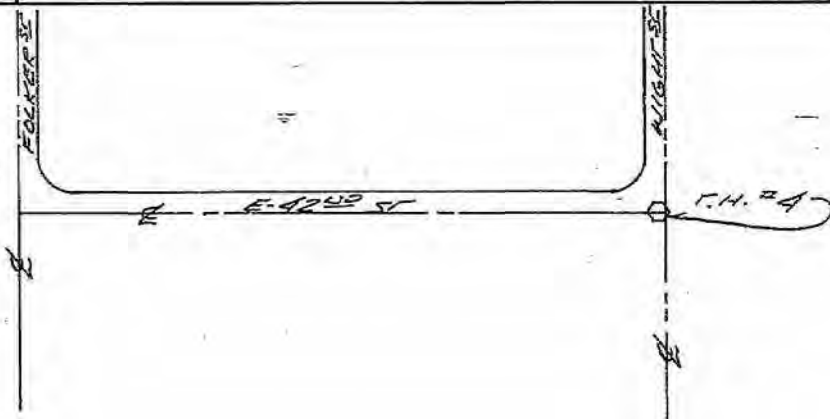
SOILS LOG

LOCATION 8 OF E-42ND AVE. / 4 FEET WEST OF THE 2  
DE WRIGHT ST  
COMMENTS ALL FROST CLASSIFICATION BASE ON  
0.07 MIN % = 50% OF - # 200%

HOLE NO. #4  
DATE 6/9/76  
BY W. E. KUEHL  
DEPTH 9.5 FT  
WATER TABLE WRA

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST GROUND / ROAD SURFACE
1		
2		
3		
4		
5	GWGM 4-A	(56%) (56%) (3%) REL. SANDY - GRAVEL W/ S.M. SILT FOLL COBBLE + ISOLATED BOULDER / - #200 = 8% / MOIST = 7% N.P. / N.E.S. TO F-1
6		
7		
8		
9		
10		

LOCATION SKETCH:



**MUNICIPALITY OF ANCHORAGE**  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

3

**SOILS LOG**

LOCATION 2 OF E-42 / 2 OF PIPER ST

HOLE NO. #5

DATE 6/9/76

BY M.E. KRUEGER

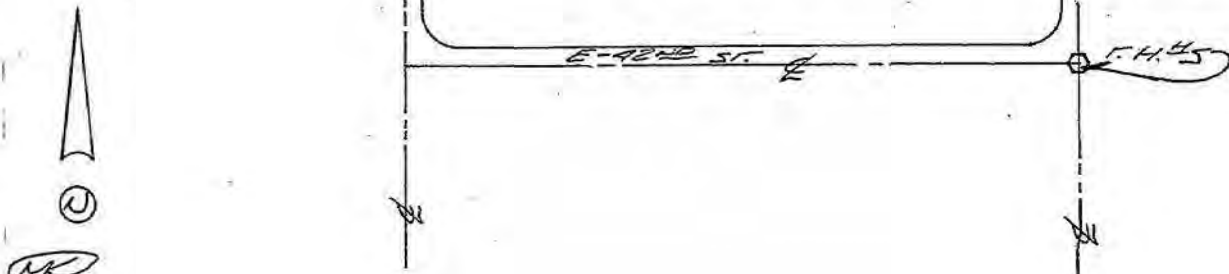
COMMENTS ALL BEST CLASSIFICATION BASED ON 20% =  
50% OF - #200 %

DEPTH 9 FT

WATER TABLE None

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1	GW S-A	(32%) (65%) (5%) BRN. SANDY-GRAVEL w/ SM. SILT & ALL. COBBLE - #200 = 5% / MOIST = 5% / NP / N.E.S. / DENSE
2		
3		
4	GW S-B	(41%) (57%) BRN. SANDY-GRAVEL w/ ALL. COBBLE / WELL-GRADED / - #200 = 2% / MOIST = 7% NP / N.E.S. / DENSE
5		
6		
7	GW S-C	(47%) (51%) BRN. SANDY-GRAVEL w/ ALL. COBBLE / - #200 = 2% / MOIST = 8% / NP / N.E.S. DENSE
8		
9		
10		

LOCATION SKETCH:



# MUNICIPALITY OF ANCHORAGE

## DEPARTMENT OF PUBLIC WORKS CONSTRUCTION DIVISION

### SOILS LOG

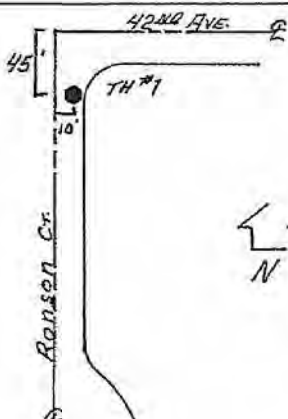
LOCATION Ranson Cr. / 10' East of E Ranson Cr.  
45' South of E 42nd Ave.

COMMENTS \_\_\_\_\_

D  
⑥  
HOLE NO. 1  
DATE 8/31/84  
BY D.N. Rolles  
DEPTH 9 2'  
WATER TABLE 7 2'

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
1-A EX-106	0			Existing Grade
	1	GW/GM	F-1	Brown - Sandy (28%) Gravel (6.2%) w/silt (10%)
	2			& Cobbles (>20%) / Moist. = 7% / Medium Density
	3			
1-B EX-107	4	GW/GM	NFS to F-1	Red + Brown - Sandy (31%) Gravel (6.3%) w/silt (6%)
	5			& Cobbles (≈ 20%) / Moist. = 5% / Moderately Low Dens.
	6			Sloughing From - 3 2'
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			

LOCATION SKETCH:



**LEGEND**

SYMBOL

TEST HOLE

WATER TABLE

FROZEN MATERIAL

ALL FROST CLASSIFICATION  
BASED ON THE .02mm = 50%  
OF THE #200 UNLESS  
OTHERWISE NOTED

**42<sup>nd</sup> Avenue**

**Piper Street to Florina Street**





# MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

## SOILS LOG

LOCATION 42<sup>ND</sup> AVE / 200' E. 4<sup>TH</sup> ST. PIPERS  
20' N. 4<sup>TH</sup> E-42<sup>ND</sup> AVE

COMMENTS \_\_\_\_\_

HOLE NO. 3

DATE 7/12/96

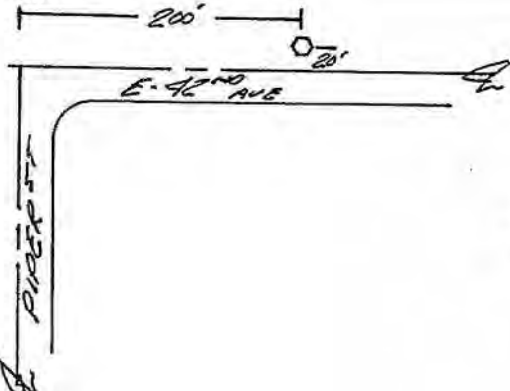
BY J. JACOBSEN

DEPTH 10.2'

WATER TABLE 7.2'

DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
0	SM	F-2	BRN SILTY-GULY-SAND / MED MOIST
1			DENSE
2			
3			
4			
5	SW	NF	BRN GULY-SAND / COBBLES (12") / MED MOIST
6			DENSE
7			
8			
9			
10			
11			
12			
13			
14			

LOCATION SKETCH:



### LEGEND

SYMBOL

- TEST HOLE
- WATER TABLE
- FROZEN MATERIAL

ALL FROST CLASSIFICATION  
 BASED ON THE .02mm = 50%  
 OF THE #200 UNLESS  
 OTHERWISE NOTED

MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

④

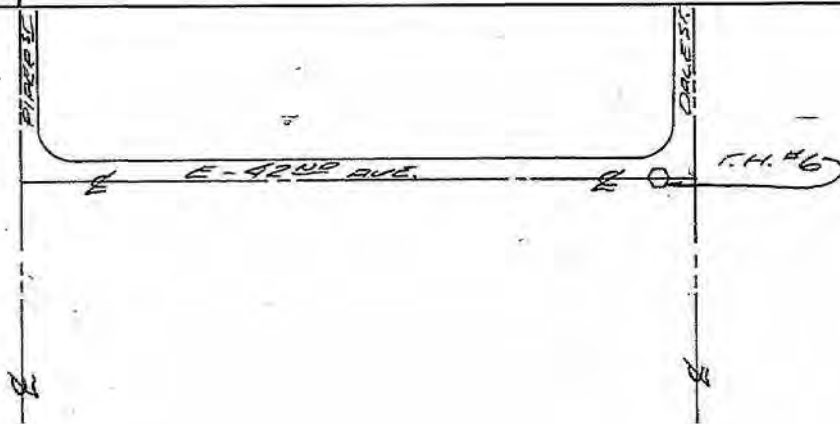
## SOILS LOG

LOCATION E OF E-42ND AVE. / 15 FT WEST OF F.H.#6  
OF DATE 5-5  
COMMENTS ACCEPTED REFUSEL AT - 7' DUE TO  
COARSE MATERIAL / ALL EROSC CLASSIFICATION  
BASE ON .02 MM % = 50% OF - #200 %

HOLE NO. #6  
DATE 6/9/76  
BY M.E. KRUHSA  
DEPTH 7'5"  
WATER TABLE 110"

DEPTH	UNIFIED CLASS	DESCRIPTION
0		EXIST. GROUND / ROAD SURFACE
1		
2		
3		
4	GW 6-A	RED SANDY - GRAVEL W / ALL COBBLE & ISOLATED BOULDER / - #200 = 4% MOIST = 5.8% / WP / NFS / DENSE
5		
6		
7		
8		
9		
10		

LOCATION SKETCH:



MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

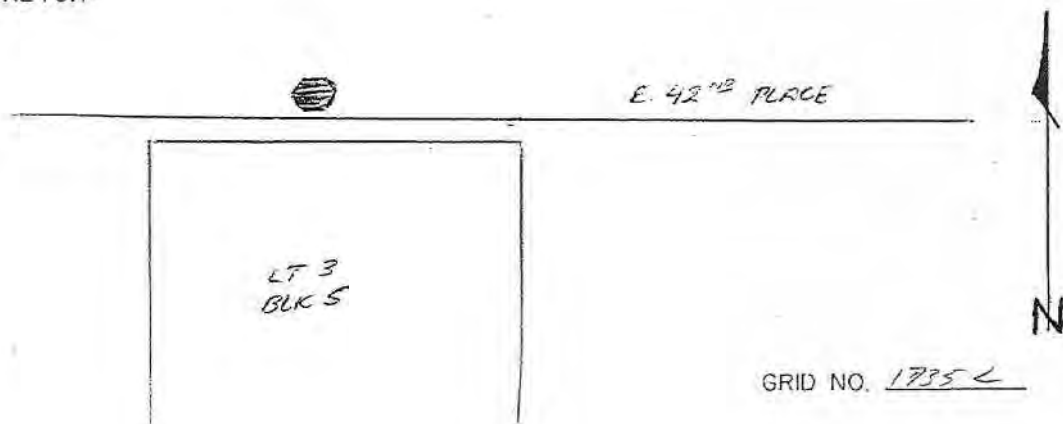
SOILS LOG

LOCATION ATHENIAN VILLAGE — LT 3, BLK 5 — E. 42<sup>ND</sup> PLACE  
SEWER MAIN TAP — PERMIT # 10154 — NORTH SIDE LT 3  
COMMENTS VISUAL CLASSIFICATION ONLY

HOLE NO. 5  
DATE 5/5/77  
BY W.G.S.  
DEPTH 9'  
WATER TABLE 9'

DEPTH	UNIFIED CLASS	DESCRIPTION
0		ROAD SURFACE
1		
2		
3		
4		
5	SP	BROWN GRAVELLY SAND
6		
7		
8		
9		WATER TABLE — 8" SEWER MAIN
0		

LOCATION SKETCH:



MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

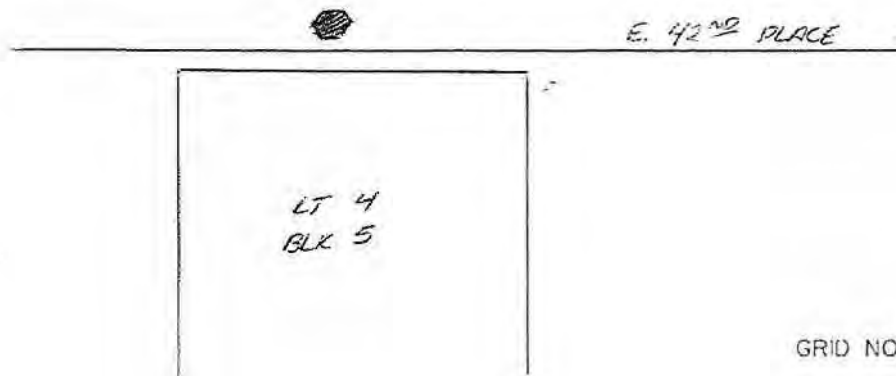
SOILS LOG

LOCATION ATHENIAN VILLAGE - LT. 4, BLK. 5 - E. 42<sup>ND</sup> PLACE  
SEWER MAIN TAP - PERMIT # 10161 - NORTH SIDE LT. 4  
COMMENTS VISUAL CLASSIFICATION ONLY

HOLE NO. 6  
DATE 5/4/77  
BY W.G.S.  
DEPTH 9'  
WATER TABLE 9'

DEPTH	UNIFIED CLASS	DESCRIPTION
0		ROAD SURFACE
1		
2		
3		
4	SP	
5		BROWN GRAVELLY SAND
6		
7		
8		
9		WATER TABLE - 8" SEWER MAIN
0		

LOCATION SKETCH:



GRID NO. 1735 L

# MUNICIPALITY OF ANCHORAGE

## DEPARTMENT OF PUBLIC WORKS

### CONSTRUCTION DIVISION

#### SOILS LOG

LOCATION ATHENIAN VILLAGE - TRACT E-1, B 8 - 42<sup>ND</sup> ST DATE             
 SEWER MAIN TAP - PERMIT # 10153 - SOUTH SIDE TRACT E-1  
 COMMENTS VISUAL ONLY

HOLE NO. 7  
 DATE             
 BY W. G. SMITH  
 DEPTH 10'  
 WATER TABLE 10' 9"

DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
0			SURFACE
1			
2			
3			
4			
5			
6	SP		BROWN GRAVELLY SAND
7			
8			
9			WATER TABLE
10			8" SEWER MAIN
11			
12			
13			
14			

LOCATION SKETCH:

TRACT E-1  
B 8

E. 42<sup>ND</sup> PLAGE

#### LEGEND

SYMBOL



TEST HOLE



WATER TABLE

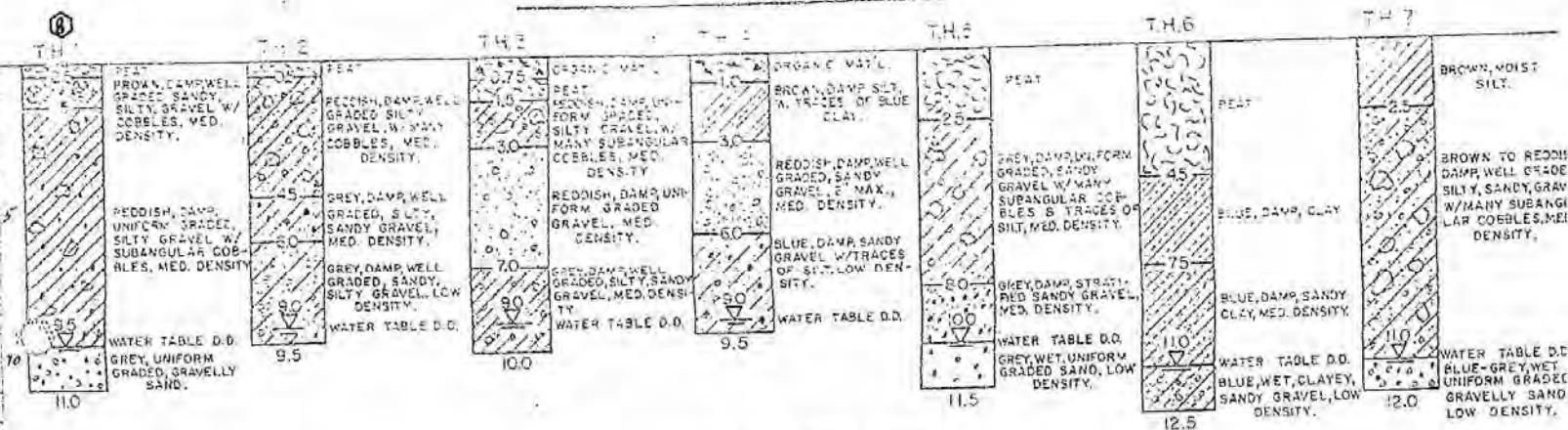


FROZEN MATERIAL

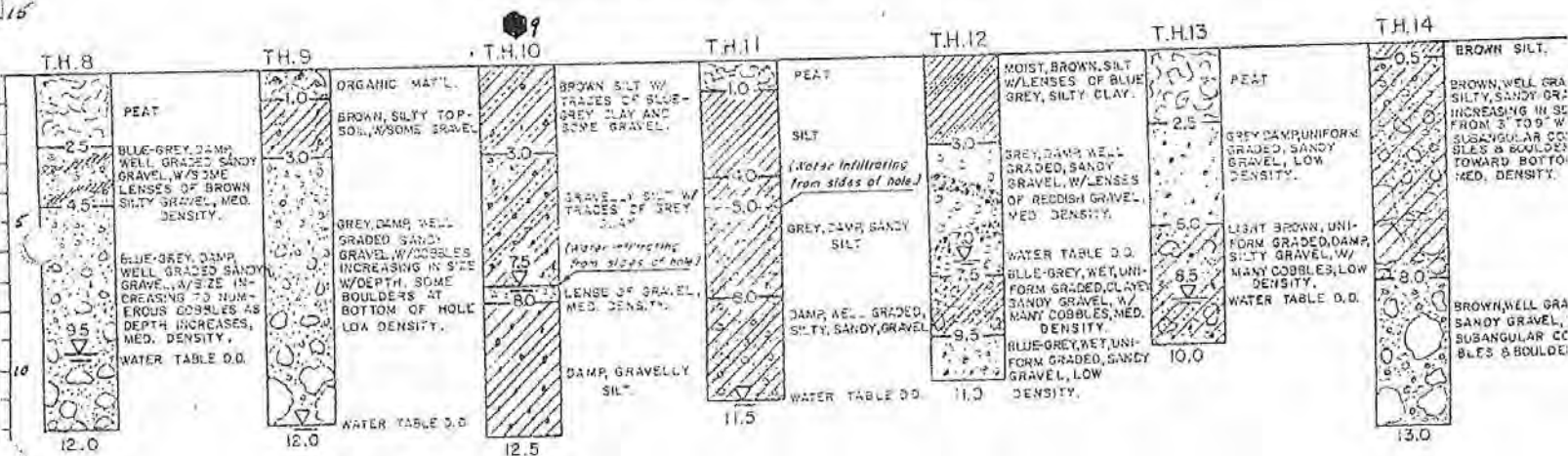
ALL FROST CLASSIFICATION  
 BASED ON THE .02mm = 50%  
 OF THE #200 UNLESS  
 OTHERWISE NOTED

GRID NO. 1735 C

# TEST HOLE LOG

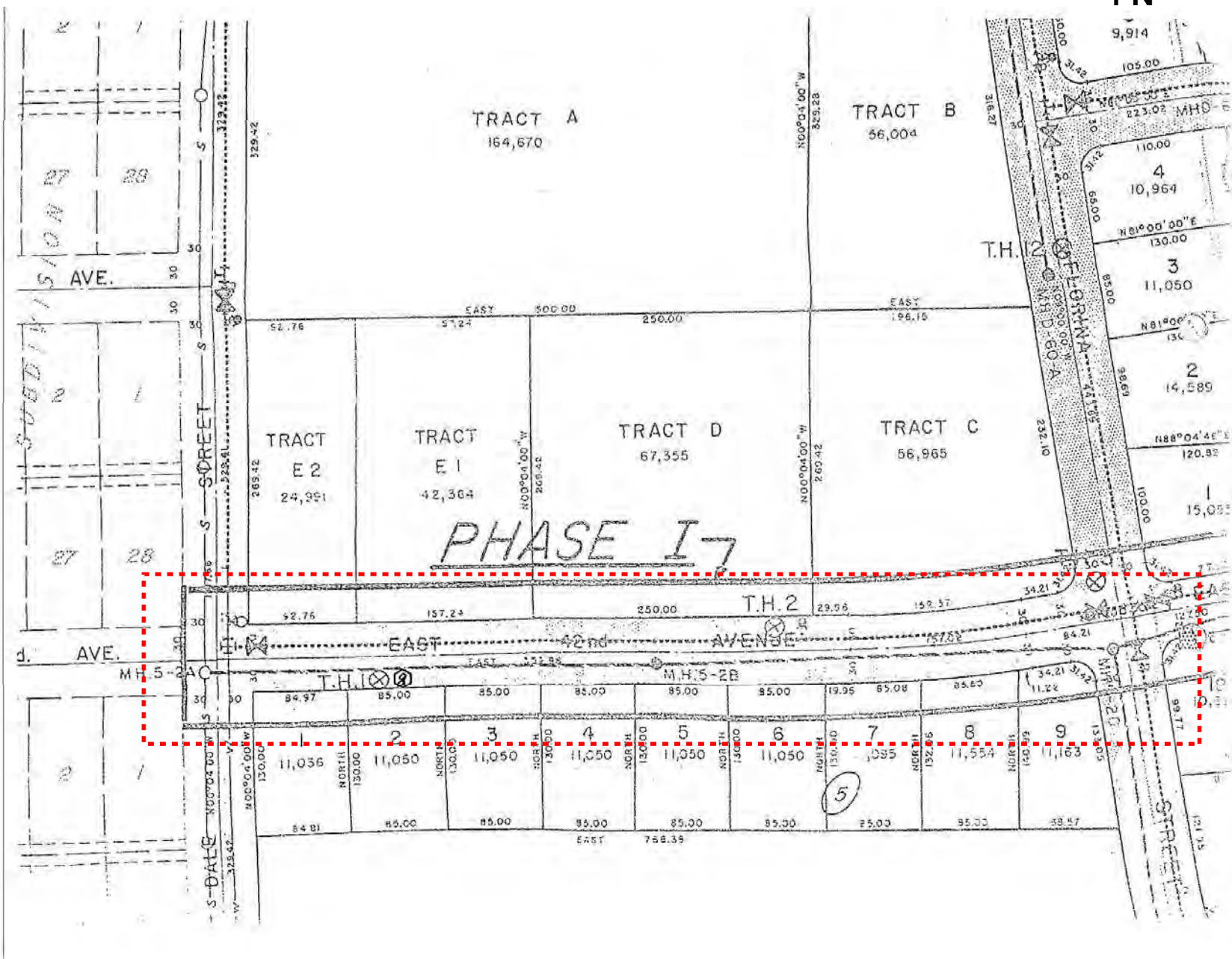


WATER TABLE D.D. = WATER TABLE DURING DIGGING



7-30-71	Added Phase I Limits	G.D.U.
Revision Date	Description	By
	KEY MAP	







# MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

## SOILS LOG

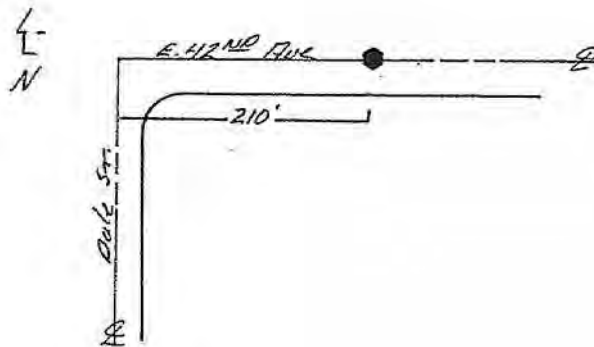
LOCATION E. 42<sup>ND</sup> Ave. / E of E. 42<sup>ND</sup> Ave. / 210' East of E  
Dale St.

COMMENTS \_\_\_\_\_

(11)  
 HOLE NO. 3  
 DATE 8/13/82  
 BY D. Ballew  
 DEPTH 3<sup>2</sup>'  
 WATER TABLE None

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
3-A Ex-406	0	GW	NFS	Existing Grade
				(31%) (6.6%)
	1			Brown - Sandy Gravel / Moisture = 20% / Silt = 3%
				Cobbles = 19% / N.P. / Dense
	2			
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			

LOCATION SKETCH:



**LEGEND**

SYMBOL

- TEST HOLE
- WATER TABLE
- FROZEN MATERIAL

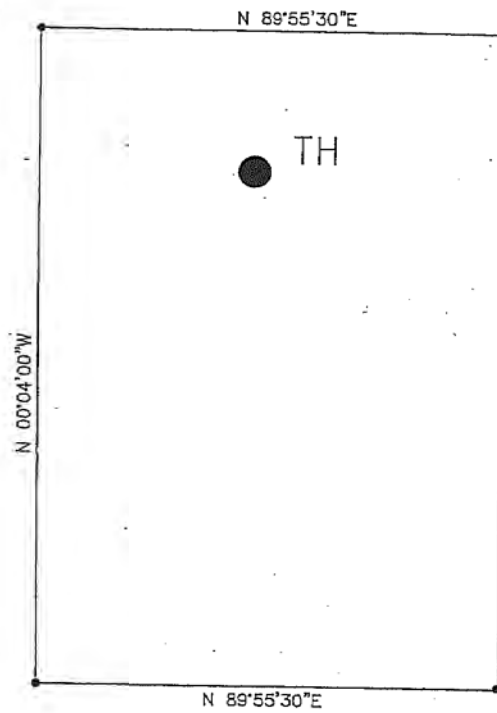
ALL FROST CLASSIFICATION  
 BASED ON THE .02mm = 50%  
 OF THE #200 UNLESS  
 OTHERWISE NOTED

LOT 14, BLOCK 3  
WENTWORTH SUBDIVISION

EAST 42ND AVENUE



PIPER STREET



TEST HOLE LOCATION PLAN

SCALE 1" = 30'

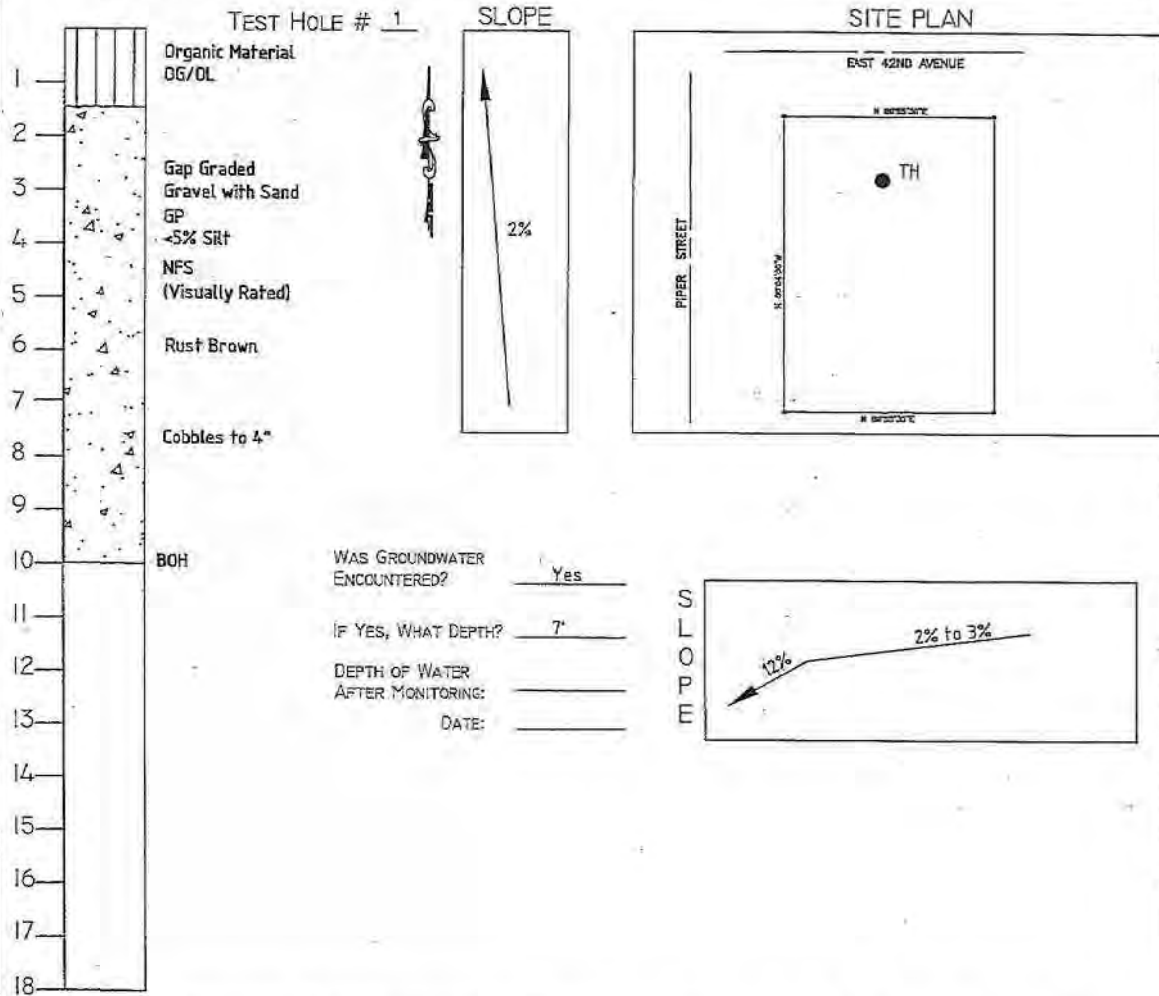
# TEST HOLE LOG SOILS REPORT

PROJECT #: 06-233

PERFORMED FOR: RPM Construction

DATE PERFORMED: 8/21/2006

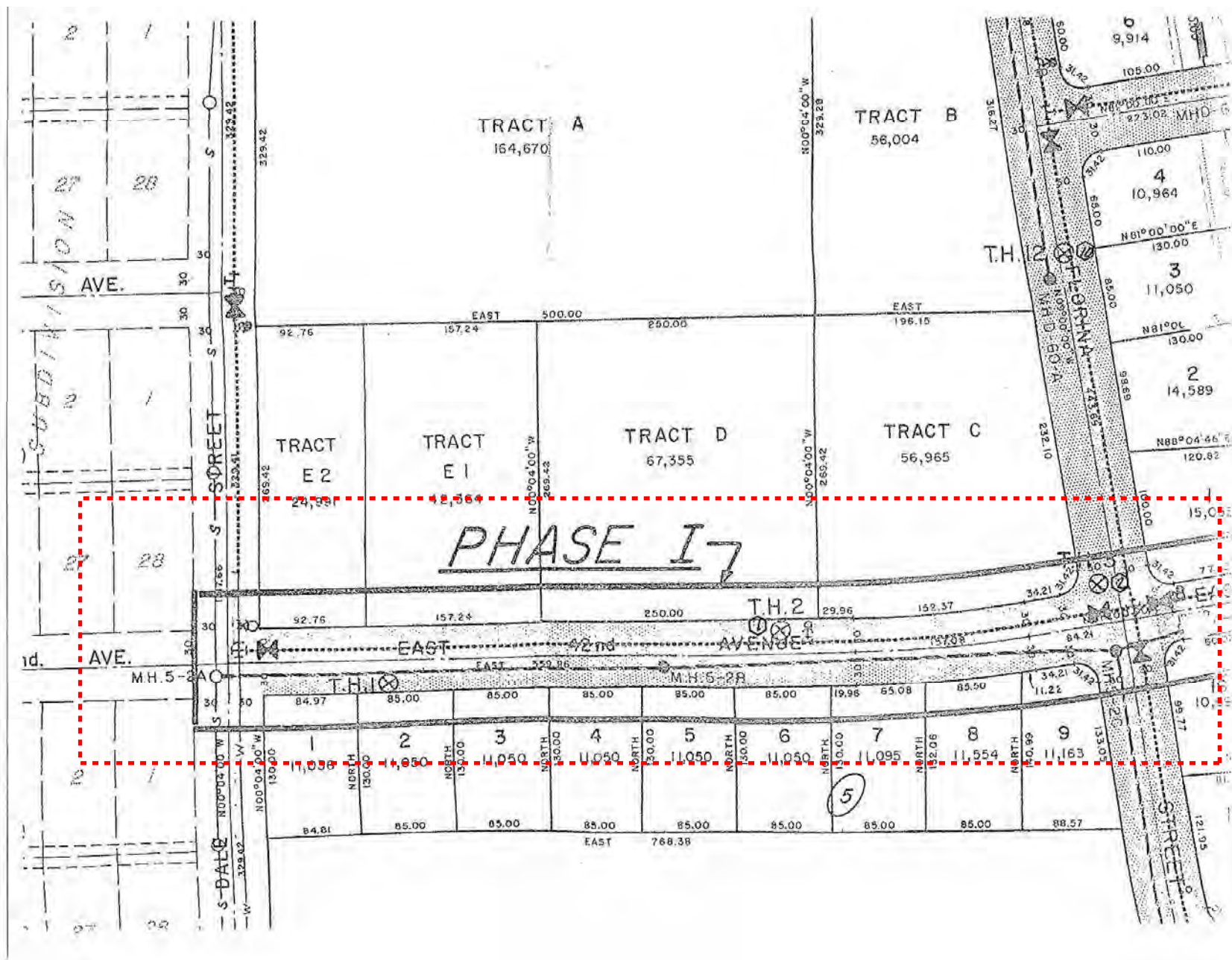
LEGAL DESCRIPTION: Lot 14, Block 3, Wentworth Subdivision



COMMENTS: ORGANIC MAT ENCOUNTERED TO 1.0' TO 1.5' UNDERLAIN BY RUST BROWN GAP GRADED GRAVEL WITH A MINOR  
AMOUNT OF SAND AND SILT (<5%). MATERIAL IS MODERATELY DENSE AND DRY. VISUALLY RATED AS NFS.  
BEARING CAPACITY CONSERVATIVELY ESTIMATED AT 2,500 PSF. GROUNDWATER ENCOUNTERED AT 7'.  
PERCOLATION RATE <<< 1 MINUTE PER INCH. WATER WILL NOT STAND IN HOLE.

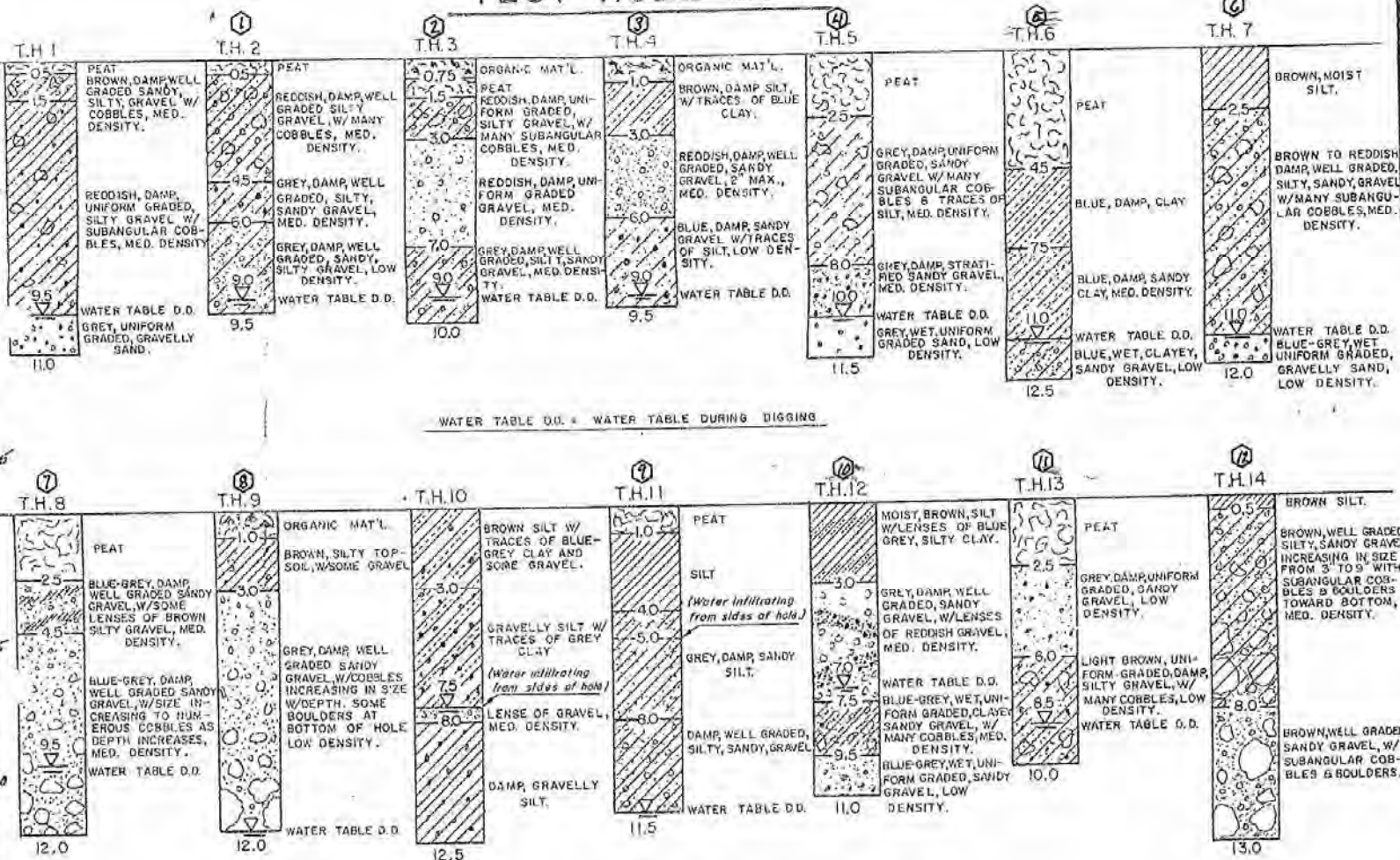
TEST PERFORMED BY: A. HARALA







# TEST HOLE LOG



WATER TABLE D.D. = WATER TABLE DURING DIGGING

7-30-71

Added Phase I Limits

Description

G.D.U.

By

KEY MAP

C-11007 T-10 1071

MUNICIPALITY OF ANCHORAGE  
DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

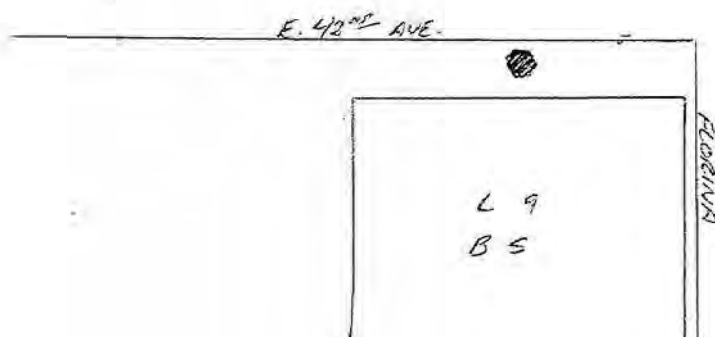
SOILS LOG

LOCATION ATHENIAN VILLAGE - L9, B.S. - E. 42<sup>ND</sup> / FLORINA  
SEWER MAIN TAP - PERMIT # 11339 - NORTH SIDE L9  
COMMENTS WISUDL ONLY

HOLE NO. 78  
DATE 5/11/78  
BY W.G.S.  
DEPTH 9'  
WATER TABLE 7'

DEPTH	UNIFIED CLASS	DESCRIPTION
0		SURFACE
1		
2		
3		
4	SP	BROWN GRAVELLY SAND
5		
6		
7		WATER TABLE
8		
9		8" SEWER MAIN
10		

LOCATION SKETCH:



GRID NO. 1735



# MUNICIPALITY OF ANCHORAGE

## DEPARTMENT OF PUBLIC WORKS

### CONSTRUCTION DIVISION

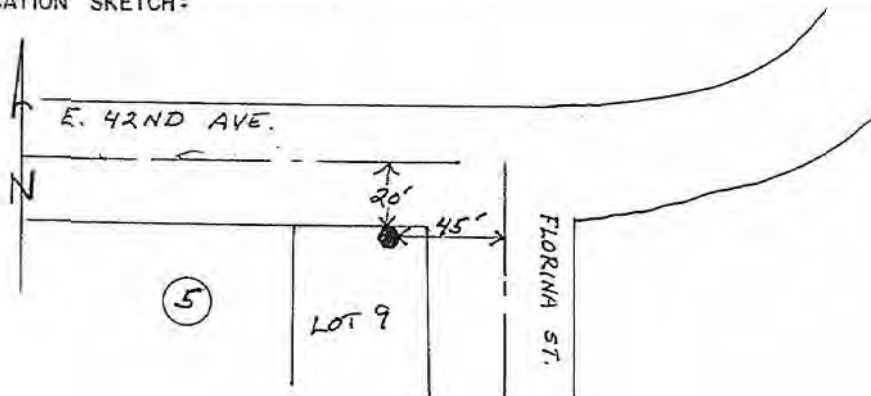
#### SOILS LOG

LOCATION Lot 9, Block 5, Athenian Village - SW corner of 42nd & Fairway  
 COMMENTS Visual inspection only

HOLE NO. 13  
 DATE 5/10/78  
 BY LDH  
 DEPTH 11'  
 WATER TABLE 7'

DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
0			
1	PT		PEAT w/ SOME ROCK & ORGANIC MATERIALS
2			
3			
4	SC		BLUE CLAYEY SAND
5			
6			
7			
8	GP		GRAY SAND w/ MEDIUM TO LARGE ROCK
9			
10			
11			BOTTOM EXCAVATION
12			
13			
14			

LOCATION SKETCH:



#### LEGEND

SYMBOL



TEST HOLE



WATER TABLE



FROZEN MATERIAL

ALL FROST CLASSIFICATION  
 BASED ON THE .02mm = 50%  
 OF THE #200 UNLESS  
 OTHERWISE NOTED

GRID NO. 1225

# MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

## SOILS LOG

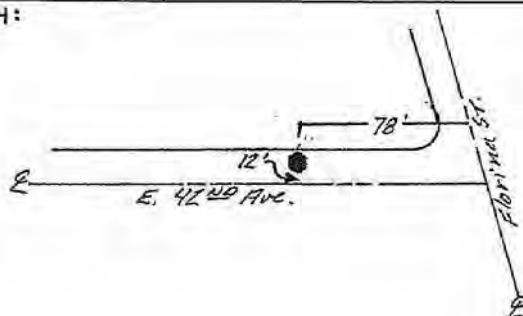
LOCATION E. 42<sup>ND</sup> Ave. / 12' North of E. 42<sup>ND</sup> Ave.  
78' West of E. Florina St.

COMMENTS \_\_\_\_\_

17  
HOLE NO. 1  
DATE 8/13/87  
BY D. Rolles  
DEPTH 3.9'  
WATER TABLE None

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
1-A EX-402	0	GP	NFS	Existing Grade
1-B EX-403	1	GP/GH	NFS TO F1	Brown - Sandy (30%) Gravel (76%) / Moisture = 2% Silt = 4% / Cobbles = 3.5% / NIP / Dense
1-C EX-404	2	GP	NFS	Grey - Sandy (31%) Gravel (63%) w/ silt (6%) Moisture = 4% / Organics 1% by wt / some cobbles Moderately Low Density / NIP
	3	GP	NFS	Brown - Gravel (89%) w/ sand (6%) and silt (5%) Organics = 2% by wt / (Cobbles in organic matrix) Moisture = 1% / Low Density / NIP
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			

LOCATION SKETCH:



**LEGEND**

SYMBOL

- TEST HOLE
- WATER TABLE
- FROZEN MATERIAL

ALL FROST CLASSIFICATION  
BASED ON THE .02mm = 50%  
OF THE #200 UNLESS  
OTHERWISE NOTED

# MUNICIPALITY OF ANCHORAGE

## DEPARTMENT OF PUBLIC WORKS CONSTRUCTION DIVISION

### SOILS LOG

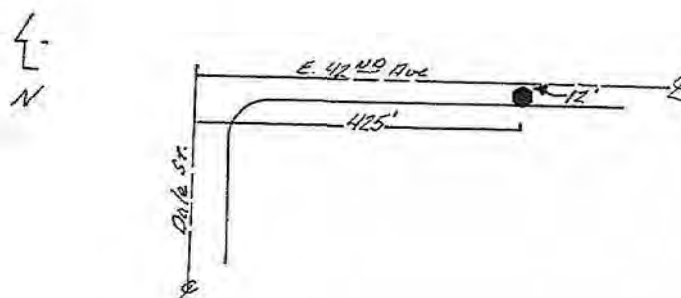
LOCATION E. 42<sup>ND</sup> Ave. / 12' south of E. E. 42<sup>ND</sup> Ave.  
425' East of E. Dale St.

COMMENTS \_\_\_\_\_

HOLE NO. 2  
 DATE 8/13/82  
 BY D. Ballas  
 DEPTH 3.2'  
 WATER TABLE None

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
2-A EX-405	0	GW	NFS	Existing Grade
2-B EX-402	1	GP	NFS	Brown - Sandy (30%) Gravel (46%) / Moisture = 3% Silt = 4% / N.P. / High Density
	2			Brown - Sandy (20%) / Gravel (76%) / Silt = 4% / Cabbles = 35% Moderately Low Moisture / Low Density
	3			
	4			
	5			
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13			
	14			

LOCATION SKETCH:



**LEGEND**

SYMBOL

- TEST HOLE
- WATER TABLE
- FROZEN MATERIAL

ALL FROST CLASSIFICATION  
 BASED ON THE .02mm = 50%  
 OF THE #200 UNLESS  
 OTHERWISE NOTED

## MUNICIPALITY OF ANCHORAGE

1735-D

DEPARTMENT OF PUBLIC WORKS  
CONSTRUCTION DIVISION

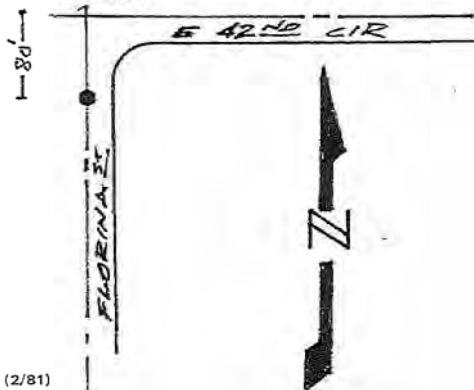
29

## SOILS LOG

LOCATION ATHENIAN VILLAGE  
80' S & E 42ND CIR. / 9' FLORINA STHOLE NO. 1DATE 1-6-82BY SLPCOMMENTS DOWN ENGINEERSDEPTH 17WATER TABLE 9'82-10.5  
SHEET 5 OF 5

DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
0			
1	SM	F-2	SILTY GRAVELLY SAND
2			
3	SM	F-3	SILTY GRAVELLY SAND
4			
5			
6			
7	SP	NFS	VERY CLEAN COARSE SAND
8			
9			
10			
11			
12			
13			
14			

LOCATION SKETCH:



## LEGEND

## SYMBOL



TEST HOLE



WATER TABLE



FROZEN MATERIAL

ALL FROST CLASSIFICATION  
BASED ON THE .02mm = 50%  
OF THE #200 UNLESS  
OTHERWISE NOTED

GRID NO. \_\_\_\_\_

# **Appendix E**

## **BERG2 Thermal Analysis Output**

Included in this section:

- 1) BERG2 Thermal Analysis Output – 2” Insulated Section
- 2) BERG2 Thermal Analysis Output – 3” Insulated Section

## BERG2 Analysis – Limited Subgrade Frost Penetration Analysis – 2" Insulated Section

LOCATION/CLIMATE:

```

FAIRBANKS      ANCHORAGE      JUNEAU      MCKINLEY PARK
NORTHWAY      DILLINGHAM    POINT BARROW  BETHEL
KOTZEBUE      GULKANA      CENTRAL      USER INPUT

LOCATION NAME..... ANCHORAGE
THAW N FACTOR..... 1.7
FREEZE N FACTOR..... 1
DESIGN AIR THAWING INDEX °DAYS..... 4000
DESIGN AIR FREEZING INDEX °DAYS..... 3200
MEAN AIR THAWING INDEX °DAYS..... 3500
MEAN AIR FREEZING INDEX °DAYS..... 2300
MEAN ANNUAL AIR TEMP. °F..... 35.3
AMPL. OF AIR TEMP. SINE WAVE..... 24.7

DESIGN SURFACE THAWING INDEX °DAYS..... 6800
DESIGN SURFACE FREEZING INDEX °DAYS..... 3200
MEAN SURFACE THAWING INDEX °DAYS..... 5950      THAW SEASON      FREEZE SEASON
MEAN SURFACE FREEZING INDEX °DAYS..... 2300      LENGTH          LENGTH
MEAN ANNUAL SURFACE TEMP. °F..... 42      AIR  198        167
AMPL. OF SURFACE TEMP. SINE WAVE..... 34      SURF 217.2      147.8

INPUT FIRST LETTER OF DESIRED LOCATION
OR USE CURSOR CONTROL KEYS TO MOVE CURSOR AND CHANGE DATA

F1-COLOR  F2-SAVE  F3-LOAD  F4-DISK  S-SOILS  R-RUN  L-NEW SCREEN  O-QUIT

```



## BERG2 Analysis – Limited Subgrade Frost Penetration Analysis – 3" Insulated Section

LOCATION/CLIMATE:

```

FAIRBANKS      ANCHORAGE      JUNEAU      MCKINLEY PARK
NORTHWAY      DILLINGHAM    POINT BARROW  BETHEL
KOTZEBUE      GULKANA      CENTRAL      USER INPUT

LOCATION NAME..... ANCHORAGE
THAW N FACTOR..... 1.7
FREEZE N FACTOR..... 1
DESIGN AIR THAWING INDEX °DAYS..... 4000
DESIGN AIR FREEZING INDEX °DAYS..... 3200
MEAN AIR THAWING INDEX °DAYS..... 3500
MEAN AIR FREEZING INDEX °DAYS..... 2300
MEAN ANNUAL AIR TEMP. °F..... 35.3
AMPL. OF AIR TEMP. SINE WAVE..... 24.7

DESIGN SURFACE THAWING INDEX °DAYS..... 6800
DESIGN SURFACE FREEZING INDEX °DAYS..... 3200
MEAN SURFACE THAWING INDEX °DAYS..... 5950      THAW SEASON      FREEZE SEASON
MEAN SURFACE FREEZING INDEX °DAYS..... 2300      LENGTH          LENGTH
MEAN ANNUAL SURFACE TEMP. °F..... 42      AIR  198        167
AMPL. OF SURFACE TEMP. SINE WAVE..... 34      SURF 217.2      147.8

INPUT FIRST LETTER OF DESIRED LOCATION
OR USE CURSOR CONTROL KEYS TO MOVE CURSOR AND CHANGE DATA

F1-COLOR  F2-SAVE  F3-LOAD  F4-DISK  S-SOILS  R-RUN  L-NEW SCREEN  O-QUIT

```

## SOIL INPUTS

Layer	Thickness (ft)	Density (pcf)	M.C. (%)	Comment
Asphalt	0.17	138	-	-
Fill (Type II-A)	1.50	130	6.0	-
Insulation	0.25	1.8	-	-
Fill (Type II)	1.25	130	6.0	-
Subgrade	2.50	114	8.0	-

ANALYSIS RESULTS:

LOCATION		THAW N	FREZ N	MAAT	THAW °F DAY	FREZ °F DAY	THAW DAYS	FREZ DAYS
ANCHORAG		1.70	1.00	35	4000	3200	198	167
				1	2	3	4	5
T C H Y A C W L E	FROZEN % MOIS.	0.0	6.0	0.0	6.0	8.0		
	FROZEN DENS.	138.0	130.0	1.8	130.0	114.0		
	LATENT HEAT	0	1123	0	1123	1313		
	FROZEN HEAT CAP	28.00	26.00	3.00	26.00	23.94		
	FROZEN COND.	0.86	1.58	0.02	1.58	1.18		
	THAWED % MOIS.	0.0	6.0	0.0	6.0	8.0		
	THAWED DENS.	138.0	130.0	1.8	130.0	114.0		
	THAWED HEAT CAP	28.00	29.90	3.00	29.90	28.50		
	THAWED COND.	0.86	1.57	0.02	1.57	1.19		
	INITIAL THICK	0.17	1.50	0.25	1.25	3.66		
F C R Y E C E L Z E E	AMOUNT THAWED	0.17	1.50	0.25	1.25	2.26		
	CONSOLIDATION	----	----	----	----	----		
	FINAL THICK	0.17	1.50	0.25	1.25	3.66		
	LATENT HEAT	0	1123	0	1123	1313		
	FROZEN DENS.	138.0	130.0	1.8	130.0	114.0		
	FROZEN HEAT CAP	28.00	26.00	3.00	26.00	23.94		
	FROZEN COND.	0.86	1.58	0.02	1.58	1.18		
	INITIAL THICK	0.17	1.50	0.25	1.25	3.66		
	AMOUNT FROZEN	0.17	1.50	0.25	1.25	0.19		
	ESTIMATED THAW=		5.43		FREEZE=		3.36	
				PRINT LOCATION		SOIL QUIT		

## RESULTS

Parameter	Value
Total Section Thickness	3.17 ft
Thaw Depth	5.43 ft
Freeze Depth	3.36 ft
Subgrade Frost Penetration	0.19 ft
Subgrade Frost Percent <sup>1</sup>	6.0%

1. Equal to Subgrade Frost Penetration divided by Total Section Thickness