APPENDIX E

Geotechnical Report

SUBMITTED TO:
Municipality of Anchorage
Department of Public Works
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Anchorage, Alaska 99507

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GEOTECHNICAL ENGINEERING REPORT

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02

ANCHORAGE, ALASKA

SHANNON & WILSON

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Submitted To: Municipality of Anchorage Department of Public Works
4700 Elmore Road
Anchorage, Alaska 99507
Attn: Mr. Timothy Huntting, PE

Subject: GEOTECHNICAL ENGINEERING REPORT, E. 74TH AVENUE, E. 75TH AVENUE, NANCY STREET AREA RECONSTRUCTION, PM&E 21-02, ANCHORAGE, ALASKA

Shannon & Wilson prepared this report and participated in this project as a consultant to the Municipality of Anchorage (MOA). Our scope of services was specified in our August 4, 2021 proposal and approved via Purchase Order 2021002598 on August 27, 2021. This report presents the results of subsurface explorations, laboratory testing, and structural section design recommendations to support the design of improvements in the 74th Avenue, 75th Avenue, and Nancy Street area and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

Ryan Collins, CPG
Senior Geologist

RDC/SKD:KLB/rdc

Kyle Brennan, PE
Vice President

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1 INTRODUCTION

This report presents the results of subsurface explorations, laboratory testing, and engineering analyses conducted by Shannon and Wilson, Inc. for proposed roadway and drainage improvements along East 74th Avenue, East 75th Avenue, Nancy Street, and Petersburg Street north of Lore Road in Anchorage, Alaska. The purpose of this geotechnical study was to gather subsurface geotechnical data and provide geotechnical engineering recommendations needed to support design of the road and drainage improvements. To accomplish this, eleven borings were advanced in the project area. Selected soil samples recovered from the borings were tested in our geotechnical laboratory.

Presented in this report are descriptions of the site and project, subsurface explorations and laboratory test procedures, an interpretation of subsurface conditions, and conclusions and recommendations from our engineering studies. This report is intended for use by project design engineering staff, the MOA, and their representatives.

2 SITE AND PROJECT DESCRIPTION

The project is located along East 74th Avenue, East 75th Avenue, Nancy Street, and Petersburg Street in Anchorage, Alaska. The area is generally developed with paved residential streets and multi-family residential dwellings in each lot. East 74th Avenue, Nancy Street, and East 75th Avenue west of Petersburg Street are developed with rolled style curb and gutter, while Peterburg Street and East 75th Avenue east of Petersburg Street are strip paved and do not have curb or gutter. Petersburg Street, south of East 74th, is the only street with storm drain of those included in the project.

The topography of the project area slopes down toward the west/northwest with approximately 17 feet of relief from the east to the west. During our explorations, ponding was observed along the north half of Nancy Street and along East 75th Avenue. The lots adjacent to the streets are elevated approximately 1 to 5 feet above the roadways. A vicinity map indicating the general project location is presented as Figure 1. The site plan, included as Figure 2, shows prominent site features and the approximate boring locations.

The existing roadways exhibit moderate to severe signs of distress, including both linear and alligator cracking, potholes, and near complete breakdown, particularly along East 74th Avenue and Nancy Street. We understand that the project generally includes improving the drainage conditions and repaving the project area. We envision that the drainage improvements will consist of establishing a storm drain system, subsurface drainage improvements, and curb and gutter, where not currently present.

3 PREVIOUS EXPLORATIONS

Shannon & Wilson performed geotechnical investigations along Petersburg Street between Lore Road and East 73rd Avenue in March 2007 to investigate the subsurface soil and groundwater conditions for improvements to Petersburg Street. These borings (Boring B-1 through B-3) were advanced to a depth of approximately 16 feet below ground surface (bgs). The approximate locations of these borings are shown on Figure 2 and the boring logs are included in Appendix A. The exploration procedures, laboratory testing, and results are included in our 2007 geotechnical report for the project.

We also reviewed seven test hole logs from explorations conducted by the MOA and others in the project area in 1982 and 1983. The subsurface soils encountered in these explorations generally consisted of sandy silty, silty sand, and silty gravel with frost classifications ranging from F2 to F4. Peat was encountered at the ground surface in several borings and ranged from about 2 to 12 feet thick. The deepest peat deposits were encountered along the Nancy Street ROW and along East 75th Avenue, east of Petersburg Street. The approximate locations of the borings we reviewed are shown on Figure 2. Boring logs are included in Appendix A.

4 SUBSURFACE EXPLORATIONS

Subsurface explorations consisted of advancing and sampling eleven borings, designated Borings B-01 through B-11, at the site on October 4 and 5, 2021. The general boring locations were provided by MOA and positioned by our representative in the field to avoid conflicts with buried and overhead utilities. The boring locations, shown on Figure 2, were recorded using a handheld GPS with a horizontal accuracy of approximately 20 feet. The ground surface elevations shown on the boring logs were estimated from topographic contours provided by the MOA. Therefore, the boring locations shown on the site plan and the elevations reported on the boring logs should be considered approximate.

Drilling services were provided by Discovery Drilling of Anchorage, Alaska, using a truck-mounted CME-75 drill rig for Borings B-01 through B-10, and a track-mounted Geoprobe 6712 DT drill rig for Boring B-11. An experienced representative from Shannon & Wilson was present during drilling to locate the borings, observe drill action, collect samples, log subsurface conditions, and observe groundwater conditions.

The borings were advanced with 3 1/4-inch inner diameter (ID), continuous flight, hollow-stem augers to depths of approximately 16.5 feet below ground surface (bgs). As the borings were advanced, samples were generally recovered using Standard Penetration Test (SPT) methods at 2.5-foot intervals to 10 feet bgs and 5-foot intervals thereafter to the bottom of the borings. With the SPT method, samples are recovered by driving a 2-inch outer diameter (OD) split-spoon sampler into the bottom of the advancing hole with blows of a 140-pound hammer free falling 30-inches onto the drill rods. For each sample, the number of blows required to drive the sampler the final 12-inches of an 18-inch penetration into undisturbed soil is recorded. Blow counts are shown graphically on the boring logs as "penetration resistance" and are displayed adjacent to sample depth. Where the sampler did not penetrate the full 18 inches, or a minimum of 18 inches in the case of a 24-inch penetration, our log reports the blow count and corresponding penetration in inches. The penetration resistance values give a measure of the relative density (compactness) or consistency (stiffness) of cohesionless or cohesive soils, respectively. In addition to the split spoon samples, a grab sample of the near-surface soils was collected from the auger cuttings in the upper 2 feet of each boring.

The soils encountered were observed and described in the field in general accordance with the classification system described by ASTM International (ASTM) D2488. Selected samples recovered during drilling were tested in our laboratory to refine our soil descriptions in general accordance with the Unified Soil Classification System (USCS) described in Appendix B, Figure B-1. Frost classifications were also estimated for samples based on laboratory testing (hydrometer and sieve analyses) and are shown on the boring logs. Frost classifications included on the logs are followed by "0.02 mil" or "P200" to indicate whether frost classifications were based on hydrometer or P-200 data, respectively. The frost classification system is presented in Appendix B, Figure B-2. Summary logs of the borings are presented on Appendix B, Figures B-3 through B-13.

Select borings were completed by installing a 1-inch, polyvinyl chloride (PVC) casing with a hand-slotted tip to facilitate observation of groundwater levels at a later date. The boring annulus was backfilled with cuttings removed during drilling. A flush-mounted, steel monument was placed over the casing and the ground surface was repaired with asphalt cold patch, except for Boring B-11, where the casing was left as a stickup. Borings that did not receive PVC casing were backfilled with auger cuttings and the surface was repaired with asphalt cold patch.

5 LABORATORY TESTING

Laboratory tests were performed on selected soil samples recovered from the borings to confirm our field classifications and to estimate the index properties of the typical materials encountered at the site. The laboratory testing was formulated with emphasis on determining gradation properties, natural water content, plasticity, and frost characteristics.

Water content tests were performed in general accordance with ASTM D2216. The results of the water content measurements are presented graphically on the boring logs in Appendix B, Figures B-3 through B-13.

Grain size classification (gradation) testing was performed to estimate the particle size distribution of selected samples from the borings. The gradation testing generally followed the procedures described in ASTM C117/C136 and D422. The test results are presented in Appendix B, Figure B-14 and summarized on the boring logs as percent gravel, percent sand, and percent fines. Percent fines on the boring logs are equal to the sum of the silt and clay fractions indicated by the percent passing the No. 200 sieve. Note that hydrometer testing indicates particle size only and visual classification under USCS designates the entire fraction of soil finer than the No. 200 sieve as silt. Plasticity characteristics (Atterberg Limits results) are required to differentiate between silt and clay soils under USCS.

Atterberg limits were evaluated for two samples of fine-grained soil to estimate plasticity characteristics. The tests generally followed procedures described in ASTM D4318. The results of these tests are presented graphically on the boring logs and on Appendix B, Figure B-15.

6 SUBSURFACE CONDITIONS

The subsurface conditions encountered in our explorations are presented graphically on the boring logs in Appendix A and Appendix B, Figures B-3 through B-13. This section is focused on the results of our current explorations although subsurface conditions in our 2007 explorations along Petersburg appeared to be generally consistent with those encountered in our current borings. In general, our borings advanced through the roadway encountered 1.5 to 2 inches of asphalt pavement (0.5 to 1 inch along East 75th Avenue, east of Petersburg Street), underlain by about 2.2 feet of fill soil (4.5 feet in Boring B-01) which typically consisted of silty sand with varying amounts of gravel, and native, predominantly granular soils. Boring B-11, advanced in the undeveloped right of way west of East 74th Avenue encountered about 2.2 feet of peat above the native, mineral soils. Native soils below the fill materials typically consisted of silty sand with gravel and resembled materials typically described as glacial till with a few exceptions. In Boring B-08 and B-09, peat was encountered below the fill to depths of 5.5 and 7 feet bgs, respectively. In Boring B-09 the peat was underlain by silt containing organics to about 9.5 feet bgs. Note that peat deposits ranging between 5 and 12 feet deep were encountered in borings advanced by the MOA along the Nancy Street ROW in 1982. Peat was not encountered in our current borings in this area (Borings B-03 and B-04); however, it is unclear if this is a localized condition or if the peat was removed during original construction of Nancy Street. A layer of non-woven geofabric was also encountered between approximately 1 and 2 feet bgs in Boring B-03. Previous borings advanced along Petersburg Street in 2007 by Shannon & Wilson encountered a similar soil profile and two of the borings encountered geotextile fabric at the base of the structural section fills.

The fill soils encountered in our borings typically consisted of silty sand, silty sand with gravel, and silty gravel with sand. Based on laboratory testing, fines contents ranged between 11 and 38 percent and moisture contents ranged from 3 to 17 percent. SPT sampling was not conducted in the fill layer; however, the fills were estimated to be medium dense based on interpretation of drill action.

Native soils encountered below the fills, excluding the peat encountered in Borings B-08 and B-09 generally consisted of silty sand, silty sand with gravel, and silt with sand. These soil descriptions are typical of materials interpreted as glacial till; however, the density was generally lower than typically observed in glacial till suggesting that the materials may have been reworked or loosened by other forces. Based on laboratory testing the native mineral soils had fines contents ranging between 8 and 56 percent, with typical values ranging between about 33 and 46 percent. Moisture contents ranged from 5 to 21 percent. Two samples of material passing the Number 40 sieve were segregated from samples of till-like materials recovered during drilling and subjected to Atterberg limits testing. Based on the results of these tests, the materials were classified as clayey sand with gravel with plasticity indices ranging between 8 and 9. Natural moisture contents in these sample were below the plastic limit. Based on penetration resistance values ranging between 9 and greater than 50 blows per foot (bpf), the native soils were generally medium dense to very dense, with a marked increase observed in most borings below about 12 to 13 feet bgs.

Groundwater was encountered during drilling at about 7.5 feet bgs in Boring B-05 and 15 feet bgs in Boring B-09. Groundwater was not observed during drilling in the remaining borings. However, the structural section materials were saturated in most borings during drilling. In our opinion this represents a temporary perched water condition due to infiltration of surface water into the structural section rather than the water table. The apparent absence of groundwater in some of the borings during drilling is likely a function of the relatively low hydraulic conductivity of the silty soils at the site, which makes groundwater determination difficult during drilling. Static water level measurements were made in the observation wells roughly six to seven days after drilling. During these observations, water levels ranged between the ground surface and 3.9 feet bgs. Water level observations are summarized in the exhibit below. Note that water levels may fluctuate by several feet seasonally and may vary during periods of high precipitation and rapid snow melt. Also note that our groundwater level readings were collected the day after a significant rainfall event. We believe the shallow readings are reflective of the perched water and demonstrate relatively poor drainage conditions throughout the project area.

Exhibit 6-1: Groundwater Level Observations

	Depth to Water (feet bgs)	
Boring	During Drilling	10/11/21
B-02	Not Observed	0.1
B-06	Not Observed	0.1
B-09	15	2.6
B-10	Not Observed	3.9
B-11	Not Observed	At the ground surface

NOTES:
Borings were advanced October 4 and 5, 2021.

7 ENGINEERING RECOMMENDATIONS

Geotechnical considerations associated with this project consist of controlling trench excavation slopes, trench backfill and compaction, potential settlements, pavement structural support, controlling construction drainage, and planning for possible dewatering needs for excavations that may be below the groundwater table. Based on the conditions encountered by our borings, the soils in the project area generally consist of several feet of sandy fill with varying amounts of fines overlying predominantly fine-grained soils. The fill and native soils are moderately to highly frost susceptible with typical frost classifications ranging between F2 and F4. Layers of peat were encountered in Borings B-08 and B-09 and extended to depths of 5.5 and 7 feet bgs, respectively, below the roadway fills, and may be present in other pockets in the project area, although not encountered by our explorations. In our opinion, these soils should be adequate to support the proposed drainage and roadway improvements as long as organic soils are removed and the pavement structural section is designed to accommodate the expected frost conditions. Proper control of excavation (including construction dewatering) and backfilling activities will also be paramount in achieving a well-constructed project.

7.1 Asphalt Pavement

We understand that the roadway pavements will be replaced as a part of this project. In general, the existing pavements along the roadways show significant signs of moisture and frost-related distress. We understand that the roadways will continue to be used for relatively lightly loaded vehicle traffic with occasional truck traffic for service and maintenance. Based on the conditions encountered in our borings, the existing fill and native soils do not meet gradation requirements for Type II/IIA fill that is specified for the pavement structural section. Therefore, we recommend reconstructing the structural section and anticipate that some of the existing materials will need to be removed to accommodate the new structural section. Additionally, we recommend that subdrains be incorporated into the roadway design to reduce potential moisture related issues as discussed in Section 6.3.

The performance of the pavement is controlled by the details of construction and by the quality (gradation characteristics) of the materials placed and compacted to develop the needed structural section. Quality control inspection is strongly recommended, with subgrade probing, support soil compaction, and asphalt testing at regular intervals to be sure that the intent of the specification be met. The structural sections recommended below assume that the surface drainage in the pavement areas is designed such that surface waters are not allowed to penetrate and accumulate into the structural section materials.

7.1.1 Site Preparation and Subgrade Development

To prepare the subgrade to receive the pavement structural section fill, the area to receive fill should be excavated, as required, to the design elevation of the bottom of the structural section fill. Organic soils (ie. peat) extending to depths between 5.5 and 7 feet bgs were encountered in Borings B-08 and B-09 along East 75th Avenue, east of Petersburg Street. These soils and any other areas where organic soils are encountered during construction should be excavated and replaced with a suitable fill material as outlined in Section 7.5 below. Overexcavation to remove unsuitable soils should be extended laterally beyond the edge of the road such that a line drawn down at a 1 horizontal (H) to 1 vertical (V) slope will encounter structural fill only to the bottom of the excavation. If loose zones or other unsuitable conditions (ie. organics, loose, soft soils) are observed, these spots should be re-compacted or removed and replaced with Type II/IIA fill. The goal of this process is to attain a relatively uniform, firm, and unyielding subgrade upon which to construct the pavement system. The base of the excavation should then be observed and proof rolled to identify loose or unsuitable subgrade materials. We also recommend establishing a crown or sloping the subgrade surface a minimum of 2 percent to encourage draining of water from the structural section should infiltration from the surface occur.

Note that the soils beneath the existing structural section materials have elevated fines contents and will likely be sensitive to moisture and disturbance. If existing soils become disturbed and or wet, construction could be difficult if the contractor is not able to control and compact fills that are placed. Care should be taken to minimize disturbance of the excavation bottom beneath asphalt structural sections by digging or excessive tracking by equipment. If moisture sensitive materials are encountered, flat-nosed excavator buckets should be used at the excavation bottom. Additionally, equipment should not be operated on the exposed subgrade prior to fill placement, and excavation and backfilling on native subgrade soils should not be conducted during periods of wet weather.

7.1.2 Structural Section

Pavement design parameters included in the January 2007 MOA Design Criteria Manual (DCM) were followed to develop the structural section recommendations provided in this report. According to the manual, a structural section over a subgrade classified as F2, F3, or F4 must be designed for either the "Complete Protection Method" or for the "Limited Subgrade Frost Penetration Method". In the limited frost penetration method, the maximum allowable depth of freeze into the subgrade soil is 10 percent of the structural section thickness by thermal analysis.

We evaluated frost penetration using the BERG2 computer program, and based on these analyses recommend the structural sections in the table below. Because of the relatively shallow groundwater table and relatively deep seasonal frost depth in the Anchorage area, we have developed recommendations for both an insulated and an uninsulated section assuming the Limited Subgrade Frost Protection Method. In comparing the two sections options, it is clear that an insulated section will require less excavation and fill than the un-insulated section, which will require substantial excavation that may increase the amount of construction dewatering. While the insulated section likely represents the less expensive construction option, buried insulation in the roadway may be problematic in the future during utility work or road repair.

Exhibit 7-1: Recommended Pavement Structural Sections

Insulated Section		Uninsulated Section	
Thickness, inches	Material	Thickness, inches	Material
2	Asphalt	2	Asphalt
2	Leveling Course	2	Leveling Course
16	Type IIA Base	6	Type IIA Base
2	Insulation	88	Type II/IIA Subbase
30	Type II/IIA Subbase		
-	Non-woven Geofabric		

These structural sections are also appropriate for use beneath new sidewalks, curbs, and gutters and should be extended a minimum of 4 feet beyond the outermost edge of these improvements.

In general, the improved pavement sections, if insulated, should include a transition of at least 20 feet relative to uninsulated existing roadways. The transition section should include at least 1 inch of insulation (versus 2 inches) so that differential settlements and frost related deflections across the 20-foot transition section are reduced. If the uninsulated section is selected, a transition should also be incorporated relative to existing roadway structural sections, such that the contact between the new and existing structural sections is not abrupt. The transition may be accomplished by sloping the subgrade between improved and unimproved pavements at 4H to 1V.

7.1.3 Insulation

If an insulated section is selected for this project, we recommend using 2 inches of extruded polystyrene "blueboard" or equivalent for the applications described above. The insulation should have a minimum R-value of 4.17 hr-ft2 ◦F/Btu. The MOA DCM provides further guidelines on the application of insulation in pavement structural sections. Insulation should be installed smoothly on the ground surface so that it covers the entire area to be paved. Fill lifts on top of insulation should be placed and compacted as described in Section 7.5. Traffic on top of the initial lift over the insulation should travel in straight lines to prevent damaging the insulation. Insulation should extend a minimum of 2 feet past the outer edge of the curb and gutter and sidewalks or pathways that are attached to the curb and gutter. Sidewalks or pathways that are detached from the curb/gutter do not require the incorporation of insulation into the structural section as long as some vertical displacement during winter months can be tolerated. Replacement, repair, or installation of new or existing utilities should occur prior to placement of the insulation in order to avoid damaging the insulation.

7.1.4 Geotextile Fabric

We have included recommendations for incorporating a geotextile fabric if the thinner, insulated section is used, to provide separation between the silty subgrade and new structural section materials. This geofabric layer will increase the stability or strength of the subgrade and should prevent intermixing of the subgrade soils with structural fill thereby maintaining the fill quality and improving fill placement/compaction efficiency. The geofabric will also provide additional support during springtime thaw weakening. After the area to be treated with geofabric has been prepared within the fill limits as described previously, the geofabric should be placed over the subgrade material before the first lifts of structural section fill are placed. Geofabric used for this project should consist of a non-woven geotextile material such as Mirafi® 180N, or equivalent. This geofabric layer will increase the stability and should provide separation between the subgrade materials and the new structural section fills. We recommend the minimum material properties in the following exhibit when selecting an equivalent geofabric for this application in the project based on Minimum Average Roll Values (MARV):

Exhibit 7-2: Non-woven Geotextile Properties (Mirafi® 180N)

Mechanical Properties	Minimum Average Roll Value
Grab Tensile Strength by ASTM D4632	205 lbs.
Trapezoidal Tear by ASTM D4533	80 lbs.
CBR Puncture Strength by ASTM D6241	500 lbs.
Grab Tensile Elongation by ASTM D4632	50 percent
Apparent Opening Size by ASTM D4751B-5	US Sieve 80
Permittivity by ASTM D4491B-6	1.4 sec-1
Flow Rate by ASTM D4491	95 gal/min/ft2

Joining of the geofabric should be in accordance with manufacturers recommendations or the Municipality of Anchorage Standard Specifications (MASS). A minimum of 12 inches of overlap is required. Additional guidelines and specifications are provided in the MASS Section 20.25.

7.2 Construction Drainage

Groundwater was observed during drilling in Borings B-05 and B-09 at about 7.5 and 15 feet bgs, respectively, but was difficult to discern during drilling due to the silty nature of the soils encountered in our borings. Static groundwater levels about one week after drilling were measured at depths ranging between the ground surface and 3.9 feet bgs in observation wells installed in several borings. The static groundwater levels were measured about 24 hours after a significant precipitation event and likely represent a temporary perched water condition caused by infiltration of surface water runoff, and demonstrate the overall poorly drained nature of the project area. Additional monitoring would be needed to evaluate the average groundwater conditions in the project area. These groundwater depths suggest that groundwater will likely be encountered during construction for excavations needed to install the structural section and install drainage improvements. The amount of water encountered will depend on the contractor's excavation plan, seasonal fluctuations in the water table, depth and size of the excavations, and other factors. In our opinion, dewatering with sumps and pumps should be adequate to control groundwater during construction; however, area-wide dewatering with well points or other dewatering methods may be required where excavations extend more than several feet below the water table, particularly if layers of sand are encountered within the native soils. These measures may also need to be used in tandem with temporary shoring.

We recommend that the contractor be required to submit an excavation plan once the project details have been determined. The excavation plan should describe the methods and sequencing for excavation as well as additional information for dewatering and shoring as necessary. The plan should highlight areas that may require dewatering and include details for the type or types of dewatering that will be undertaken (including, but not limited to, pumping rates, discharge locations, water treatment, etc…). The excavation plan should also include the types and locations of shoring to be used and engineered plans for the shoring if required. We recommend that we be retained to review the excavation plan prior to authorizing work to proceed at the site to ensure that the plan contains the necessary information and is appropriate for the conditions at the site. It is also likely that permits from the Alaska Department of Natural Resources (DNR) and the Alaska Department of Environmental Conservation (DEC), and other agencies will be required for construction dewatering.

In general, excavation and backfilling work should be closely coordinated such that seepage and surface runoff is not allowed to collect and stand in open trenches for long time periods. Seepage from the trench walls may cause local running or sloughing of the soil, which may require the use of a trench box or shoring depending on the excavation slope angles and depth of the excavations. Exposed silty soils should be protected from additional moisture during construction as they are likely moisture sensitive and may lose significant strength if saturated. The ground surface around excavations should be contoured to drain away from the excavation and the excavation bottoms should be graded to drain to a sump.

7.3 Subdrain Recommendations

As mentioned in Section 7.1, we recommend that subdrains be incorporated into the project design to discourage seasonal saturation of the structural section during periods of high groundwater. The depth of the subdrain pipe should be such that the system only receives water during periods of high groundwater, as area-wide "dewatering" is not intended due to the risk of potential settlements to adjoining properties associated with long-term lowering of the area groundwater below the existing average condition. Therefore, assuming the road is constructed at or above the existing grade, we recommend that the subdrains be placed with the bottom of the pipe no more than 4.5 feet below the finished grade of the road surface. We recommend that drains be placed on both sides of the roadway, in the 4-foot extension of the structural section behind curb/gutter or walkways (if present). The drain pipes should feed directly to the storm drain piping that will be installed for this project. The pipe should be placed with perforations facing down, bedded on all sides with a minimum of 12 inches of MOA Type D filter material (see Figure 3 for gradation requirements). The filter material should be wrapped on all sides with a MOA Type C geotextile fabric. The fabric should have an elongation equal to or greater than 50 percent, a permittivity of at least 1.5 sec^{-1}, and a water flow of at least 110 gpm/ft^2. The size of the pipes will be controlled by the hydraulic demands on the drainage system.

7.4 Utility Trench Design

Utility lines, including storm drain pipes, below the road surface may be constructed when the road is improved. Trenches excavated for installation of these new utilities should be constructed as presented in Figure 4. The soils encountered near the surface in our explorations were generally medium dense and granular. These soils were underlain by silty granular soils. Soils above the water table will likely tend to stand steeply initially due to apparent cohesion but may ravel to their natural angle of repose as they dry, which for planning purposes is estimated at about 1.5 horizontal to 1 vertical. Granular soils excavated below the water table may also slough or run into the open excavation if dewatering is not conducted (see Section 7.2). The trench side slopes and bottom conditions should be made the responsibility of the contractor as he or she is present on a day-to-day basis and can adjust his or her efforts to obtain the needed stability and meet the applicable Alaska and Federal (OSHA) safety regulations.

If wet conditions persist at the trench bottom, crushed aggregate may be used to stabilize the trench bottom (i.e. provide a firm unyielding surface on which to support the new pipe) and E chips or pea gravel may be used as a substitute for pipe bedding material. This should only be done if it is too wet to compact mineral soils, as E chips or pea gravel may be placed in relatively wet conditions and can be compacted with hand equipment.

Trench backfill should be placed in maximum 12-inch loose lifts and compacted to at least 95 percent of the Modified Proctor maximum dry density, as discussed in Section 6.5. The bedding and fill material around the pipe should be compacted to at least 95 percent of the Modified Proctor maximum dry density or per manufacturer recommendations to support and hold the pipe firmly in place. Utility trenches should be backfilled with existing, inorganic, native soils as much as practical between the top of the pipe bedding and the bottom of the road subgrade, or to original ground surface in areas where no pavement is needed. This procedure limits the contrast between trench backfill and the surrounding soil conditions that can lead to adverse settlement or frost heave behavior. Bulking of backfill into trenches should be discouraged as this can cause variable subgrade support or voids and lead to large future surface settlements with associated pavement distress.

Note that the shallow groundwater and variable soils can create a corrosive environment for buried utilities. Corrosion testing was not included in our scope, and lacking test results that indicate the corrosion potential is low, we recommend using pipe materials that are not vulnerable to corrosion.

7.5 Structural Fill and Compaction

Structural fill will be needed to support pavements and new utilities. Classified structural fill that is imported should be clean, granular soil free of organic material to provide drainage and frost protection. These soils should contain less than about six percent passing the No. 200 sieve. Generally, Type II or Type IIA material as specified in the MASS works well for this application and as the subbase layer. Gradation properties for the classified materials mentioned above are included in Figure 3.

Based on laboratory test results from our borings in the project area, the fill and native soils generally consisted of silty sand with variable amounts of gravel and typical fines contents ranging between about 11 and 46 percent. These materials do not meet the gradation requirements for Type II/IIA classified fill and should not be reused in the pavement structural section; however, they may be used as backfill beneath the pavement structural section and in nonstructural areas. The reuse of onsite materials as backfill beneath structural areas should be evaluated on a case-by-case-basis during construction, and depending on the contractor's ability to place and compact the material with proper moisture density control as described below.

Structural fills below pavements should be placed in lifts not to exceed 12 inches loose thickness and compacted to at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557). Non-structural fills that are not subject to building or traffic loads should be compacted to at least 90 percent of the Modified Proctor optimum dry density. Bulking of backfill into the trench should be discouraged as this can cause voids and lead to large future surface settlements. During fill placement, we recommend that large cobbles or boulders with dimensions in excess of 8 inches be removed from any structural fills.

8 CLOSURES AND LIMITATIONS

This report was prepared for the exclusive use of our client and their representatives for evaluating the site as it relates to the geotechnical aspects discussed herein. The analyses and conclusions contained in this report are based on site conditions as they presently exist. It is assumed that the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions everywhere are not significantly different from those disclosed by the explorations.

If, during construction, subsurface conditions different from those encountered in these explorations are observed or appear to be present, Shannon & Wilson, Inc. should be advised at once so that these conditions can be reviewed, and recommendations can be reconsidered where necessary. If there is a 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, it is recommended that this report be reviewed to determine the applicability of the conclusions considering the changed conditions and time lapse.

We recommend that we be retained to review those portions of the plans and specifications pertaining to earthwork and foundations to determine if they are consistent with our recommendations. In addition, we should be retained to review design/build contractor's design and submittals, and to observe construction, particularly the site excavations, compaction of structural fill, preparation of foundations, and such other field observations as may be necessary.

Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs. Shannon & Wilson has prepared the attachment, Important Information About Your

Geotechnical/Environmental Report, to assist you and others in understanding the use and limitations of the reports.

Copies of documents that may be relied upon by our client are limited to the printed copies (also known as hard copies) that are signed or sealed by Shannon & Wilson with a wet, blue ink signature. Files provided in electronic media format are furnished solely for the convenience of the client. Any conclusion or information obtained or derived from such electronic files shall be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, or you question the authenticity of the report please contact Shannon & Wilson.

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Miles

N

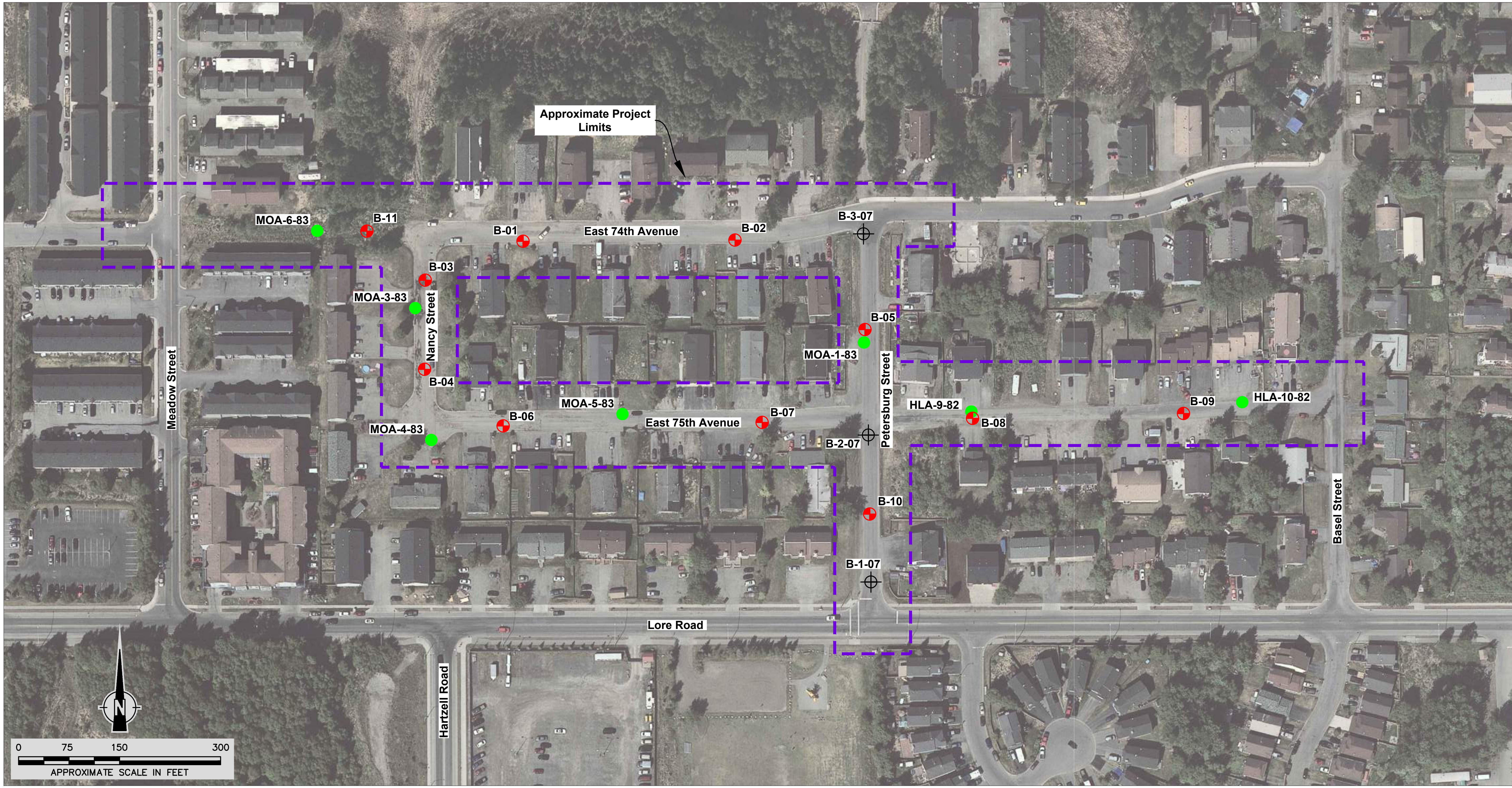
E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

VICINITY MAP

December 2021 107664-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1



LEGEND

B-01 — Approximate location of Boring B-01, advanced by Shannon & Wilson, Inc., October 2021

B-1-07 — Approximate Location of Boring B-1, Advanced by Shannon & Wilson, Inc., March 2007

MOA-1-83 — Approximate Location of Boring 1, Advanced by the Municipality of Anchorage, 1983. Boring name indicates 'Company-Boring ID-Year'. See Appendix A. MOA- Municipality of Anchorage, HLA-Harding Lawson Associates, Inc.

NOTES

1. Map adapted from aerial imagery provided by the Municipality of Anchorage. Image date: May 2015

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

SITE PLAN

December 2021 | 107664-001

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Geotechnical and Environmental Consultants

FIG. 2

GRADATION REQUIREMENTS

(Adapted from Municipality of Anchorage Standard Specifications, 2015)

LEVELING COURSE

U.S. STANDARD SIEVE SIZE English	Metric	PERCENT PASSING BY WEIGHT
1 in.	25.0 mm	100
3/4 in.	19.0 mm	70 - 100
3/8 in.	9.5 mm	50 - 80
No. 4	4.75 mm	35 - 65
No. 8	2.36 mm	20 - 50
No. 50	0.30 mm	8 - 28
No. 200	0.075 mm	2 - 6*

TYPE II-A BACKFILL

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
3 in.	75 mm	100
3/4 in.	19.0 mm	50 - 100
No. 4	4.75 mm	25 - 60
No. 10	2.00 mm	15 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6***

TYPE II BACKFILL

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
8 in.	-	100
3 in.	75 mm	70 - 100
1-1/2 in.	37.5 mm	55 - 100
3/4 in.	19.0 mm	45 - 85
No. 4	4.75 mm	20 - 60
No. 10	2.00 mm	12 - 50
No. 40	0.425 mm	4 - 30
No. 200	0.075 mm	2 - 6**

TYPE D FILTER MATERIAL

U.S. STANDARD SIEVE SIZE		PERCENT PASSING BY WEIGHT
1 in.	25.0 mm	100
3/4 in.	19.0 mm	90 - 100
1/2 in.	12.5 mm	50 - 70
3/8 in.	9.5 mm	20 - 50
No. 4	4.75 mm	0 - 5
No. 200	0.075 mm	0 - 1

* The fraction passing the No. 200 sieve shall not exceed 75 percent of the fraction passing the No. 50 sieve.

** The fraction passing the No. 200 sieve shall not exceed 15 percent of the fraction passing the No. 4 sieve.

*** The fraction passing the No. 200 sieve shall not exceed 20 percent of the fraction passing the No. 4 sieve.

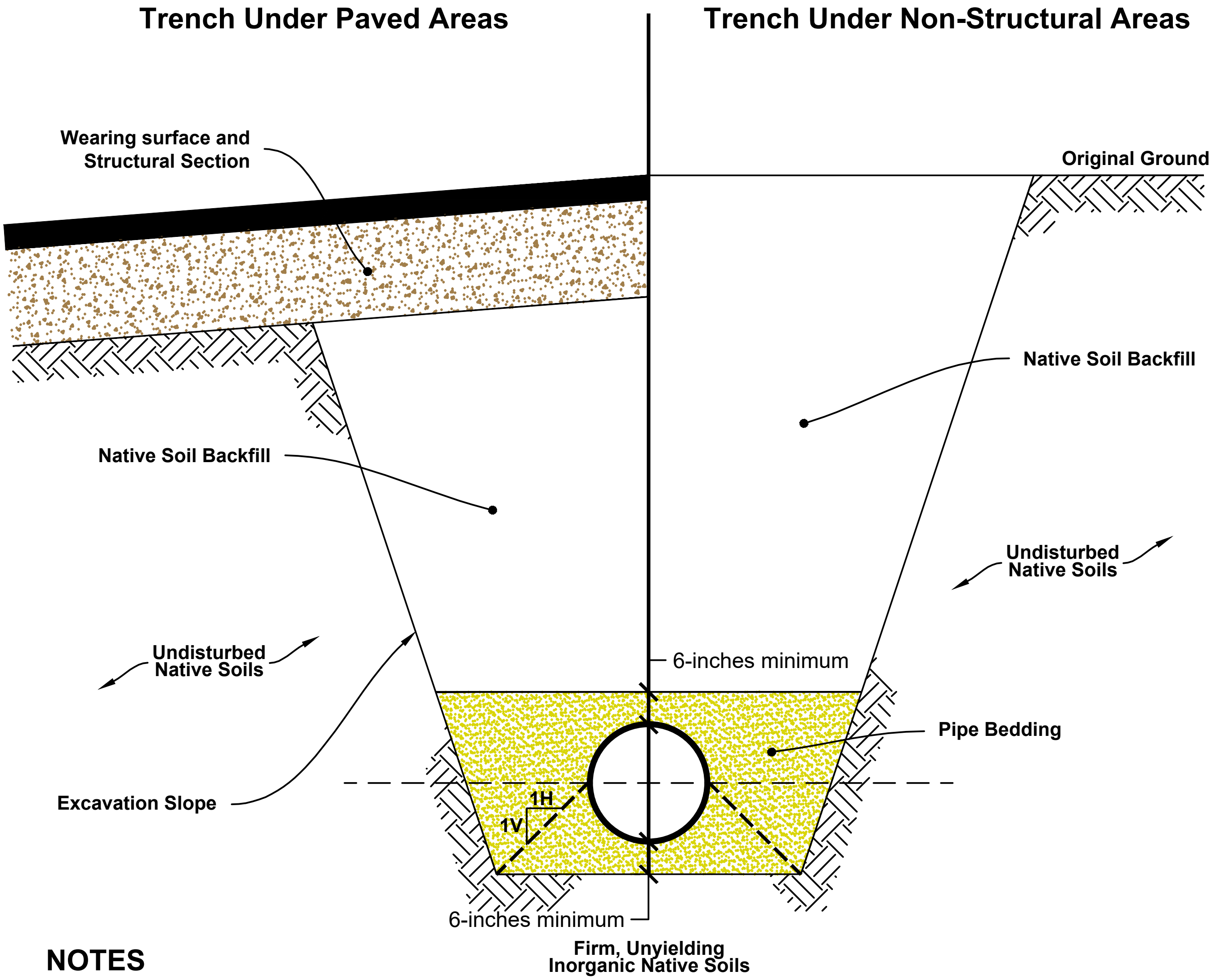
E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

GRADATION REQUIREMENTS

December 2021 107664-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. 3



NOTES

1. Trench backfill under paved areas should be placed in loose lifts not to exceed 12 inches and compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557.

2. Trench backfill under non-structural areas should be placed in loose lifts not to exceed 18 inches and compacted to at least 90 percent of its maximum dry density as determined by ASTM D-1557.

3. Pipe bedding should conform to MOA Class C bedding material or as recommended by pipe manufacturer.

4. Pipe bedding and cover thickness shown above should be used absent pipe manufacturer requirements.

5. OSHA requires slope protection and support for all trenches greater than 4 feet deep. Side slope requirements are variable depending upon soil type and the duration of time in which the trench remains open. The contractor should be made responsible for compliance to these regulations as he/she is at the project on a day to day basis, is aware of the changing conditions and has authority to direct work.

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

UTILITY TRENCH DETAIL

December 2021 107664-001

SHANNON & WILSON, INC.
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FIG. 4

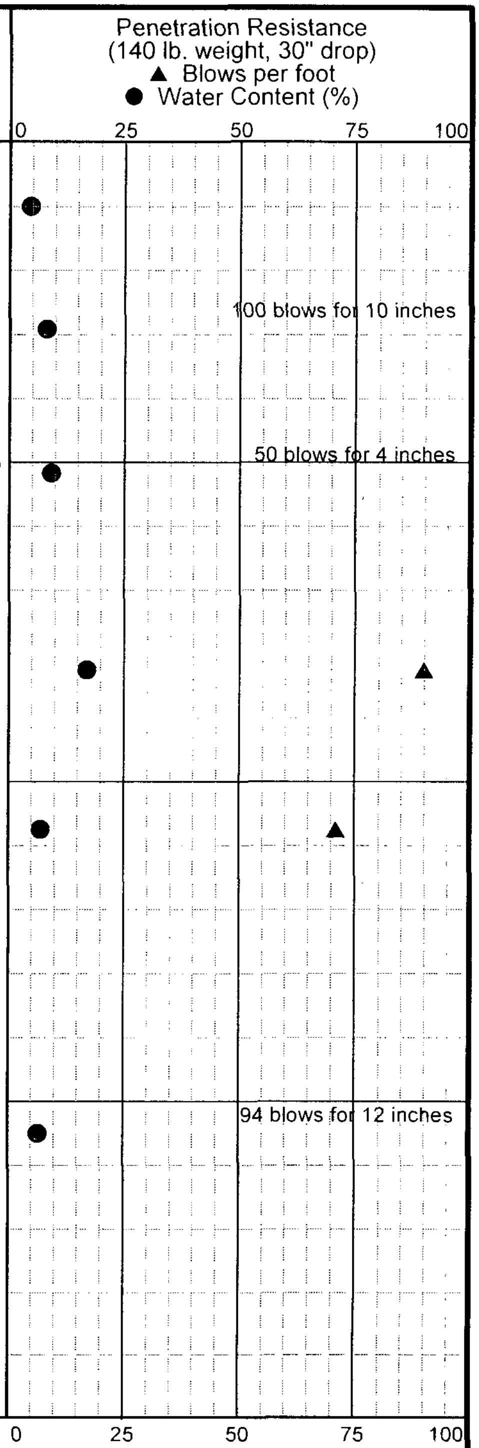
APPENDIX A: BORING LOGS FROM PRIOR EXPLORATIONS

Appendix A

Boring Logs from Prior Explorations

MATERIAL DESCRIPTION Approx. Elevation: Level with Petersburg St. Centerline	Depth, Ft.	Samples
2 inches Chip Seal Asphalt Pavement	0.2	
Frozen, brown, silty, gravelly SAND; moist [FILL] Woven Geofabric layer at 2 feet bgs		S1
Frozen to very dense, brown to gray, silty, gravelly SAND; moist	2.0	S2, S3
S4: 36% Gravel, 41% Sand, 23% Fines (F2)		S4, S5, S6
Bottom of Boring Boring Completed 19 March 2007	16.0	

Ground Water: Groundwater not encountered during drilling on 19 March 2007



LEGEND

- * Sample Not Recovered
- Bulk Sample
- 2" O.D. Split Spoon Sample
- ▮ Frozen
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Petersburg Street, Lore Road to E. 73rd Avenue
Anchorage, Alaska

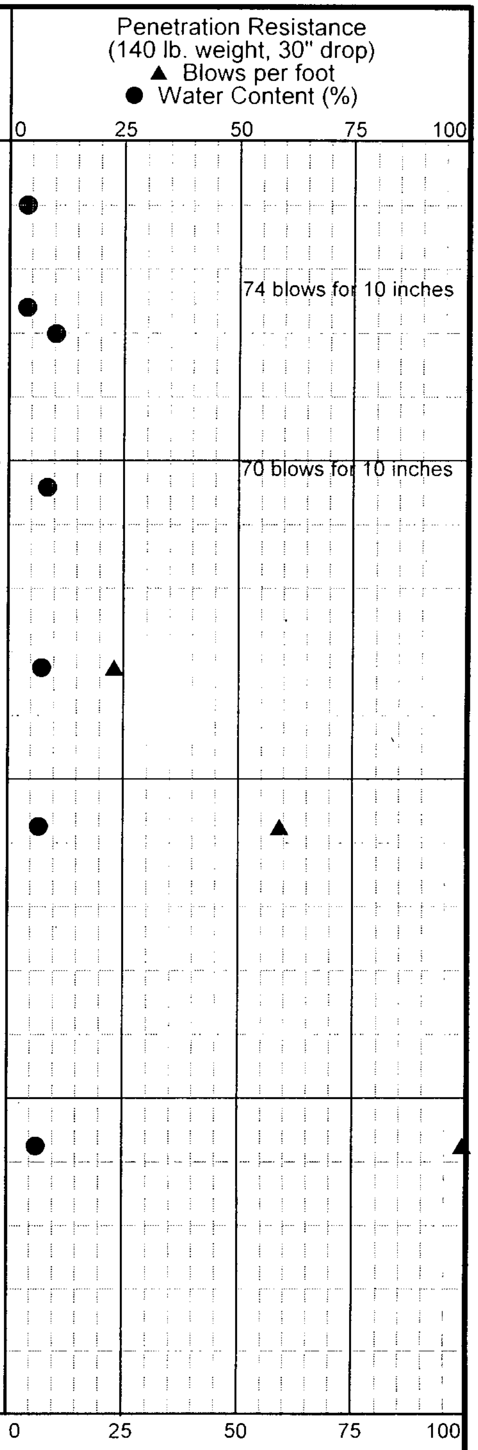
LOG OF BORING B-1

April 2007 32-1-01891

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. 5

MATERIAL DESCRIPTION Approx. Elevation: Level with Petersburg St. Centerline	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
2.5 inches Chip Seal Asphalt Pavement	0.2				
Frozen, brown, silty, gravelly SAND; moist [FILL] Woven Geofabric layer at 2.7 feet bgs	2.7		S1		
Medium dense to very dense, brown to gray, gravelly, silty SAND; moist to wet			S2a S2b		
S3: 28% Gravel, 38% Sand, 35% Fines (F3)			S3		5
			S4		
S5: 29% Gravel, 40% Sand, 31% Fines (F3)			S5		10
Unable to read static water level due to blockage in piezometer at approximately 4 feet bgs (28 March 2007)	16.5		S6	19 March 2007	15
Bottom of Boring Boring Completed 19 March 2007					



LEGEND

- * Sample Not Recovered
- Bulk Sample
- 2" O.D. Split Spoon Sample
- Frozen
- Blank Section, Cuttings Backfill
- Slotted Section, Cuttings Backfill
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Petersburg Street, Lore Road to E. 73rd Avenue
Anchorage, Alaska

LOG OF BORING B-2

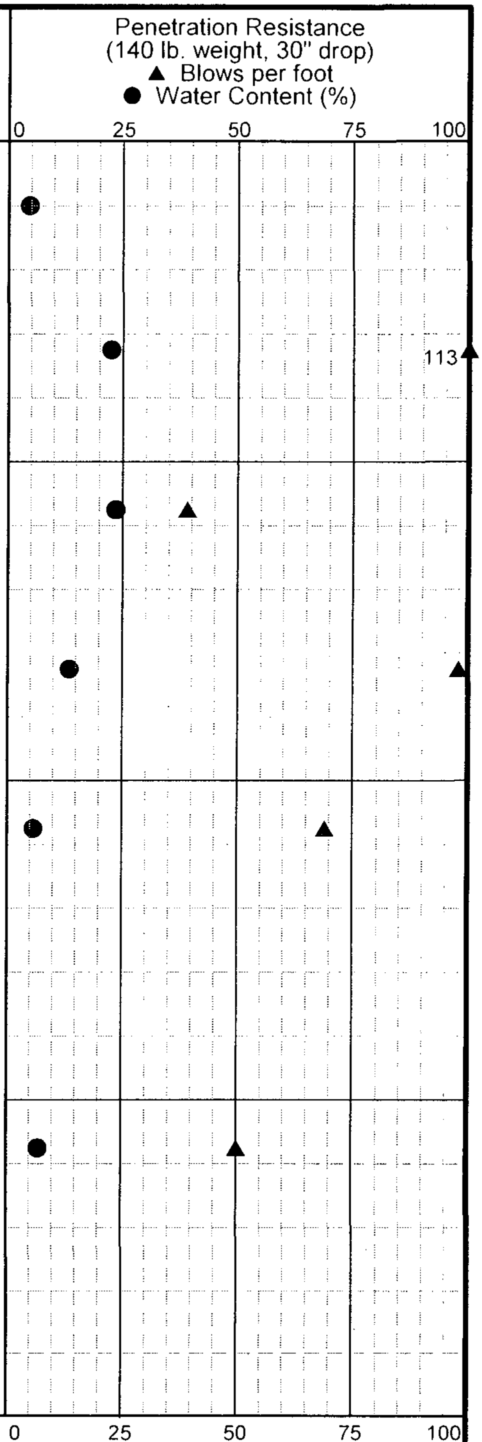
April 2007 32-1-01891

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. 6

GEOTECHNICAL LOG 01891 LOGS.GPJ S&W GEO1.GDT 4/6/07

MATERIAL DESCRIPTION Approx. Elevation: Level with Petersburg St. Centerline	Depth, Ft.	Symbol	Samples	Ground Water
2.5 inches Chip Seal Asphalt Pavement	0.2			
Frozen, brown, silty, gravelly SAND; moist [FILL] S1: 29% Gravel, 54% Sand, 18% Fines (F2)			S1	
Frozen to very dense, dark brown to gray, gravelly, silty SAND; moist; occasional organics from 7.5 to 7.9 feet bgs [Vr] Randomly oriented ice crystals observed within frost zone and represents between approximately 3% and 5% of the total soil volume S3: 22% Gravel, 31% Sand, 47% Fines (F3)	2.0		S2, S3, S4	Groundwater not encountered during drilling on 19 March 2007
Very dense, silty, sandy GRAVEL; moist	10.4		S5, S6	
Bottom of Boring Boring Completed 19 March 2007	16.5			



LEGEND

- * Sample Not Recovered
- Bulk Sample
- 2" O.D. Split Spoon Sample
- ▽ Ground Water Level At Time Of Drilling
- ∎ Frozen

● Water Content (%)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

Petersburg Street, Lore Road to E. 73rd Avenue
Anchorage, Alaska

LOG OF BORING B-3

April 2007 — 32-1-01891

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Fig. 7

MUNICIPALITY OF ANCHORAGE

2133-C

(12)

DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION DIVISION

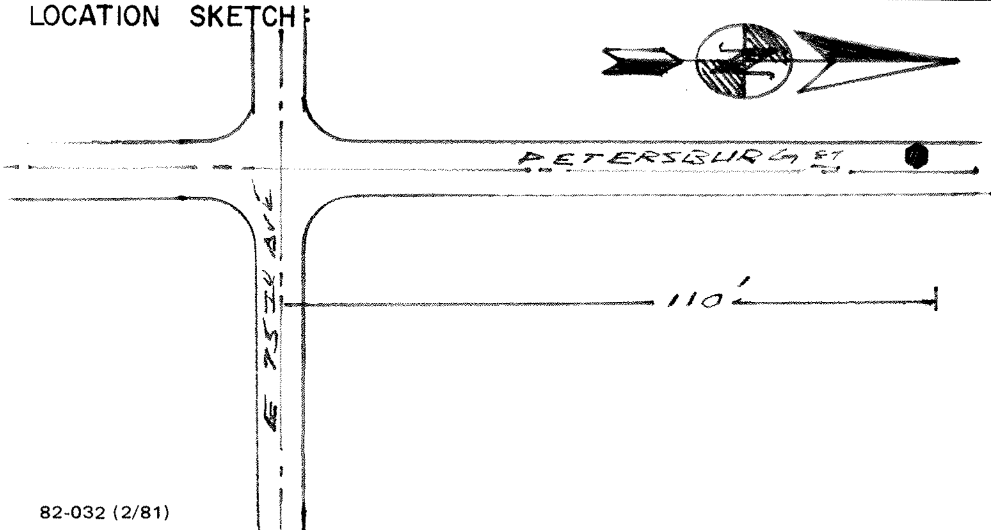
SOILS LOG

LOCATION CHUGALCH MEADOWS SUBD. 110' N of E 75TH AVE / 15' W of PETERSBURG
COMMENTS DAVID HARMAN
77-190
SHEET 10 OF 10

HOLE NO. 1
DATE 3-9-83
BY SLD
DEPTH 17'
WATER TABLE NONE

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0			
	1			
	2	GM	F-3	SILTY SANDY GRAVEL
	3			
	4			
	5			
	6	GM	F-1	SANDY GRAVEL + TRACE SILT
	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

GRID NO. ______

82-032 (2/81)

MUNICIPALITY OF ANCHORAGE

2132-D

DEPARTMENT OF PUBLIC WORKS

23

CONSTRUCTION DIVISION

SOILS LOG

HOLE NO. 3

LOCATION CHUGACH MEADOWS SUBD.
110' S ℄ E 74TH AVE / 16' W ℄ NANCY ST

DATE 3-9-83

BY SLD

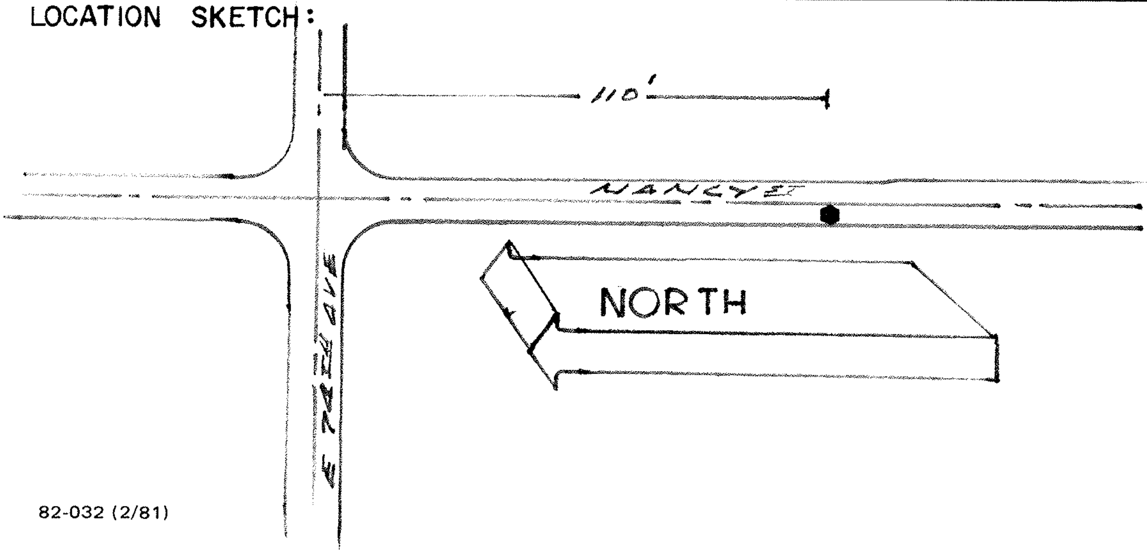
COMMENTS DAVID HARMAN
77-190
SHEET 9 OF 10

DEPTH 24'

WATER TABLE NONE

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0			
	1			
	2			
	3			
	4			
	5	PT	N/A	PEAT
	6			
	7			
	8			
	9			
	10			
	11			
	12			
	13	SM	F-2	BROWN SILTY SAND
	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.

82-032 (2/81)

2132-D

MUNICIPALITY OF ANCHORAGE
DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION DIVISION

24

SOILS LOG

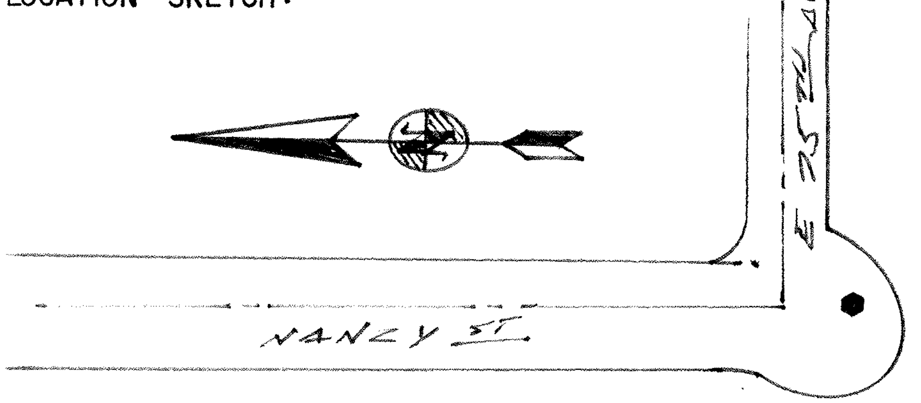
LOCATION CHUGACH MEADOWS SUBD.
30' S E E 75TH AVE / E NANCY ST

COMMENTS CHUGACH MEADOWS
77-190
SHEET 9 OF 10

HOLE NO. 4
DATE 3-9-83
BY SLF
DEPTH 20
WATER TABLE NONE

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0–5	PT	N/A	PEAT
	5–10	ML	F-4	SANDY SILT
	10–14	GM	F-3	SANDY SILTY GRAVEL

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. ______

82-032 (2/81)

2133-C

(13)

MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

SOILS LOG

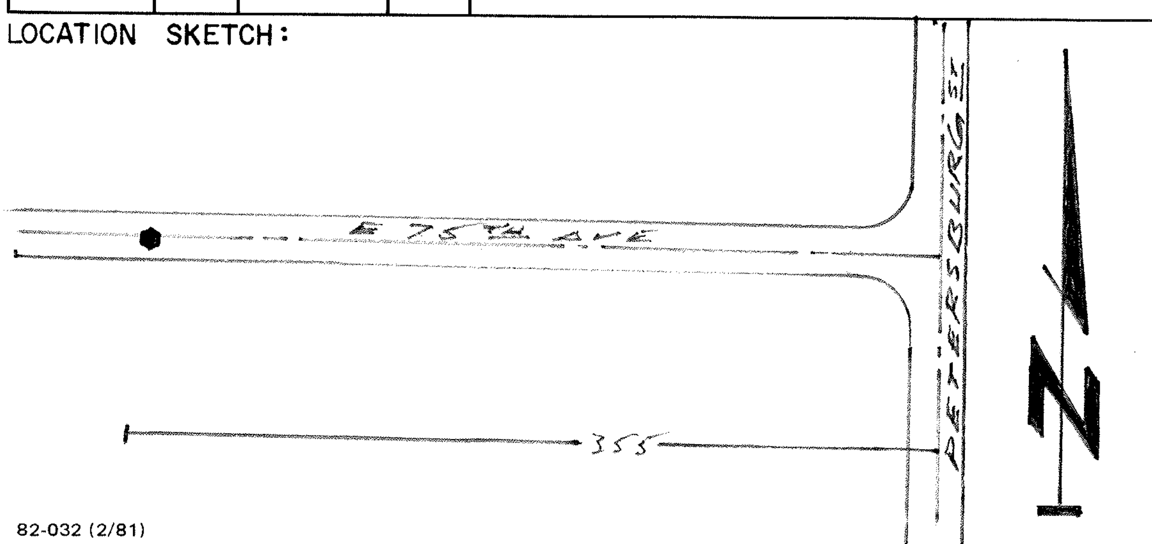
HOLE NO. 5
DATE 3-9-83
BY SLP
DEPTH 20
WATER TABLE NONE

LOCATION CHUGACH MEADOWS SUBD.
355' W ℄ PETERSBURG ST./℄ E 75TH

COMMENTS DAVID HARMAN
77-190
SHEET 9 OF 10

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0–2	PT	N/A	PEAT WITH SILT
	2–14	GM	F-3	SANDY SILTY GROVEL

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. ______

82-032 (2/81)

2132-D

(20)

MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

SOILS LOG

HOLE NO. N. 6

LOCATION CHUGACH MEADOWS SUB.
160' W of NANCY ST / E 74TH AVE

DATE 3-7-83

BY JLD

COMMENTS DAVID HARMAN, P.E.
77-190
SHEET 7 OF 10

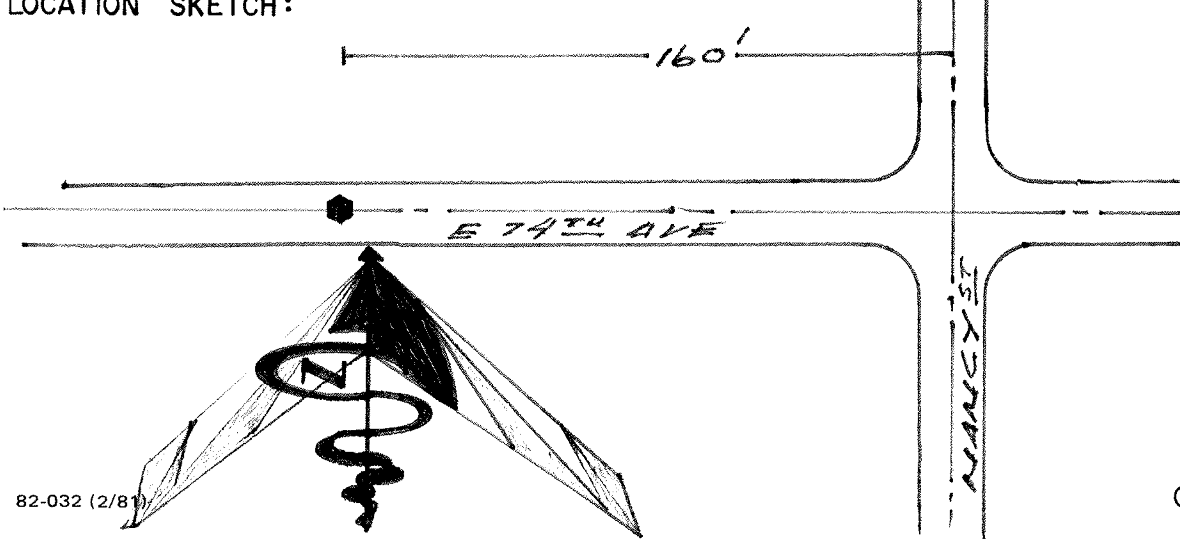
DEPTH 10'

WATER TABLE NONE

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0–4	SM	F-2	BROWN SILTY GRAVELLY SAND
	4–8	ML	F-4	GREY SANDY SILT
	8–	ML	F-4	GREY CLAYEY SILT

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14

LOCATION SKETCH:



LEGEND

SYMBOL

- TEST HOLE
- WATER TABLE
- FROZEN MATERIAL (2, 3, 4, 5)

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

GRID NO. ______

82-032 (2/81)

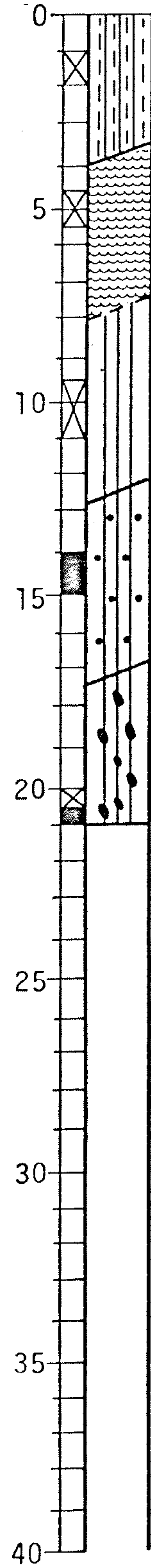
ENTERED

LOG OF BORING 9

Equipment 3-3/8" I.D. Hollow Stem Auger

Elevation - Date Drilled 10/20/82

Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blows/Foot (1)	Depth (ft)	Description
Dry Strength - Low		231.3		0	DARK BROWN ORGANIC SILT (OL) soft, moist, amorphous
			2*	5	LIGHT BROWN PEAT (Pt) very soft, wet, with fibrous organics; water level 10-20-82
Dry Strength - High		8.0	72*	10	GRAY SANDY GRAVELLY SILT (ML) very stiff, wet, angular gravel to 1" diameter, fine to medium sand
Dry Strength - Medium		6.5	90	15	GRAY GRAVELLY SILTY SAND (SM) very dense, dry, fine to medium sand, subrounded gravel to 1.5" Diameter
Dry Strength - Medium		8.0	64	20	GRAY SILTY SANDY GRAVEL (GM) very dense, dry, subrounded gravel to 2.5" diameter, fine to medium sand



Harding Lawson Associates
Engineers, Geologists & Geophysicists

Log of Boring 9
Zurich and Rosewood L.I.D.
Anchorage, Alaska

PLATE 10

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	5502,014.08		10/82		

9

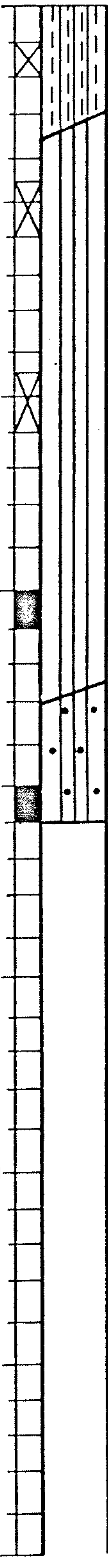
94

LOG OF BORING 10

Equipment 3-3/8" I.D. Hollow Stem Auger

Elevation - Date Drilled 10/20/82

Laboratory Tests	Dry Density (pcf)	Moisture Content (%)	Blows/Foot (1)	Depth (ft)	Description
				0	DARK BROWN ORGANIC SILT (OL) soft, moist, amorphous
Dry Strength - High		21.0	18*	5	GRAY SANDY SILT (ML) stiff, moist, fine sand, contains fibrous organics
			22*	10	contains a trace of angular fine gravel at 10.0'
Dry Strength - High		9.2	36	15	contains subrounded gravel to 1/2" diameter at 15.0'
Dry Strength - Medium		6.3	86	20	GRAY GRAVELLY SILTY SAND (SM) dense, dry, fine to medium sand, subrounded gravel to 2" diameter
					No free water encountered
				25	
				30	
				35	
				40	



Harding Lawson Associates
Engineers, Geologists
& Geophysicists

Log of Boring 10
Zurich and Rosewood L.I.D.
Anchorage, Alaska

PLATE
11

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
	5502,014.08		10/82		

APPENDIX B: BORING LOGS AND LABORATORY TEST RESULTS

Appendix B

Boring Logs and Laboratory Test Results

CONTENTS

- Soil Description & Log Key
- Frost Classification Legend
- Log of Borings
- Grain Size Classification
- Atterberg Limits Results

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT[2]	FINE-GRAINED SOILS (50% or more fines)[1]	COARSE-GRAINED SOILS (less than 50% fines)[1]
Major	***Silt, Lean Clay, Elastic Silt,*** or ***Fat Clay***[3]	***Sand*** or ***Gravel***[4]
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: ***Sandy*** or ***Gravelly***[4]	More than 12% fine-grained: ***Silty*** or ***Clayey***[3]
Minor Follows major constituent	15% to 30% coarse-grained: ***with Sand*** or ***with Gravel***[4]	5% to 12% fine-grained: ***with Silt*** or ***with Clay***[3]
	30% or more total coarse-grained *and* lesser coarse-grained constituent is 15% or more: ***with Sand*** or ***with Gravel***[5]	15% or more of a second coarse-grained constituent: ***with Sand*** or ***with Gravel***[5]

[1]All percentages are by weight of total specimen passing a 3-inch sieve.
[2]The order of terms is: *Modifying Major with Minor*.
[3]Determined based on behavior.
[4]Determined based on which constituent comprises a larger percentage.
[5]Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.

NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND	
Fine	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.)
Medium	#40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.)
Coarse	#10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL	
Fine	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.)
Coarse	3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

Bentonite Cement Grout	Surface Cement Seal
Bentonite Grout	Asphalt or Cap
Bentonite Chips	Slough
Silica Sand	Inclinometer or Non-perforated Casing
Perforated or Screened Casing	Vibrating Wire Piezometer

PERCENTAGES TERMS [1, 2]

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

[1]Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

[2]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

SOIL DESCRIPTION AND LOG KEY

December 2021 107664-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
(Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS
COARSE-GRAINED SOILS *(more than 50% retained on No. 200 sieve)*	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Gravel *(less than 5% fines)*	GW	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel *(more than 12% fines)*	GM	Silty Gravel; Silty Gravel with Sand
			GC	Clayey Gravel; Clayey Gravel with Sand
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Sand *(less than 5% fines)*	SW	Well-Graded Sand; Well-Graded Sand with Gravel
			SP	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand *(more than 12% fines)*	SM	Silty Sand; Silty Sand with Gravel
			SC	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	MH	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat or other highly organic soils (see ASTM D4427)

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

1. Dual symbols *(symbols separated by a hyphen, i.e., SP-SM, Sand with Silt)* are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

2. Borderline symbols *(symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand)* indicate that the soil properties are close to the defining boundary between two groups.

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SOIL DESCRIPTION AND LOG KEY

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FIG. B-1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS[1]

Weak	Crumbles or breaks with handling or slight finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

PLASTICITY[2]

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASITICTY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It take considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS[1]

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q_u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS[1]

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

[1]Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.
[2]Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

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SOIL DESCRIPTION AND LOG KEY

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FIG. B-1
Sheet 3 of 3

FROST CLASSIFICATION

(after Municipality of Anchorage, 2007)

GROUP		0.02 Mil.	P-200*	USC SYSTEM (based on P-200 results)
NFS	Sandy Soils	0 to 3	0 to 6	SW, SP, SW-SM, SP-SM
	Gravelly Soils	0 to 3	0 to 6	GW, GP, GW-GM, GP-GM
F1	Gravelly Soils	3 to 10	6 to 13	GM, GW-GM, GP-GM
F2	Sandy Soils	3 to 15	6 to 19	SP-SM, SW-SM, SM
	Gravelly Soils	10 to 20	13 to 25	GM
F3	Sands, except very fine silty sands**	Over 15	Over 19	SM, SC
	Gravelly Soils	Over 20	Over 25	GM, GC
	Clays, PI>12			CL, CH
F4	All Silts	Over 15	Over 19	ML, MH
	Very fine silty sands**			SM, SC
	Clays, PI<12			CL, CL-ML
	Varved clays and other fined grained, banded sediments			CL and ML CL, ML, and SM; SL, SH, and ML; CL, CH, ML, and SM

PI = Plasticity Index
P-200 = Percent passing the number 200 sieve
0.02 Mil. = Percent material below 0.02 millimeter grain size

*Approximate P-200 value equivalent for frost classification. Value range based on typical, well-graded soil curves.

** Very fine sand : greater than 50% of sand fraction passing the number 100 sieve

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FROST CLASSIFICATION LEGEND

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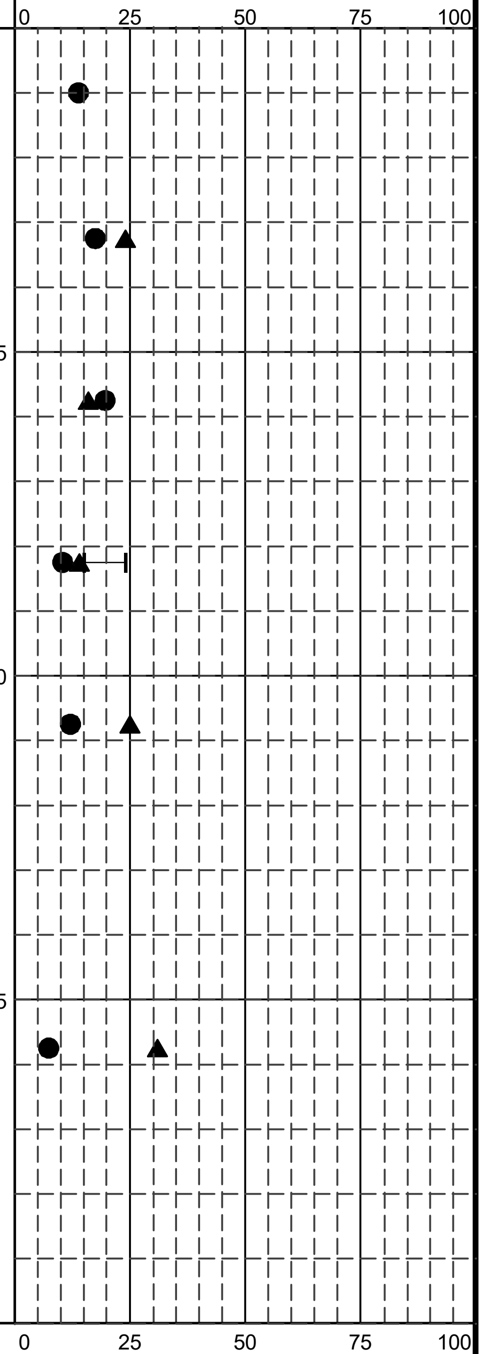
FIG. B-2

MATERIAL DESCRIPTION Approx. Elevation: 123 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
1.5 inches asphalt	0.1			10/5/2021*	
S1: 6% Gravel, 72% Sand, 22% Fines (F3 [0.02 mil]) Medium dense, brown, *Silty Sand (SM)*; wet [FILL]			S1		
			S2		
Medium dense to dense, gray, *Silty Sand with Gravel (SM) to Clayey Sand with Gravel (SC)*; moist 1 inch *Peat* at approximately 5.5 feet bgs	4.5		S3		5
S4: 46.9% Fines (F3 [P200])			S4		
			S5		10
			S6		15
Bottom of Boring Boring Completed 10/5/2021 *Groundwater likely perched over low permeability native soils	16.5				

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-01

December 2021 107664-001

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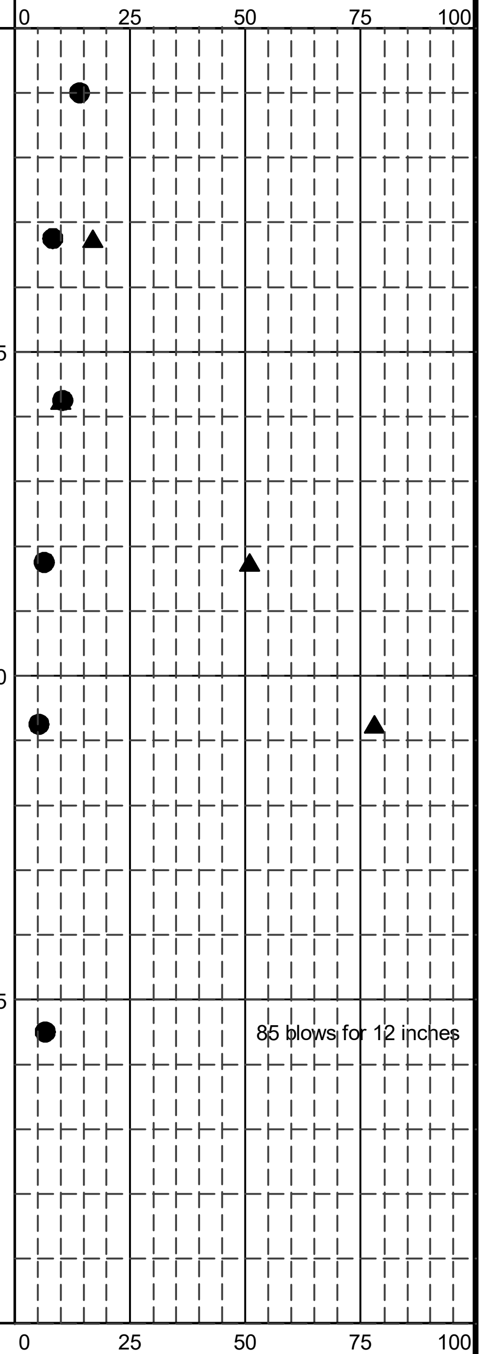
FIG. B-3

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION Approx. Elevation: 126 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
2 inches asphalt	0.2			▼ 10/11/2021* ∇ 10/5/2021*	
S1: 19.4% Fines (F3 [P200]) Medium dense, brown, *Silty Sand (SM)*; wet [FILL]			S1 (Grab)		
Medium dense to very dense, gray, *Silty Sand with Gravel to Silty Sand (SM)*; moist	2.2		S2		
S3: 14% Gravel, 39% Sand, 46% Fines (F3 [0.02 mil])			S3		5
			S4		
			S5		10
			S6		15
Bottom of Boring Boring Completed 10/5/2021	16.0				
*Groundwater likely perched over low permeability native soils					

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



● Water Content (%)
Plastic Limit |—●—| Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- ∇ Ground Water Level At Time Of Drilling
- ▼ Static Water Level
- Solid Casing, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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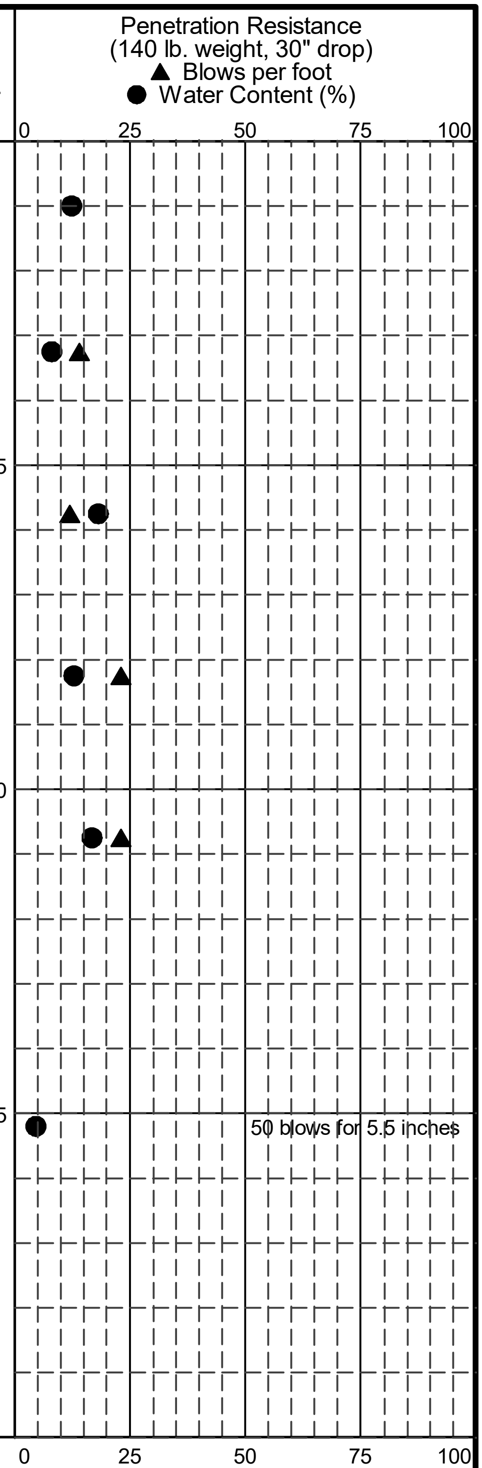
FIG. B-4

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION Approx. Elevation: 122 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
2 inches asphalt	0.2			10/5/2021*	
S1: 9% Gravel, 75% Sand, 16% Fines (F2 [P200]) Medium dense, dark brown, *Silty Sand (SM)*; wet; gray nonwoven geotextile observed in cuttings from between approximately 1 and 2 feet bgs [FILL]	2.2		S1		
Medium dense, gray, *Silty Sand with Gravel (SM)*; moist [FILL?] S2: 38.1% Fines (F3 [P200]) Mottled with *Peat* from approximately 4.5 to 7 feet bgs	7.0		S2 S3		5
Medium dense, gray, *Silty Sand (SM)*; moist	9.5		S4		
Medium dense to very dense, gray to gray-brown, *Silt with Sand (ML)*; moist S5: 3% Gravel, 21% Sand, 76% Fines (F4 [P200])	15.4		S5 S6		10 15
Bottom of Boring Boring Completed 10/5/2021 *Groundwater likely perched over low permeability native soils					



● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

LEGEND

* Sample Not Recovered

Grab Sample

2" O.D. Split Spoon Sample

Ground Water Level At Time Of Drilling

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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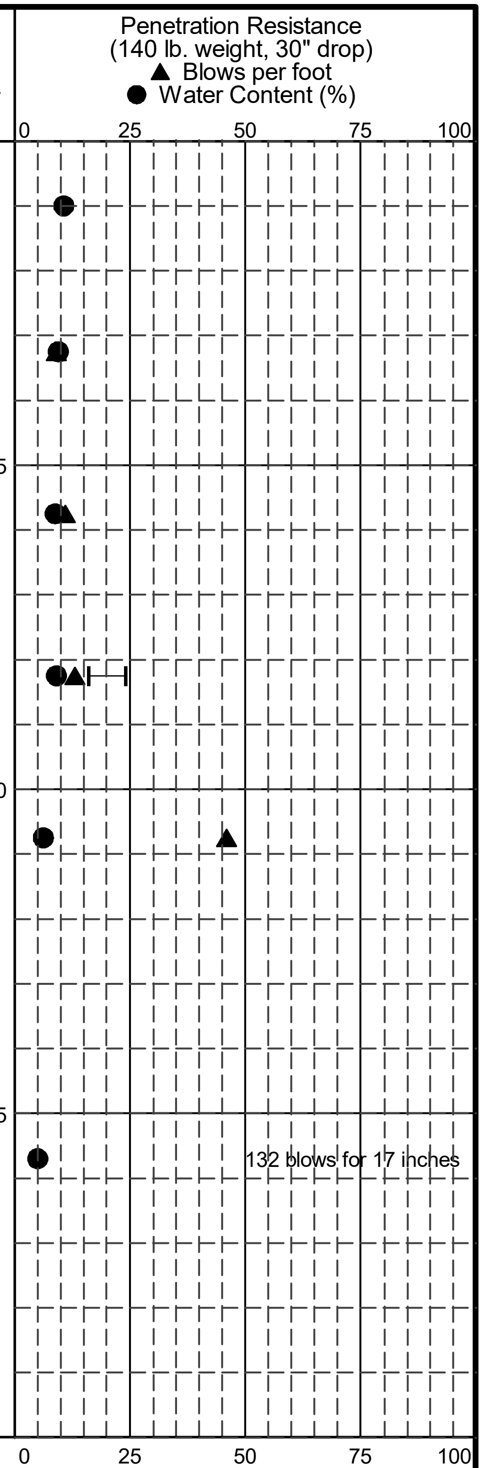
FIG. B-5

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION Approx. Elevation: 123 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
1.5 inches asphalt	0.1				
S1: 15% Gravel, 70% Sand, 15% Fines (F2 [0.02 mil]) Medium dense, brown, *Silty Sand with Gravel (SM)*; wet [FILL]			S1	10/5/2021*	
Loose to very dense, gray to gray-brown, *Silty Sand with Gravel (SM) to Clayey Sand with Gravel (SC)*; moist	2.2		S2		
S3: 41.8% Fines (F3 [P200])			S3		5
			S4		
			S5		10
			S6		15
Bottom of Boring Boring Completed 10/5/2021 *Groundwater likely perched over low permeability native soils	16.4				



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ●—● Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-04

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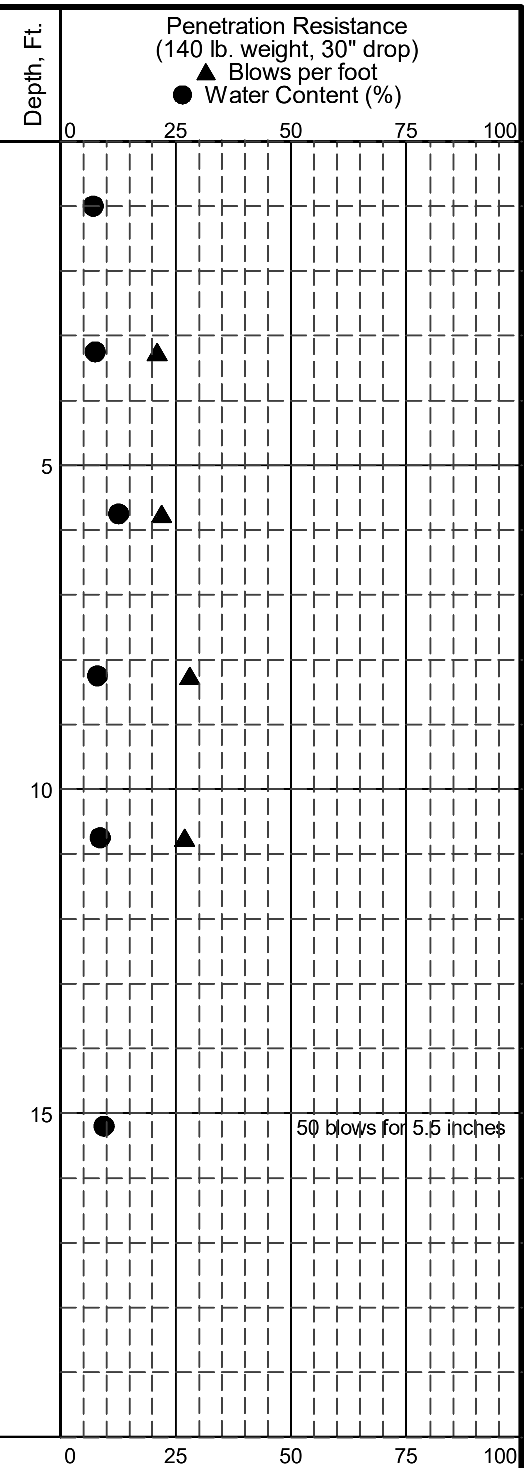
FIG. B-6

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water
Approx. Elevation: 129 Ft. GAAB72				
2 inches asphalt	0.2			
S1: 21% Gravel, 54% Sand, 25% Fines (F3 [0.02 mil]) Medium dense, brown, *Silty Sand with Gravel (SM)*; moist [FILL]			S1	
Medium dense, tan, *Silty Sand with Gravel (SM)*; moist S2: 45.0% Fines (F3 [P200])	2.2		S2, S3	
Medium dense, tan, *Well-Graded Gravel with Silt and Sand (GW-GM)*; wet S4: 51% Gravel, 41% Sand, 8% Fines (F1 [P200])	7.0		S4	10/4/2021
Medium dense to very dense, gray, *Silty Sand with Gravel (SM)*; moist to wet	9.5		S5, S6	
Bottom of Boring Boring Completed 10/4/2021	15.4			



LEGEND

* Sample Not Recovered
Grab Sample
2" O.D. Split Spoon Sample
Ground Water Level At Time Of Drilling

● Water Content (%)
Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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FIG. B-7

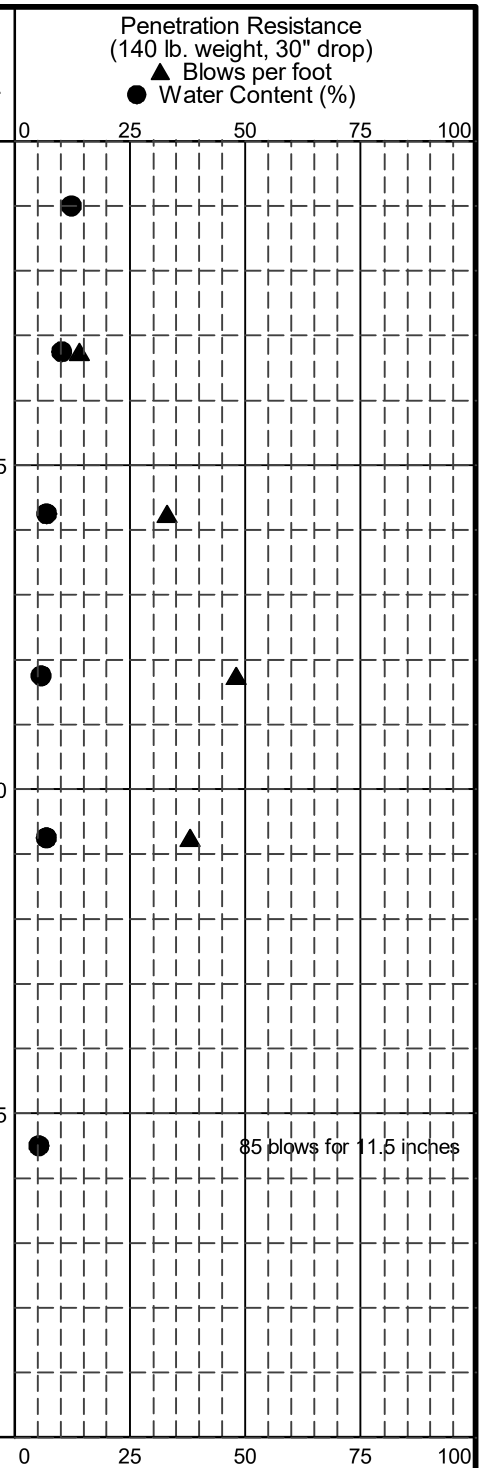
REV 3 - Approved for Submittal

MATERIAL DESCRIPTION

Approx. Elevation: 124 Ft. GAAB72

Material Description	Depth, Ft.	Samples
1.5 inches asphalt	0.1	
Medium dense, dark brown, *Poorly Graded Sand with Silt (SP-SM)*; wet [FILL]	2.2	S1
Medium dense to very dense, gray to gray-brown, *Silty Sand with Gravel (SM)*; moist S2: 22% Gravel, 36% Sand, 42% Fines (F3 [0.02 mil]) S4: 36.8% Fines (F3 [P200])	16.0	S2, S3, S4, S5, S6

Ground Water: 10/5/2021*, 10/11/2021*



Bottom of Boring
Boring Completed 10/5/2021

*Groundwater likely perched over low permeability native soils

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Static Water Level
- Solid Casing, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-06

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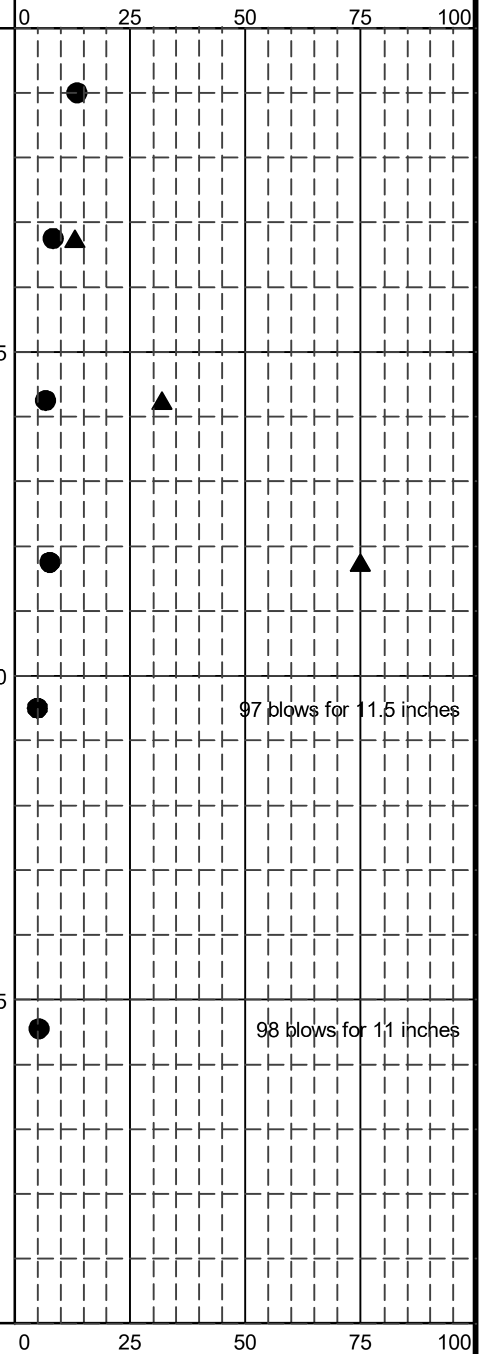
FIG. B-8

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Approx. Elevation: 129 Ft. GAAB72					
2 inches asphalt	0.2			10/4/2021*	
S1: 11.3% Fines (F2 [P200])			S1		
Medium dense, brown, *Poorly Graded Sand with Silt (SP-SM)*; wet [FILL]					
Medium dense to very dense, gray, *Silty Sand with Gravel (SM)*; moist	2.2		S2		
S3: 30% Gravel, 37% Sand, 33% Fines (F3 [P200])			S3		5
			S4		
S5: 17.0% Fines (F2 [P200])			S5		10
			S6		15
Bottom of Boring Boring Completed 10/4/2021	15.9				
*Groundwater likely perched over low permeability native soils					

Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot
● Water Content (%)



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-07

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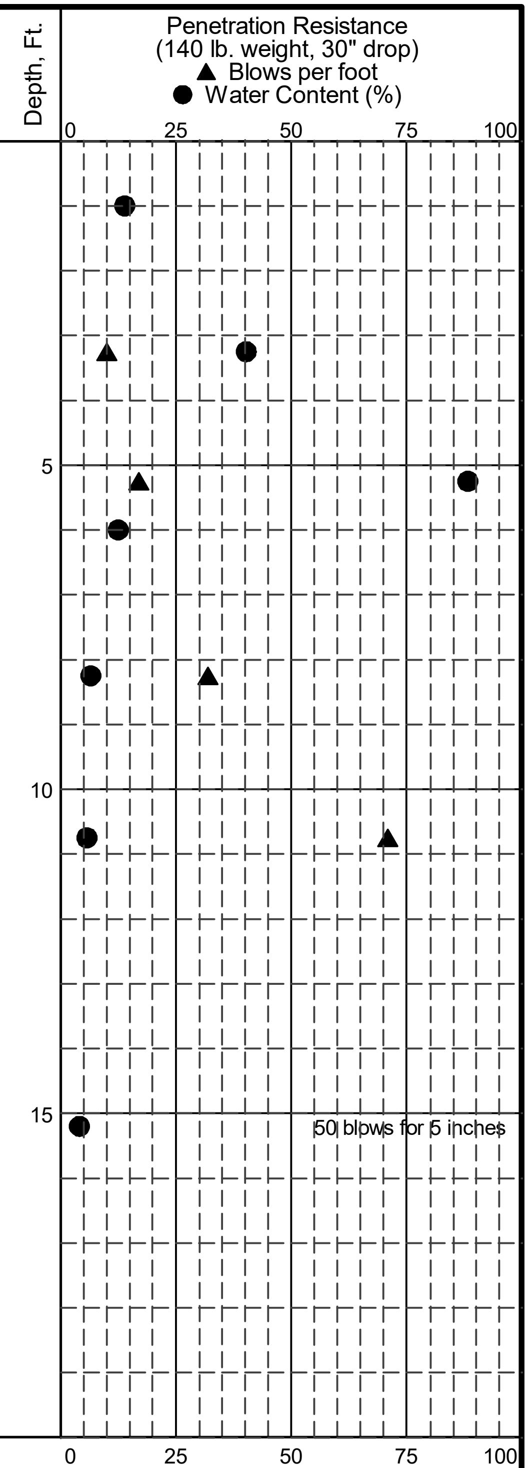
FIG. B-9

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION Approx. Elevation: 131 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water
0.5 inches asphalt	0.1			
S1: 19% Gravel, 42% Sand, 38% Fines (F3 [P200]) Medium dense, dark brown, *Silty Sand with Gravel (SM)*; moist [FILL]			S1	
Stiff, brown, *Peat (PT)*; moist to wet; intermingled with *Silty Sand with Gravel* [FILL] from approximately 2.2 to 4 feet bgs	2.2		S2	
Medium dense to very dense, gray, *Silty Sand with Gravel (SM)*; moist S3B: 49.3% Fines (F3 [P200])	5.5		S3A, S3B, S4, S5, S6	Groundwater not encountered during drilling on 10/4/2021
Bottom of Boring Boring Completed 10/4/2021	15.4			



● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

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LOG OF BORING B-08

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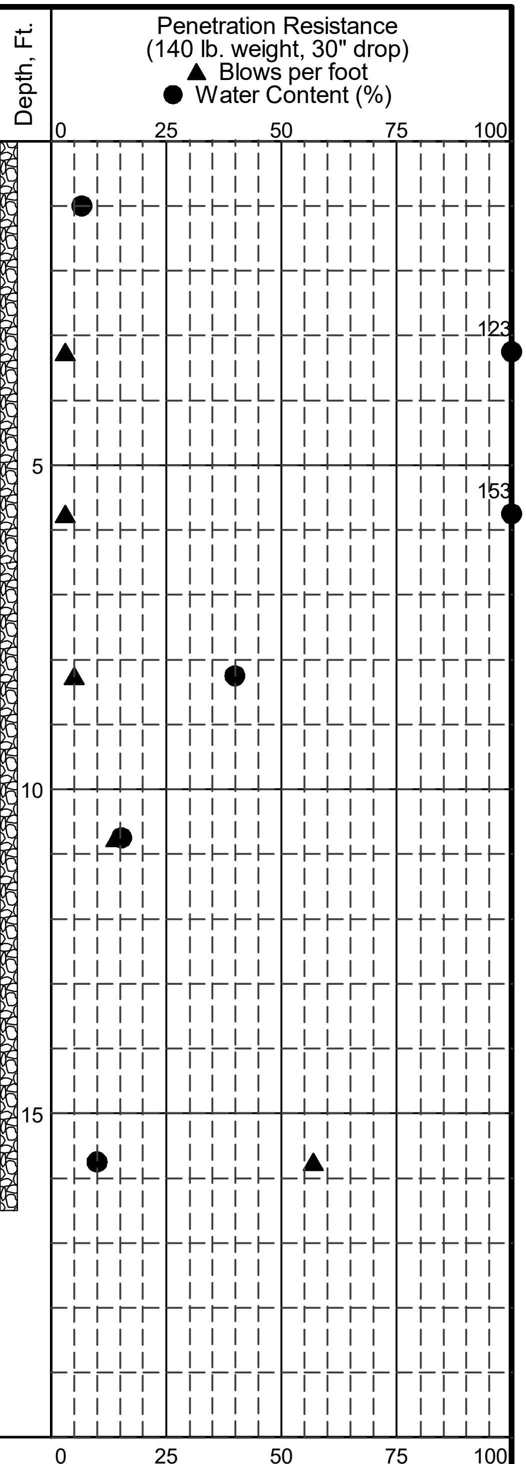
FIG. B-10

MATERIAL DESCRIPTION Approx. Elevation: 134 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water
0.5 to 1 inch asphalt	0.1			
S1: 45% Gravel, 41% Sand, 13% Fines (F2 [0.02 mil]) Medium dense, gray-brown, *Silty Gravel with Sand (GM)*; moist [FILL]	2.2		S1	
Soft, brown, *Peat (PT)*; moist	7.0		S2, S3	10/11/2021
Medium stiff, gray, *Silt (ML)*; moist; few fibrous organics S4: 93.0% Fines (F4 [P200])	9.5		S4	
Medium dense to very dense, gray, *Silty Sand to Silty Sand with Gravel (SM)*; moist to wet; trace fibrous organics from approximately 9.5 to 12 feet bgs	16.5		S5, S6	10/4/2021
Bottom of Boring Boring Completed 10/4/2021				



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Static Water Level
- Solid Casing, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02
Anchorage, Alaska

LOG OF BORING B-09

December 2021 107664-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-11

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21

MATERIAL DESCRIPTION

Approx. Elevation: 132 Ft. GAAB72

1.5 inches asphalt (0.1 ft)

S1: 42% Gravel, 44% Sand, 14% Fines (F2 [0.02 mil])

Medium dense, brown, *Silty Sand with Gravel (SM)*; moist [FILL]

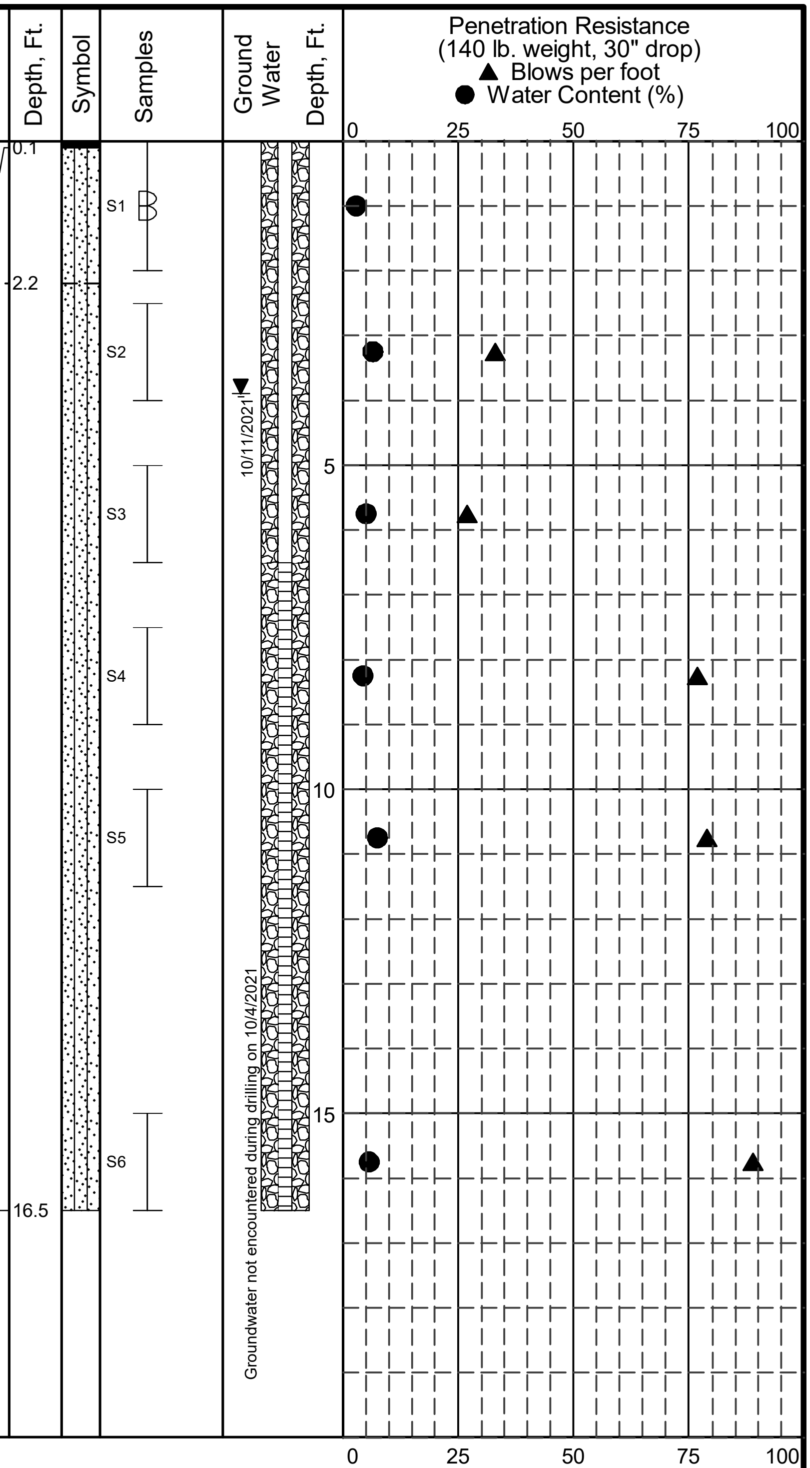
(2.2 ft)

Medium dense to very dense, gray to gray-brown, *Silty Sand with Gravel (SM)*; moist

S2: 27.5% Fines (F3 [P200])

(16.5 ft)

Bottom of Boring
Boring Completed 10/4/2021



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Static Water Level
- Solid Casing, Cuttings Backfill
- Slotted Section, Cuttings Backfill

● Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

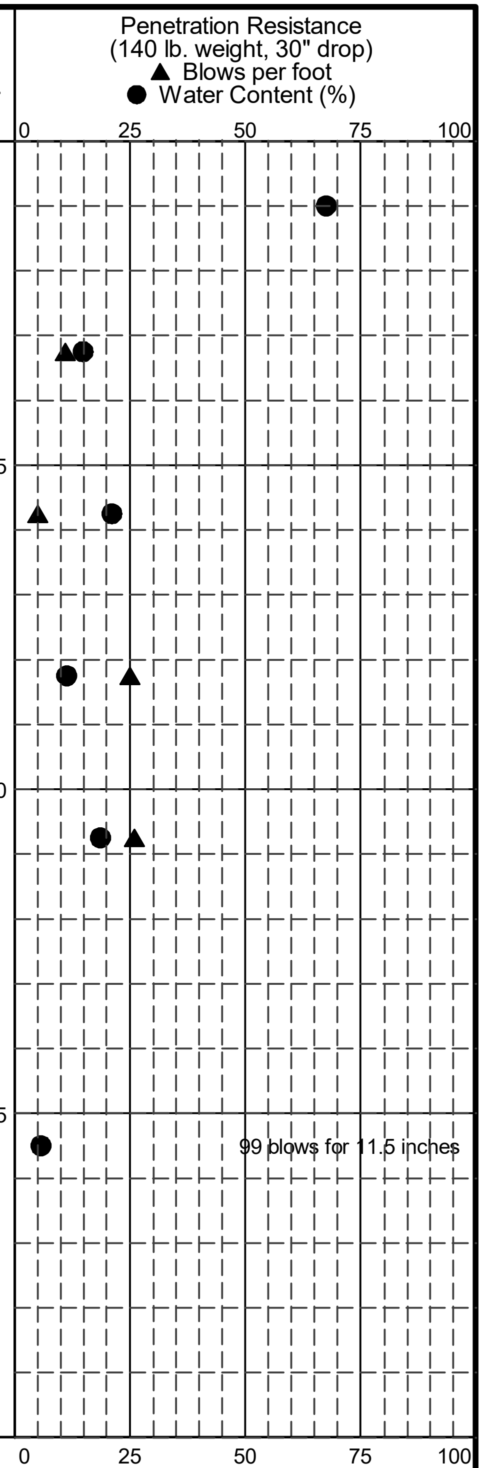
LOG OF BORING B-10

December 2021 107664-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-12

MATERIAL DESCRIPTION Approx. Elevation: 121 Ft. GAAB72	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
Soft, brown, *Peat (PT)*; wet*			S1	10/5/2021* 10/11/2021*	
Loose to medium dense, dark gray, *Silty Sand (SM)*; wet; trace peaty organics S2: 13.4% Fines (F2 [P200])	2.2		S2		
Loose to very dense or medium stiff to hard, gray, *Sandy Silt with Gravel (ML) to Silty Sand with Gravel (SM)*; moist; trace fibrous organics from approximately 6 to 7 feet bgs S4: 18% Gravel, 27% Sand, 56% Fines (F4 [P200])	6.0		S3, S4, S5, S6		5, 10, 15
Bottom of Boring Boring Completed 10/5/2021 *Groundwater likely perched over low permeability native soils	16.0				



LEGEND

- * Sample Not Recovered
- Grab Sample
- 2" O.D. Split Spoon Sample
- Ground Water Level At Time Of Drilling
- Static Water Level
- Solid Casing, Cuttings Backfill
- Slotted Section, Cuttings Backfill

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02
Anchorage, Alaska

LOG OF BORING B-11

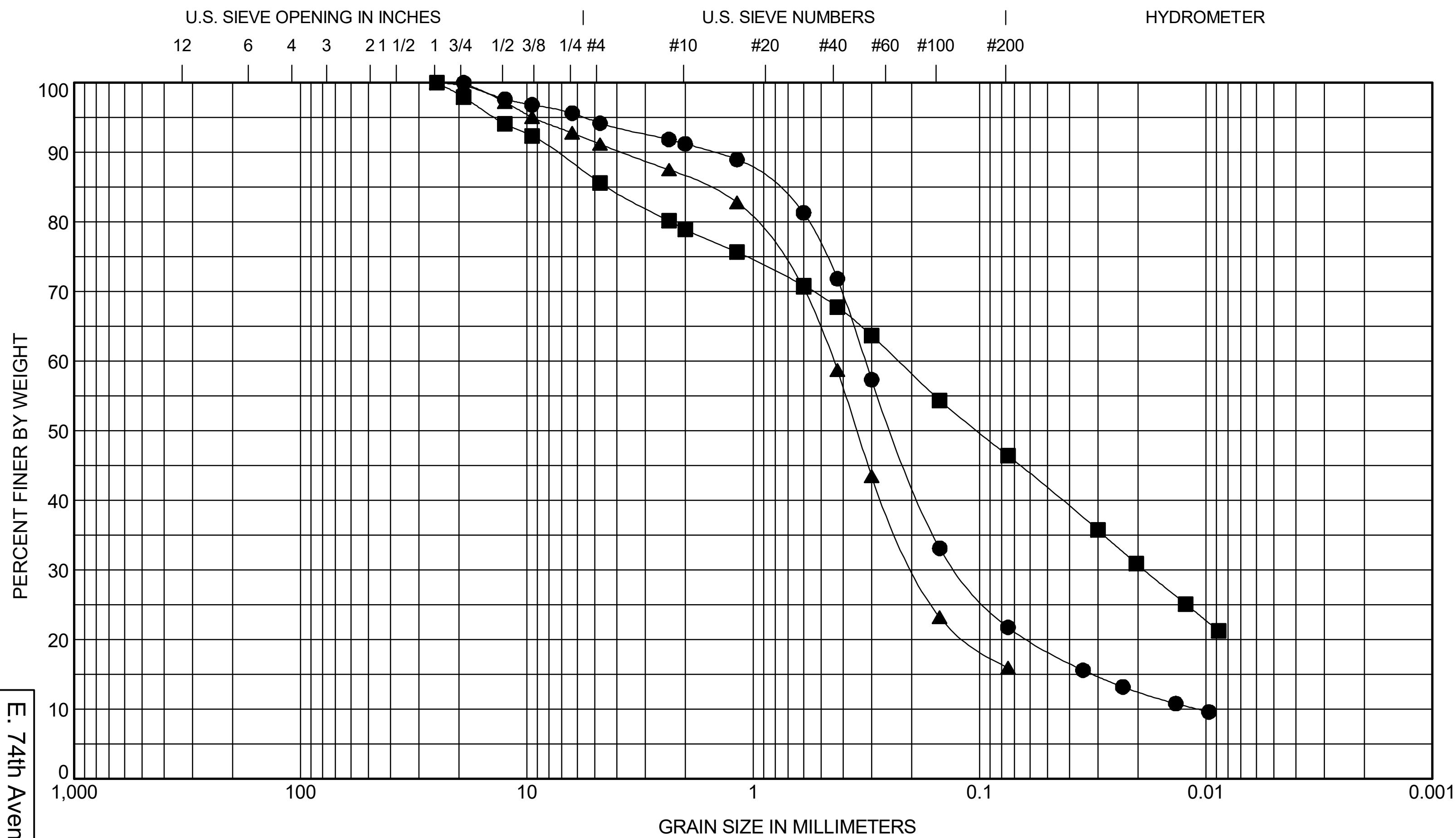
December 2021 107664-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B-13

REV 3 - Approved for Submittal

GEOTECHNICAL LOG 107664 GINT TEMPLATE7.GPJ S&W GEO1.GDT 12/20/21



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-01 S1**	**0.0 - 2.0**	**Silty Sand (SM)**				**4.4**	**29.4**
■	**B-02 S3**	**5.0 - 6.5**	**Silty Sand (SM)**					
▲	**B-03 S1**	**0.0 - 1.5**	**Silty Sand (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-01 S1**	**0.0 - 2.0**	**19**	**0.32**	**0.12**	**0.01**	**6**	**72**	**22**	
■	**B-02 S3**	**5.0 - 6.5**	**25**	**0.23**	**0.02**		**14**	**39**	**46**	
▲	**B-03 S1**	**0.0 - 1.5**	**25**	**0.44**	**0.19**		**9**	**75**	**16**	

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

December 2021

107664-001

SHANNON & WILSON, INC.
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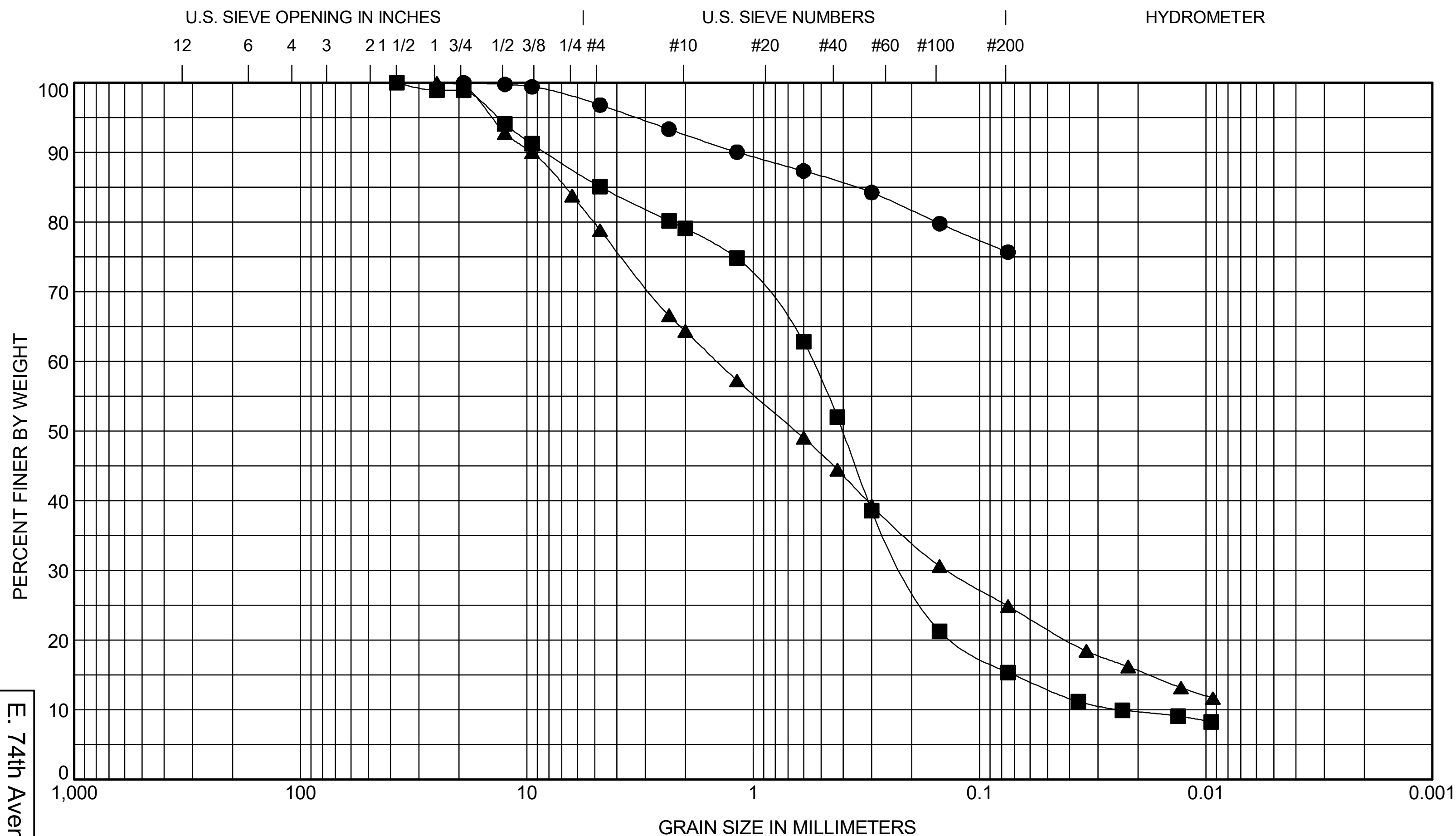
FIG. B-14
Sheet 1 of 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-03 S5**	**10.0 - 11.5**	**Silt with Sand (ML)**					
■	**B-04 S1**	**0.0 - 2.0**	**Silty Sand with Gravel (SM)**				**3.4**	**22.9**
▲	**B-05 S1**	**0.0 - 2.0**	**Silty Sand with Gravel (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-03 S5**	**10.0 - 11.5**	**19**				**3**	**21**	**76**	
■	**B-04 S1**	**0.0 - 2.0**	**37.5**	**0.55**	**0.21**	**0.02**	**15**	**70**	**15**	
▲	**B-05 S1**	**0.0 - 2.0**	**25**	**1.45**	**0.14**		**21**	**54**	**25**	

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Area Reconstruction, PM&E 21-02
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

December 2021

107664-001

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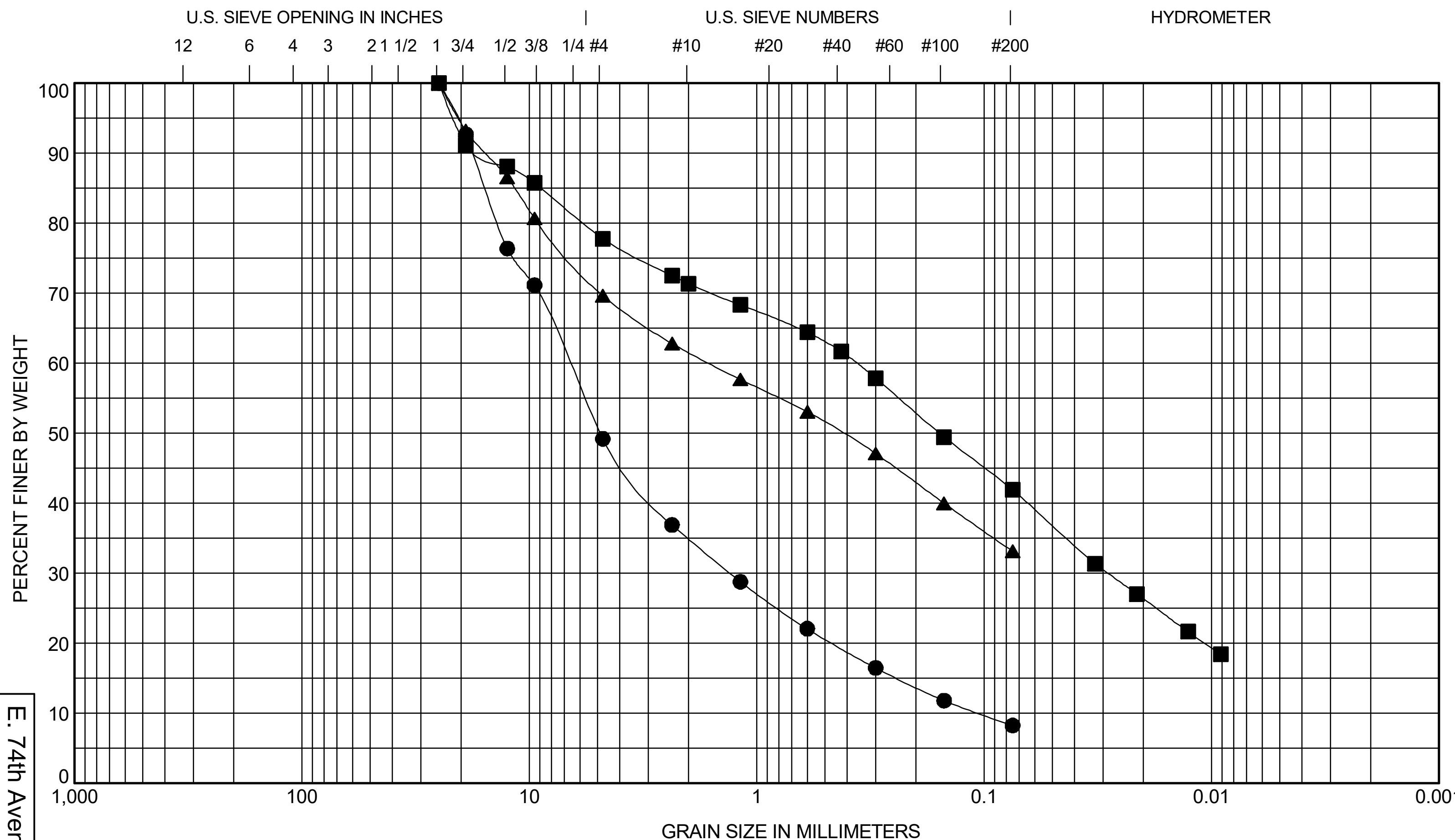
FIG. B-14
Sheet 2 of 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-05 S4**	**7.5 - 9.0**	**Well-Graded Gravel with Silt and Sand (GW-GM)**				**2.4**	**63.2**
■	**B-06 S2**	**2.5 - 4.0**	**Silty Sand with Gravel (SM)**					
▲	**B-07 S3**	**5.0 - 6.5**	**Silty Sand with Gravel (SM)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-05 S4**	**7.5 - 9.0**	**25**	**6.68**	**1.31**	**0.11**	**51**	**41**	**8**	
■	**B-06 S2**	**2.5 - 4.0**	**25**	**0.36**	**0.03**		**22**	**36**	**42**	
▲	**B-07 S3**	**5.0 - 6.5**	**25**	**1.62**			**30**	**37**	**33**	

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

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107664-001

SHANNON & WILSON, INC.
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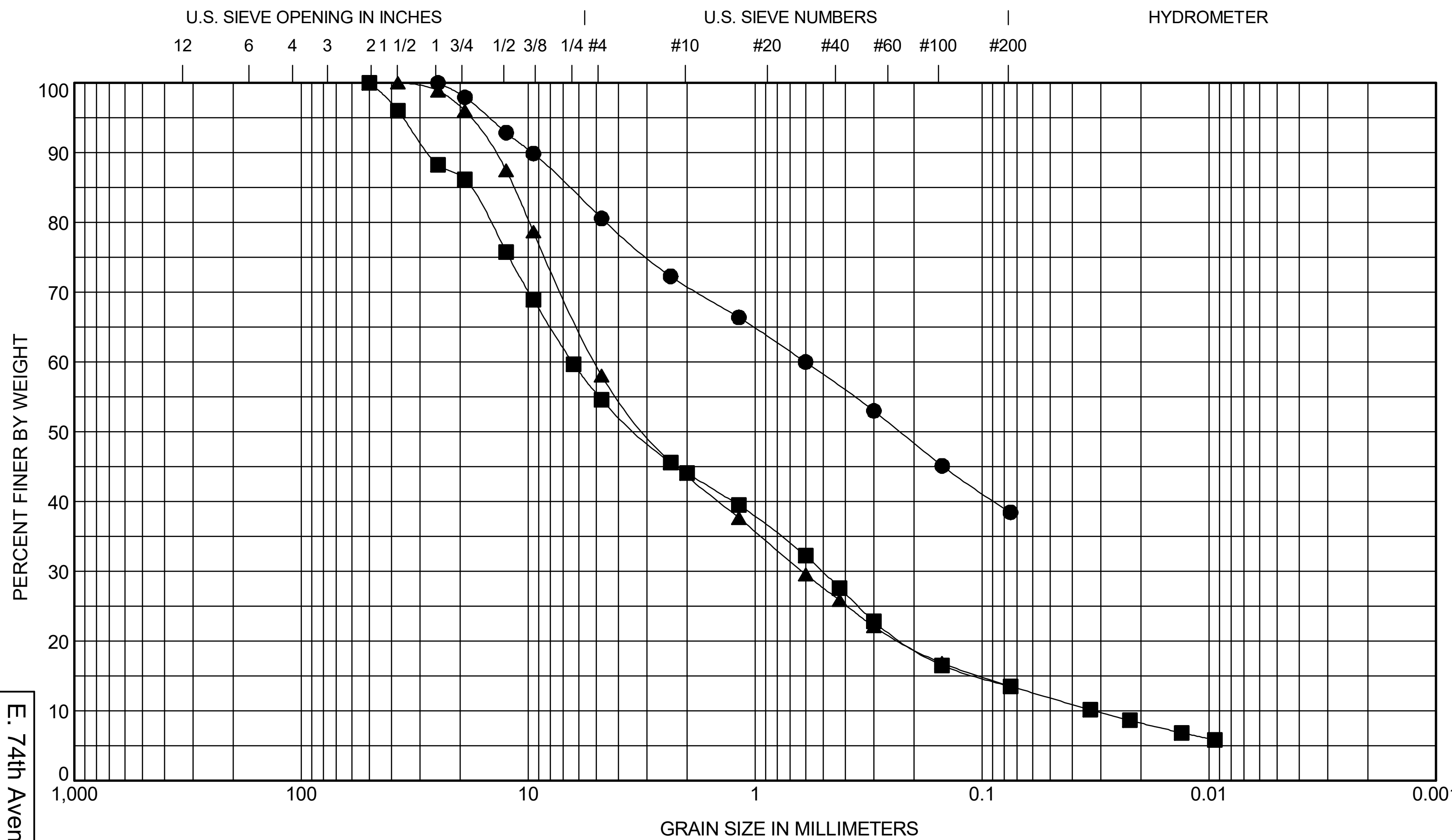
FIG. B-14
Sheet 3 of 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample		Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-08 S1**	**0.0 - 1.5**	**Silty Sand with Gravel (SM)**					
■	**B-09 S1**	**0.0 - 2.0**	**Silty Gravel with Sand (GM)**				**1.3**	**199.0**
▲	**B-10 S1**	**0.0 - 1.5**	**Silty Sand with Gravel (SM)**					

Sample		Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-08 S1**	**0.0 - 1.5**	**25**	**0.6**			**19**	**42**	**38**	
■	**B-09 S1**	**0.0 - 2.0**	**50**	**6.39**	**0.51**	**0.03**	**45**	**41**	**13**	
▲	**B-10 S1**	**0.0 - 1.5**	**37.5**	**5.08**	**0.62**		**42**	**44**	**14**	

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
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GRAIN SIZE CLASSIFICATION

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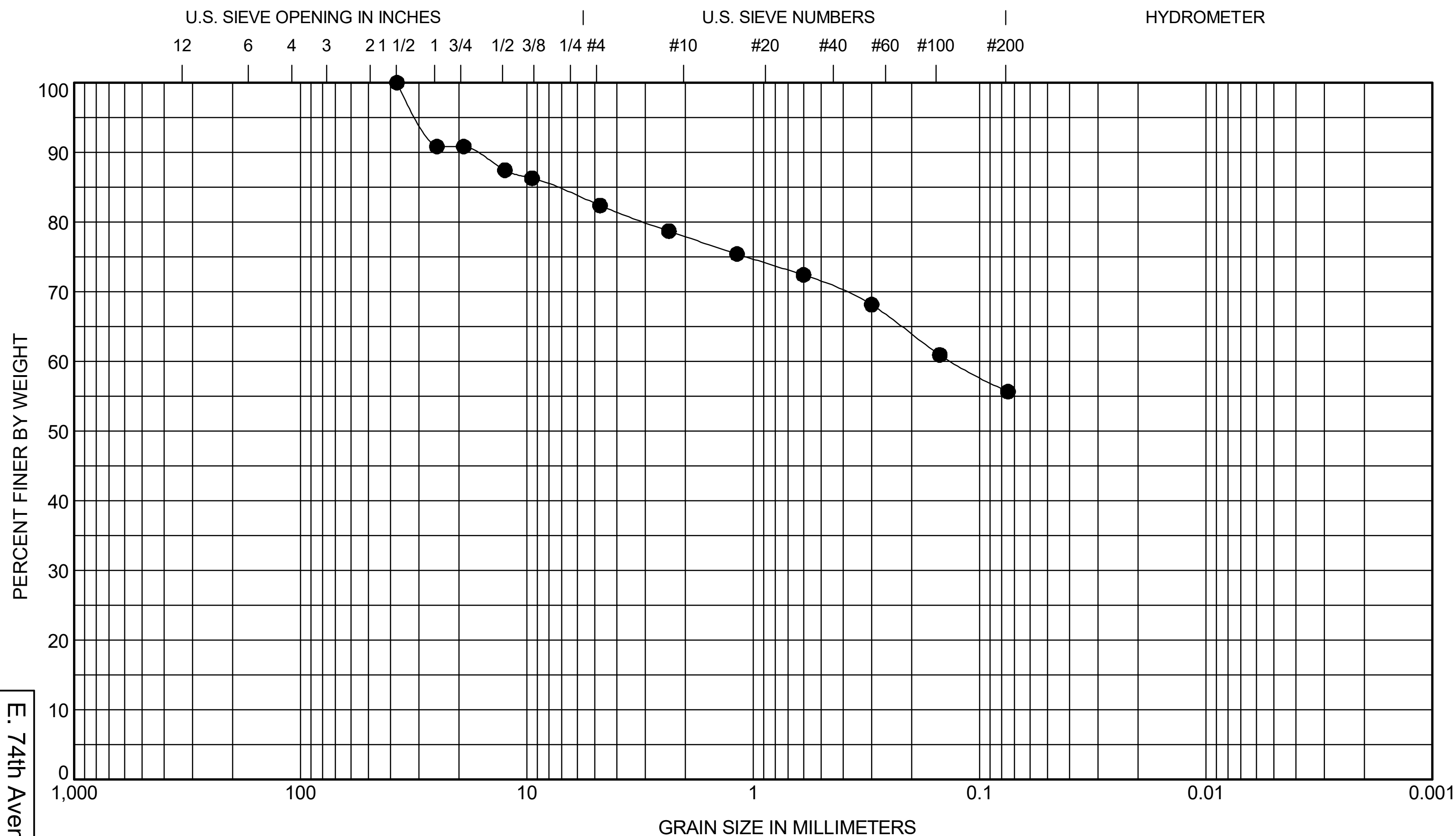
FIG. B-14
Sheet 4 of 5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Sample	Depth, Ft	Classification	LL	PL	PI	Cc	Cu
●	**B-11 S4**	**7.5 - 9.0**	**Sandy Silt with Gravel (ML)**					

	Sample	Depth, Ft	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-11 S4**	**7.5 - 9.0**	**37.5**	**0.13**			**18**	**27**	**56**	

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

GRAIN SIZE CLASSIFICATION

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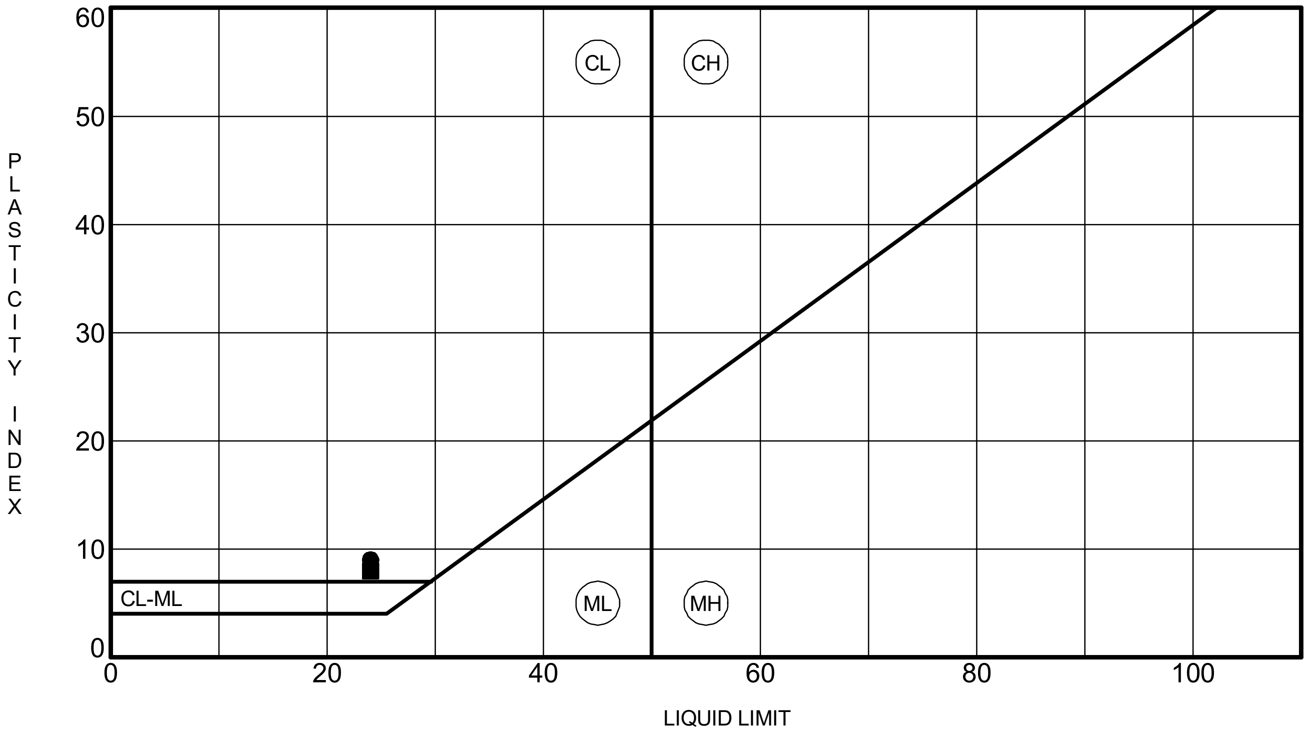
FIG. B-14
Sheet 5 of 5



	Boring	Depth, Ft	LL	PL	PI	Fines	Classification
●	**B-01**	**7.5 - 9.0**	**24**	**15**	**9**		**Clayey Sand with Gravel (SC)**
■	**B-04**	**7.5 - 9.0**	**24**	**16**	**8**		**Clayey Sand with Gravel (SC)**

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

ATTERBERG LIMITS RESULTS

December 2021 107664-001

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FIG. B-15

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent

such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

IMPORTANT INFORMATION

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

August 29, 2024

Mr. Timothy Huntting, PE
Municipality of Anchorage
Department of Public Works
4700 Elmore Road
Anchorage, Alaska 99507

RE: MULTI-CHANNEL ANALYSIS OF SURFACE WAVES (MASW) SURVEY, 74TH AVE./75TH AVE./NANCY ST. AREA RECONSTRUCTION, PM&E PROJECT NO. 21-02, ANCHORAGE, ALASKA

Dear Mr. Huntting:

This letter presents the results of a Multi-Channel Analysis of Surface Waves (MASW) survey performed by Shannon & Wilson, Inc. to support design of the above referenced project. Information collected during the survey was used to evaluate the shear wave velocity profile with depth and to infer the presence and location of possible organic soils (i.e. peat) along the roadway alignment in order to supplement information collected during our 2021 geotechnical explorations. To accomplish this, we collected approximately 2,820 feet of MASW data at 5-foot intervals along East 74th Avenue, East 75th Avenue, Nancy Street, and Petersburg Streets in the project area. This report presents descriptions of the site and project, subsurface exploration methodology and results, and interpretation of the subsurface conditions.

Shannon & Wilson conducted geotechnical explorations and provided geotechnical engineering recommendations for the project in 2021. The results of these explorations are included in our December 2021, *Geotechnical Engineering Report, E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02*. This report is intended to be an addendum to our 2021 report.

Our scope of services was specified in our May 14, 2024 proposal and approved via Purchase Order 2024001803 on June 10, 2024.

SITE AND PROJECT DESCRIPTION

The project is located along East 74th Avenue, East 75th Avenue, Nancy Street, and Petersburg Street in Anchorage, Alaska. The area is generally developed with paved residential streets and multi-family residential dwellings. East 74th Avenue, Nancy Street,

5430 Fairbanks Street ▪ Suite 3 ▪ Anchorage, Alaska 99518-1263 ▪ 907 561-2120 ▪ Fax 206 695-6777 ▪ www.shannonwilson.com ▪

and East 75th Avenue west of Petersburg Street are developed with rolled style curb and gutter, while Peterburg Street and East 75th Avenue east of Petersburg Street are strip paved and do not have curb or gutter. Petersburg Street, south of East 74th Avenue, is the only street with storm drain of those included in the project.

The topography of the project area slopes down toward the west/northwest with approximately 17 feet of relief from the east to the west. During our 2021 explorations, ponding was observed along the north half of Nancy Street and along East 75th Avenue. The lots adjacent to the streets are elevated approximately 1 to 5 feet above the roadways. The site plan, included as Figure 1, shows prominent site features.

We understand that the project generally includes improving the drainage conditions and repaving the roadways in the project area. We envision that the drainage improvements will consist of establishing a storm drain system, subsurface drainage improvements, and curb and gutter, where not currently present.

SUBSURFACE EXPLORATIONS

Subsurface explorations for this study are supplemental to those performed to develop our 2021 geotechnical report. Additional subsurface explorations were performed using the MASW method. In general, the survey consisted of one line of measurements along each roadway within the project area.

Data were collected using a Geometrics Geode 24-channel seismograph. The seismograph was connected to twenty-three, 4.5 hertz geophones mounted to a land streamer. The geophone spacing for the survey was 5 feet with a total streamer length of 115 feet. The survey was conducted using the active source MASW method using a 50 pound, Big-Bang 50 accelerated weight drop as a source. Shot points were located 30 feet from the end of the geophone array. Because of the strength of seismic source "stacking" of shots was not required. After each shot the land streamer was advanced 10-feet and another record was acquired. Data was collected every 10 feet along the entire length of the survey.

Data was processed using the Seisimager suite of software from Geometrics. The analysis used the 2-D Active Source MASW module in Seisimager/SW. The method uses Common Mid-Point Cross Correlation to improve result accuracy. The software automatically performs a velocity-frequency transformation, stacks common mid-point data in the frequency domain, and picks dispersions curves (frequency vs. phase velocity) for each shot location based on the maximum amplitude. The collection of dispersion curves was then used to create an initial model and an inversion was run to establish a best fit model. The

SHANNON & WILSON

results of this modeling are presented in Figures 2 through 4 and discussed in the following section.

SURVEY RESULTS

Organic soils are typically represented by shear wave velocities below approximately 400 feet per second. Shear wave velocities above 400 feet per second to about 1,100 feet per second are typical in unconsolidated to normally consolidated mineral soils. Note, organic soils that have gravel or mineral soils mixed in may have shear wave velocities greater than 400 feet per second and very soft or very loose mineral soils may have shear wave velocities lower than 400 feet per second. Difficult excavation may occur in over-consolidated soils with shear wave velocities over 1,100 feet per second.

As shown on the figures and the site plan on Figure 1, locations along the survey lines are referenced by horizontal distance from the start of each survey line (0 feet). Based on our profiles, shear wave velocities consistent with organic soils were encountered along East 75th Avenue from approximate Station 9+00 to 10+00 and from Station 11+00 to 12+50 at depths up to approximately 16 feet bgs. Velocities consistent with organic soils were also observed near the start of the Nancy Street line, which may be measuring data beyond the limits of the roadway improvement. It should be noted that some recent boring logs indicated organic soils that did not show as a low velocity on the shear wave survey (see Boring B-08 on East 75th Avenue), therefore, it is essential that subsurface data from boring logs be used in conjunction with shear wave interpretations. Organic soil was also noted in several older borings (MOA 3-83, MOA 5-83, HLA 9-82), however, it is likely that this material was removed during construction of the roadways or installation of deep utilities. Additionally, actual subsurface conditions may vary from those shown on boring logs from previous explorations due to subsequent construction projects.

Although we attempted to avoid known utility trench alignments, it is possible that velocity interpretations were influenced in some areas due to the proximity and quantity of utilities within the roadways. Utility trench influence would likely result in faster velocities due to compaction and higher quality material used for construction. Additionally, shear wave velocity measurements were taken along one distinct line within each roadway and are not meant to delineate exact limits of organic soils that may be encountered during construction.

Note the MASW survey is based on the measured soil response to an input ground motion and is a bulk correlation of the soil properties at a given point. MASW solutions are non-unique and therefore are based on interpretation and judgment. Small anomalies less than

10 feet in lateral extent, or thinner than 2 to 3 feet in vertical extent may be smaller than the survey resolution in some areas (i.e. isolated pockets of organic or slow velocity material may not be depicted on the attached figures). Vertical resolution of the survey increases with depth. MASW velocities and modeled depths are typically accurate to within 25 percent.

CLOSURE AND LIMITATIONS

The analyses, and conclusions contained in this report are based on the results of a geophysical survey and were correlated with existing explorations. The result of the survey are interpretive and should be considered approximate. If subsurface conditions different from those encountered in the explorations or interpreted from our geophysical survey are encountered or appear to be present during construction, we should be advised at once so that we can review these conditions and reconsider our recommendations, where necessary. If there is a substantial lapse of time between the submission of this report and the start of construction at the site, or if conditions have changed because of natural forces or construction operations at or adjacent to the site, we recommend that we review our report to determine the applicability of the conclusions and recommendations.

Within the limitations of scope, schedule, and budget, the analyses, and conclusions, presented in this report were prepared in accordance with generally accepted professional geotechnical engineering principles and practice in this area at the time this report was prepared. We make no other warranty, either express or implied. These conclusions were based on our understanding of the project as described in this report and the site conditions as observed at the time of our explorations.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples from test borings or inferred by geophysical methods. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

If there is a 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, it is recommended 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 merely taking soil samples or advancing borings. Shannon & Wilson has

SHANNON & WILSON

prepared the attachments *Important Information About Your Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports.

Sincerely,

SHANNON & WILSON

Digitally signed by Ryan Collins
Date: 2024.08.29 10:37:58 -08'00'

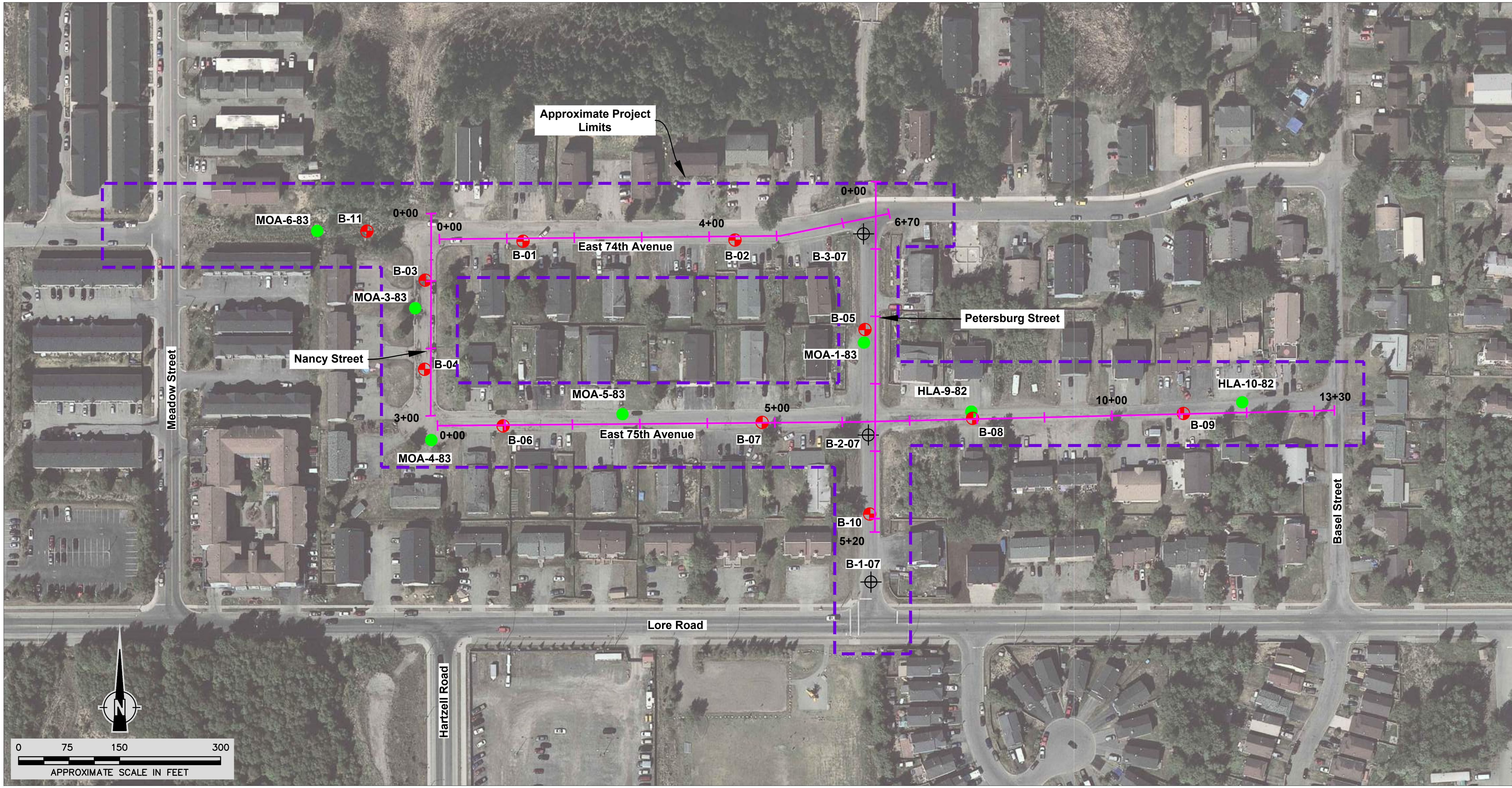
Ryan Collins, CPG
Associate Geologist

STATE OF ALASKA
49TH
Kyle Brennan
CE - 11122
8-29-24
REGISTERED PROFESSIONAL ENGINEER

RDC/TMK:KLB/rdc

Kyle Brennan, PE
Vice President

Enc. Figure 1: Site Plan
Figure 2: Interpreted MASW Shear Wave Velocity Profile - East 75th Avenue
Figure 3: Interpreted MASW Shear Wave Velocity Profile - East 74th Avenue
Figure 4: Interpreted MASW Shear Wave Velocity Profile – Nancy and Petersburg Streets
Important Information about your Geotechnical/Environmental Report



LEGEND

B-01 — Approximate location of Boring B-01, advanced by Shannon & Wilson, Inc., October 2021

B-1-07 — Approximate Location of Boring B-1, Advanced by Shannon & Wilson, Inc., March 2007

MOA-1-83 — Approximate Location of Boring 1, Advanced by the Municipality of Anchorage, 1983. Boring name indicates 'Company-Boring ID-Year'. See Appendix A. MOA- Municipality of Anchorage, HLA-Harding Lawson Associates, Inc.

5+00 — Approximate MASW Seismic Line and Stationing

NOTES

1. Map adapted from aerial imagery provided by the Municipality of Anchorage. Image date: May 2015

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

SITE PLAN

August 2024 | 107664-002

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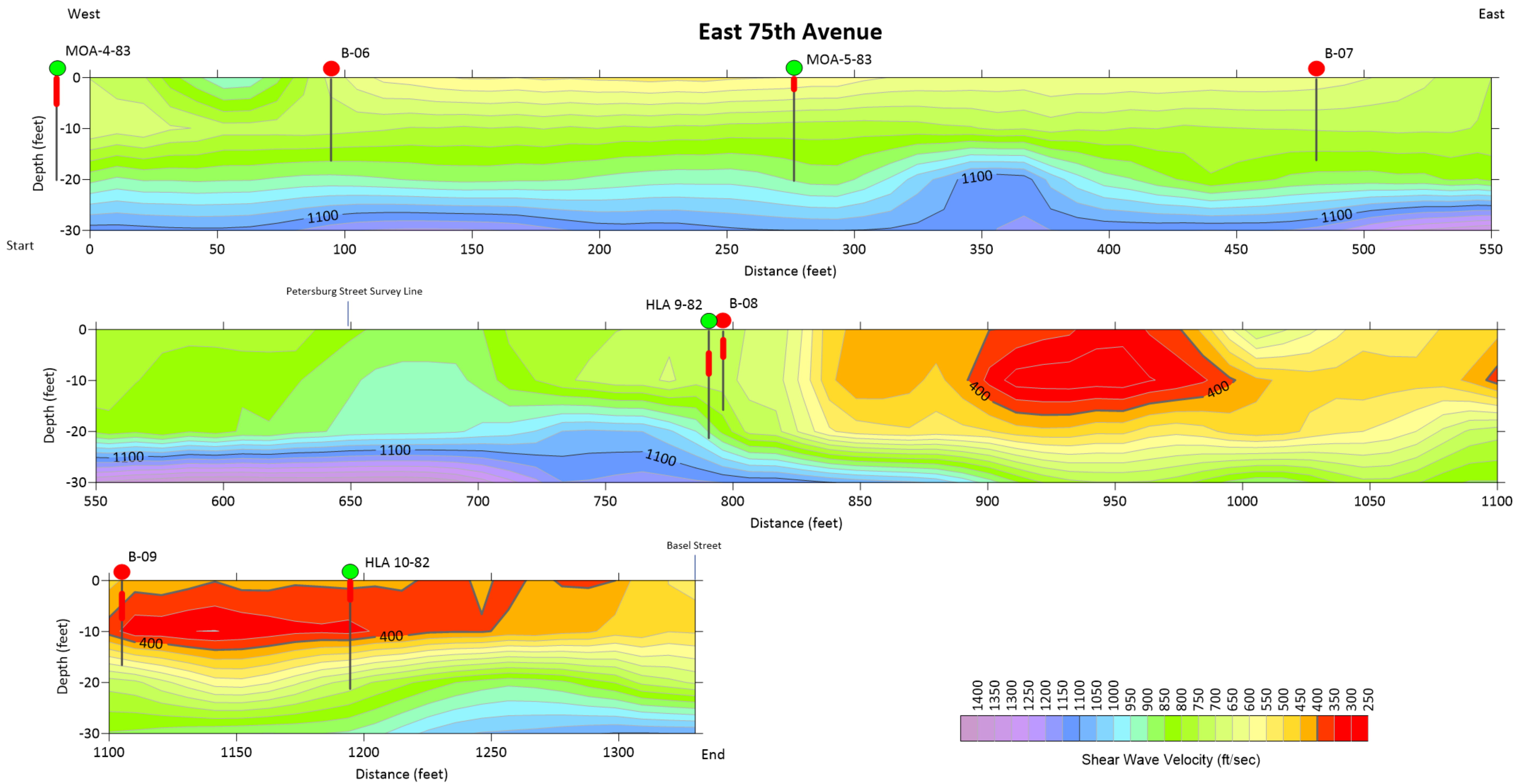
FIG. 1



Legend

B-06
Approximate Location of Boring B-06, advanced by Shannon & Wilson, October 2021

HLA 10-82
Approximate Location of Boring 10, provided by Municipality of Anchorage.
Boring name indicates 'Company-Boring ID-Year'.
MOA-Municipality of Anchorage, HLA-Harding Lawson Associates, Inc.

Notes:

1. Interpreted data should be used in conjunction with report text and boring logs from Shannon & Wilson's *Geotechnical Engineering Report, E.74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02*, dated October 2021.

2. Vertical Scale Exaggerated 2 times

3. Stick log at boring location denotes approximate boring depth with red indicating peat and/or organic soil observed at the time of drilling. See boring logs in Geotechnical Report for details.

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02
Anchorage, Alaska

INTERPRETED MASW SHEAR WAVE VELOCITY PROFILE EAST 75th AVENUE

August 2024 | 107664-002

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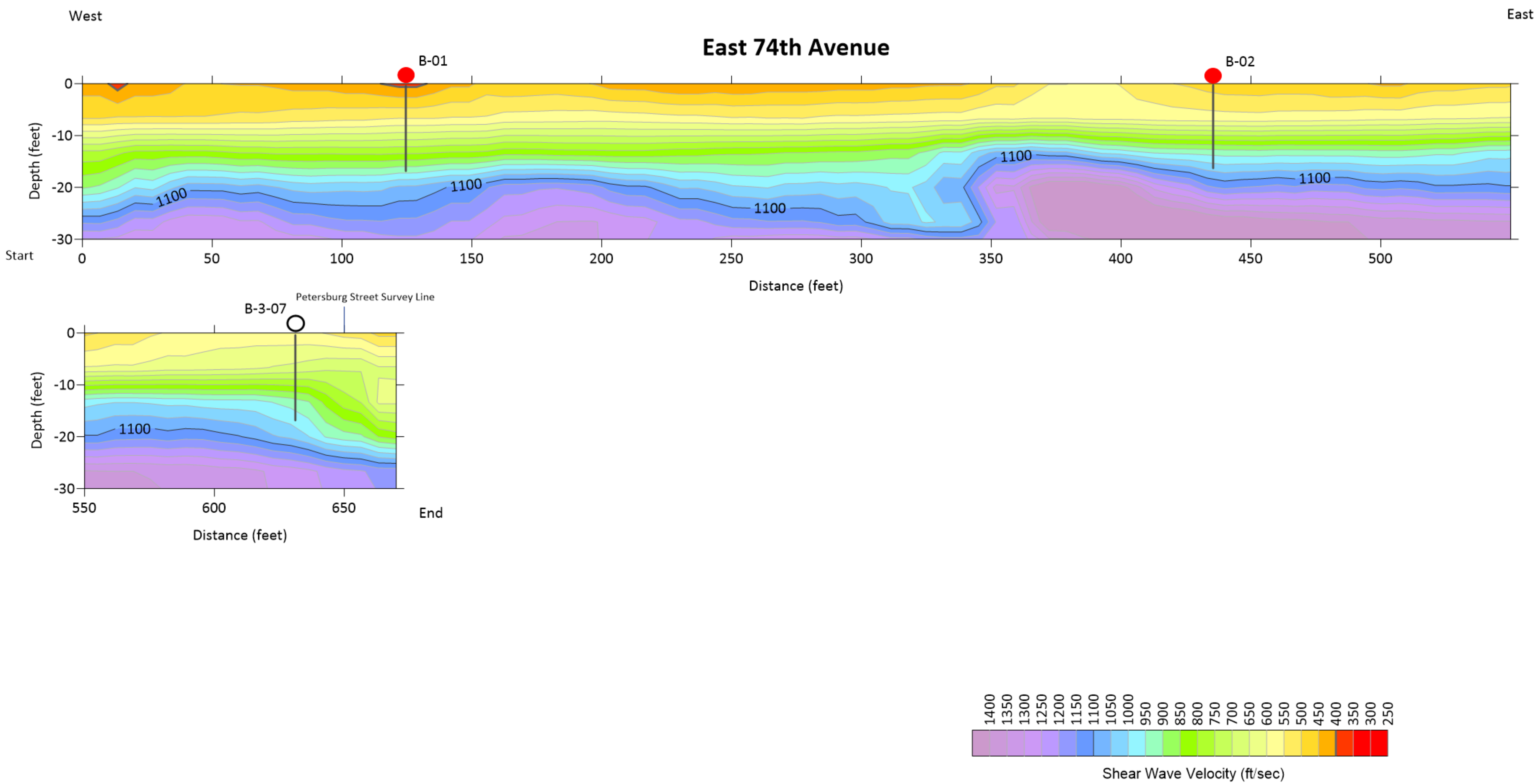
FIG. 2



Legend

B-01 Approximate Location of Boring B-01, advanced by Shannon & Wilson, October 2021

B-3-07 Approximate Location of Boring B-3, advanced by Shannon & Wilson, March 2007

Notes:

1. Interpreted data should be used in conjunction with report text and boring logs from Shannon & Wilson's *Geotechnical Engineering Report, E.74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02*, dated October 2021.

2. Vertical Scale Exaggerated 2 times

3. Stick log at boring location denotes approximate boring depth with red indicating peat and/or organic soil observed at the time of drilling. See boring logs in Geotechnical Report for details.

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02
Anchorage, Alaska

INTERPRETED MASW SHEAR WAVE VELOCITY PROFILE EAST 74th AVENUE

August 2024 107664-002

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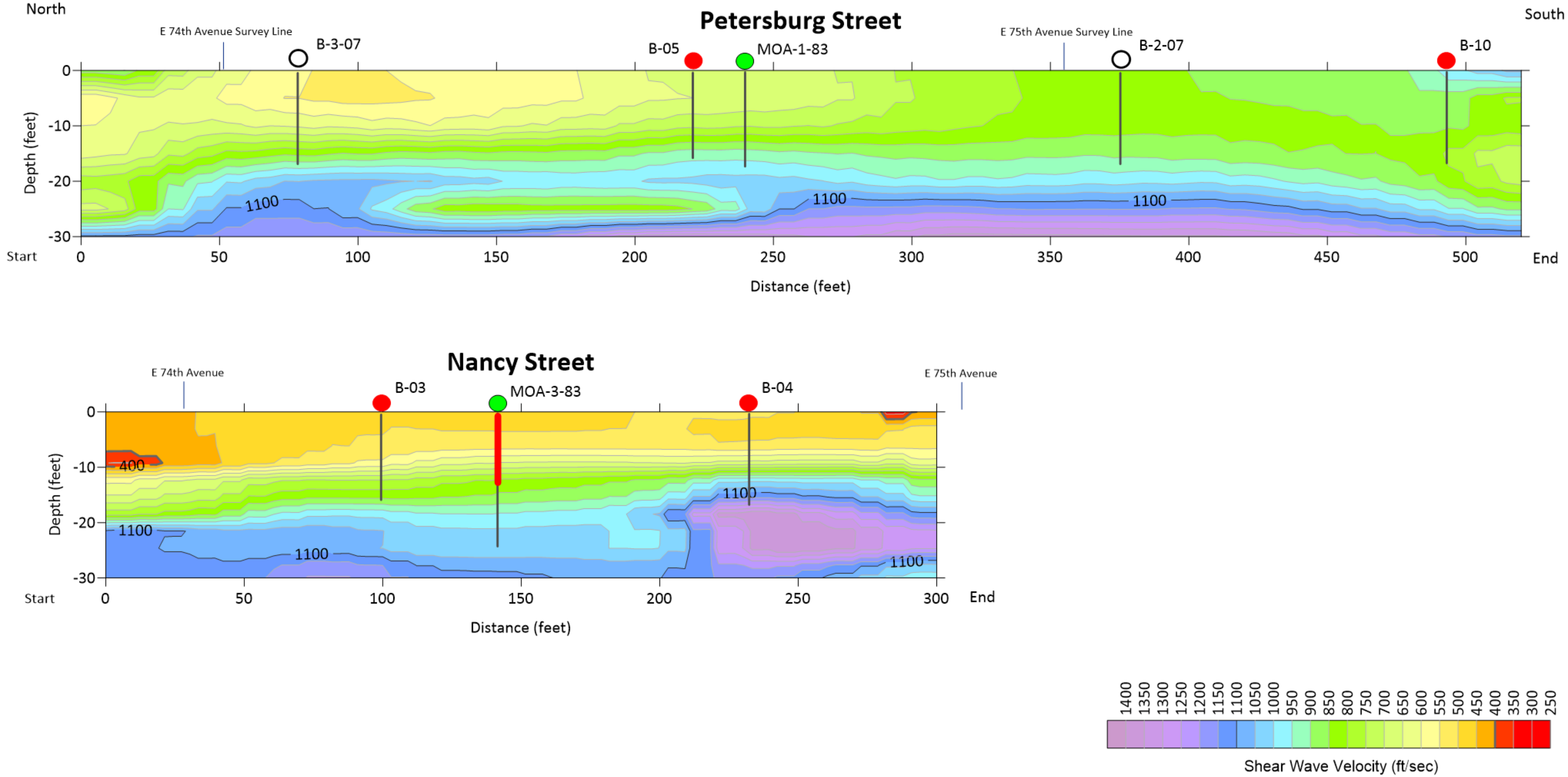
FIG. 3



Legend

B-03 Approximate Location of Boring B-03, advanced by Shannon & Wilson, October 2021

MOA-1-83 Approximate Location of Boring 1, provided by Municipality of Anchorage. Boring name indicates 'Company-Boring ID-Year'.
MOA-Municipality of Anchorage, HLA-Harding Lawson Associates, Inc.

Notes:

1. Interpreted data should be used in conjunction with report text and boring logs from Shannon & Wilson's *Geotechnical Engineering Report, E.74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02*, dated October 2021.

2. Vertical Scale Exaggerated 2 times

3. Stick log at boring location denotes approximate boring depth with red indicating peat and/or organic soil observed at the time of drilling. See boring logs in Geotechnical Report for details.

E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02
Anchorage, Alaska

INTERPRETED MASW SHEAR WAVE VELOCITY PROFILE NANCY and PETERSBURG STREETS

August 2024 107664-002

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FIG. 4

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent

such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

IMPORTANT INFORMATION

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

August 6, 2025

Mr. Timothy Huntting, PE
Municipality of Anchorage
Department of Public Works
4700 Elmore Road
Anchorage, Alaska 99507

RE: REVISED ADDITIONAL PAVEMENT STRUCTURAL SECTION AND DESIGN RECOMMENDATIONS, 74^{TH} AVE./75^{TH} AVE./NANCY ST. AREA RECONSTRUCTION, PM&E PROJECT NO. 21-02, ANCHORAGE, ALASKA

Dear Mr. Huntting:

This letter presents our additional recommendations related to the presence of organic soils that were encountered during our previous explorations for the above-referenced project in Anchorage, Alaska. Revisions herein include modifications to the pavement structural section presented in our original addendum letter and added recommendations for storm drain design. Shannon & Wilson conducted subsurface explorations in October 2021 for this project, which encountered peat in two borings advanced along East 75th Avenue, east of its intersection with Petersburg Street. Peat deposits ranging between 5 and 12 feet deep were also encountered in borings advanced by the Municipality of Anchorage (MOA) along the Nancy Street right-of-way (ROW) in 1982. Subsequently, S&W was retained to perform additional investigations along the project alignment using Multi-Channel Analysis of Surface Waves (MASW) methods to evaluate the shear wave velocity profile with depth and infer the presence and location of possible organic soils (i.e. peat). Shear wave velocities consistent with organic soils were encountered along East 75^{th} Avenue from approximate Station 9+00 to 10+00 and from Station 11+00 to 12+50 to depths up to approximately 16 feet below the ground surface (bgs), and to about 10 feet bgs just beyond the northern end of the developed Nancy Street ROW. The results of our previous studies and engineering recommendations for the project are presented in our December 2021, *Geotechnical Engineering Report, E. 74th Avenue, E. 75th Avenue, Nancy Street Area Reconstruction, PM&E 21-02* and August 29, 2024 letter, *Multi-channel Analysis of Surface Waves (MASW) Survey, 74^{th} Ave./75^{th} Ave./Nancy St. AREA Reconstruction, PM&E Project No. 21-02, Anchorage, Alaska.* This report is intended to be an addendum to our 2021 and 2024 reports to supplement our original recommendations.

5430 Fairbanks Street ▪ Suite 3 ▪ Anchorage, Alaska 99518-1263 ▪ 907 561-2120 ▪ Fax 206 695-6777
▪ www.shannonwilson.com ▪

The MOA's January 2007 Design Criteria Manual (DCM), Section 1.10C, states that "all organic material must be removed from the road subgrade." Based on these criteria, we provided recommendations in our geotechnical report for removal of the peat as part of the roadway improvements. As the design effort progressed, remaining uncertainties regarding the actual extents of the peat, related concerns regarding potential construction changes, and space inside the ROW for potentially deep excavations lead to conversations between the design team and MOA, in which the possibility of constructing the road on top of the peat layer was discussed. Presented in this letter are additional considerations for developing the new roadway and storm drains on top of the peat.

The effort herein was approved via e-mail by you and performed under our existing Purchase Order 2021002598 for the project.

SITE AND PROJECT DESCRIPTION

The project is located along East 74th Avenue, East 75th Avenue, Nancy Street, and Petersburg Street in Anchorage, Alaska. The area is generally developed with paved residential streets and multi-family residential dwellings. East 74th Avenue, Nancy Street, and East 75th Avenue west of Petersburg Street are developed with rolled style curb and gutter, while Peterburg Street and East 75th Avenue east of Petersburg Street are strip paved and do not have curb or gutter. Petersburg Street, south of East 74th Avenue, is the only street with storm drain of those included in the project. A site plan showing the project area and our boring locations is included as Figure 1.

We understand that the project generally includes improving the drainage conditions and repaving the roadways in the project area. We envision that the drainage improvements will consist of establishing a storm drain system, subsurface drainage improvements, and curb and gutter, where not currently present.

SUBSURFACE CONDITIONS

In general, our borings advanced through the roadway encountered 1.5 to 2 inches of asphalt pavement (0.5 to 1 inch along East 75th Avenue, east of Petersburg Street), underlain by about 2 feet of fill soil (4.5 feet in Boring B-01) which typically consisted of silty sand with varying amounts of gravel, and native, predominantly granular soils. Boring B-11, advanced in the undeveloped right of way west of East 74th Avenue encountered about 2.2 feet of peat above the native, mineral soils. Native soils below the fill materials typically

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consisted of silty sand with gravel and resembled materials typically described as glacial till with a few exceptions. In Boring B-08 and B-09, peat was encountered below the fill to depths of 5.5 and 7 feet bgs, respectively. In Boring B-09 the peat was underlain by silt containing organics to about 9.5 feet bgs. Note that peat deposits ranging between 5 and 12 feet deep were encountered in borings advanced by the MOA along the Nancy Street ROW in 1982. Peat was not encountered in our current borings in this area (Borings B-03 and B-04); however, it is unclear if this is a localized condition or if the peat was removed during original construction of Nancy Street.

Results from our MASW survey identified shear wave velocities consistent with organic soils along East 75th Avenue from approximate Station 9+00 to 10+00 and from Station 11+00 to 12+50 to depths up to approximately 16 feet bgs, and to about 10 feet bgs just beyond the northern end of the developed Nancy Street ROW. Note that low velocities may also be associated with very soft or loose mineral soils and these depths could be overestimated. Widespread areas of peat were not detected by the MASW testing; however, we note that shear wave velocity measurements were taken along one distinct line within each roadway and were not intended to delineate exact limits of organic soils that may be encountered during construction. Our 2024 report should be referenced for limitations on MASW data collection and interpretation.

ADDITIONAL GEOTECHNICAL CONSIDERATIONS

The following sections provide additional recommendations and considerations for developing the roadway pavements and new storm drains on top of the peat soils encountered beneath portions of the project alignment.

Pavement Considerations

As stated previously, the MOA's January 2007 DCM, Section 1.10C, states that "all organic material must be removed from the road subgrade." Based on the findings from our explorations at the site and discussions with CRW Engineering (CRW) and the MOA, we understand that removing the peat soils may result in unacceptable construction risks and costs that are prohibitive to construction of the project, and would likely require obtaining construction easements outside the existing ROW. The presence of shallow groundwater, underground utilities and other development may also create constructability issues for the project if deep peat soils were to be excavated and replaced. We understand that the MOA

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is therefore considering a variance from the DCM to allow peat soils to remain beneath the roadway.

Design of a "floating" roadway will primarily need to consider differential loading that the new road, sidewalks, and other improvements will impart on the peat. Grade changes and variable thickness of peat may reactivate primary consolidation within that layer. Based on our discussions with the design team and preliminary drawings provided by CRW, we understand that the proposed improvements will not result in grade increases greater than about 1 foot. Considering the age and thickness of the existing fills over the peat, it is our opinion that the planned improvements should not cause significant, additional consolidation of the peat which would result in adverse settlements at the ground surface. Additional testing to attempt to determine additional settlements is likely impractical, however, we estimate that additional short-term settlement caused by construction activity or minor increases in grade (less than 1-foot in localized areas), should not be greater than several inches. Long-term settlements should be expected to be less than half of the short-term settlements.

The structural sections presented in our 2021 geotechnical report were designed following the MOA DCM "Limited Subgrade Frost Penetration Method" (LSFP) and are recommended for this project, in concert with drainage improvements and other construction details. We understand the MOA may consider an alternative structural section for this project to reduce the amount of excavation and backfill required for the LSFP design. If an alternative structural section is preferred, we recommend a structural section consisting of, in descending order, 2 inches of asphalt, 2 inches Leveling Course, 6 inches Type IIA Base, over 36 inches Type II/IIA Subbase. This section may be used for the entire project alignment. The insulated structural section presented in our 2021 report may also be used instead of the alternative structural section and will provide additional frost protection. The recommendations provided herein for floating the structural section over the peat are also applicable for the insulated structural section.

To prepare the subgrade to receive the pavement structural section fill, the area to receive fill should be excavated, as required, to the design elevation of the bottom of the structural section fill. In areas with organic soils, excavating with a flat-edged bucket will be necessary to reduce disturbance of remaining organic soils to the greatest extent practicable. Once exposed, organic soils left in place should not be exposed to disturbance from equipment and should not be left exposed during periods of rain. A woven geotextile (described below) should be placed at the base of the structural fill for the alternative structural section above or for insulated structural sections in lieu of the nonwoven geotextile recommended in our December 2021 report, to provide additional reinforcement and to provide separation between the structural section materials and existing soils. The initial 12-inch lift of structural section fill should be placed and compacted with a static drum roller to a dense state. The compaction criteria in our original report may need to be relaxed for this initial lift. Conventional filling and compaction of structural fill material may be conducted in subsequent lifts, however careful attention should be given to excess moisture and vibration during the compaction process.

Based on the anticipated traffic loading, and assuming the subdrain improvements recommended in our 2021 report are incorporated in the design, it is our opinion that a thinner structural section relative to the section derived from thermal analysis could provide satisfactory performance for the new pavements. However, this section will experience greater seasonal movement due to freezing and thawing and will likely have a shorter design life than a frost protected section.

Geofabric used below the structural section should consist of a woven geotextile material such as Mirafi® RS280i, or equivalent. This geofabric layer will increase the stability and provide separation between the subgrade materials and the new structural section fills. We recommend the minimum material properties in the following exhibit when selecting an equivalent geofabric for this application in the project based on Minimum Average Roll Values (MARV):

Exhibit 1: Woven Geotextile Properties (Mirafi® RS280i)

Mechanical Properties	Minimum Average Roll Value
Tensile Strength at 2% Strain (MD/CD) by ASTM D4595	600/660 lbs.
Tensile Strength at 5% Strain (MD/CD) by ASTM D4595	1620/1632 lbs.
Flow Rate by ASTM D4491	70 gal/min/ft^2
Permittivity by ASTM D4491	0.9 sec^{-1}
Pore Size $0_{95}/0_{50}$ by ASTM D6767	273/173 microns
Apparent Opening Size by ASTM 4751	U.S. Sieve 40 max.
Interaction Coefficient by ASTM D6706	0.89

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Joining of the geofabric should be in accordance with manufacturers recommendations or the MASS. A minimum of 12 inches of overlap is required. Additional guidelines and specifications are provided in the MASS Section 20.25.

Additional Storm Drain Considerations

Storm Drain Pipe Support

We understand replacing peat and organic soils beneath the new storm drain lines may be problematic for construction due to the thickness of the organic soils in some areas and the presence of existing water and sewer utilities. Based on our correspondence with the design team and MOA, the preferred solution is to leave the organic soils in place and support the new storm drain lines using helical piles to reduce potential adverse settlements of the utility without the deeper excavation. We envision this will consist of a rigid framework constructed under the pipe and supported by pairs of helical piles, spaced evenly along the utility line. We understand this solution would only be applied to the main line pipe and that services would be allowed to "float" on top of organic soils and designed with increased slopes to the extent practicable.

Design of helical pile supports for the proposed storm drain pipe should consider the bearing capacity of the soils, expected settlements, possible frost conditions within the subsurface soils, and constructability issues. We anticipate that the pipe support piles will consist of round (e.g., pipe) or square shaft piles fitted with welded helical plates at one or more positions near the tip of the pile section. Pile types and sizes must be selected based on vertical and lateral load requirements, settlement, and installation considerations as addressed below. The piles will generally need to support their own weight, the weight of the pipe, and the weight of the overlying soil and traffic loads. Helical pile design is typically a proprietary process that will be conducted by the contractor or pile manufacturer, who can verify pile capacities and provide additional information on pile materials, helix design, verification testing, and installation criteria. As such, the recommendation herein are intended to support preliminary design.

For preliminary design purposes, we estimate ultimate single helix pile capacities in medium dense, predominantly granular soils will be on the order of 20 kips per square foot (ksf) for piles with the helix embedded a minimum of 15 feet below the ground surface and 5 feet into the medium dense to dense soils encountered in our borings, measured to the shallowest pile helix. Actual pile capacities will depend on the type and density of the soil encountered. Assuming the top of the storm drain pipe is buried 5 feet bgs and a pipe support spacing of 10 feet, we estimate the total load on each pipe support will be roughly 15 kips, excluding traffic loading. Based on the assumed loading and pile capacity, including a factor of safety of 3.0 on the calculated pile capacity, we recommend assuming a double helix pile with helix diameters of 12 and 10 inches. The bottom helix diameter should be 10 inches and the distance between the helices should be 3 feet. In general, the vertical capacity of the helical pile is estimated based on the measured torque during installation and an empirical torque coefficient developed by the pile manufacturer. Using a default torque factor of 10 ft^{-1}, and assuming a pile shaft size less than 3.5 inches, the estimated minimum installation torque needed to achieve the required capacity is 2,750 pound-feet (lb-ft). To provide increased lateral support the helical piles may be installed at an angle. For piles that are installed at an angle, the total capacity of the pile is determined in the direction the pile was installed according to the torque relationship and the axial (and lateral) capacity would be determined as the vectored component of the total capacity.

To provide support between the piles, a rigid framing system should be developed to limit the development of stress points on the pipe at the piles and reduce the potential for differential settlement between the helical pile supports. Because the frame is anticipated to be more rigid than the softer surrounding soils, they should also be designed to support the overlying soils (and any potential traffic surcharge loads), depending on the depth of the embedment. For design purposes, we recommend a unit weight of 135 pounds per cubic foot (pcf) for classified fill materials recommended for use in the pavement structural section. For soils below the water table, a buoyant unit weight equal to the difference between unit weight above the water table and the unit weight of water (taken to be 62.4 pcf) can be used.

Additionally, depending on the distance between the storm drain facilities and amount of unsuitable support soils, the piles should be checked for slenderness buckling if significant lateral or moment loads are anticipated during installation. For peat and soft organic silt, we recommend using a subgrade reaction modulus, k, on the order of 10 pounds per square inch per inch (pci). A value of 65 pci can be used for evaluation in medium dense mineral soils.

Settlement along the line will be a function of the spacing of the helical piles, pipe material and thickness, overburden, and stiffness of the framing system. If the pipe and framing system is considered perfectly rigid and there is no support from the underlying soils, the settlement along the pipe would generally be equal to the settlement of the helical piles under load, which is anticipated to be 1 inch or less, assuming the pile is properly installed and achieves the required design capacity. Settlements of several inches may be anticipated if the pipe is not properly supported, depending on the stiffness of the pipe and framing system.

Note that design parameters included herein should be used for planning purposes only and the actual support design will depend on factors such as support spacing, pipe depth, and anchor type. The final anchor design should be performed by the anchor provider to meet the load requirements established in the design documents. We recommend that the helical piles be designed according to the manufacturer's design procedures assuming a factor of safety of at least 2. Helical piles should also be installed per the manufacturer's specifications using appropriate equipment and experienced contractors. We also recommend that the contractor verify the torque-load capacity relationship of the helical pile by conducting pile load testing in accordance with ASTM D1143 to verify capacity and to quantify settlement. Load tests should be conducted on at least five percent of the piles installed along the line.

Storm Drain Manholes

Organic soils, where present, should be overexcavated from beneath new manholes to provide adequate support and frost protection for the manhole structures. Overexcavation to remove unsuitable soils should be extended laterally from a point at least 2 feet beyond the outer edge of the manhole structure such that a line drawn down at a 1 horizontal (H) to 1 vertical (V) slope will encounter structural fill only to the bottom of the excavation. The excavation should be backfilled with Type II/IIA classified fill placed and compacted as described in our 2021 report.

Existing utilities encountered near an excavation should be supported and braced. In areas that are not in close proximity (within 15 feet) of existing buildings, trenches should generally be constructed as presented in Figure 4 of our 2021 report. If trenches are excavated within 15 feet of existing building structures or paved surfaces, the open trench (including undercutting caused by wall caving) should not penetrate a plane line extending out and down from the outer edge of the building foundation element or edge of pavement at a slope of 1 horizontal (H) to 1 vertical (V) unless shoring is provided to support the trench side and building/pavement surcharge loads.

CLOSURE AND LIMITATIONS

Engineering recommendations for the project, including the pavement structural section, drainage considerations, and structural fill and compaction are presented in our December 2021 report. This letter should be considered an addendum to our December 2021 geotechnical report and all limitations included therein should be applied to the information presented in this extension. Unanticipated soil conditions are commonly encountered and cannot fully be determined by merely taking soil samples or advancing borings. Shannon & Wilson has prepared the attachments Important Information About Your *Geotechnical/Environmental Report* to assist you and others in understanding the use and limitations of the reports

We at Shannon & Wilson appreciate this opportunity to be of service. Please call the undersigned with any questions or comments concerning the contents of this submittal.

Sincerely,

SHANNON & WILSON

Digitally signed by Ryan Collins
Date: 2025.08.19 10:02:04 -08'00'

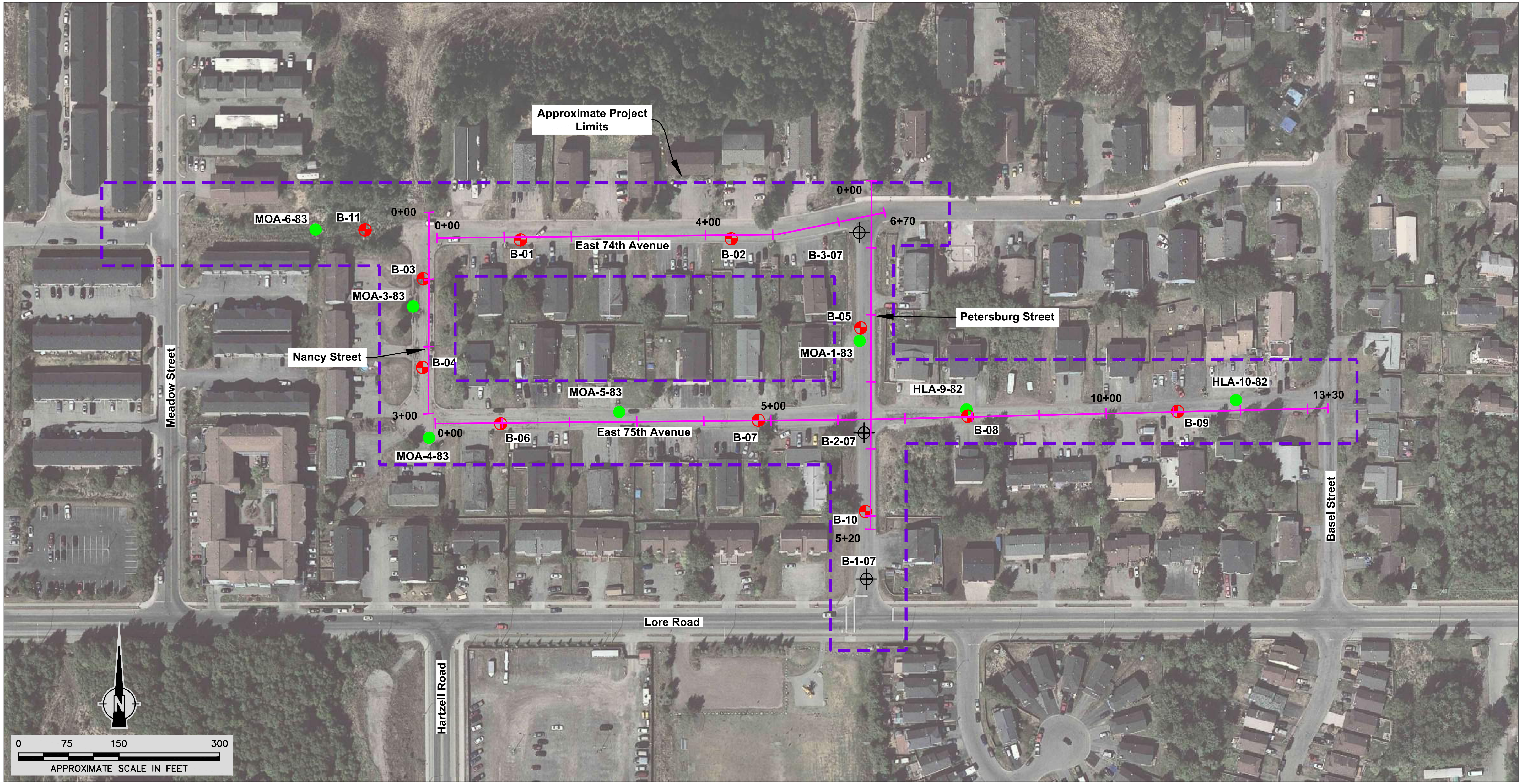
Ryan Collins, CPG
Associate Geologist

STATE OF ALASKA
49TH
Kyle Brennan
CE - 11122
8-19-25
REGISTERED PROFESSIONAL ENGINEER

Kyle Brennan, PE
Vice President

RDC:KLB/rdc

Enc. Figure 1: Site Plan
Important Information about your Geotechnical/Environmental Report



LEGEND

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- B-1-07 — Approximate Location of Boring B-1, Advanced by Shannon & Wilson, Inc., March 2007
- MOA-1-83 — Approximate Location of Boring 1, Advanced by the Municipality of Anchorage, 1983. Boring name indicates 'Company-Boring ID-Year'. See Appendix A. MOA- Municipality of Anchorage, HLA-Harding Lawson Associates, Inc.
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NOTES

1. Map adapted from aerial imagery provided by the Municipality of Anchorage. Image date: May 2015

E. 74th Avenue, E. 75th Avenue, Nancy Street
Area Reconstruction, PM&E 21-02
Anchorage, Alaska

SITE PLAN

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FIG. 1

IMPORTANT INFORMATION

Important Information

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Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent

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such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

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READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland