Geotechnical Report

Appendix F

Geotechnical Investigation

Norann Subdivision Area Road Reconstruction

(MOA PM&E Project No. 20-14)

November 2021

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Geotechnical Investigation
Norann Subdivision Area Road Reconstruction
(MOA PM&E Project No. 20-14)

Submitted To:

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CRW Project Number 10149.00

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1. Introduction and Project Description

CRW Engineering Group, LLC (CRW) is pleased to present this geotechnical investigation and design recommendations report to support the upgrades to West 57th Avenue (57th Avenue) and West 58th Avenue (58th Avenue) from Cope Street to Arctic Boulevard and Cope Street from 57th to 58th Avenue in Anchorage, Alaska. A vicinity map is shown in Figure 1.

The project is being managed by the Municipality of Anchorage (MOA) Project Management & Engineering Department (PM&E) and has been assigned MOA PM&E project number 20-14. Improvements are expected to include a new roadway structural section, pavement, drainage improvements, curb and gutter, pedestrian facilities (if warranted), and street lights.

The scope of geotechnical work included:

- Reviewing historical geotechnical investigations within and near the project area.
- Performing a geotechnical field investigation which included advancing boreholes along the project alignment and soil sampling.
- Installing three piezometer wells for groundwater level monitoring.
- Overseeing index laboratory testing of recovered soil samples including moisture content, grain size distribution including hydrometer, and Atterberg Limits.
- Analyzing field observations and testing results.
- Preparing the geotechnical report to provide design recommendations for the project.

2. Existing Conditions

The project area is the Norann Subdivision and is a local neighborhood situated west of Arctic Boulevard, south of West International Airport Road and north of Dowling Road (Figure 1). The existing streets are two-lane roadway surfaces with curb and gutter along 57th and 58th Avenue but not along Cope Street. There are currently no sidewalks along any of the project streets. The street pavements show significant distresses including cracking, settling, heaving, and rolled curb and gutters along 57th and 58th Avenue.

Storm and meltwater is currently conveyed along the surface though much of the roadway grade is generally flat resulting in ponding water.

3. Subsurface Investigation

CRW's geotechnical investigation consisted of drilling and sampling six boreholes (BH-01 through BH-06) on May 11th, 2021 at the locations shown in Figure 2. Borehole locations were selected by CRW following the guidelines presented in the 2007 MOA PM&E Design Criteria Manual (DCM) Section 1.7 – Soil Investigation Standards. The soil boring locations were approved by PM&E prior to performing the field investigations.

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

3.1 Subsurface Drilling

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

Traffic control was performed in accordance with the requirements of the MOA approved traffic control plan.

A CRW engineer supervised the field investigation program, recovered soil samples, and managed field operations. All borings were advanced to a depth of 17 feet below ground surface (BGS).

3.2 Sample Collection

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

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

3.3 Borehole Completion and Piezometer Well Installation

All boreholes were backfilled with cuttings brought to the ground surface during drilling. In select borings (BH-01, BH-03, and BH-05), a 1-inch PVC piezometer well was installed for groundwater level monitoring. The PVC pipe was hand-slotted the last 10 feet and was installed over the length of each boring. After the piezometer was installed, the annular space around the PVC was backfilled with cuttings. A 7-inch flush mount cover was installed at the surface with the annulus filled with pea gravel. A cold patch asphalt was placed around the flush mount to match the existing pavement surface where required. If no piezometer

well was installed, the boring was backfilled with cuttings and a cold patch asphalt was placed at the surface to match the existing pavement where required. For BH-06, no piezometer was installed and the surface was left as gravel.

Evidence of ground movement at BH-05 was observed when groundwater level readings were collected after drilling. The ground had subsided around the monument and left the casing protruding above the lip of the monument. The casing was cut down so the monument lid could be closed. The monument was replaced in September 2021 and the ground brought back to level to minimize the effect on traffic.

3.4 Groundwater Monitoring

Groundwater levels were noted during drilling. Additional groundwater level measurements occurred approximately two weeks after completion of drilling, and again in late August and late September. Groundwater levels observed during drilling and measurements after drilling are presented on the borehole logs, in Appendix A, and in this report in Table 6-1.

3.5 PID Field Testing

Soil samples were tested with a Photo Ionization Detector (PID) to test for the presence of volatile organic compounds (VOC) after being placed into a polyurethane bags during sampling. The PID was calibrated at the beginning of each field day with 100-parts per million (ppm) isobutylene calibration gas. The PID used was equipped with a 10.2-eV lamp. Screening was performed between 15 and 60 minutes after the sample was placed in the bag. Prior to screening, each sample was shaken or agitated for 15 seconds to assist volatilization. After vapor development, the PID sampling probe was inserted to about one-half the headspace depth and the highest measurement was recorded. Care was taken when inserting the sampling probe into the bag to avoid uptake of any moisture or soil particles. The field PID readings are presented on the borehole logs in Appendix A.

3.6 Contaminated Soils Disposal

All cuttings from BH-06 with a petroleum odor were disposed of at the borehole location. No other evidence of contamination was observed at any other boreholes.

4. Laboratory Testing and Results

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

The laboratory tests were performed in accordance with the test methods of ASTM International as summarized in Table 4-1.

Table 4-1. Laboratory Analyses and Methods

Analysis	Method	Number of Samples
Water Content	ASTM D2216	50
Grain-size Distribution	ASTM D6913 ASTM D422	8
Limited Mechanical Analysis	ASTM D1140	10
Atterberg Limits	ASTM D4318	4

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

5. Historical Geotechnical Investigations

CRW consulted the on-line MOA Soil Boring map to evaluate historic borings in the project area. No historic borings were noted to have been completed along 57th and 58th Avenue. One boring along Cope Street and two borings along Arctic Boulevard were reviewed. A brief discussion of the historic investigation and their findings are below. Historical logs and locations are included in Appendix D.

5.1 Cope Street

A geotechnical investigation was completed by R&M Consultants, Inc. (R&M) in 1974. The MOA on-line Soil Boring map indicates a boring at the corner of Cope Street and 57th Avenue; we do note that the R&M borehole map has mislabeled 57th Avenue.

The closest R&M boring encountered a 1-foot layer of gravelly sand with silt overlaying silty sand, silt with sand, and sand with silt to a total depth of 10 feet.

No groundwater was observed.

5.2 Arctic Boulevard

Two borings along Arctic Boulevard, at the intersections of 57th and 58th Avenues, were completed by the MOA Department of Public Works Construction Division in 1980.

Materials encountered consisted generally of a 2- to 3-foot layer of well graded gravel with sand and silt. Underlying the gravel was peat which ranged from 3.5 to 6 feet in thickness. Below the peat was silt or silty sand which extended to the depth of the borings to 10 feet.

No groundwater was observed.

6. Site Conditions

6.1 Geology

The geology for the project area was determined from the Simplified Geologic Map of Central and East Anchorage, Alaska, as mapped by R.A. Combellick with the Alaska Division of Geologic and Geophysical Surveys (DGGS) in 1999 in addition to the 1972 map by Schmoll and Dobrovolny (Commellick, 1999; Schmoll and Dobrovolny, 1972). The geology of the project area consists primarily of sand deposits underlain by Bootlegger Cove Clay at depth of 20 to 40 feet or more.

Near the intersection of 58th Avenue and Arctic Boulevard the area is mapped as having peat (Schmoll and Dobrovolny, 1972).

Geologic conditions in the boreholes agreed with the general geology though variations between borings was noted.

6.2 Pavement Thickness and General Soil Lithology

The pavement thickness, where encountered, ranged from 1.5 to 2.5 inches based on measurements of recovered samples.

The subsurface conditions within the existing road prism where borings occurred generally consisted of a 1- to 3-foot-thick layer of granular fill underlain by fine grained material. The granular fill classification mixed between poorly graded gravel to poorly graded sand with varying fines content. The moisture content ranged between 3 and 8 percent. The fines content ranged between 5 and 8 percent. The frost susceptibility was estimated to be F-1 frost classification.

The fine-grained material below the granular fill varied between poorly graded sand, silty sand, silt, sandy silt, and clayey silt. The moisture content ranged between 5 and 41 percent. Fines content ranged between 3 and 95 percent. The frost susceptibility was estimated or determined to range from F-2 to F-4 frost classification.

A layer of peat was encountered in BH-06 from approximately 2.5 to 6 feet BGS. The moisture content ranged from 157 to 216 percent. BH-06 was located in the alley north of 58th Avenue beyond the right-of-way line extended. Peat was not encountered in any other borings.

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

6.3 Groundwater Conditions

Groundwater, if observed, was recorded on the borehole logs. Only the most recent measurement taken after drilling is displayed on the borehole logs in Appendix A. Table 6-1 provides a summary of the groundwater levels at the time of drilling and all subsequent measurements. All depths are relative to the existing roadway surface.

Table 6-1. Summary of Groundwater Levels

Borehole	Groundwater Levels While Drilling on 5/11/2021 (feet BGS)	Groundwater Levels on 5/28/2021 (feet BGS)	Groundwater Levels on 8/23/2021 (feet BGS)	Groundwater Levels on 9/26/2021 (feet BGS)
BH-01	14.0	10.5	10.4	10.2
BH-02	12.0	N/A	N/A	N/A
BH-03	Not Observed	15.6	15.5	15.0
BH-04	Not Observed	N/A	N/A	N/A
BH-05	3.2 (Perched) 16.3	14.6	7.9	6.4
BH-06	9.0	N/A	N/A	N/A

A perched groundwater lens was observed in BH-05 above the clayey silt at 3.2 feet BGS. Perched groundwater layers occur when zones of impervious soil prevent infiltration resulting in ponding water at shallow depths.

6.4 PID Field Testing Results

Standard practice in the MOA is to consider soil samples with PID readings of 20 parts per million (ppm) or higher potentially contaminated. Only one sample, at a depth of 1.7 feet BGS (S1B) in BH-06, had a PID reading above this threshold at 53.1 ppm and had a faint petroleum odor. The 2.5-foot sample screened had a PID reading of 1.1 ppm and had no petroleum odor. The extent of any potential contamination at the BH-06 location is shallow and very limited in vertical extent, and is more than 10 feet away from the project corridor. Due to the limited number of borings for this geotechnical effort, the limits of the contamination in the vicinity of BH-06 is unknown. To reduce the risk of encountering unknown conditions during construction, the MOA may elect to perform additional testing in this area.

6.5 Contaminated Site Review

Soil samples were tested using a PID during the field investigation per MOA requirements with results previously discussed in this report and values provided on the borehole logs. In addition, CRW consulted the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program (CSP) on-line database for nearby recorded contaminated sites. A review of the CSP database revealed no sites within 500 feet of the project area.

7. Geotechnical Engineering Recommendations

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

7.1 Site Preparation

All pavements, existing fill, existing curbs and gutters, trees, stumps, and other deleterious material should be cleared from the roadway reconstruction limits. Exposed subgrade at the bottoms of excavations should be scarified a minimum of 6 inches, moisture conditioned, and rolled smooth.

7.2 Utility Excavation

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

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

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

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

7.3 Dewatering

Subsurface conditions show the groundwater table below anticipated excavation bottoms based on measurements taken at the time of drilling and during subsequent readings. Dewatering is not anticipated to be required for the project.

7.4 Frost Depth and Permafrost

Seasonal frost was observed in BH-01 between 1 and 4 feet BGS, primarily in silt. Ice lenses up to 1 millimeter thick were observed below 3 feet BGS. BH-06 contained frozen peat from 2.5 to 3.5 feet BGS.

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

We have estimated design frost depths based on the modified Berggren equation using the commercially available Microsoft DOS program BERG2 as discussed in the next section of this report.

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

7.5 Recommended Road Structural Sections

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

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

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

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

The frost depth was analyzed using the commercially available MSDOS computer program BERG2 written by Braley and Connor (Braley and Connor, 1989) as approved in the DCM. The analysis calculates the estimated total frost penetration depth and determines the recommended structural section. For our analysis, we used the program default climate parameters for Anchorage and assumed conservative surface freeze/thaw n-factors based on local practice and published values. Soil layers were assigned in the program with estimated dry unit weights of the soil and average or anticipated water contents. Soil thermal parameters were calculated from the equations built into the BERG2 program (see Braley and Connor for further discussion).

7.5.1 Recommended Structural Section – Limited Subgrade Frost Protection Method

The project area contains frost susceptible subgrade with a F-2 to F-4 frost classification within 8 feet of the ground surface. Based on this, we recommend an insulated structural section using the Limited Subgrade Frost Penetration for the entire project alignment. We have developed a recommended structural section based on the BERG2 analysis, and have evaluated 2 inches of insulation. The insulation for the structural section in this analysis assumed a minimum R-value of R-4.5 per inch. Our recommended structural sections are presented in Table 7-1. A typical insulated section is presented in Figure 3.

Table 7-1. Recommended Structural Section – 2 inches Insulation

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

See Appendix E for BERG2 analysis and detailed results. Note that the recommended structural section considers only minimum thicknesses.

7.6 Compaction Requirements

Pavement structural section fill material should be placed in loose lift thickness, no more than 12 inches, and compacted to a minimum of 95 percent of the Modified Proctor maximum dry density in accordance with ASTM D1557. Compaction verification of the backfill by a qualified inspector is also recommended.

7.7 Rigid Insulation

We recommend that rigid board insulation for the road structural section have a minimum compressive strength of 60 pounds per square inch (psi) and a maximum water absorption of 0.3 percent by volume in accordance with the current version of Municipality of Anchorage Standard Specifications (MASS). We recommend the insulation have a minimum R-value of R-4.5 per inch. We recommend a minimum of 12 inches of loose fill be placed over the insulation to protect from wheel loads during construction. We recommend a minimum of 16 inches of fill over the insulation for design to prevent frost formation in the form of differential icing.

Board insulation installation should be extended a minimum of 4 feet beyond the back of the curb when no sidewalk is present. Extending the insulation 4 feet will reduce the risk of the curb heaving up or “curb rolling”. The potential for curb rolling decreases as the distance the insulation extends beyond the back of curb increases. The 4-foot layout has protected the curb well on past projects especially where the curbs need to be protected due to the flat longitudinal roadway grades like those on this project.

The insulation should extend 1 foot minimum beyond the back of any sidewalk but will not perform as well as the curb. To increase the performance of any sidewalk, the owner could consider extending the insulation 4 feet as well. Additionally, insulation below separated sidewalks that are separated by 4 feet or more could be reduced in thickness to save cost but will not perform as well.

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

7.8 Geotextiles

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

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

Typical installation involves placing the geotextile transverse to the centerline in order to avoid large overlaps. Fabric joints should be overlapped according to manufactures recommendations. Fabric joints may require sewing together depending on subgrade conditions and should follow the manufacturer's requirements.

7.9 Subdrains

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

7.10 Reuse of Material

Existing fill and native material that meets the classification for MOA Type II and Type II-A fill can be reused as classified fill in the roadway structural section. It is anticipated that the majority of existing fill and native material along the project alignment contain frost susceptible material and will not meet MOA Type II and Type II-A classification.

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

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

7.11 Utility Recommendations

All utilities should be bedded, backfilled, and compacted per MASS. The satisfactory performance of piped utilities is highly dependent upon the quality of soil below and along the sides of the pipe.

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

8. Limitations and Closure

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

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

Samples will be retained by CRW for six months following the date on which the final report is issued. Other arrangements may be made at the client's request.

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

9. References

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

Combellick, R.A., 1999. Simplified geologic map and cross sections of central and east Anchorage, Alaska: Alaska Division of Geological and Geophysical Surveys Preliminary Interpretive Report 1999-1.

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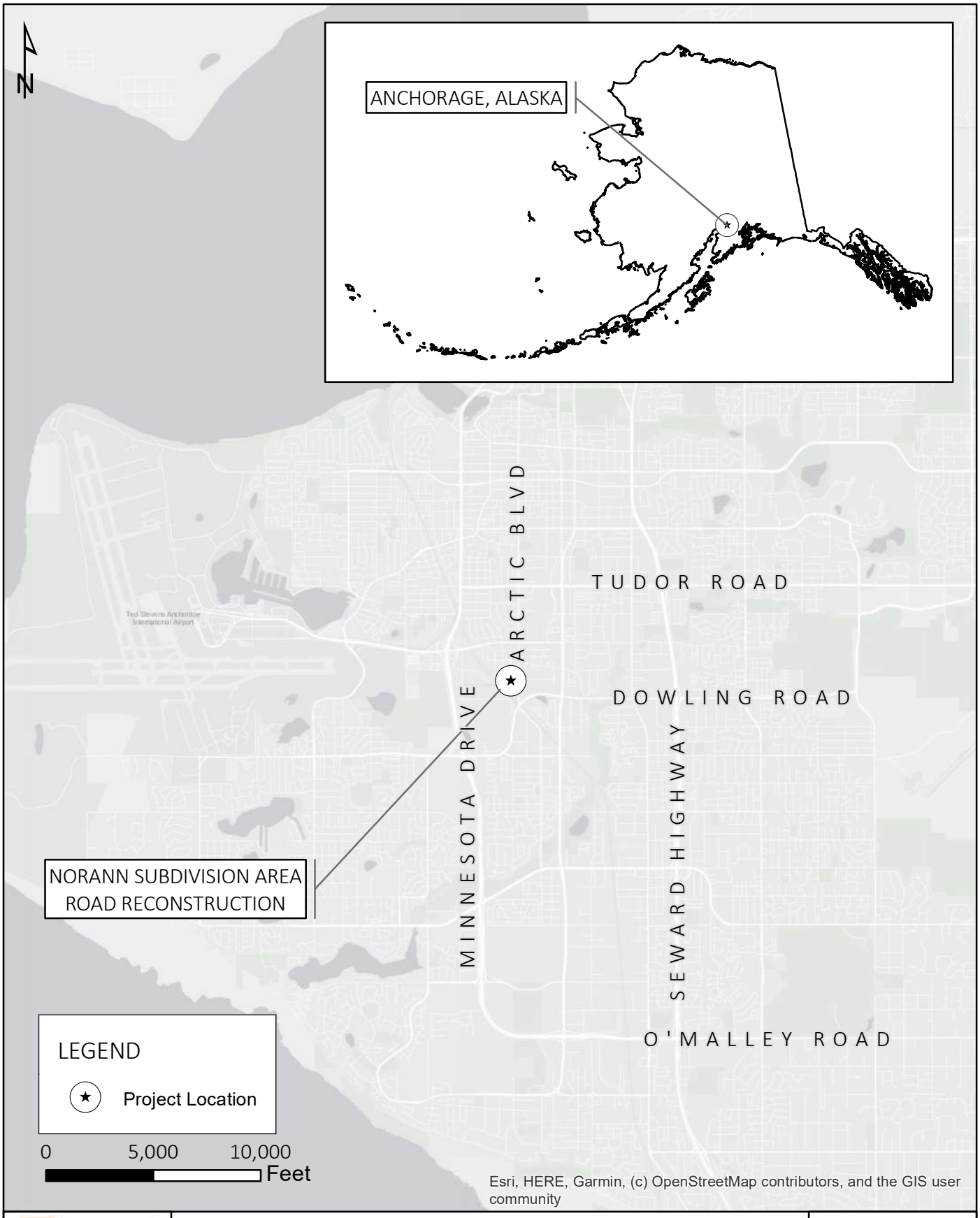
Figures



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NORANN SUBDIVISION AREA ROAD RECONSTRUCTION
PM&E PROJECT NO. 20-14
GEOTECHNICAL EXPLORATION
VICINITY MAP

Project:	10149.00
Drawn By:	AFS
Scale:	Graphical Scale
Date:	November 2021
Figure:	1

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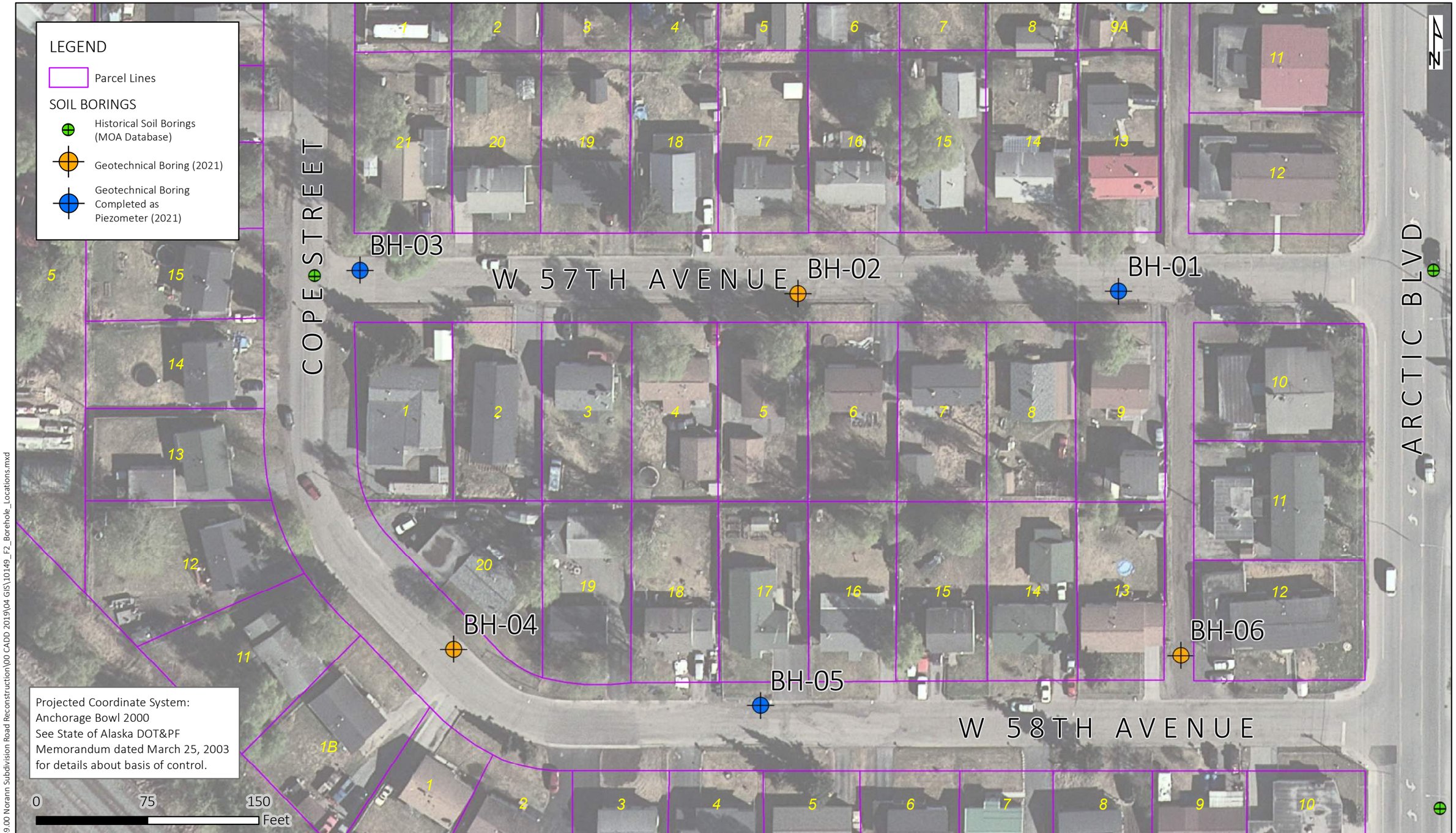

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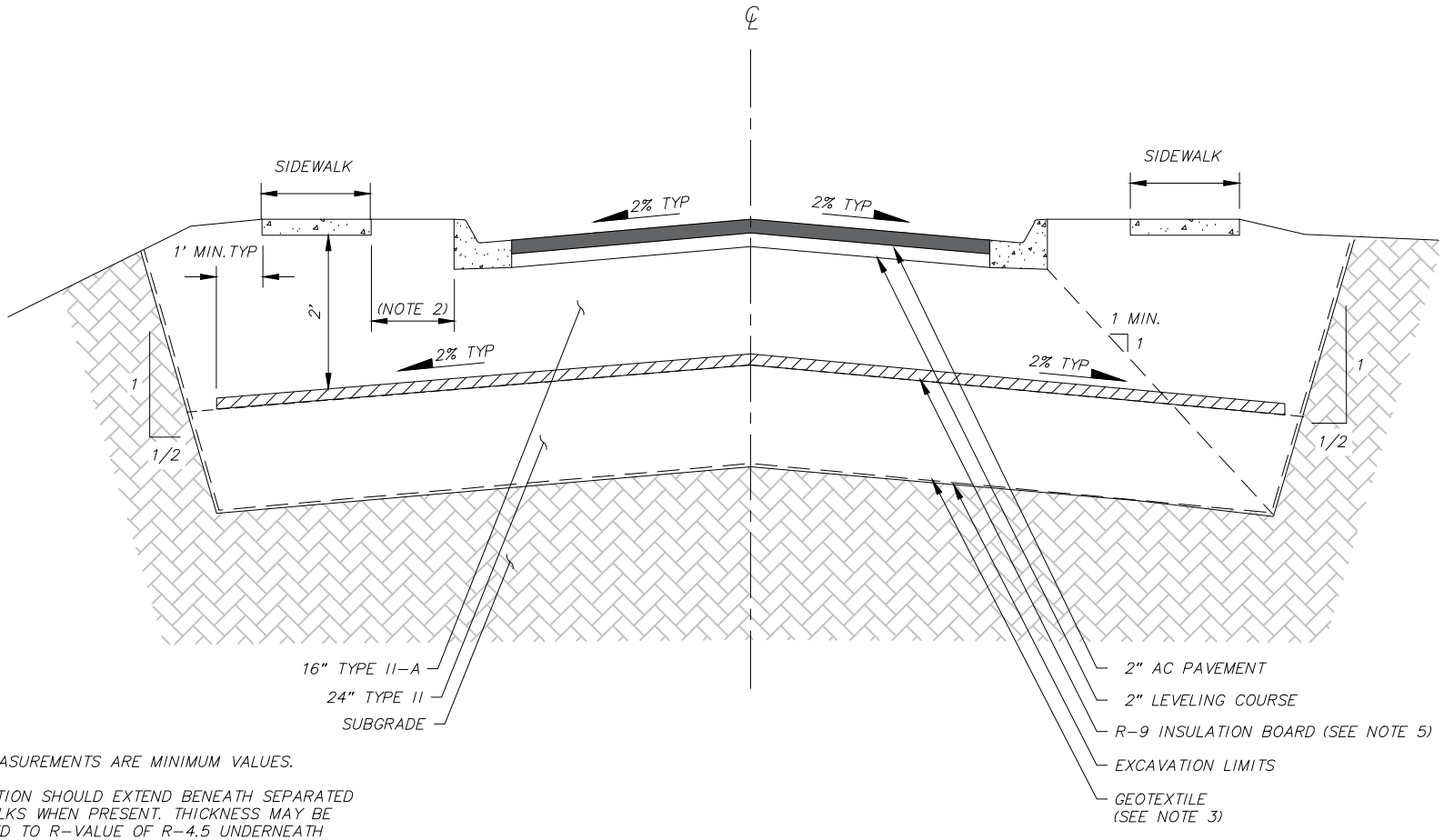
NORANN SUBDIVISION AREA ROAD RECONSTRUCTION: GEOTECHNICAL EXPLORATION

PM&E PROJECT NO. 20-14

BOREHOLE LOCATION MAP

Project:	10149.00
Drawn By:	AFS
Scale:	Graphic
Date:	November 2021
Figure:	2



NOTES:

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

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NORANN SUBDIVISION AREA ROAD RECONSTRUCTION
PM&E PROJECT NO. 20-14

TYPICAL INSULATED SECTION
WITHOUT EDGE SUBDRAINS

Project:	10149.00
Drawn By:	SMH/AFS
Scale:	NTS
Date:	NOV 2021
Figure:	3

Appendix A

Borehole Logs

Included in this section:

1) Borehole Log Legend
2) Borehole Logs (BH-01 through BH-06)

UNIFIED SOIL CLASSIFICATION (ASTM D 2487)

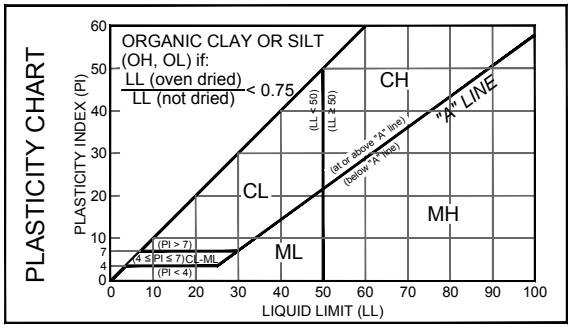
GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
GW	WELL-GRADED GRAVEL	if soil contains ≥ 15% sand, add "with sand"
GP	POORLY GRADED GRAVEL	
GM	SILTY GRAVEL	
GC	CLAYEY GRAVEL	
SW	WELL-GRADED SAND	if soil contains ≥ 15% gravel, add "with gravel"
SP	POORLY GRADED SAND	
SM	SILTY SAND	
SC	CLAYEY SAND	
CL	LEAN CLAY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

Gravels or sands with 5% to 12 % fines require dual symbols (GW-GM, GW-GC, GP-GM, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC) and add "with clay or "with silt" to group name. If fines classify as CL-ML for GM or SM, use dual symbol GC-GM or SC-SM.

Optional Abbreviations: Lower case "s" after USCS group symbol denotes either "sandy or "with sand" and "g" denotes either "gravelly" or "with gravel."

COMPONENT DEFINITIONS BY GRADATION

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



OTHER SYMBOLS

SYMBOL	NAMES & LEGEND	
BLDR	COBBLES AND BOULDERS	overlay
FILL	GRANULAR FILL	man-made or placed
WD	WOODY DEBRIS	
RAP	RECLAIMED ASPHALT PAVEMENT	

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

COHESIONLESS SOILS[a]		COHESIVE SOILS[b]		
RELATIVE DENSITY	N_{60} (BLOWS/FOOT)[c]	CONSISTENCY	N_{60} (BLOWS/FOOT)[c]	UNCONFINED COMPRESSIVE STRENGTH (TSF)[d]
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 4	0.25 - 0.50
MED DENSE	10 - 30	MEDIUM	4 - 8	0.50 - 1.0
DENSE	30 - 50	STIFF	8 - 15	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	15 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

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

CRITERIA FOR DESCRIBING MOISTURE CONDITION (ASTM D 2488)

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

SAMPLER ABBREVIATIONS

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

DESCRIPTIVE TERMINOLOGY FOR PERCENTAGES (ASTM D 2488)

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

LABORATORY TEST ABBREVIATIONS

AL	Atterberg Limit	PI	Plastic Index	TS	Thaw Consolidation
Consol	Consolidation	PID	Photoionization Detector	TV	Torvane
LMA	Limited Mechanical Analysis	Proc	Proctor	TXCD	Consolidated Drained Triaxial
MA	Sieve and Hydrometer Analysis	PP	Pocket Penetrometer	TXCU	Consolidated Undrained Triaxial
MC	Moisture Content	P200	Percent Fines (Silt & Clay)	TXUU	Unconsolidated Undrained Triaxial
NP	Non-plastic	SA	Sieve Analysis	VS	Vane Shear
OLI	Organic Loss on Ignition	SpG	Specific Gravity	Ω	Soil Resistivity

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LEGEND: FIELD AND LABORATORY TEST ABBREVIATIONS

FILE NAME: M:\Engineering References\Tech Geotechnical\CRW Geotechnical Report Template\Borehole Log Legend\Geotech_RAP_debris_added.dwg

FROZEN SOIL CLASSIFICATION (ASTM D 4083)

1. DESCRIBE SOIL INDEPENDENT OF FROZEN STATE	CLASSIFY SOIL BY THE UNIFIED SOIL CLASSIFICATION SYSTEM				
	MAJOR GROUP		SUBGROUP		
	DESCRIPTION	DESIGNATION	DESCRIPTION		DESIGNATION
2. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF FROZEN SOIL	Segregated ice not visible by eye	N	Poorly bonded of friable		N_f
			Well bonded	No excess ice	Nbn
				Excess ice	Nbe
	Segregated ice visible by eye (ice less than 25 mm thick)	V	Individual ice crystals or inclusions		V_x
			Ice coatings on particles		V_c
			Random or irregularly oriented ice formations		V_r
			Stratified or distinctly oriented ice formations		V_s
			Uniformly distributed ice		V_u
3. MODIFY SOIL DESCRIPTION BY DESCRIPTION OF SUBSTANTIAL ICE STRATA	Ice greater than 25 mm thick	ICE	Ice with soil inclusions		ICE+soil type
			Ice without soil inclusions		ICE

FROST DESIGN SOIL CLASSIFICATION[1]

FROST GROUP[2]	GENERAL SOIL TYPE	% FINER THAN 0.02 mm BY WEIGHT	TYPICAL USCS SOIL CLASS
NFS[3]	(a) Gravels Crushed stone Crushed rock	0 - 1.5	GW, GP
	(b) Sands	0 - 3	SW, SP
PFS[4] [MOA NFS] [FAA NFS]	(a) Gravels Crushed stone Crushed rock	1.5 - 3	GW, GP
[MOA F2] [FAA FG-2]	(b) Sands	3 - 10	SW, SP
S1 [MOA F1] [FAA FG-1]	Gravelly soils	3 - 6	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
S1 [MOA F2] [FAA FG-2]	Sandy soils	3 - 6	SW, SP, SW-SM, SP-SM, SW-SC, SP-SC
F1[5] [FAA FG-1]	Gravelly soils	6 - 10	GM, GC, GM-GC, GW-GM, GP-GM, GW-GC, GP-GC
F2[5] [FAA FG-2]	(a) Gravelly soils	10 - 20	GW, GP, GW-GM, GP-GM, GW-GC, GP-GC
	(b) Sands	6 - 15	SM, SW-SM, SP-SM, SC, SW-SC, SP-SC, SM-SC
F3[5] [FAA FG-2] [For Clays, FAA FG-3]	(a) Gravelly soils	10 -20	GM, GC, GM-GC
	(b) Sands, except very fine silty sands	6 - 15	SM, SC, SM-SC
	(c) Clays, PI>12	--	CL, CH
F4[5] [FAA FG-4]	(a) Silts	--	ML, MH, ML-CL
	(b) Very fine silty sands	Over 15	SM, SC, SM-SC
	(c) Clays, PI<12	--	CL, ML-CL
	(d) Varved clays or other fine-grained banded sediments	--	CL or CH layered with ML, MH, ML-CL, SM, SC, or SM-SC

(1) From the U.S. Army Corps of Engineers (USACE), EM 1110-3-138, "Pavement Criteria for Seasonal Frost Conditions", April 1984
(2) USACE frost groups directly correspond to frost groups in Municipality of Anchorage (MOA) Design Criteria Manual (DCM). Federal Aviation Administration (FAA) frost groups come from Table 2-2 in Section 2.7 of Advisory Circular (AC) 150/5320-6F, Airport Pavement Design and Evaluation.
(3) Non-frost susceptible
(4) Possibly frost susceptible, requires lab test for void ratio to determine frost design classification.
(5) Consistent with MOA Definition.

ICE BONDING SYMBOLS

DEFINITIONS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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LEGEND: FROZEN SOIL CLASSIFICATION

CRW Engineering Group, LLC
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Anchorage Alaska 99503

BOREHOLE BH-01

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING 14.00 ft
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING 10.95 ft
NOTES
AFTER DRILLING 10.15 ft 9/26/2021

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 10 20 30 40
0	GP-GM		1.5 inches asphalt, intensely cracked. POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 48% gravel, 45% sand, 7% fines Brown, moist, no odor. Gravel subrounded to rounded up to 2 inches. Frost class F-1 (estimated).	HD S1A	71	5-5-6-4 (11)			0.3	LMA	
	SM			HD S1B					0.3		
	ML		SILTY SAND, (SM) 0% gravel, 90% sand, 10% fines Tan to brown, moist, no odor. Subangular gravel up to 0.5 inches, fine to medium sand. Frost class F-2 (estimated).	HD S2A	75	2-4-6-9 (10)			0.3		
	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Brown, moist to wet, no odor. Frost class F-4 (estimated).	HD S2B					0.2	LMA	
5	SM		SILT WITH SAND, (ML) 0% gravel, 29% sand, 71% fines Tan, moist to wet, no odor, non-plastic. Partially frozen (Vs), 15% ice. 1-mm ice lenses throughout upper 5 inches of frozen interval. Wet at interface with unfrozen silt above. Frost class F-4 (estimated). SILTY SAND, (SM) 2% gravel, 56% sand, 42% fines Tan, moist, no odor. Interbedded silty sand and sand. Frost class F-3 (estimated).	HD S3	75	2-2-3-5 (5)			0.2	LMA	
	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Tan, moist, no odor. Soft, non-plastic.	HD S4A	83	7-9-8-9 (17)			0.7	AL	
	SP		POORLY GRADED SAND, (SP) 0% gravel, 97% sand, 3% fines Olive, moist to wet, no odor. Transitions to wet at approximately 12 feet BGS. Fine to medium sand.	HD S4B					0.2		
10				HD S5	79	6-6-6-8 (12)			0.3	SA	
15				HD S6	100	7-11-14-15 (25)			0.3		

Bottom of borehole at 17.0 feet.

Notes:
Completed as standpipe piezometer, 1" Sch40 PVC, hand-slotted screen 7-17 ft BGS. Backfilled with cuttings. Steel flushmount monument with 1/2" bolts.

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BOREHOLE BH-02

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
▽ **AT TIME OF DRILLING** 12.00 ft
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS
0			2 inches asphalt, intensely cracked.							
	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 60% gravel, 35% sand, 5% fines Brown, moist, no odor. Gravel subrounded to rounded up to 3 inches. Frost class F-1 (estimated).	HD S1	50	6-4-5-3 (9)			0.2	
	ML		SILT, (ML) 1% gravel, 1% sand, 98% fines Tan, moist to wet, no odor, slightly plastic. Upper 5 inches of sample spoon as above, not sampled. Occasional subrounded gravel up to 0.75 inches. Partially frozen (Vs), 15% ice. 2- to 5-mm ice lenses at approximately 3 and 3.5 feet BGS. Wet at interface with unfrozen silt above. Frost class F-4 (hydrometer).	HD S2	100	5-5-6-4 (11)			0.2	MA
5				HD S3A					0.9	
	SM		SILTY SAND, (SM) 0% gravel, 81% sand, 19% fines Olive, moist, no odor. Fine to medium sand. Frost class F-3 (estimated).	HD S3B	67	1-3-8-6 (11)			0.5	SA
				HD S4	67	6-6-5-6 (11)			0.2	
10	SM		SILTY SAND, (SM) 0% gravel, 53% sand, 47% fines Olive brown, moist, no odor.	HD S5A	100	4-5-4-3 (9)	2		0.2	LMA
	ML	▽	SILT, (ML) 10% gravel, 10% sand, 80% fines Olive brown, moist to wet, no odor. Clear bedding delineations formed by single layers of fine gravel . VS 25.1/6.3 psf	HD S5B			2.75		0.2	
15	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Olive brown, wet, no odor, slightly plastic, moderately soft. Very fine sand. Gradational changes in sand and silt content throughout this interval. Water comes to surface of sample after resting or agitating. VS 33.4/16.7 psf	HD S6	100	4-4-4-3 (8)	2.75		0.2	

Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings, cold patch.

▲ SPT N VALUE ▲ 10 20 30 40
PL MC LL 10 20 30 40

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BOREHOLE BH-03

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING --- Not observed.
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING --- Not observed.
NOTES
AFTER DRILLING 15.00 ft 9/26/2021

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS	SPT N VALUE / PL MC LL
0			2 inches asphalt.								
	SP-SM		POORLY GRADED SAND WITH SILT AND GRAVEL, (SP-SM) 44% gravel, 48% sand, 8% fines Brown, moist, no odor. Gravel subangular to subrounded up to 2.5 inches. Frost class F-1 (estimated).	HD S1	58	6-9-5-7 (14)			0.3	SA	
	ML		SILT WITH SAND, (ML) 0% gravel, 15% sand, 85% fines Tan, moist, no odor, slightly plastic, moderately soft. Frost class F-4 (estimated). VS 33.4/16.7 psf	HD S2	92	4-2-3-3 (5)	2.75 3.3 2		0.2		
5	SP ML		POORLY GRADED SAND, (SP) 0% gravel, 95% sand, 5% fines Tan, moist, no odor. Small amount sampled in shoe of 2.5-ft BGS spoon. Frost class NFS (estimated). SILT, (ML) 0% gravel, 5% sand, 95% fines Tan, moist, no odor. 2 inches of tan silt in top of 5-ft BGS spoon. No tests on small amount recovered. Frost class F-4 (estimated).	HD S3	83	3-6-6-7 (12)			0.1	LMA	
	SM		SILTY SAND, (SM) 0% gravel, 85% sand, 15% fines Tan, moist, no odor. Fine to medium sand. Frost class F-2 (estimated).	HD S4	75	1-4-5-6 (9)			0.1		
10	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Tan, wet, no odor, non-plastic.	HD S5A	100	3-3-3-3 (6)			0.1	AL	
	ML		SILT, (ML) 0% gravel, 10% sand, 90% fines Tan silt, moist to wet, no odor, slightly plastic, soft. Contains thin lenses of fine to medium sand.	HD S5B			3 2.5		0.2		
15	ML		SANDY SILT, (ML) 6% gravel, 36% sand, 58% fines Tan, moist to wet, no odor, non-plastic. Fine to medium sand and gravel.	HD S6A	100	3-2-5-7 (7)			0.2	SA	
	SM		SILTY SAND, (SM) 5% gravel, 55% sand, 40% fines Tan, moist to wet, no odor.	HD S6B					0		

Bottom of borehole at 17.0 feet.

Notes:
Completed as standpipe piezometer, 1" Sch40 PVC, hand-slotted screen 6.5-16.5 ft BGS. Backfilled with cuttings. Steel flushmount monument with 1/2" bolts.

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BOREHOLE BH-04

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING --- Not observed.
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 10 20 30 40
0			2.5 inches asphalt.								
	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 49% gravel, 44% sand, 7% fines Brown, moist, no odor. Gravel subangular to subrounded up to 2.5 inches. Auger grinding in upper 2 feet BGS and gravel up to 3 inches in auger cuttings. Small amount of native sand in shoe of first sample spoon. Frost class F-1 (estimated).	HD S1	75	9-9-6-5 (15)			0.3	LMA	
	SM		SILTY SAND, (SM) 1% gravel, 58% sand, 41% fines Olive brown, moist, no odor. Layered sand and silty sand with gradational transitions between. Fine to coarse sand. Frost class F-3 (hydrometer).	HD S2	67	4-3-2-2 (5)			0.2	MA	
5											
	SM		SILTY SAND, (SM) 6% gravel, 72% sand, 22% fines Olive brown, moist, no odor. Gravel subangular to subrounded up to 2 inches. Some silt lenses throughout, infrequent organic partings at 10 feet BGS and deeper. Frost class F-3 (estimated).	HD S3	67	1-3-3-3 (6)			0.1	LMA	
				HD S4	92	3-2-4-5 (6)			0.2		
10											
	SM			HD S5	67	3-4-4-6 (8)			0.2		
15											
				HD S6A	83	5-5-4-7 (9)			0.2		
	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Olive brown, moist, no odor, friable and non-plastic. One 1-inch piece of angular gravel at interface with silty sand above.	HD S6B					0.2		

Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings, cold patch.

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BOREHOLE BH-05

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING 3.17 ft Likely perched.
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING 16.30 ft
NOTES Evidence of ground movement.
AFTER DRILLING 6.40 ft 9/26/2021

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS	SPT N VALUE / PL MC LL
0	GP-GM		2 inches asphalt, intensely cracked and distressed. A local low spot where water pools.	HD S1A	58	4-3-2-2 (5)	2.6		0.5	SA	
			POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 50% gravel, 44% sand, 6% fines Brown, moist, no odor. Gravel subangular to rounded up to 2 inches. Cobbles up to 7 inches in auger cuttings. Frost class F-1 (estimated).	HD S1B			>4.5		0.5		
	ML		SILT, (ML) 0% gravel, 5% sand, 95% fines Tan, wet, no odor, slightly plastic, soft to stiff. Saturated with water at top of sample. Frost class F-4 (estimated). VS insufficient quantity to test	HD S2A	83	1-1-3-3 (4)			0.3		
	CL-ML			HD S2B					0.3	MA, AL	
5			CLAYEY SILT, (CL-ML) 0% gravel, 14% sand, 86% fines Tan, moist, no odor, low plasticity. Frost class F-4 (hydrometer).								
			CLAYEY SILT, (CL-ML) 0% gravel, 7% sand, 93% fines Tan, moist, no odor, low plasticity, moderately stiff. Frost class F-4 (estimated). VS 62.7/25.1, 54.3/33.4 psf	HD S3	83	2-4-4-5 (8)	4.0		0.3	LMA	
	CL-ML						4.25				
			VS 48.0/10.4, 62.7/18.8 psf	HD S4	100	2-3-3-5 (6)	3.25		0.2		
10							3.0				
			SANDY SILT, (ML) 4% gravel, 40% sand, 56% fines Tan-brown, moist, no odor, non-plastic.	HD S5	75	3-4-5-7 (9)			0.2	LMA	
	ML										
15											
	ML		SILT, (ML) 5% gravel, 5% sand, 90% fines Olive-gray, moist, no odor, slightly plastic. Coarse sand/fine gravel (up to 0.25 inches) suspended in sandy silt matrix around 15-15.5 feet BGS. VS 25.1/4.2, 35.5/6.3 psf	HD S6	100	2-2-3-5 (5)	2.3		0.2		
							2.25				

Bottom of borehole at 17.0 feet.

Notes:
Completed as standpipe piezometer, 1" Sch40 PVC, hand-slotted screen 6.5-16.5 ft BGS. Backfilled with granular cuttings from BH-03 and BH-04. Steel flushmount monument with 1/2" bolts.

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BOREHOLE BH-06

CLIENT Municipality of Anchorage
PROJECT NAME Norann Subdivision Area Road Reconstruction
PROJECT NUMBER MOA PM&E Project No. 20-14
PROJECT LOCATION Anchorage, Alaska
DATE STARTED 5/11/21 **COMPLETED** 5/11/21
GROUND ELEVATION
DRILLING CONTRACTOR Discovery Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow-Stem Auger
AT TIME OF DRILLING 9.00 ft
LOGGED BY AFS **CHECKED BY** SMH
AT END OF DRILLING ---
NOTES In unpaved alleyway adjacent to 58th Ave.
AFTER DRILLING ---

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	ICE BOND	PID (ppm)	OTHER TESTS	▲ SPT N VALUE ▲ 10 20 30 40 / PL MC LL 10 20 30 40
0	GP-GM		POORLY GRADED GRAVEL WITH SILT AND SAND, (GP-GM) 55% gravel, 40% sand, 5% fines Brown, moist, no odor. Gravel subangular to subrounded up to 2 inches. Frost class F-1 (estimated).	HD S1A	83	8-6-4-3 (10)			0.4		
				HD S1B					53.1		
	SM		SILTY SAND, (SM) 10% gravel, 70% sand, 20% fines Brown-gray, moist, faint POL odor. Gravel rounded up to 1.25 inches. Occasional oxidized/blackened roots. Frost class F-3 (estimated).								
	PT		PEAT, (PT) Brown, frozen (Nbn), organic odor.	HD S2A	100	3-3-1-2 (4)			1.1		157
				HD S2B					1.3		216
5	PT		PEAT, (PT) Brown, fibrous, moist, organic odor. Becoming less fibrous and gradationally transitioning to silt at bottom.	HD S3A					1.7		173
	ML		SANDY SILT, (ML) 0% gravel, 34% sand, 66% fines Gray, moist, no odor, stiff, non-plastic. Some roots and iron-oxide staining. Frost class F-4 (estimated). VS 50.1/failure psf	HD S3B	100	1-3-3-4 (6)	>4.5		0.2	LMA	
			SILT, (ML) 0% gravel, 5% sand, 95% fines Gray silt, moist to wet, no odor, non-plastic to slightly plastic, soft. Wet at 9 and 15 feet BGS. VS 71.0/35.5, 41.8/16.7 psf	HD S4	75	2-4-3-4 (7)	>4.5, 3.75		0.2		
10	ML		VS 71.0/37.6, 25.1/16.7 psf	HD S5	75	3-4-3-2 (7)	>4.5 1.75		0.1		
15			VS 16.7/12.5 psf	HD S6A	100	4-6-12-13 (18)	>4.5		0.1	AL	
	SM		SILTY SAND, (SM) 0% gravel, 80% sand, 20% fines Gray, moist, no odor. Medium sand.	HD S6B			2.75		0.1		

Bottom of borehole at 17.0 feet.

Notes:
Backfilled with cuttings, gravel cuttings spread at surface.

Appendix B

Laboratory Results

Included in this section:

1) Laboratory Results from Alaska Testlab

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0705
Issue No: 4

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0705-S01	21-0705-S02	21-0705-S03	21-0705-S04	21-0705-S05	21-0705-S06
Client Sample ID	BH-01 Sample 1A	BH-01 Sample 1B	BH-01 Sample 2A	BH-01 Sample 2B	BH-01 Sample 3	BH-01 Sample 4A
Date Sampled						

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	3.5	16.9	16.7	19.0	16.0	17.6	
Method		B	B	B	B	B	B	
Group Symbol	ASTM D 2487	GP-GM			ML	SM		
Group Name		Poorly graded gravel with silt and sand			Silt with sand (unknown)	Silty sand		
Tested By								
Percent Gravel	LMA (Internal Method)	48			0	2		
Percent Sand		45			29	56		
Percent Fines (Silt/Clay)		7			71	42		
Group Symbol		GP-GM			ML	SM		
Approximate maximum grain size Material retained on 425µm (No. 40) (%)	ASTM D 4318							
Method of Removal							N/A	
Grooving Tool Type							Plastic	
Specimen preparation method							Dry	
Drying Method							Air	
Special selection process							N/A	
Rolling Method for PL							Hand	
As Received Water Content (%)							17.6	
Liquid Limit Device Type							Mechanical	
Liquid Limit							N/A	
Plastic Limit							NP	
Plasticity Index							NP	
Liquid Limit Procedure							Multipoint (A)	
Tested By							Nathan Lervold	

Comments

N/A

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0705
Issue No: 4

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0705-S07	21-0705-S08	21-0705-S09
Client Sample ID	BH-01 Sample 4B	BH-01 Sample 5	BH-01 Sample 6
Date Sampled			

Particle Size Distribution

Method:
ASTM D 6913

Description:
Particle size distribution (gradation) of soils using sieve analysis.

Drying by:
Oven

Washed:
Sample Washed

Sieve Size	% Passing	Limits
75.0mm	100	
50.0mm	100	
37.5mm	100	
25.0mm	100	
19.0mm	100	
12.5mm	100	
9.5mm	100	
4.75mm	100	
2.0mm	100	
850µm	100	
425µm	98	
250µm	57	
150µm	9	
75µm	3	
Finer 75µm	2.7	

Other Test Results

Description	Method	Results			Limits
Water Content (%)	ASTM D 2216	4.8	18.8	21.3	
Method		B	B	B	
Group Symbol	ASTM D 2487		SP		
Group Name			Poorly graded sand		
Method	ASTM D 6913		Method A		
Sample Obtained While			Oven-Dried		
Group Name			Poorly graded sand		
Group Symbol			SP		
Composite Sieving Used			No		
Dispersion Method			Dispersant by hand		
Prior Testing					

Comments

N/A

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:21-0705-S08
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC:

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/1/2021

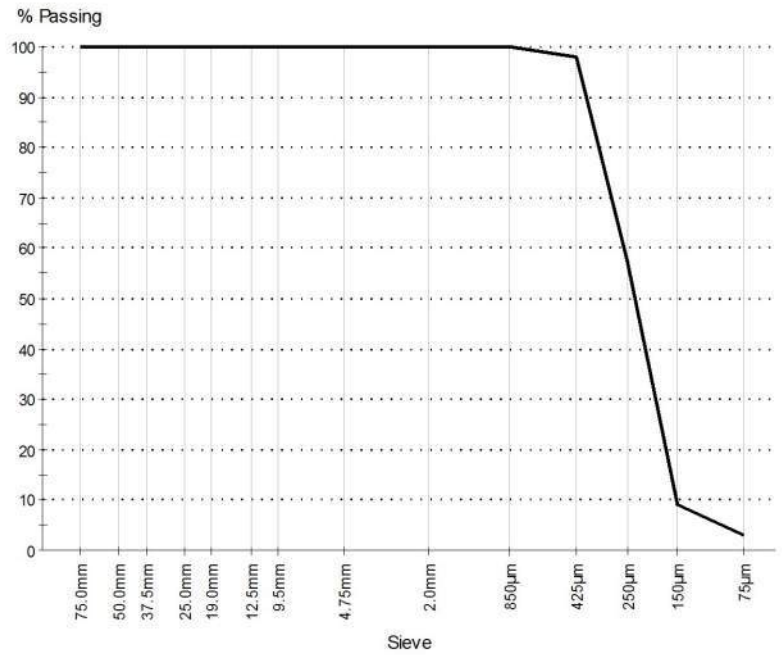
Sample Details

Sample ID	21-0705-S08
Client Sample ID	BH-01 Sample 5
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	18.8	
Method		B	
Method	ASTM D 6913	Method A	
Sample Obtained While		Oven-Dried	
Group Name		Poorly graded sand	
Group Symbol		SP	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing			

Particle Size Distribution



Method: ASTM D 6913
Drying by: Oven
Date Tested: 5/21/2021
Tested By: Nathan Lervold

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	100	
1in (25.0mm)	100	
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	98	
No.60 (250µm)	57	
No.100 (150µm)	9	
No.200 (75µm)	3	
Finer 75µm	2.7	

Comments

NP = Non Plastic

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0707
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0707-S01	21-0707-S02	21-0707-S03	21-0707-S04	21-0707-S05	21-0707-S06
Client Sample ID	BH-02 Sample 1	BH-02 Sample 2	BH-02 Sample 3A	BH-02 Sample 3B	BH-02 Sample 4	BH-02 Sample 5A
Date Sampled						

Particle Size Distribution

Method:
ASTM D 422

Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing		Limits
3in (75.0mm)	100	100	
2in (50.0mm)	100	100	
1½in (37.5mm)	100	100	
1in (25.0mm)	100	100	
¾in (19.0mm)	100	100	
½in (12.5mm)	100	100	
3/8in (9.5mm)	100	100	
No.4 (4.75mm)	99	100	
No.10 (2.0mm)	99	100	
No.20 (850µm)	99	100	
No.40 (425µm)	99	99	
No.60 (250µm)	99	92	
No.100	99	49	
No.200 (75µm)	99	19	
Finer No.200	98.4	19.5	

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	8.3	47.4	28.8	3.8	15.2	23.3	
Method		B	B	B	B	B	B	
Tested By		John Platt	John Platt	John Platt	John Platt	John Platt	John Platt	
Group Symbol	ASTM D 2487		ML		SM		SM	
Group Name			Silt		Silty sand		Silty sand	
Tested By			John Platt		John Platt		John Platt	
Dispersion device	ASTM D 422		Dispersant by hand					
Dispersion time (min)								
Shape								
Hardness								
Method	ASTM D 6913							
Sample Obtained While					Oven-Dried			
Group Name					Silty sand			
Group Symbol					SM			
Composite Sieving Used					No			
Dispersion Method					Dispersant by hand			
Prior Testing								
Percent Gravel	LMA (Internal Method)						0	
Percent Sand							53	
Percent Fines (Silt/Clay)							47	
Group Symbol							SM	

Comments

N/A

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Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0707
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0707-S07	21-0707-S08
Client Sample ID	BH-02 Sample 5B	BH-02 Sample 6
Date Sampled		

Other Test Results

Description	Method	Results		Limits
Water Content (%)	ASTM D 2216	29.7	23.0	
Method		B	B	
Tested By		John Platt	John Platt	

Comments

N/A

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:21-0707-S02
Issue No: 2

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/8/2021

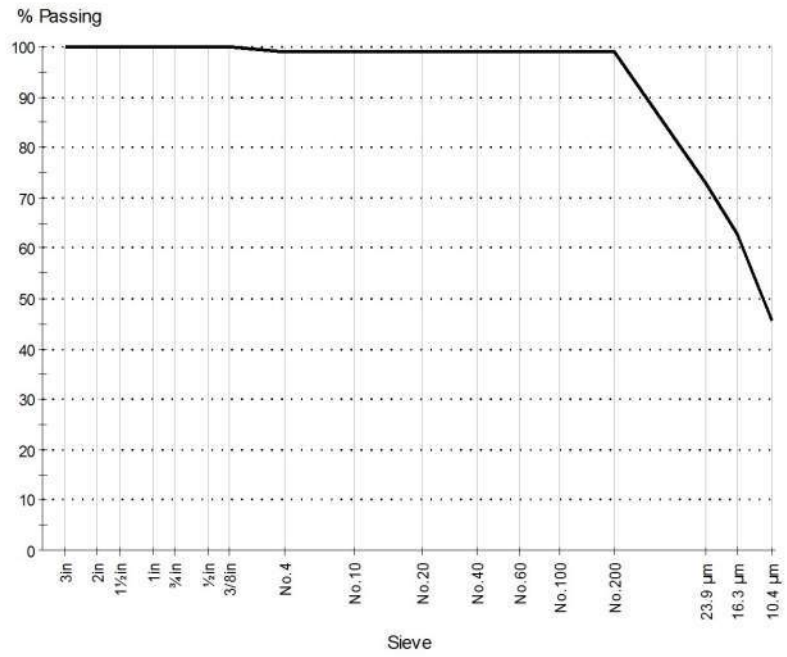
Sample Details

Sample ID	21-0707-S02
Client Sample ID	BH-02 Sample 2
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	47.4	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Group Symbol	ASTM D 2487	ML	
Group Name		Silt	
Tested By		John Platt	
Date Tested		5/20/2021	

Particle Size Distribution



Method: ASTM D 422

Date Tested: 5/20/2021
Tested By: John Platt

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No.4	99	
No.10	99	
No.20	99	
No.40	99	
No.60	99	
No.100	99	
No.200	99	
Finer No.200 (75µm)	98.4	
23.9 µm	72.9	
16.3 µm	62.9	
10.4 µm	45.7	

Comments

Frost Class: F4

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4040 B Street, Suite 102
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Material Test Report

Report No: MAT:21-0707-S02
Issue No: 2

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/8/2021

Other Test Results

Description	Method	Result	Limits
Dispersion device	ASTM D 422	Dispersant by hand	
Dispersion time (min)			
Shape			
Hardness			

Comments

Frost Class: F4

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4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
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info@alaskatestlab.com

Material Test Report

Report No: MAT:21-0707-S04
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/2/2021

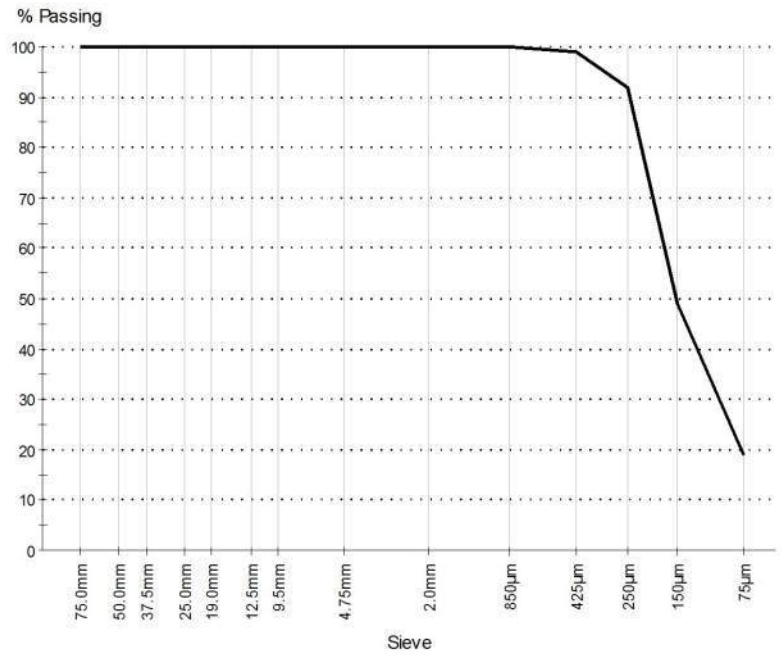
Sample Details

Sample ID	21-0707-S04
Client Sample ID	BH-02 Sample 3B
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	3.8	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Method	ASTM D 6913		
Sample Obtained While		Oven-Dried	
Group Name		Silty sand	
Group Symbol		SM	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing			

Particle Size Distribution



Method: ASTM D 6913

Date Tested: 5/24/2021
Tested By: John Platt

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	100	
1in (25.0mm)	100	
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	100	
No.10 (2.0mm)	100	
No.20 (850µm)	100	
No.40 (425µm)	99	
No.60 (250µm)	92	
No.100 (150µm)	49	
No.200 (75µm)	19	
Finer 75µm	19.5	

Comments

N/A

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4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0708
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0708-S01	21-0708-S02	21-0708-S03	21-0708-S04	21-0708-S05	21-0708-S06
Client Sample ID	BH-03 Sample 1	BH-03 Sample 2	BH-03 Sample 3	BH-03 Sample 4	BH-03 Sample 5A	BH-03 Sample 5B
Date Sampled						

Particle Size Distribution

Method:
ASTM D 6913

Description:
Particle size distribution (gradation) of soils using sieve analysis.

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
75.0mm	100	
50.0mm	100	
37.5mm	89	
25.0mm	83	
19.0mm	79	
12.5mm	72	
9.5mm	67	
4.75mm	56	
2.0mm	45	
850µm	34	
425µm	25	
250µm	17	
150µm	11	
75µm	8	
Finer 75µm	7.7	

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	3.5	30.7	8.5	6.8	29.0	33.0	
Method		B	B	B	B	B	B	
Tested By		John Platt	John Platt	John Platt	John Platt	John Platt	John Platt	
Group Symbol	ASTM D 2487	SP-SM		SM				
Group Name		Poorly graded sand with silt and gravel		Silty sand				
Method	ASTM D 6913							
Sample Obtained While		Oven-Dried						
Group Name		Poorly graded sand with silt and gravel						
Group Symbol		SP-SM						
Composite Sieving Used		No						
Dispersion Method		Dispersant by hand						
Prior Testing								
Percent Gravel	LMA (Internal Method)			0				
Percent Sand				85				
Percent Fines (Silt/Clay)				15				
Group Symbol				SM				

Comments

NP = Non Plastic

Alaska Testlab - Anchorage
4040 B Street, Suite 102
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Phone: 907-205-1987
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Material Test Report

Report No: ASM:21-0708
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0708-S01	21-0708-S02	21-0708-S03	21-0708-S04	21-0708-S05	21-0708-S06
Client Sample ID	BH-03 Sample 1	BH-03 Sample 2	BH-03 Sample 3	BH-03 Sample 4	BH-03 Sample 5A	BH-03 Sample 5B
Date Sampled						

Other Test Results

Description	Method	Results	Limits
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)			
Method of Removal		N/A	
Grooving Tool Type		Plastic	
Specimen preparation method		Dry	
Drying Method		Air	
Special selection process		N/A	
Rolling Method for PL		Hand	
As Received Water Content (%)		29.0	
Liquid Limit Device Type		Mechanical	
Liquid Limit		N/A	
Plastic Limit		NP	
Plasticity Index		NP	
Liquid Limit Procedure		Multipoint (A)	
Tested By		Nathan Lervold	

Comments

N/A

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: ASM:21-0708
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0708-S07	21-0708-S08
Client Sample ID	BH-03 Sample 6A	BH-03 Sample 6B
Date Sampled		

Particle Size Distribution

Method:
ASTM D 6913

Description:
Particle size distribution (gradation) of soils using sieve analysis.

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
75.0mm	100	
50.0mm	100	
37.5mm	100	
25.0mm	100	
19.0mm	100	
12.5mm	99	
9.5mm	98	
4.75mm	94	
2.0mm	93	
850µm	91	
425µm	88	
250µm	84	
150µm	76	
75µm	58	
Finer 75µm	58.1	

Other Test Results

Description	Method	Results		Limits
Water Content (%)	ASTM D 2216	26.2	27.6	
Method		B	B	
Tested By		John Platt	John Platt	
Group Symbol	ASTM D 2487	ML		
Group Name		Sandy silt		
Method	ASTM D 6913			
Sample Obtained While		Oven-Dried		
Group Name		Sandy silt		
Group Symbol		ML		
Composite Sieving Used		No		
Dispersion Method		Dispersant by hand		
Prior Testing				

Comments

N/A

Alaska Testlab - Anchorage
4040 B Street, Suite 102
Anchorage, AK 99503
Phone: 907-205-1987
Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:21-0708-S01
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/2/2021

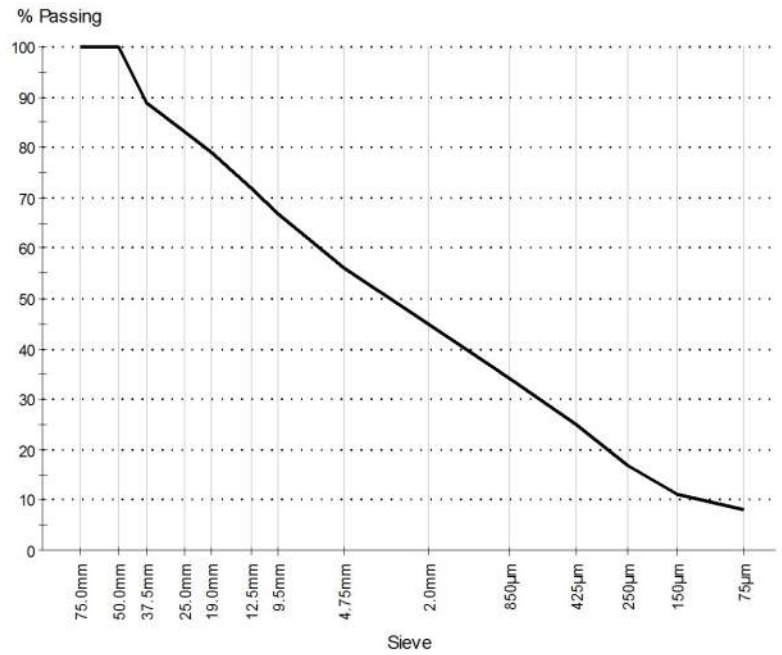
Sample Details

Sample ID	21-0708-S01
Client Sample ID	BH-03 Sample 1
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	3.5	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Method	ASTM D 6913		
Sample Obtained While		Oven-Dried	
Group Name		Poorly graded sand with silt and gravel	
Group Symbol		SP-SM	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing			

Particle Size Distribution



Method: ASTM D 6913

Date Tested: 5/22/2021
Tested By: Nathan Lervold

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	89	
1in (25.0mm)	83	
¾in (19.0mm)	79	
½in (12.5mm)	72	
3/8in (9.5mm)	67	
No.4 (4.75mm)	56	
No.10 (2.0mm)	45	
No.20 (850µm)	34	
No.40 (425µm)	25	
No.60 (250µm)	17	
No.100 (150µm)	11	
No.200 (75µm)	8	
Finer 75µm	7.7	

Comments

N/A

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Fax: 907-782-4409
info@alaskatestlab.com

Material Test Report

Report No: MAT:21-0708-S07
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/2/2021

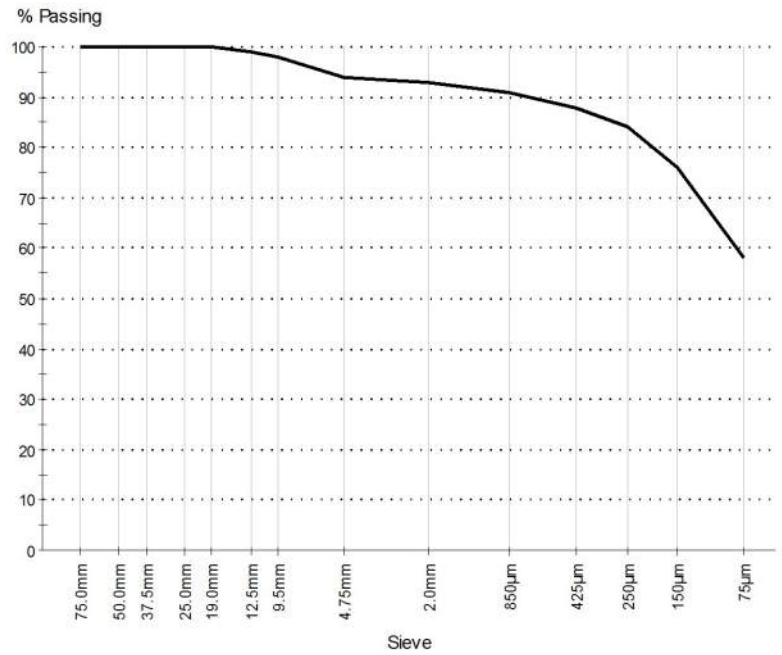
Sample Details

Sample ID	21-0708-S07
Client Sample ID	BH-03 Sample 6A
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	26.2	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Method	ASTM D 6913		
Sample Obtained While		Oven-Dried	
Group Name		Sandy silt	
Group Symbol		ML	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing			

Particle Size Distribution



Method: ASTM D 6913

Date Tested: 5/22/2021
Tested By: Nathan Lervold

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	100	
1in (25.0mm)	100	
¾in (19.0mm)	100	
½in (12.5mm)	99	
3/8in (9.5mm)	98	
No.4 (4.75mm)	94	
No.10 (2.0mm)	93	
No.20 (850µm)	91	
No.40 (425µm)	88	
No.60 (250µm)	84	
No.100 (150µm)	76	
No.200 (75µm)	58	
Finer 75µm	58.1	

Comments

N/A

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Material Test Report

Report No: ASM:21-0709
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0709-S01	21-0709-S02	21-0709-S03	21-0709-S04	21-0709-S05	21-0709-S06
Client Sample ID	BH-04 Sample 1	BH-04 Sample 2	BH-04 Sample 3	BH-04 Sample 4	BH-04 Sample 5	BH-04 Sample 6A
Date Sampled						

Particle Size Distribution

Method:
ASTM D 422

Description:
Analysis of Particle Size Distribution in Soils. Sieving for Particles >75µm, Hydrometer

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	100	
1in (25.0mm)	100	
¾in (19.0mm)	100	
½in (12.5mm)	100	
3/8in (9.5mm)	100	
No.4 (4.75mm)	99	
No.10 (2.0mm)	98	
No.20 (850µm)	95	
No.40 (425µm)	86	
No.60 (250µm)	72	
No.100	56	
No.200 (75µm)	41	
Finer No.200	40.4	

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	2.9	10.9	9.2	8.6	13.9	3.6	
Method		B	B	B	B	B	B	
Group Symbol	ASTM D 2487	GP-GM	SM	SM				
Group Name		Poorly graded gravel with silt and sand	Silty sand	Silty sand				
Tested By		John Platt						
Percent Gravel	LMA (Internal Method)	49		6				
Percent Sand		44		72				
Percent Fines (Silt/Clay)		7		22				
Group Symbol		GP-GM		SM				
Dispersion device	ASTM D 422		Dispersant by hand					
Dispersion time (min)								
Shape								
Hardness								

Comments

N/A

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Material Test Report

Report No: ASM:21-0709
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0709-S07
Client Sample ID	BH-04 Sample 6B
Date Sampled	

Other Test Results

Description	Method	Results	Limits
Water Content (%)	ASTM D 2216	18.7	
Method		B	

Comments

N/A

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Material Test Report

Report No: MAT:21-0709-S02
Issue No: 2

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/8/2021

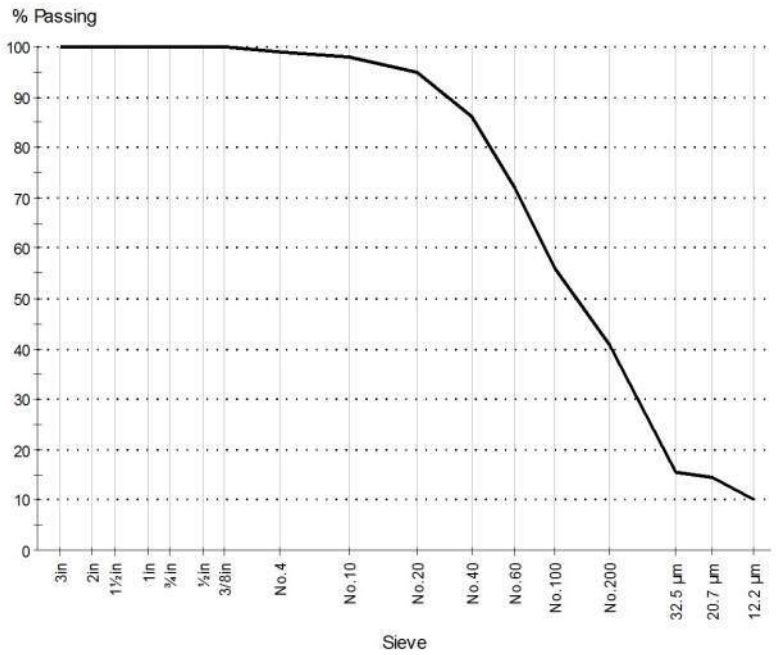
Sample Details

Sample ID	21-0709-S02
Client Sample ID	BH-04 Sample 2
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	10.9	
Method		B	
Group Symbol	ASTM D 2487	SM	
Group Name		Silty sand	
	ASTM D 422		
Dispersion device		Dispersant by hand	
Dispersion time (min)			
Shape			
Hardness			

Particle Size Distribution



Method: ASTM D 422

Date Tested: 5/20/2021
Tested By: John Platt

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No.4	99	
No.10	98	
No.20	95	
No.40	86	
No.60	72	
No.100	56	
No.200	41	
Finer No.200 (75µm)	40.4	
32.5 µm	15.6	
20.7 µm	14.5	
12.2 µm	10.0	

Comments

Frost Class: F3

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Material Test Report

Report No: ASM:21-0711
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0711-S01	21-0711-S02	21-0711-S03	21-0711-S04	21-0711-S05	21-0711-S06
Client Sample ID	BH-05 Sample 1A	BH-05 Sample 1B	BH-05 Sample 2A	BH-05 Sample 2B	BH-05 Sample 3	BH-05 Sample 4
Date Sampled						

Particle Size Distribution

Method:
ASTM D 6913

Description:
Particle size distribution (gradation) of soils using sieve analysis.

Drying by:

Washed:
Sample Washed

Sieve Size	% Passing						Limits
75.0mm	100			100			
50.0mm	100			100			
37.5mm	100			100			
25.0mm	87			100			
19.0mm	78			100			
12.5mm	66			100			
9.5mm	61			100			
4.75mm	50			100			
2.0mm	39			97			
850µm	31			97			
425µm	23			97			
250µm	16			97			
150µm	10			95			
75µm	6			87			
Finer 75µm	6.4			85.8			

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	6.1	22.1	41.4	28.5	30.9	30.7	
Method		B	B	B	B	B	B	
Tested By		John Platt	John Platt	John Platt	John Platt	John Platt	John Platt	
Group Symbol	ASTM D 2487	GP-GM			CL-ML	ML		
Group Name		Poorly graded gravel with silt and sand			Silty clay	Silt		
Method	ASTM D 6913							
Sample Obtained While		Oven-Dried						
Group Name		Poorly graded gravel with silt and sand						
Group Symbol		GP-GM						
Composite Sieving Used		No						
Dispersion Method Prior Testing		Dispersant by hand						
Dispersion device	ASTM D 422				Dispersant by hand			
Dispersion time (min)								
Shape								
Hardness								
Percent Gravel	LMA (Internal Method)					0		
Percent Sand						7		
Percent Fines (Silt/Clay)						93		
Group Symbol						ML		

Comments

N/A

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Material Test Report

Report No: ASM:21-0711
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0711-S01	21-0711-S02	21-0711-S03	21-0711-S04	21-0711-S05	21-0711-S06
Client Sample ID	BH-05 Sample 1A	BH-05 Sample 1B	BH-05 Sample 2A	BH-05 Sample 2B	BH-05 Sample 3	BH-05 Sample 4
Date Sampled						

Other Test Results

Description	Method	Results	Limits
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)			
Method of Removal		N/A	
Grooving Tool Type		Plastic	
Specimen preparation method		Dry	
Drying Method		Air	
Special selection process		N/A	
Rolling Method for PL		Hand	
As Received Water Content (%)		28.5	
Liquid Limit Device Type		Mechanical	
Liquid Limit		25	
Plastic Limit		21	
Plasticity Index		4	
Liquid Limit Procedure		Multipoint (A)	
Tested By		Nathan Lervold	

Comments

N/A

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Material Test Report

Report No: ASM:21-0711
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
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CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0711-S07	21-0711-S08
Client Sample ID	BH-05 Sample 5	BH-05 Sample 6
Date Sampled		

Other Test Results

Description	Method	Results		Limits
Water Content (%)	ASTM D 2216	23.1	27.2	
Method		B	B	
Tested By		John Platt	John Platt	
Group Symbol	ASTM D 2487	ML		
Group Name		Sandy silt		
Percent Gravel	LMA (Internal Method)	4		
Percent Sand		40		
Percent Fines (Silt/Clay)		56		
Group Symbol		ML		

Comments

N/A

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Material Test Report

Report No: MAT:21-0711-S01
Issue No: 1

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/2/2021

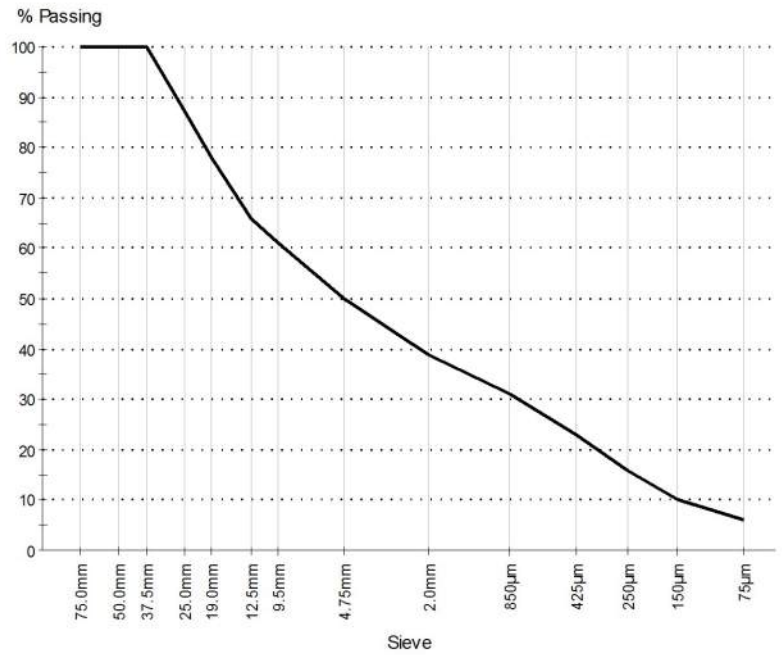
Sample Details

Sample ID	21-0711-S01
Client Sample ID	BH-05 Sample 1A
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	6.1	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Method	ASTM D 6913		
Sample Obtained While		Oven-Dried	
Group Name		Poorly graded gravel with silt and sand	
Group Symbol		GP-GM	
Composite Sieving Used		No	
Dispersion Method		Dispersant by hand	
Prior Testing			

Particle Size Distribution



Method: ASTM D 6913

Date Tested: 5/22/2021
Tested By: Nathan Lervold

Sieve Size	% Passing	Limits
3in (75.0mm)	100	
2in (50.0mm)	100	
1½in (37.5mm)	100	
1in (25.0mm)	87	
¾in (19.0mm)	78	
½in (12.5mm)	66	
3/8in (9.5mm)	61	
No.4 (4.75mm)	50	
No.10 (2.0mm)	39	
No.20 (850µm)	31	
No.40 (425µm)	23	
No.60 (250µm)	16	
No.100 (150µm)	10	
No.200 (75µm)	6	
Finer 75µm	6.4	

Comments

N/A

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Material Test Report

Report No: MAT:21-0711-S04
Issue No: 2

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/8/2021

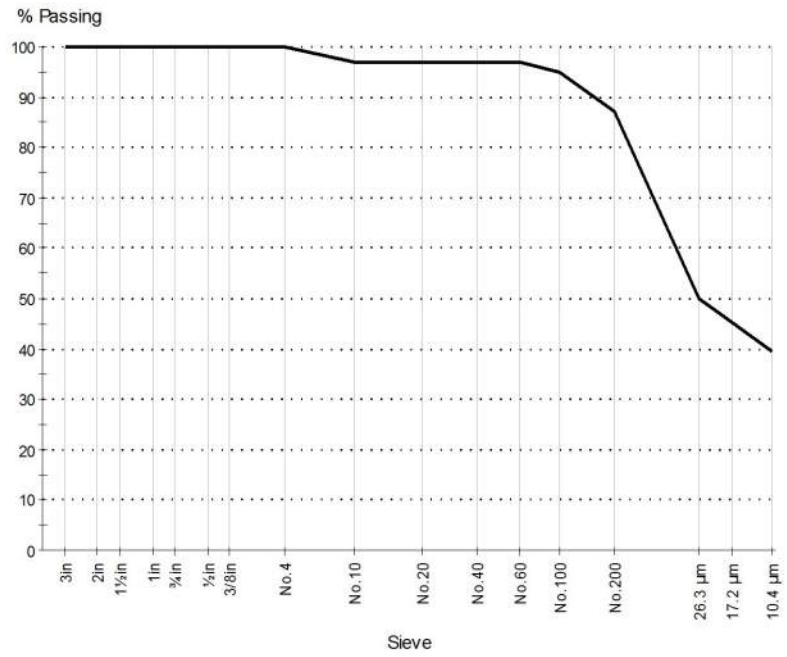
Sample Details

Sample ID	21-0711-S04
Client Sample ID	BH-05 Sample 2B
Specification	Sieve

Other Test Results

Description	Method	Result	Limits
Water Content (%)	ASTM D 2216	28.5	
Method		B	
Tested By		John Platt	
Date Tested		5/18/2021	
Group Symbol	ASTM D 2487	CL-ML	
Group Name		Silty clay	
	ASTM D 422		
Dispersion device		Dispersant by hand	
Dispersion time (min)			
Shape			
Hardness			

Particle Size Distribution



Method: ASTM D 422

Date Tested: 5/25/2021
Tested By: Nathan Wilson

Sieve Size	% Passing	Limits
3in	100	
2in	100	
1½in	100	
1in	100	
¾in	100	
½in	100	
3/8in	100	
No.4	100	
No.10	97	
No.20	97	
No.40	97	
No.60	97	
No.100	95	
No.200	87	
Finer No.200 (75µm)	85.8	
26.3 µm	50.1	
17.2 µm	45.3	
10.4 µm	39.4	

Comments

Frost Class: F4

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Material Test Report

Report No: MAT:21-0711-S04
Issue No: 2

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/8/2021

Other Test Results

Description	Method	Result	Limits
Approximate maximum grain size	ASTM D 4318		
Material retained on 425µm (No. 40) (%)			
Method of Removal		N/A	
Grooving Tool Type		Plastic	
Specimen preparation method		Dry	
Drying Method		Air	
Special selection process		N/A	
Rolling Method for PL		Hand	
As Received Water Content (%)		28.5	
Liquid Limit Device Type		Mechanical	
Liquid Limit		25	
Plastic Limit		21	
Plasticity Index		4	
Liquid Limit Procedure		Multipoint (A)	
Tested By		Nathan Lervold	
Date Tested		5/27/2021	

Comments

Frost Class: F4

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Material Test Report

Report No: ASM:21-0712
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0712-S01	21-0712-S02	21-0712-S03	21-0712-S04	21-0712-S05	21-0712-S06
Client Sample ID	BH-06 Sample 1A	BH-06 Sample 1B	BH-06 Sample 2A	BH-06 Sample 2B	BH-06 Sample 3A	BH-06 Sample 3B
Date Sampled						

Other Test Results

Description	Method	Results						Limits
Water Content (%)	ASTM D 2216	3.9	16.6	157.1	215.7	173.1	19.3	
Method		B	B	B	B	B	B	
Tested By		John Platt	John Platt	John Platt	John Platt	John Platt	John Platt	
Group Symbol	ASTM D 2487						ML	
Group Name							Sandy silt	
Percent Gravel	LMA (Internal Method)						0	
Percent Sand							34	
Percent Fines (Silt/Clay)							66	
Group Symbol							ML	

Comments

NP = Non Plastic

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Material Test Report

Report No: ASM:21-0712
Issue No: 3

Client: CRW Engineering Group, LLC
3940 Arctic Blvd., Ste. 300
Anchorage, AK 99503

CC: Maria Kampsen
Steven Halcomb

Project: 10149.00 - Norann

,

Reviewed By: Oscar Lage
Title: Laboratory Supervisor
Date: 6/3/2021

Sample Details

Sample ID	21-0712-S07	21-0712-S08	21-0712-S09	21-0712-S10
Client Sample ID	BH-06 Sample 4	BH-06 Sample 5	BH-06 Sample 6A	BH-06 Sample 6B
Date Sampled				

Other Test Results

Description	Method	Results				Limits
Water Content (%)	ASTM D 2216	26.1	24.9	25.9	21.3	
Method		B	B	B	B	
Tested By		John Platt	John Platt	John Platt	John Platt	
Group Symbol	ASTM D 2487					
Group Name						
Approximate maximum grain size	ASTM D 4318					
Material retained on 425µm (No. 40) (%)						
Method of Removal				N/A		
Grooving Tool Type				Plastic		
Specimen preparation method				Dry		
Drying Method				Air		
Special selection process				N/A		
Rolling Method for PL				Hand		
As Received Water Content (%)				25.9		
Liquid Limit Device Type				Mechanical		
Liquid Limit				N/A		
Plastic Limit				NP		
Plasticity Index				NP		
Liquid Limit Procedure				Multipoint (A)		
Tested By				Nathan Lervold		

Comments

NP = Non Plastic

Appendix C

Site Investigation Photos

Included in this section:

1) Select Site Photos

Norann Subdivision Area Road Reconstruction: Geotechnical Investigation — Site Investigation Photos

05/11/2021: Setting up rig on BH-01 with utility markings (left). Borehole marked with white paint. BH-01 after completion as a piezometer with flush-mount monument (right).

05/11/2021: Drill rig on BH-02 with utility markings prior to drilling. Borehole marked with white paint.

Norann Subdivision Area Road Reconstruction:
Geotechnical Investigation — Site Investigation Photos

05/11/2021: BH-02 after completion of drilling and cold patch (no piezometer).

05/11/2021: Setting up rig on BH-03 with utility markings (left). Borehole marked with white paint. BH-03 after completion as a piezometer with flush-mount monument (right).

Norann Subdivision Area Road Reconstruction:
Geotechnical Investigation — Site Investigation Photos

05/11/2021: BH-04 with utility markings prior to drilling. Borehole marked with white paint.

05/11/2021: BH-04 after drilling and completion. Backfilled and cold patched.

Norann Subdivision Area Road Reconstruction:
Geotechnical Investigation — Site Investigation Photos

05/11/2021: BH-05 with utility markings prior to drilling Borehole marked with white paint.

05/11/2021: BH-05 after completion as a piezometer with flush-mount monument (left). After approximately a month, ground had subsided around the monument and left the casing protruding above the lip of the monument (right). The casing was cut down so the monument lid could be closed.

Norann Subdivision Area Road Reconstruction:
Geotechnical Investigation — Site Investigation Photos

05/11/2021: BH-06 with utility markings prior to drilling. Borehole marked with white paint. Alleyway had been graded the day before drilling, eradicating previous markings in the road.

05/11/2021: BH-06 after completion. Hole was backfilled with cuttings from this hole and gravel was spread at surface and leveled.

Appendix D

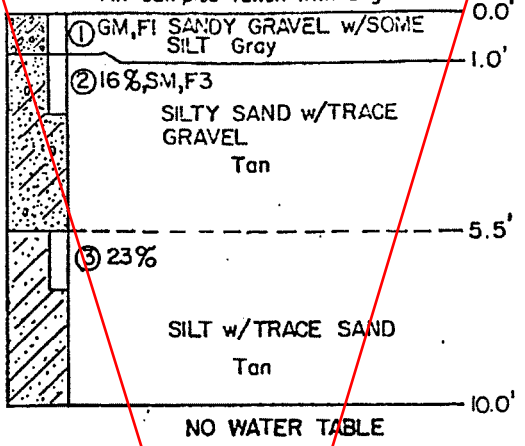
Historic Geotechnical Data

Included in this section:

1) Cope Street
2) Arctic Boulevard

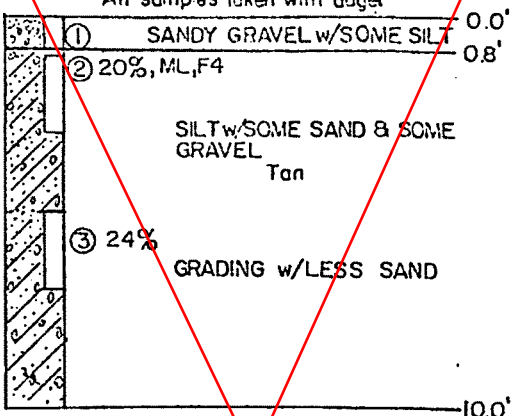
Cope Street

T.H.-5
7/15/74
All samples taken with auger



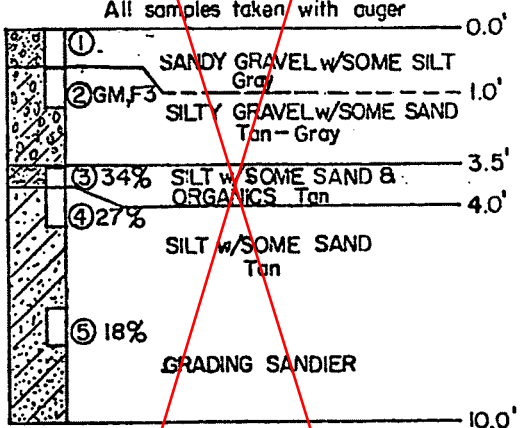
NO WATER TABLE

T.H.-6
7/15/74
All samples taken with auger



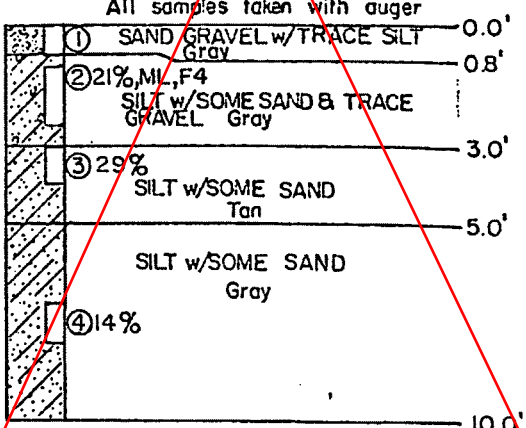
NO WATER TABLE

T.H.-7
7/15/74
All samples taken with auger



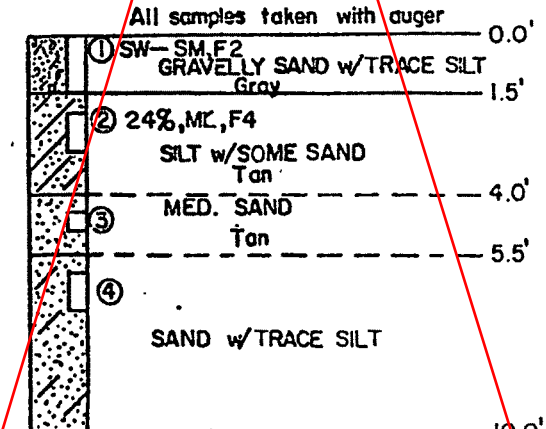
NO WATER TABLE

T.H.-8
7/15/74
All samples taken with auger



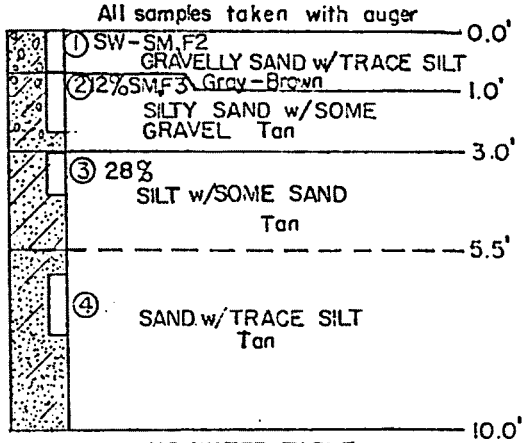
NO WATER TABLE

T.H.-9
7/15/74
All samples taken with auger



NO WATER TABLE

T.H. - 10
7/15/74
(1)
All samples taken with auger

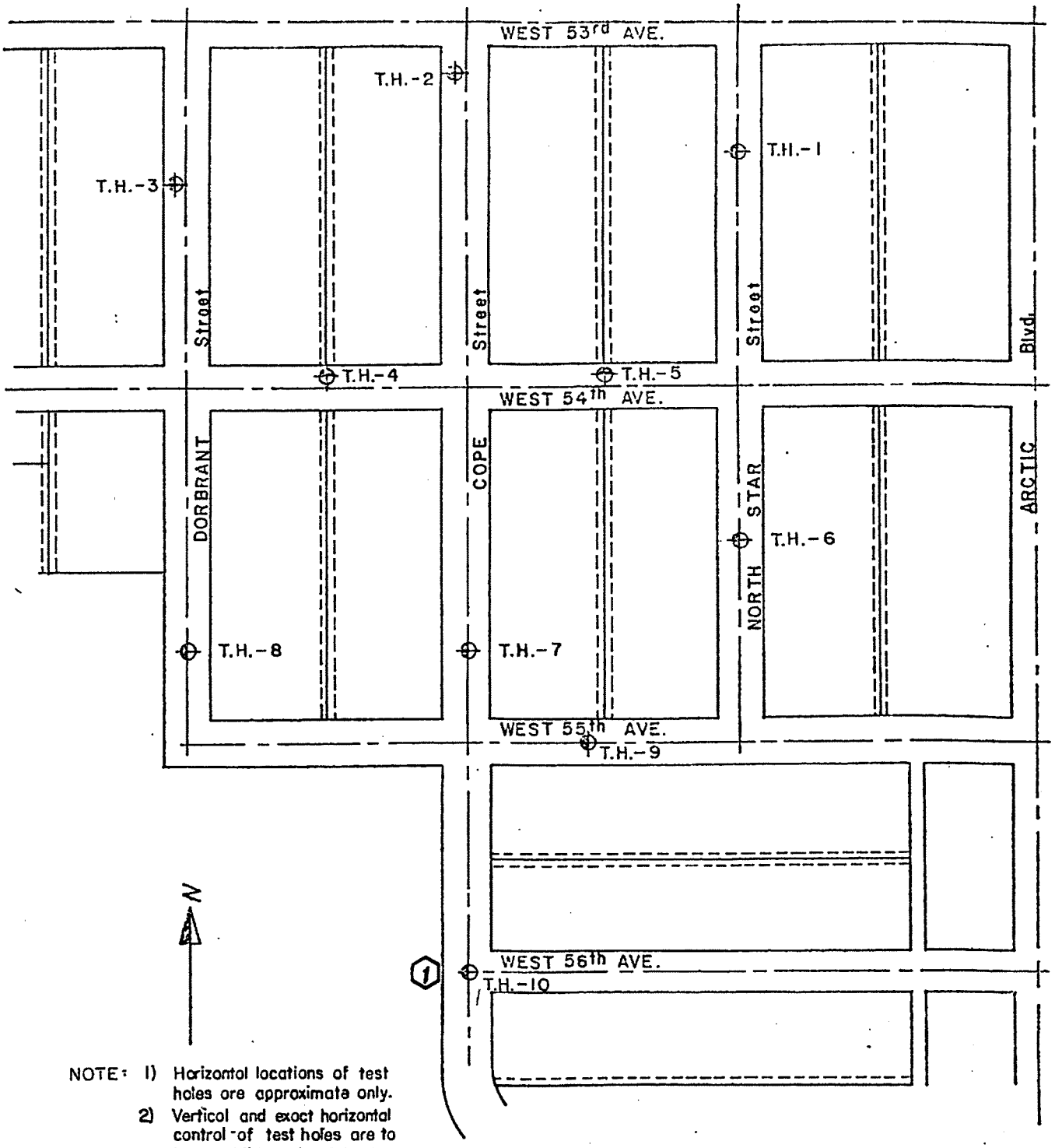


NO WATER TABLE

R&M Engineering & Geological Consultants Inc.
ANCHORAGE FAIRBANKS ALASKA JUNEAU

LOG OF TEST HOLES
NORANN-SPERSTAD . G.A.A.B. RID# 43
ANCHORAGE, ALASKA

DATE 7/15/74	SCALE 1"= 5'	DWN BY M.A.M.	CHKD BY PJ	PROJ. NO. 451027	DWG NO. B-04



NOTE: 1) Horizontal locations of test holes are approximate only.
2) Vertical and exact horizontal control of test holes are to be established by GAAB.

LOCATION DIAGRAM
Greater Anchorage Area Borough
Norann / Sperstad
R.I.D. # 43
Anchorage, Alaska

R&M Engineering & Geological Consultants Inc.
ANCHORAGE FAIRBANKS ALASKA JUNEAU

DATE	SCALE	DWN BY	CHKD BY	PROJ. NO	DWG NO.
7/17/74	1" = 200'	J.E.A.	P.J.	451027	A-01

Arctic Boulevard

MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

SOILS LOG

HOLE NO. 40 (15)

LOCATION ARCTIC BLVD (INTERNATIONAL AIRPORT RD TO RASPBERRY RD) 40.50 E OF 57TH AVE (WEST OF ARCTIC BLVD) 22' E. ℄ OF ARCTIC BLVD

DATE 10/30/80

BY M.E. KRUEGER

COMMENTS MEASUREMENTS ARE APPROX. SEE FIELD BOOK # 1626 FOR EXACT TIE

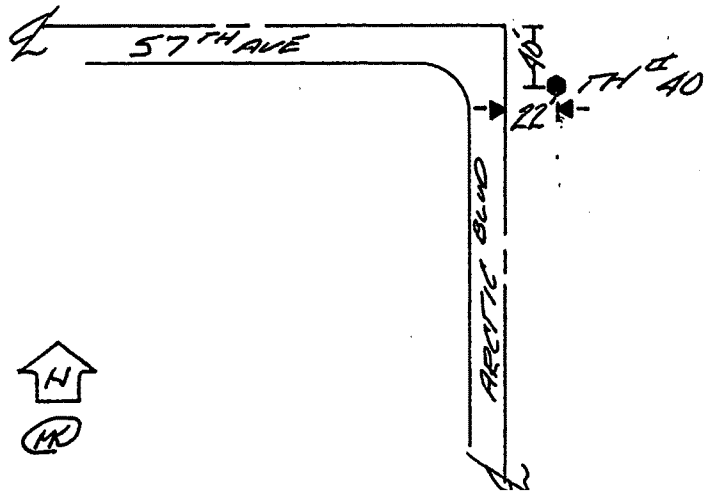
DEPTH 10'

WATER TABLE NONE

NOTE: STRATUM DESCRIPTION ON (40-C) IS BASE ON VISUAL ANALYSIS

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0			EXIST GROUND / ROAD SURFACE
EX-776 40-A	1	GW-GM	NFS TO F-1	BRN SDY (37%) GRAVEL (63%) w/ SILT (6%) + ORG. / MOIST = 5% NP / ORG. CONTENT (BY WT) = 1% / DENSE
	2			
	3			
VISUAL	4	PT	N/A	BRN. ORG. (PEAT) w/ STICKS & ROOTS
	5			
EX-777 40-B	6	ML	F-1	GR. SDY (6%) - SILT (94%) + TRACE ORGANIC / MOIST = 23%
	7			NP / DENSE
	8			
EX-778 40-C	9	(SM)	(F-2)	GR SILTY (40%) - SAND (60%) / HIGH MOIST / DENSE
	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. 1930

MUNICIPALITY OF ANCHORAGE
DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION DIVISION

FILE COPY

TEST NO. EX-776

PROJECT Arctic Blvd. 68th Ave to International Airport Rd. DATE Oct. 30, 1980

CONTRACTOR

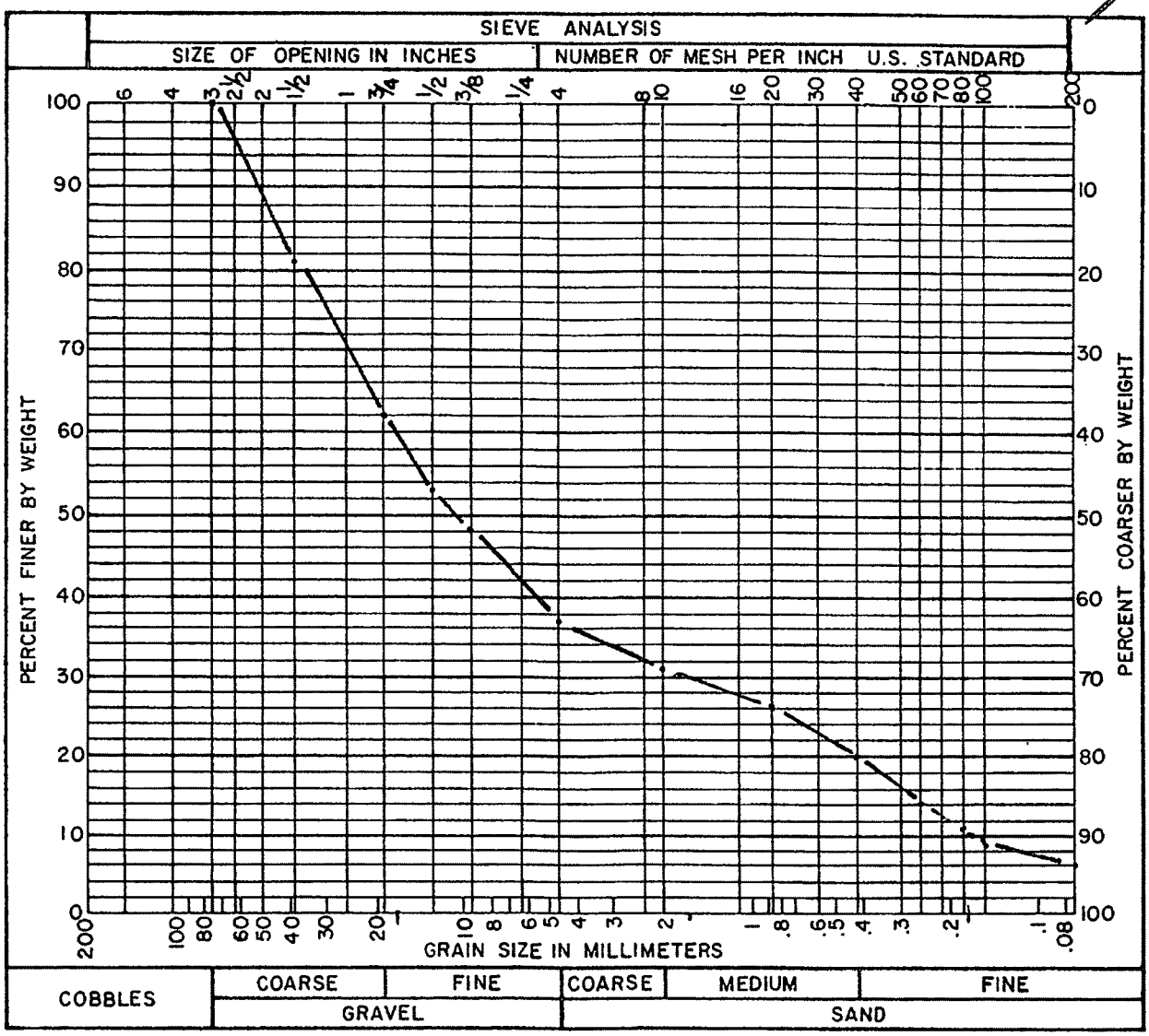
MATERIAL SOURCE 40-A/O to 29' below O.G.

LOCATION SAMPLED 40' S & 52nd Ave / 22' E & Arctic Blvd. BY M. Krueger

COMMENTS GW-GM/NES to E-1 (borderline) / Sandy 31½% Gravel 6% / Silty 6½% / 5% Moisture / Plus ¼% Organic

REPORTED TO

PLOTTED BY [illegible] CHECKED BY BD MATERIALS SUPERVISOR [illegible]



INSPECTOR'S COMMENTS

MUNICIPALITY OF ANCHORAGE
DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION DIVISION

FILE COPY

TEST NO. EX-777

PROJECT Arctic Blvd 68th Ave to International Airport Rd DATE Oct. 30, 1980

CONTRACTOR

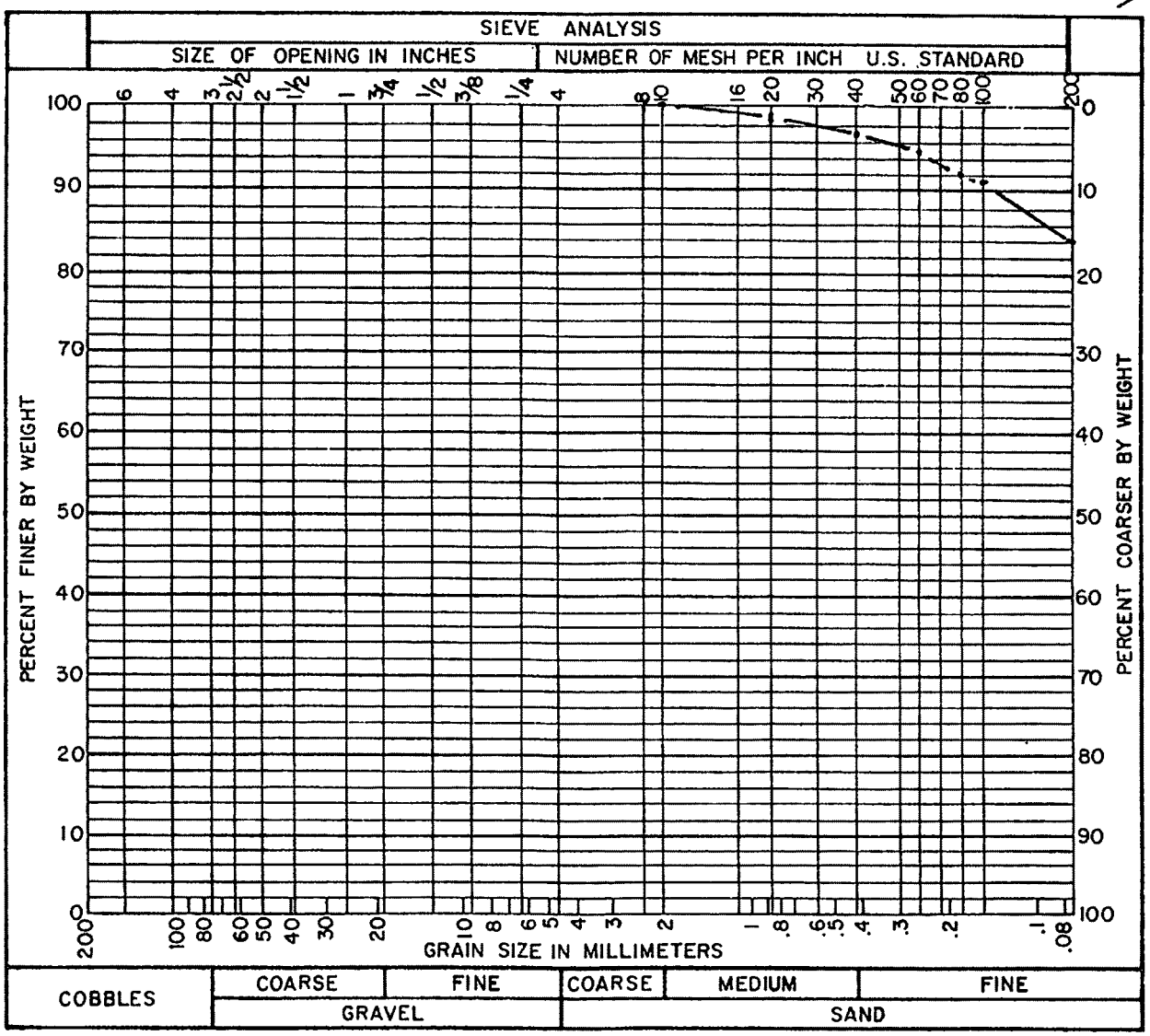
MATERIAL SOURCE HO-B / 5' to 7½' below O.G.

LOCATION SAMPLED 40' S & 57th Ave / 22' E & Arctic Blvd BY M. Krueger

COMMENTS ML / F-4 / S 16% Sandy Silt / 23% Moisture / Plus Trace Organic

REPORTED TO

PLOTTED BY [illegible] CHECKED BY BD MATERIALS SUPERVISOR [illegible]



INSPECTOR'S COMMENTS

82-009 (2/77)

MUNICIPALITY OF ANCHORAGE

DEPARTMENT OF PUBLIC WORKS

CONSTRUCTION DIVISION

SOILS LOG

HOLE NO. B (16)

LOCATION ARCTIC BLVD (INTERNATIONAL AIRPORT RD TO RASPBERRY RD)
60' S/L OF 58TH AVE. (EAST OF ARCTIC BLVD) E/L OF ARCTIC BLVD

DATE 10/13/80

BY M.E. KRUEGER

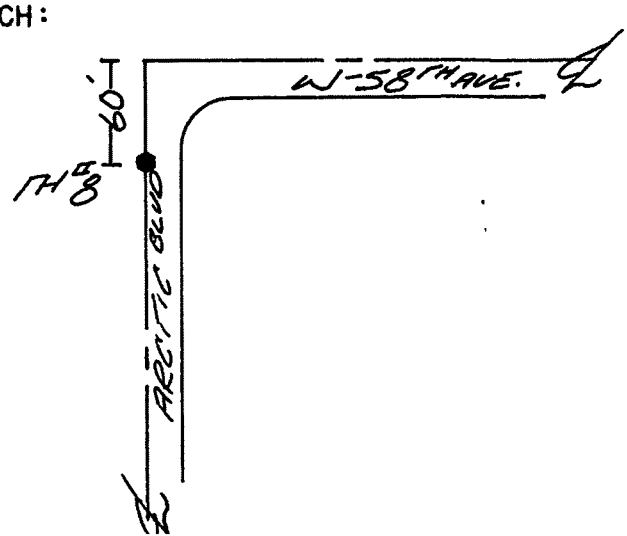
COMMENTS MEASUREMENTS ARE APPROX. SEE FIELD BOOK # 1626 FOR EXACT TIE

DEPTH 10.0'

WATER TABLE NONE

	DEPTH	UNIFIED CLASS	FROST GROUP	DESCRIPTION
	0			EXIST. GROUND / ROAD SURFACE
EX-675 B-A	1	GW	NFS	GR. SD. (35%) - GRAVEL (61%) + OCC. COBBLE / MOIST. = 2% SILT = 4% / NP / DENSE
	2			
	3			
	4			
VISUAL	5	PT	N/A	BRN. ORG. (PEAT) W/ STICKS & ROOTS
	6			
	7			
	8			
	9			
EX-676 B-B	10	ML	F-4	GR. SD. (15%) - SILT (85%) / MOIST. = 7% / SILT = 4% NP /
	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. 1930

MUNICIPALITY OF ANCHORAGE
DEPARTMENT OF PUBLIC WORKS
CONSTRUCTION DIVISION

FILE COPY

TEST NO. ex-675

PROJECT Arctic Blvd / 68th Ave to International Airport Rd DATE Oct. 13, 1980

CONTRACTOR

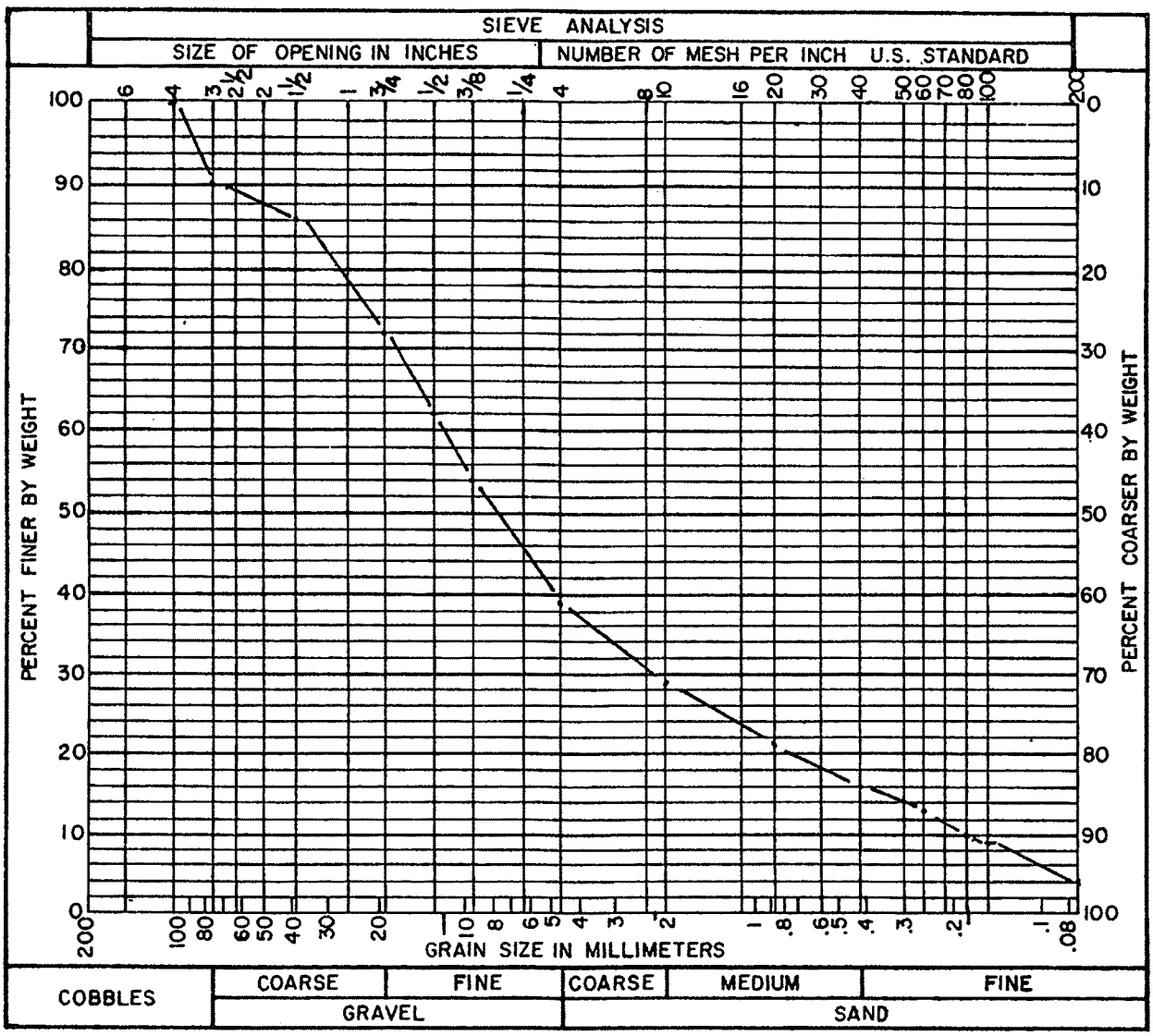
MATERIAL SOURCE 8-A/O to 32' below Q.G.

LOCATION SAMPLED 60' S & 58th Ave / & Arctic Blvd BY M. Krueger

COMMENTS GW/NES/Sandy 35% Gravel 61% / 2% Moisture / 4% Silt

REPORTED TO

PLOTTED BY [illegible] CHECKED BY BD MATERIALS SUPERVISOR [illegible]



INSPECTOR'S COMMENTS

82-009 (2/77)

Appendix E

BERG2 Thermal Analysis Output

Included in this section:

1) BERG2 Analysis – Limited Subgrade Frost Penetration Analysis – 2" Insulated Section

BERG2 Analysis – Limited Subgrade Frost Penetration Analysis – 2” Insulated Section

LOCATION/CLIMATE:

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

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

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

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

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

ANALYSIS RESULTS:

```
LOCATION  THAW N  FREZ N  MAAT THAW °F DAY  FREZ °F DAY  THAW DAYS  FREZ DAYS
ANCHORAG   1.70     1.00    35        4000         3200        198        167

                                        1      2      3      4      5
          FROZEN % MOIS.              0.0    6.0    0.0    6.0   18.0
          FROZEN DENS.              138.0  130.0    1.8  130.0  100.0
          LATENT HEAT                 0   1123      0   1123   2592
          FROZEN HEAT CAP           28.00  26.00   3.00  26.00  26.00
T C       FROZEN COND.               0.86   1.58   0.02   1.58   0.94
H Y       THAWED % MOIS.              0.0    6.0    0.0    6.0   18.0
A C       THAWED DENS.              138.0  130.0    1.8  130.0  100.0
W L       THAWED HEAT CAP           28.00  29.90   3.00  29.90  35.00
  E       THAWED COND.               0.86   1.57   0.02   1.57   0.77
          INITIAL THICK              0.17   1.50   0.17   2.00   2.50
          AMOUNT THAWED              0.17   1.50   0.17   2.00   1.72
          CONSOLIDATION              ----   ----   ----   ----   ----
          FINAL THICK                0.17   1.50   0.17   2.00   2.50

F C       LATENT HEAT                 0   1123      0   1123   2592
R Y       FROZEN DENS.              138.0  130.0    1.8  130.0  100.0
E C       FROZEN HEAT CAP           28.00  26.00   3.00  26.00  26.00
E L       FROZEN COND.               0.86   1.58   0.02   1.58   0.94
Z E       INITIAL THICK              0.17   1.50   0.17   2.00   2.50
E         AMOUNT FROZEN              0.17   1.50   0.17   2.00   0.18

ESTIMATED THAW= 5.56          FREEZE= 4.02          PRINT LOCATION SOIL QUIT
```

SOIL INPUTS

Layer	Thickness (ft)	Density (pcf)	M.C. (%)	Comment
Asphalt	0.17	138	-	-
Fill (Type II-A)	1.50	130	6.0	-
Insulation	0.17	1.8	-	-
Fill (Type II)	2.00	130	6.0	-
Subgrade	2.50	100	18.0	-

RESULTS

Parameter	Value
Total Section Thickness	3.83 ft
Thaw Depth	5.59 ft
Freeze Depth	4.02 ft
Subgrade Frost Penetration	0.18 ft
Subgrade Frost Percent[1]	4.7%

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

Project Cost Estimates

Appendix G

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

ENGINEER'S ESTIMATE - FINAL DSM - ALTERNATIVE 1

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule A - Roadway Improvements									
A-1	20.02	Storm Water Pollution Prevention Plan (Type 3)	LS	1	1.00	0	1	$37,000	$37,000
A-2	20.03	Test Pit for Utility Locate	Hour	24	1.00	0	24	$800	$19,200
A-3	20.04	Clearing and Grubbing	LS	1	1.00	0	1	$37,000	$37,000
A-4	20.07	Remove Sidewalk or Concrete Apron	SY	390	1.00	0	390	$35	$13,650
A-5	20.08	Remove Curb and Gutter	LF	2,793	1.00	0	2,793	$12	$33,516
A-6	20.09	Remove Pavement	SY	6,947	1.00	0	6,947	$4	$27,788
A-7	20.10	Unusable Excavation	CY	12,776	1.20	-2	15,300	$21	$321,300
A-8	20.12	Dewatering	LS	1	1.00	0	1	$15,000	$15,000
A-9	20.21	Classified Fill and Backfill (Type II)	Ton	12,368	1.20	-2	14,800	$21	$310,800
A-10	20.21	Classified Fill and Backfill (Type II-A)	Ton	11,017	1.20	-2	13,200	$21	$277,200
A-11	20.22	Leveling Course	Ton	766	1.06	-1	810	$60	$48,600
A-12	20.25	Geotextile (Type A)	SY	11,001	1.00	-1	11,000	$2	$22,000
A-13	20.26	Insulation Board (R-9)	SF	78,901	1.01	-1	79,690	$4	$318,760
A-14	20.26	Insulation Board (R-4.5)	SF	7,193	1.01	-1	7,260	$3	$21,780
A-15	30.02	P.C.C. Curb and Gutter (All Types)	LF	3,408	1.00	0	3,408	$40	$136,320
A-16	30.03	P.C.C. Sidewalk (Standard Finish)	SY	2,071	1.00	0	2,071	$100	$207,100
A-17	30.04	P.C.C. Curb Ramp (6" Thick)	EA	7	1.00	0	7	$4,500	$31,500
A-18	30.04	Detectable Warnings	SF	84	1.00	0	84	$150	$12,600
A-19	30.05	P.C.C. Structures/Retaining Wall (Class AA-3)	CY	10	1.15	0	12	$500	$6,000
A-20	30.10	Colored Concrete (Red, Imprinted)	CY	909	1.15	0	1,045	$300	$313,500
A-21	40.06	A.C. Pavement (Class A)	Ton	38	1.06	-1	40	$240	$9,600
A-22	40.06	A.C. Pavement (Class E)	Ton	780	1.06	-1	830	$175	$145,250
A-23	50.06	Remove and Replace Manhole Cone Section	EA	6	1.00	0	6	$2,650	$15,900
A-24	50.06	Remove and Replace Manhole Cover and Frame	EA	2	1.00	0	2	$1,400	$2,800
A-25	55.08	Adjust Storm Drain Manhole Ring to Finish Grade	EA	2	1.00	0	2	$1,000	$2,000
A-26	60.03	Remove and Replace Valve Box Top Section	EA	5	1.00	0	5	$700	$3,500
A-27	60.05	Adjust Key Box	EA	16	1.00	0	16	$600	$9,600
A-28	65.02	Construction Survey Measurement	LS	1	1.00	0	1	$60,000	$60,000
A-29	65.02	Two-Person Survey Crew	Hour	40	1.00	0	40	$250	$10,000
A-30	70.08	Remove and Reset Fence	LF	1,040	1.05	0	1,092	$55	$60,060
A-31	70.08	Remove Fence	LF	425	1.00	0	425	$14	$5,950
A-32	70.08	Remove and Reset Gate	LF	32	1.00	0	32	$20	$640
A-33	70.10	Inlaid Traffic Markings (Methyl Methacrylate, 4" Yellow, 125 Mil)	LF	195	1.00	0	195	$20	$3,900
A-34	70.10	Inlaid Traffic Markings (Methyl Methacrylate, 24" White, 125 Mil)	LF	34	1.00	0	34	$100	$3,400
A-35	70.10	Inlaid Traffic Markings (Methyl Methacrylate, Words & Symbols, 125 Mil)	EA	2	1.00	0	2	$1,100	$2,200
A-36	70.11	Standard Sign	SF	41	1.00	0	41	$110	$4,510
A-37	70.12	Traffic Maintenance	LS	1	1.00	0	1	$240,000	$240,000
A-38	70.16	Temporary Group Mailboxes	LS	1	1.00	0	1	$7,000	$7,000
A-39	70.17	Relocate Mailbox	EA	41	1.00	0	41	$800	$32,800
A-40	70.22	Removal/Disposal and/or Salvage/Installation of Obstructions	LS	1	1.00	0	1	$20,000	$20,000
A-41	70.23	Temporary Fencing	LF	1,072	1.05	0	1,126	$20	$22,520
A-42	75.12	Temporary Tree Protection Fence	LF	450	1.00	0	450	$18	$8,100
A-43	75.13	Landscaping	LS	1	1.00	0	1	$25,000	$25,000
								TOTAL	**$2,905,344**

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule B - Drainage Improvements									
B-1	20.13	Trench Dewatering	LS	1	1.00	0	1	$15,000	$15,000
B-2	20.13	Trench Excavation and Backfill (Various Depths)	LF	1,156	1.00	0	1,156	$35	$40,460
B-3	20.15	Furnish Trench Backfill (Type II)	Ton	40	1.20	0	48	$20	$960
B-4	20.16	Bedding Material (Class D)	LF	1,156	1.00	0	1,156	$35	$40,460
B-5	20.26	Insulation Board (R-20)	SF	1,000	1.20	0	1,200	$7	$8,400
B-6	20.27	Disposal of Unusable or Surplus Material	CY	110	1.20	0	132	$25	$3,300
B-7	50.04	Relocate Sewer Service (4-Inch)	LF	161	1.00	0	161	$250	$40,250
B-8	55.02	Furnish and Install Pipe (6-Inch, Type S, CPEP)	LF	26	1.00	0	26	$60	$1,560
B-9	55.02	Furnish, Install, and Televise Pipe (12-Inch, Type S, CPEP)	LF	1,130	1.00	0	1,130	$75	$84,750
B-10	55.04	Connect to Existing Storm Drain System	EA	3	1.00	0	3	$3,500	$10,500
B-11	55.05	Construct (Type I) Manhole	EA	8	1.00	0	8	$7,000	$56,000
B-12	55.05	Construct (Type II) Bypass Manhole	EA	2	1.00	0	2	$30,000	$60,000
B-13	55.09	Construct Catch Basin	EA	14	1.00	0	14	$6,000	$84,000
B-14	55.11	Remove Manhole	EA	1	1.00	0	1	$1,200	$1,200
B-15	55.11	Remove Catch Basin	EA	4	1.00	0	4	$1,000	$4,000
B-16	55.22	Oil and Grit Separator (Stormceptor STC 450i)	EA	2	1.00	0	2	$30,000	$60,000
B-17	55.23	Heat Trace	LF	210	1.10	-1	230	$52	$11,960
B-18	55.27	Storm Drain Bypass System	LS	1	1.00	0	1	$20,000	$20,000
B-19	55.28	Construct Infiltration Trench	LS	1	1.00	0	1	$30,000	$30,000
B-20	70.07	Remove Pipe	LF	351	1.00	0	351	$15	$5,265
B-21	80.02	Trench and Backfill (2'W x 3.5'D)	LF	20	1.10	-1	20	$25	$500
B-22	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,900	$6,900
B-23	80.07	Liquid-Tight Flexible Metal Conduit (1 inch)	LF	30	1.05	0	32	$24	$768
B-24	80.07	GRC Steel Conduit (1-1/2 inch)	LF	20	1.05	0	21	$16	$336
B-25	80.08	Junction Box (Type 1A)	EA	1	1.00	0	1	$1,250	$1,250
B-26	80.08	Junction Box (Type 2)	EA	1	1.00	0	1	$1,850	$1,850
B-27	80.10	Conductor, 3C #8 AWG XHHW-2 Cable	LF	20	1.10	-1	20	$8	$160
B-28	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Heat Trace Control	EA	1	1.00	0	1	$14,250	$14,250
								TOTAL	**$604,079**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

ENGINEER'S ESTIMATE - FINAL DSM - ALTERNATIVE 1

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule C - Illumination Improvements									
C-1	80.01	Temporary Illumination	LS	1	1.00	0	1	$10,000	$10,000
C-2	80.02	Trench and Backfill (2'W x 3.5'D)	LF	1,549	1.10	-1	1,700	$17	$28,900
C-3	80.04	Cast-In-Place Luminaire Pole Foundations	EA	14	1.00	0	14	$2,900	$40,600
C-4	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,900	$6,900
C-5	80.05	Fixed Base Luminaire Pole (26-29 Ft. Length)	EA	14	1.00	0	14	$4,800	$67,200
C-6	80.05	Spare Fixed Base Luminaire Pole (28 Ft. Length)	EA	1	1.00	0	1	$3,750	$3,750
C-7	80.05	Luminaire Arm (6-17 Ft. Length)	EA	15	1.00	0	15	$850	$12,750
C-8	80.07	GRC Steel Conduit (2 inch)	FT	1,607	1.05	-1	1,690	$23	$38,870
C-9	80.08	Junction Box (Type IA)	EA	15	1.00	0	15	$1,250	$18,750
C-10	80.08	Junction Box (Type II)	EA	1	1.00	0	1	$1,900	$1,900
C-11	80.10	3 Conductor 8 AWG Type XHHW-2 Cable	FT	2,212	1.05	-1	2,320	$8	$18,560
C-12	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Lighting Control	EA	1	1.00	0	1	$9,100	$9,100
C-13	80.23	Luminaire (5000 Lm, Medium, Type 2)	EA	9	1.00	0	9	$561	$5,049
C-14	80.23	Luminaire (8000 Lm, Medium, Type 2)	EA	5	1.00	0	5	$715	$3,575
C-15	80.23	Spare Luminaire (5000 Lm, Medium, Type 2)	EA	2	1.00	0	2	$411	$822
C-16	80.23	Spare Luminaire (8000 Lm, Medium, Type 2)	EA	2	1.00	0	2	$565	$1,130
								TOTAL	**$267,856**

Schedule A - Roadway Improvements	$2,905,344
Schedule B - Drainage Improvements	$604,079
Schedule C - Illumination Improvements	$267,856
Total Estimated Construction Cost:	**$3,777,279**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

Utility Relocation Cost Estimate Summary Alternative 1	
Electric (CEA)	$15,000
Telephone (ACS)	$0
Cable Television (GCI)	$0
Natural Gas (ENSTAR)	$102,000
Subtotal:	*$117,000*
Construction Contingency (15%)	*$18,000*
Total Utility Relocation Cost:	**$135,000**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 1
CEA Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
CEA-1	10+97	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-2	12+23	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-3	14+15	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-4	17+87	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-5	19+81	RT	Utility Pole	Retaining Wall Installation	Protect in Place, Shore as Required	1	EA	$0	$0
CEA-6	34+30	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-7	37+38	RT	Utility Pole	Installation of Sidewalk	Protect in Place, Shore as Required	1	EA	$0	$0

Construction Costs:	$10,985
Engineering/Administration (30%):	$3,296
Total:	**$15,000**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 1
ACS Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
ACS-1	19+93	Crossing	UG Fiber Optic Cable	Roadway Structural Section, Storm Drain Pipe	Protect in Place, Shore as Required	20	LF	$0	$0
ACS-2	19+93	Crossing	UG Copper Cable	Roadway Structural Section, Storm Drain Pipe	Protect in Place, Shore as Required	20	LF	$0	$0
ACS-3	37+50	Crossing	UG Fiber Optic Cable	Roadway Structural Section, Storm Drain Pipe, Catch Basin	Protect in Place, Shore as Required	59	LF	$0	$0
ACS-4	37+50	Crossing	UG Copper Cable	Roadway Structural Section, Storm Drain Pipe, Catch Basin	Protect in Place, Shore as Required	59	LF	$0	$0
								Construction Costs:	$0
								Engineering/Administration (30%):	$0
								Total:	**$0**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 1
GCI Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
GCI-1	19+81	RT	Utility Pole	Retaining Wall Installation	Protect in Place	1	EA	$0	$0
GCI-2	37+38	RT	Utility Pole	Installation of Sidewalk	Protect in Place	1	EA	$0	$0
								Construction Costs:	$0
								Engineering/Administration (30%)	$0
								Total:	**$0**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 1
ENSTAR Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
ENSTAR-1	10+52 to 12+09	RT	2-inch Steel	Roadway Structural Section	Verify Depth, Relocate as Required	166	LF	$172	$28,502
ENSTAR-2	12+03	Crossing	2-inch Steel	Roadway Structural Section	Verify Depth, Relocate as Required	49	LF	$172	$8,413
ENSTAR-3	12+33 to 12+55	RT	1 1/4-inch Steel	Storm Drain Pipe	Verify Depth, Relocate as Required	29	LF	$148	$4,304
ENSTAR-4	19+87	Crossing	4-inch Steel	Storm Drain Pipe, Roadway Structural Section	Relocate as Required	30	LF	$192	$5,769
ENSTAR-5	36+19 to 37+33	RT	4-inch Steel	Within Roadway Cut Slope, Reduced Cover	Verify Depth, Relocate as Required	114	LF	$192	$21,922
ENSTAR-6	36+20	Crossing	4-inch Steel	Roadway Structural Section	Relocate as Required	47	LF	$192	$9,038
ENSTAR-7	37+44 to 37+44	RT	4-inch Steel	Roadway Structural Section	Protect in Place	32	LF	$0	$0
								Construction Costs:	$77,948
								Engineering/Administration (30%)	$23,385
								Total:	**$102,000**

Date: 12/1/2023 **Basis:** **Prepared By:** **CRW** **Ver. 5.1**

Project: Norann Subdivision Area Road Reconstruction Alternative 1

Project Number: **20-14** [B]=local bond; [S]=state grant; [F]= federal grant

DESIGN		Design Management	$55,371	
	Start 20??	PM&E Design Services	$0	
		PM&E Design Survey	$0	
		PM&E Design Soil	$0	
		Contractual Dsgn Sers (Basic)	$450,000	
		Contractual Dsgn Sers (Add'l)	$250,000	
		Contractual Design Survey	$60,000	
		Contractual Design Soils	$30,000	
		Miscellaneous	$0	
Subtotal				$845,371
UTILITIES		AWWU	$0	
	Start 20??	MOA Shoring	$0	
		CEA	$17,000	
		ACS	$0	
		GCI	$0	
		Enstar	$118,000	
Subtotal				$135,000
ROW		Real Estate Services	$63,000	
	Start 20??	Land Acquisition	$16,000	
Subtotal				$79,000
CONSTRUCTION		Construction Management	$86,871	
	Start 20??	Inspection	$230,397	
		Materials Testing	$37,770	
		Survey	$33,993	
		Miscellaneous	$0	
		Construction Contract	$3,777,000	
Subtotal				$4,166,031
MISCELLANEOUS		Bond Overhead (15.0%)	$1,022,189	
		Grant Overhead (0.0%)	$0	
		Contingency (15%)	$567,000	
Subtotal				$1,589,189
PROJECT TOTAL				$6,814,590

WEBPAGE DATA	
Environ	$0
DS	$211,343
Prelim Dsgn	$422,685
Final Dsgn	$211,343
ROW	$79,000
Utilities	$135,000
Const	$5,755,220
Total	$6,814,590

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

ENGINEER'S ESTIMATE - FINAL DSM - ALTERNATIVE 2

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule A - Roadway Improvements									
A-1	20.02	Storm Water Pollution Prevention Plan (Type 3)	LS	1	1.00	0	1	$32,000	$32,000
A-2	20.03	Test Pit for Utility Locate	Hour	24	1.00	0	24	$800	$19,200
A-3	20.04	Clearing and Grubbing	LS	1	1.00	0	1	$32,000	$32,000
A-4	20.07	Remove Sidewalk or Concrete Apron	SY	370	1.00	0	370	$35	$12,950
A-5	20.08	Remove Curb and Gutter	LF	2,778	1.00	0	2,778	$12	$33,336
A-6	20.09	Remove Pavement	SY	6,588	1.00	0	6,588	$4	$26,352
A-7	20.10	Unusable Excavation	CY	11,889	1.20	-2	14,300	$21	$300,300
A-8	20.12	Dewatering	LS	1	1.00	0	1	$13,000	$13,000
A-9	20.21	Classified Fill and Backfill (Type II)	Ton	11,303	1.20	-2	13,600	$21	$285,600
A-10	20.21	Classified Fill and Backfill (Type II-A)	Ton	9,730	1.20	-2	11,700	$21	$245,700
A-11	20.22	Leveling Course	Ton	748	1.06	-1	790	$60	$47,400
A-12	20.25	Geotextile (Type A)	SY	10,074	1.00	-1	10,070	$2	$20,140
A-13	20.26	Insulation Board (R-9)	SF	71,936	1.01	-1	72,660	$4	$290,640
A-14	20.26	Insulation Board (R-4.5)	SF	6,907	1.01	-1	6,980	$3	$20,940
A-15	30.02	P.C.C. Curb and Gutter (All Types)	LF	3,398	1.00	0	3,398	$40	$135,920
A-16	30.03	P.C.C. Sidewalk (Standard Finish)	SY	1,038	1.00	0	1,038	$100	$103,800
A-18	30.04	P.C.C. Curb Ramp (6" Thick)	EA	6	1.00	0	6	$4,500	$27,000
A-19	30.04	Detectable Warnings	SF	72	1.00	0	72	$150	$10,800
A-20	30.05	P.C.C. Structures/Retaining Wall (Class AA-3)	CY	10	1.15	0	12	$500	$6,000
A-20	30.10	Colored Concrete (Red, Imprinted)	CY	512	1.15	0	589	$300	$176,700
A-21	40.06	A.C. Pavement (Class A)	Ton	35	1.06	-1	40	$240	$9,600
A-22	40.06	A.C. Pavement (Class E)	Ton	757	1.06	-1	800	$175	$140,000
A-23	50.06	Remove and Replace Manhole Cone Section	EA	6	1.00	0	6	$2,650	$15,900
A-24	50.06	Remove and Replace Manhole Cover and Frame	EA	2	1.00	0	2	$1,400	$2,800
A-25	55.08	Adjust Storm Drain Manhole Ring to Finish Grade	EA	2	1.00	0	2	$1,000	$2,000
A-26	60.03	Remove and Replace Valve Box Top Section	EA	5	1.00	0	5	$700	$3,500
A-27	60.05	Adjust Key Box	EA	15	1.00	0	15	$600	$9,000
A-28	65.02	Construction Survey Measurement	LS	1	1.00	0	1	$50,000	$50,000
A-29	65.02	Two-Person Survey Crew	Hour	40	1.00	0	40	$250	$10,000
A-30	70.08	Remove and Reset Fence	LF	927	1.05	0	973	$55	$53,515
A-31	70.08	Remove Fence	LF	425	1.00	0	425	$14	$5,950
A-32	70.08	Remove and Reset Gate	LF	32	1.00	0	32	$20	$640
A-33	70.10	Inlaid Traffic Markings (Methyl Methacrylate, 4" Yellow, 125 Mil)	LF	188	1.00	0	188	$20	$3,760
A-34	70.10	Inlaid Traffic Markings (Methyl Methacrylate, 24" White, 125 Mil)	LF	34	1.00	0	34	$100	$3,400
A-34	70.10	Inlaid Traffic Markings (Methyl Methacrylate, Words & Symbols, 125 Mil)	EA	2	1.00	0	2	$1,100	$2,200
A-35	70.11	Standard Sign	SF	41	1.00	0	41	$110	$4,510
A-36	70.12	Traffic Maintenance	LS	1	1.00	0	1	$200,000	$200,000
A-37	70.16	Temporary Group Mailboxes	LS	1	1.00	0	1	$7,000	$7,000
A-38	70.17	Relocate Mailbox	EA	41	1.00	0	41	$800	$32,800
A-39	70.22	Removal/Disposal and/or Salvage/Installation of Obstructions	LS	1	1.00	0	1	$20,000	$20,000
A-40	70.23	Temporary Fencing	LF	959	1.05	0	1,007	$20	$20,140
A-41	75.12	Temporary Tree Protection Fence	LF	450	1.00	0	450	$18	$8,100
A-42	75.13	Landscaping	LS	1	1.00	0	1	$25,000	$25,000
								TOTAL	**$2,469,593**

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule B - Drainage Improvements									
B-1	20.13	Trench Dewatering	LS	1	1.00	0	1	$30,000	$30,000
B-2	20.13	Trench Excavation and Backfill (Various Depths)	LF	1,708	1.00	0	1,708	$35	$59,780
B-3	20.15	Furnish Trench Backfill (Type II)	Ton	510	1.20	0	612	$20	$12,240
B-4	20.16	Bedding Material (Class D)	LF	1,708	1.00	0	1,708	$35	$59,780
B-5	20.26	Insulation Board (R-18)	SF	1,000	1.20	0	1,200	$7	$8,400
B-6	20.27	Disposal of Unusable or Surplus Material	CY	400	1.20	0	480	$25	$12,000
B-7	50.04	Relocate Sewer Service (4-Inch)	LF	540	1.00	0	540	$250	$135,000
B-8	55.02	Furnish and Install Pipe (6-Inch, Type S, CPEP)	LF	26	1.00	0	26	$60	$1,560
B-9	55.02	Furnish, Install, and Televise Pipe (12-Inch, Type S, CPEP)	LF	1,378	1.00	0	1,378	$75	$103,350
B-10	55.02	Furnish, Install, and Televise Pipe (15-Inch, Type S, CPEP)	LF	305	1.00	0	305	$90	$27,450
B-11	55.04	Connect to Existing Storm Drain System	EA	3	1.00	0	3	$3,500	$10,500
B-12	55.05	Construct (Type I) Manhole	EA	13	1.00	0	13	$7,000	$91,000
B-13	55.05	Construct (Type II) Bypass Manhole	EA	2	1.00	0	2	$30,000	$60,000
B-14	55.09	Construct Catch Basin	EA	20	1.00	0	20	$6,000	$120,000
B-15	55.11	Remove Manhole	EA	1	1.00	0	1	$1,200	$1,200
B-16	55.11	Remove Catch Basin	EA	4	1.00	0	4	$1,000	$4,000
B-17	55.13	Abandon Storm Drain Pipe	EA	1	1.00	0	1	$5,000	$5,000
B-18	55.22	Oil and Grit Separator (Stormceptor STC 450i)	EA	2	1.00	0	2	$30,000	$60,000
B-19	55.23	Heat Trace	LF	570	1.10	-1	630	$52	$32,760
B-20	55.27	Storm Drain Bypass System	LS	1	1.00	0	1	$15,000	$15,000
B-21	60.02	Raise or Lower Water Main (10-Inch Cast Iron)	EA	1	1.00	0	1	$20,000	$20,000
B-22	60.05	Furnish and Install (1-Inch, Copper) Water Service Line	LF	533	1.00	0	533	$200	$106,600
B-23	70.07	Remove Pipe	LF	351	1.00	0	351	$15	$5,265
B-24	80.02	Trench and Backfill (2'W x 3.5'D)	LF	140	1.10	-1	150	$25	$3,750
B-25	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,900	$6,900
B-26	80.07	Liquid-Tight Flexible Metal Conduit (1 inch)	LF	140	1.05	-1	150	$24	$3,600
B-27	80.07	GRC Steel Conduit (1-1/2 inch)	LF	570	1.05	-1	600	$16	$9,600
B-28	80.08	Junction Box (Type 1A)	EA	1	1.00	0	1	$1,250	$1,250
B-29	80.08	Junction Box (Type 2)	EA	2	1.00	0	2	$1,850	$3,700
B-30	80.10	Conductor, 3C #8 AWG XHHW-2 Cable	LF	60	1.10	-1	70	$8	$560
B-31	80.10	Conductor, 3C #10 AWG XHHW-2 Cable	LF	250	1.10	-1	280	$7	$1,960
B-32	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Heat Trace Control	EA	1	1.00	0	1	$14,250	$14,250
								TOTAL	**$1,026,455**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

ENGINEER'S ESTIMATE - FINAL DSM - ALTERNATIVE 2

ITEM No.	MASS No.	ITEM DESCRIPTION	UNIT	CALC. QUANT	CONT. FACTOR	ROUND FACTOR	EST QUANT	UNIT PRICE	TOTAL COST
Schedule C - Illumination Improvements									
C-1	80.01	Temporary Illumination	LS	1	1.00	0	1	$10,000	$10,000
C-2	80.02	Trench and Backfill (2'W x 3.5'D)	LF	1,549	1.10	-1	1,700	$17	$28,900
C-3	80.04	Cast-In-Place Luminaire Pole Foundations	EA	14	1.00	0	14	$2,900	$40,600
C-4	80.04	Load Center Foundation (Type 1A)	EA	1	1.00	0	1	$6,900	$6,900
C-5	80.05	Fixed Base Luminaire Pole (26-29 Ft. Length)	EA	14	1.00	0	14	$4,800	$67,200
C-6	80.05	Spare Fixed Base Luminaire Pole (28 Ft. Length)	EA	1	1.00	0	1	$3,750	$3,750
C-7	80.05	Luminaire Arm (6-17 Ft. Length)	EA	15	1.00	0	15	$850	$12,750
C-8	80.07	GRC Steel Conduit (2 inch)	FT	1,607	1.05	-1	1,690	$23	$38,870
C-9	80.08	Junction Box (Type IA)	EA	15	1.00	0	15	$1,250	$18,750
C-10	80.08	Junction Box (Type II)	EA	1	1.00	0	1	$1,900	$1,900
C-11	80.10	3 Conductor 8 AWG Type XHHW-2 Cable	FT	2,212	1.05	-1	2,320	$8	$18,560
C-12	80.14	Single-Meter Pad-Mount Load Center, Type 1A, with Lighting Control	EA	1	1.00	0	1	$9,100	$9,100
C-13	80.23	Luminaire (5000 Lm, Medium, Type 2)	EA	9	1.00	0	9	$561	$5,049
C-14	80.23	Luminaire (8000 Lm, Medium, Type 2)	EA	5	1.00	0	5	$715	$3,575
C-15	80.23	Spare Luminaire (5000 Lm, Medium, Type 2)	EA	2	1.00	0	2	$411	$822
C-16	80.23	Spare Luminaire (8000 Lm, Medium, Type 2)	EA	2	1.00	0	2	$565	$1,130
								TOTAL	**$267,856**

Schedule A - Roadway Improvements	$2,469,593
Schedule B - Drainage Improvements	$1,026,455
Schedule C - Illumination Improvements	$267,856
Total Estimated Construction Cost:	**$3,763,904**

Utility Relocation Cost Estimate Summary Alternative 2	
Electric (CEA)	$15,000
Telephone (ACS)	$0
Cable Television (GCI)	$0
Natural Gas (ENSTAR)	$85,000
Subtotal:	*$100,000*
Construction Contingency (15%)	*$15,000*
Total Utility Relocation Cost:	**$115,000**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 2
CEA Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
CEA-1	11+01	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-2	12+29	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-3	14+17	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-4	17+88	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-5	19+81	RT	Utility Pole	Installation of New Retaining Wall	Protect in Place, Shore as Required	1	EA	$0	$0
CEA-6	34+30	LT	Luminaire Pole	Installation of New Roadway Lighting	Remove	1	EA	$2,197	$2,197
CEA-7	37+38	RT	Utility Pole	Installation of Sidewalk	Protect in Place, Shore as Required	1	EA	$0	$0

Construction Costs:	$10,985
Engineering/Administration (30%):	$3,296
Total:	**$15,000**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 2
ACS Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
ACS-1	19+93	Crossing	UG Fiber Optic Cable	Roadway Structural Section, Storm Drain Pipe	Protect in Place, Shore as Required	20	LF	$0	$0
ACS-2	19+93	Crossing	UG Copper Cable	Roadway Structural Section, Storm Drain Pipe	Protect in Place, Shore as Required	20	LF	$0	$0
ACS-3	37+50	Crossing	UG Fiber Optic Cable	Roadway Structural Section, Storm Drain Pipe, Catch Basin	Protect in Place, Shore as Required	59	LF	$0	$0
ACS-4	37+50	Crossing	UG Copper Cable	Roadway Structural Section, Storm Drain Pipe, Catch Basin	Protect in Place, Shore as Required	59	LF	$0	$0
								Construction Costs:	$0
								Engineering/Administration (30%):	$0
								Total:	**$0**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 2
GCI Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
GCI-1	19+81	RT	Utility Pole	Installation of New Retaining Wall	Protect in Place	1	EA	$0	$0
GCI-2	37+38	RT	Utility Pole	Installation of Sidewalk	Protect in Place	1	EA	$0	$0
								Construction Costs:	$0
								Engineering/Administration (30%)	$0
								Total:	**$0**

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14
Alternative 2
ENSTAR Relocation Summary

Id No.	APPROX. STATION	OFFSET	UTILITY CONFLICT	DESCRIPTION OF CONFLICT	RECOMMENDED ACTION	AMOUNT	UNIT	UNIT PRICE	COST
ENSTAR-1	10+52 to 12+09	RT	2-inch Steel	Roadway Structural Section, Storm Drain Pipe, Catch Basin	Verify Depth and Location, Relocate as Required	155	LF	$172	$26,614
ENSTAR-2	12+08	Crossing	2-inch Steel	Roadway Structural Section, Storm Drain Pipe	Verify Depth, Relocate as Required	54	LF	$172	$9,272
ENSTAR-3	19+87	Crossing	4-inch Steel	Roadway Structural Section, Storm Drain Pipe	Protect in Place, Shore as Required	82	LF	$0	$0
ENSTAR-4	36+19 to 37+33	RT	4-inch Steel	Within Roadway Cut Slope, Reduced Cover	Verify Depth, Relocate as Required	114	LF	$192	$21,922
ENSTAR-5	36+20	Crossing	4-inch Steel	Roadway Structural Section	Relocate as Required	39	LF	$192	$7,500
ENSTAR-6	37+33 to 37+44	RT	4-inch Steel	Roadway Structural Section	Protect in Place	37	LF	$0	$0
								Construction Costs:	$65,307
								Engineering/Administration (30%)	$19,592
								Total:	**$85,000**

Date: 12/1/2023 **Basis:** **Prepared By:** **CRW** **Ver. 5.1**

Project: Norann Subdivision Area Road Reconstruction Alternative 2

Project Number: **20-14** [B]=local bond; [S]=state grant; [F]= federal grant

DESIGN	Design Management	$55,180		
Start 20??	PM&E Design Services	$0		
	PM&E Design Survey	$0		
	PM&E Design Soil	$0		
	Contractual Dsgn Sers (Basic)	$450,000		
	Contractual Dsgn Sers (Add'l)	$250,000		
	Contractual Design Survey	$60,000		
	Contractual Design Soils	$30,000		
	Miscellaneous	$0		
Subtotal			$845,180	
UTILITIES	AWWU	$0		
Start 20??	MOA Shoring	$0		
	CEA	$17,000		
	ACS	$0		
	GCI	$0		
	Enstar	$98,000		
Subtotal			$115,000	
ROW	Real Estate Services	$58,000		
Start 20??	Land Acquisition	$8,000		
Subtotal			$66,000	
CONSTRUCTION	Construction Management	$86,572		
Start 20??	Inspection	$229,604		
	Materials Testing	$37,640		
	Survey	$33,876		
	Miscellaneous	$0		
	Construction Contract	$3,764,000		
Subtotal			$4,151,692	
MISCELLANEOUS	Bond Overhead (15.0%)	$1,013,448		
	Grant Overhead (0.0%)	$0		
	Contingency (15%)	$565,000		
Subtotal			$1,578,448	
PROJECT TOTAL			$6,756,320	

WEBPAGE DATA	
Environ	$0
DS	$211,295
Prelim Dsgn	$422,590
Final Dsgn	$211,295
ROW	$66,000
Utilities	$115,000
Const	$5,730,140
Total	$6,756,320

Summary of Driveway Grades

Appendix H

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

DRIVEWAY SUMMARY - ALTERNATIVE 1

SHEET	PARCEL	CENTERLINE REFERENCE		EXISTING GRADE	PROPOSED GRADE	REMARKS
		STATION	OFFSET			
A1.1	22	10+19.98	RT	2.7%	3.7%	
A1.1	23	10+80.06	RT	0.1%	1.0%	
A1.1	24	11+36.56	RT	4.8%	4.0%	
A1.1	20 West	11+61.83	LT	14.5%	14.6%	
A1.1	25	11+92.28	RT	6.0%	1.9%	
A1.1	26	12+41.80	RT	1.9%	2.9%	
A1.1	27	12+50.61	RT	0.8%	1.7%	
A1.1	47	12+92.98	LT	11.9%	12.7%	
A1.1	28	13+55.60	RT	4.5%	3.1%	
A1.1	29	13+71.34	RT	7.2%	5.2%	
A1.1	30	14+40.04	RT	6.3%	7.0%	
A1.1	31	14+56.19	RT	5.6%	6.6%	
A1.1	46	14+77.77	LT	5.5%	9.4%	
A1.2	32	15+22.66	RT	3.7%	5.2%	
A1.2	45	15+32.60	LT	10.4%	10.8%	
A1.2	44	15+93.76	LT	11.8%	12.0%	
A1.2	33	16+28.51	RT	3.5%	8.2%	
A1.2	34	16+57.08	RT	6.7%	12.0%	
A1.2	43	16+58.72	LT	11.2%	12.0%	
A1.2	42	16+92.77	LT	8.3%	10.0%	
A1.2	35	17+60.11	RT	9.2%	11.0%	
A1.2	41	17+69.58	LT	11.5%	12.0%	
A1.2	36	18+20.43	RT	8.9%	10.8%	
A1.2	40	18+37.28	LT	8.2%	8.0%	
A1.2	39	18+78.96	LT	1.8%	5.4%	
A1.2	37	18+86.18	RT	7.2%	9.4%	
A1.2	38	19+12.57	RT	7.8%	9.7%	
A1.3	1	31+15.30	LT	7.5%	8.6%	
A1.3	20 (North)	31+16.49	RT	17.1%	12.6%	
A1.3	2	31+31.33	LT	7.5%	9.3%	
A1.3	19	31+75.63	RT	12.4%	9.6%	
A1.3	18	31+96.41	RT	12.0%	10.6%	
A1.3	3	32+34.21	LT	7.2%	7.8%	
A1.3	4	32+92.79	LT	10.2%	9.3%	
A1.3	17	32+99.57	RT	10.0%	11.5%	
A1.3	5	33+10.51	LT	10.7%	9.9%	
A1.3	16	33+22.46	RT	10.3%	11.9%	
A1.4	15	34+16.22	RT	14.3%	13.7%	
A1.4	6	34+17.21	LT	10.6%	11.0%	
A1.4	14	34+32.42	RT	15.4%	13.8%	
A1.4	7	34+75.74	LT	5.4%	8.4%	
A1.4	8	35+33.70	LT	3.1%	6.4%	
A1.4	13	35+33.74	RT	9.7%	11.4%	
A1.4	9	35+93.99	LT	2.6%	2.4%	
A1.4	12	35+98.54	RT	5.1%	9.1%	

Norann Subdivision Area Road Reconstruction
MOA Project No. 20-14

DRIVEWAY SUMMARY - ALTERNATIVE 2

SHEET	PARCEL	CENTERLINE REFERENCE		EXISTING GRADE	PROPOSED GRADE	REMARKS
		STATION	OFFSET			
A2.1	22	10+24.77	RT	2.7%	5.0%	
A2.1	23	10+84.86	RT	0.1%	5.0%	
A2.1	24	11+41.37	RT	4.8%	5.7%	
A2.1	20 West	11+66.59	LT	14.5%	12.4%	
A2.1	25	11+96.68	RT	6.0%	2.3%	
A2.1	26	12+46.16	RT	1.9%	3.1%	
A2.1	27	12+55.16	RT	0.8%	3.3%	
A2.1	47	12+96.96	LT	11.9%	12.0%	
A2.1	28	13+59.32	RT	4.5%	4.6%	
A2.1	29	13+73.36	RT	7.2%	6.4%	
A2.1	30	14+41.07	RT	6.3%	7.6%	
A2.1	31	14+56.54	RT	5.6%	7.1%	
A2.1	46	14+77.97	LT	5.5%	9.8%	
A2.2	32	15+22.66	RT	3.7%	6.1%	
A2.2	45	15+32.60	LT	10.4%	9.3%	
A2.2	44	15+94.06	LT	11.8%	11.2%	
A2.2	33	16+28.51	RT	3.5%	8.1%	
A2.2	34	16+57.08	RT	6.7%	10.2%	
A2.2	43	16+58.72	LT	11.2%	11.4%	
A2.2	42	16+92.77	LT	8.3%	9.3%	
A2.2	35	17+60.11	RT	9.2%	9.4%	
A2.2	41	17+69.58	LT	11.5%	11.2%	
A2.2	36	18+20.43	RT	8.9%	9.6%	
A2.2	40	18+37.28	LT	8.2%	6.9%	
A2.2	39	18+78.96	LT	1.8%	5.2%	
A2.2	37	18+86.18	RT	7.2%	9.2%	
A2.2	38	19+12.57	RT	7.8%	8.8%	
A2.3	1	31+15.30	LT	7.5%	7.9%	
A2.3	20 North	31+16.49	RT	17.1%	12.0%	
A2.3	2	31+31.33	LT	7.5%	8.1%	
A2.3	19	31+75.63	RT	12.4%	8.1%	
A2.3	18	31+96.41	RT	12.0%	9.0%	
A2.3	3	32+34.21	LT	7.2%	6.7%	
A2.3	4	32+92.79	LT	10.2%	8.2%	
A2.3	17	32+99.57	RT	10.0%	10.0%	
A2.3	5	33+10.51	LT	10.7%	9.2%	
A2.3	16	33+22.46	RT	12.2%	10.3%	
A2.4	15	34+16.22	RT	14.3%	14.3%	
A2.4	6	34+17.21	LT	10.6%	8.0%	
A2.4	14	34+32.42	RT	15.4%	14.5%	
A2.4	7	34+75.74	LT	5.4%	4.0%	
A2.4	13	35+33.74	RT	9.7%	9.9%	
A2.4	8	35+33.81	LT	3.1%	5.1%	
A2.4	9	35+93.99	LT	2.6%	3.7%	
A2.4	12	35+98.54	RT	5.1%	9.8%	

Draft Technical Memorandum

Appendix I

Draft Technical Memorandum

Date: June 29, 2021

To: Nichole Rehm (PTS, Inc.); Glenda Radvansky, Kris Langley (MOA Traffic Engineering); Paul VanLandingham (MOA Street Maintenance)

From: Justin Keene; Rob Burdick (CRW Engineering Group, LLC)

Project: Norann Subdivision Area Road Reconstruction

Project No: PM&E #20-14 (CRW#10149.00)

Subject: Draft Technical Memorandum

A. Purpose and Background

The Municipality of Anchorage Project Management and Engineering (MOA PM&E) has contracted with CRW Engineering Group, LLC (CRW) to provide professional services to develop and evaluate alternatives to upgrade the Norann Subdivision Area (see FIGURE 1 for project location/limits including parcel number labels referenced in this document). The purpose of the project is to upgrade West 57th Avenue (57th Avenue) and West 58th Avenue (58th Avenue) from Cope Street to Arctic Boulevard and Cope Street from 57th to 58th Avenue to meet current MOA Design Criteria for a local roadway.

The purpose of this Technical Memorandum is to gain concurrence from MOA PM&E, MOA Traffic Engineering Department, and MOA Street Maintenance Department on the conceptual roadway design elements before presenting the concepts to the public and beginning the Design Study Memorandum (DSM). A meeting was held on June 22, 2021 with MOA PM&E, Traffic Engineering, and Street Maintenance to discuss the conceptual roadway design elements. This draft Technical Memorandum is being submitted for their review and comment.

B. Existing Conditions

1. Neighborhood Context, Zoning, Private Improvements and Driveways

The Norann Subdivision area is a local neighborhood situated west of Arctic Boulevard, south of West International Airport Road and north of Dowling Road. Alaska Railroad Corporation (ARRC) right-of-way (ROW) and an active railroad track is located adjacent to the southwest quadrant of the neighborhood. The main access into the neighborhood is from Arctic Boulevard east of the project limits, an alternate access is available from Cope Street north of the project limits. The majority of homes were built in the 1960s prior to the establishment of many MOA building and driveway codes.

The neighborhood is zoned as R-1 “single family residential” and R-3 “mixed residential”, an alley located just west of Arctic Boulevard separates the single family residential area from the mixed residential area. The parcels directly adjacent to the project roadways consist of 41 single family homes, three 4-plexes, and one duplex.

Like many established neighborhoods, private improvements such as fences, retaining walls, mature trees and planters have been placed into the ROW. These private improvements hinder available snow storage areas. Some driveways appear to be wider than allowable based on current MOA Design Criteria for maximum width requirements and Parcels 20 and 47 have full frontage driveways. Most of the homes are higher than the adjacent roadway with positive drainage away from the garages, and some driveways are fairly steep.

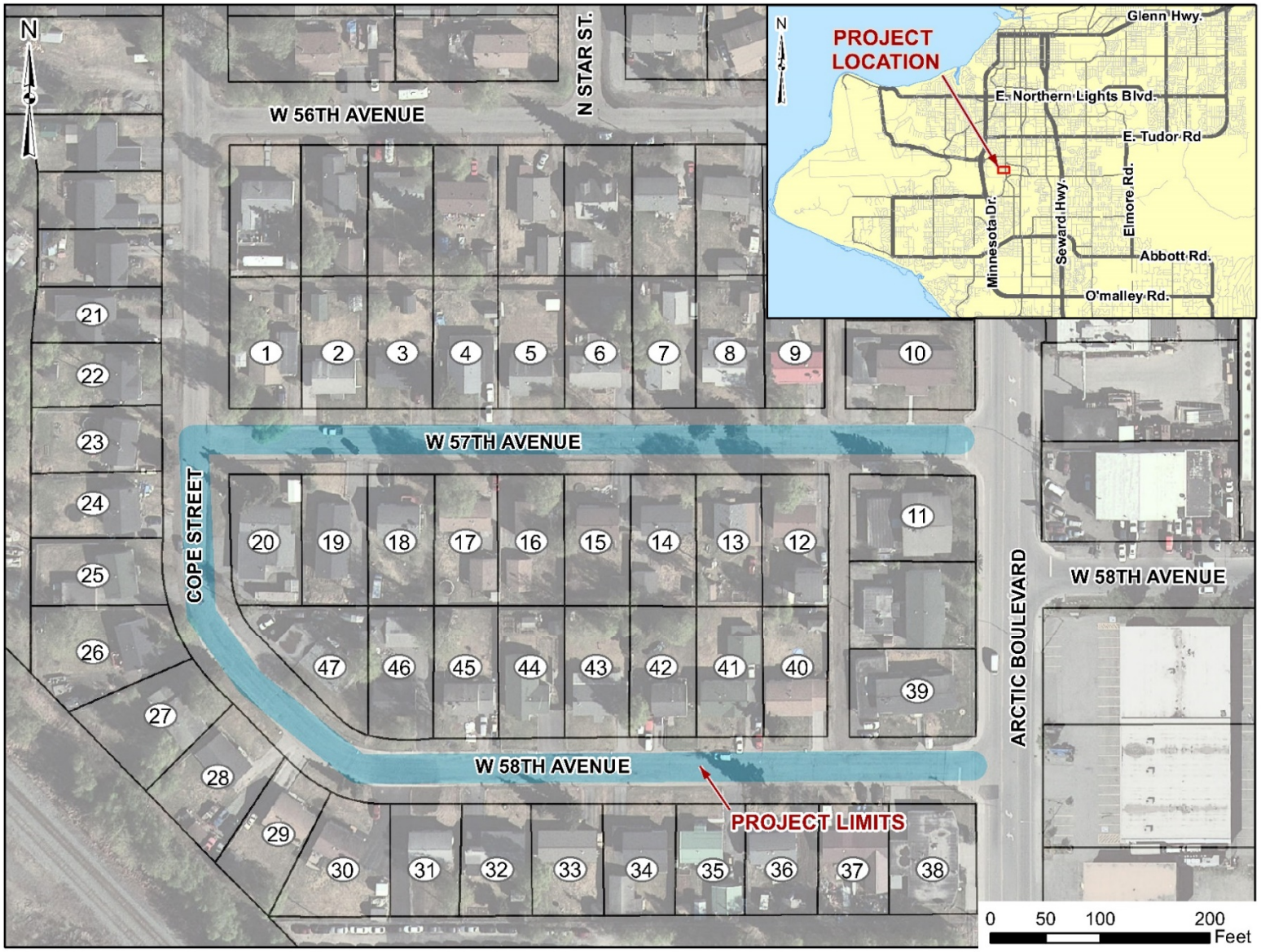


Figure 1 – Project Location and Limits Map

2. Traffic and Parking Studies

The posted speed along the entire project corridor is 25 miles per hour (mph). Existing daily traffic volumes and speeds were collected for this project in late May and early June 2021. The traffic data collected was adjusted for day and month, based on the nearest permanent Alaska Department of Transportation and Public Facilities (ADOT&PF) traffic recorder. The adjusted annual average daily traffic (AADT) volumes and 85th percentile speeds are shown below in TABLE 1.

Table 1. Existing Conditions – Traffic Data

Location	AADT	85th Percentile Speed (mph)
W. 57th Avenue west of alley	140	17
W. 58th Avenue west of alley	170	19

A parking study was conducted to document the current use of on-street parking for consideration in the design of the proposed improvements. The parking study was based on observations from four separate site visits. Site visits were organized to include one weekday afternoon/evening and one weekend afternoon/evening and took place on Saturday, May 15, 2021 and Wednesday, May 19, 2021 (see APPENDIX A for the parking study memorandum). Parking demand is summarized below in TABLE 2. Based upon the study results there does not appear to be a need for a wider roadway to accommodate more on-street parking than what currently exists.

Table 2. On-Street Parking Demand Summary

Segment	Maximum On-Street Parking Demand Observed (Vehicle Count)
W. 57th Avenue	5
W. 58th Avenue	5
Cope Street	2

3. Roadways, Alleys and Drainage

The existing roadway grades in the project area are generally very flat, between approximately 0% and 1.3%. There are low spots along the roadways where drainage can't effectively drain to a catch basin, and during spring break up or large rain events these areas form large ponds in the roadway. The existing roadway pavement conditions are very poor with cracking, settling, and heaving conditions throughout many sections of the roadway. Rolled curb and gutter is present on 57th and 58th Avenue; however, some sections of curb are missing, broken, or are undulating. Cope Street has no curb and gutter. There are no sidewalks within the project area.

There is a gravel alley that connects 57th Avenue to 58th Avenue and a gravel alley between 57th Avenue and West 56th Avenue. These alleys provide access to the car ports and parking spaces for the 4-plexes located west of Arctic Boulevard.

Other existing roadway conditions are summarized in TABLE 3 below.

Table 3. Existing Conditions – Roadway

Item	Value	Notes
Right-of-Way (ROW) Width:	60 ft. (roadways) 20 ft. (alleys)	Existing improvements are approximately centered in the ROW on 57th & 58th Avenue. Existing improvements on Cope Street are skewed to the west side of the ROW.
Roadway width: 57th & 58th Avenue Cope Street	 32 ft.[1] 21-25 ft.[2]	
Curb Type	Type 2 (rolled)	No curb along Cope Street
Posted speed	25 mph	
Sidewalk width	N/A	None along the project corridor

1. Roadway width is measured from back of curb to back of curb.
2. Roadway width is measured from edge of pavement to edge of pavement.

At the intersections with Arctic Boulevard there are two curb inlet catch basins located at 58th Avenue and one curb inlet catch basin at 57th Avenue. There is a set of curb inlet catch basins on 58th Avenue as it transitions to Cope Street which are intended to be the low point where drainage flows from Arctic Boulevard and from Cope Street to the north. However drainage is not able to make it effectively to the low point due to the heaving and flat curb lines. These catch basins outfall to the southwest to a vegetated area within the ARRC ROW.

4. Utilities

The neighborhood is served by Anchorage Water and Wastewater (AWWU) water and sewer mains. The mains are located in non-standard locations, approximately 7 feet within each side of the ROW lines. The project area is also served by overhead utilities including electric, cable television, and telephone/communication lines which run along the backside of the parcels. Natural gas mains also run primarily along the backside of parcels with the exception of the gas main along Cope Street and on 57th Avenue between the alley and Arctic Boulevard. Further information regarding the existing water/sewer systems and utilities, and any impacts to these systems, will be analyzed and discussed in the DSM.

5. Illumination

The project roadways, within the project area, do not currently have continuous roadway lighting. Illumination currently only exists intermittently as follows: One light on 58th Avenue just west of the alley, two lights on the horizontal curve as 58th Avenue transitions into Cope Street, one on Cope Street at the 57th Avenue/Cope Street intersection, and one about mid-block on 57th Avenue. The street lights are owned by CEA and consist of luminaire arms mounted to wooden utility poles. It is anticipated that the roadway lighting along the project corridor will be upgraded to meet current MOA lighting standards. A full illumination analysis and design recommendations will be provided in the DSM.

6. Survey Questionnaire

A survey questionnaire was mailed and e-mailed out to the residents/owners within the project limits in February of 2021. A total of 19 responses were received, of which all owned the property (see APPENDIX B for questionnaire responses). Relevant roadway related responses to the questions are summarized in TABLE 4.

Table 4. Questionnaire Responses

Question	Answers
Do you have concerns about speeding along the streets within the project area?	No (17) Yes (2)
Do you think there should be additional space in the roadway for on-street parking within the project limits?	No (15) Yes (3)
Are you aware of any sight distance problems within the project limits that may need to be corrected as part of the project?	No (15) Yes (3)
Do you think pedestrian facilities (e.g. sidewalks) should be constructed as part of this project?	No (12) Yes (7)
If yes for pedestrian facilities, on one side or both sides of the roadway?	Both (4) One (3)

C. Design Challenges

Some of the significant design challenges associated with the Norann project area include:

- Street grades are typically flat, as low as 0% percent in some locations and most of the curb is heaving and not draining adequately. Roadway improvements may require forced high and low spots to facilitate adequate drainage. Matching into the existing driveways may be a challenge with the forced low spots and steep driveways.
- Removal of private improvements in the ROW to provide adequate snow storage will likely be a sensitive topic with residents.
- A few parcels have full-frontage access to their driveways or garages, and some driveways have wider than the allowable maximum driveway widths. Residents may resist eliminating their full-frontage access with the construction of barrier curb with driveway cuts. Only if approved by MOA Traffic Engineering Department, some parcels may be allowed to keep wider than allowable driveways. A design variance waiver will be required for installing a wider than allowable driveway.
- Several parcels have private retaining walls near the existing curb. Removal of these retaining walls to install the proposed improvements may require new retaining walls or extensive grading to match into the existing ground.
- The project will attempt to eliminate the existing storm drain system that outfalls into ARRC ROW. It may be challenging to extend a proposed storm drain from the existing low point to Arctic Boulevard.

D. Design Criteria & Proposed Design

1. Roadway Design Criteria

The MOA Design Criteria Manual (DCM) requires roadway improvements to be centered in the ROW; the existing roadway improvements are generally centered in the ROW. It is anticipated that the overall proposed footprint of the roadway will also be centered in the ROW, this will be confirmed during the development of the DSM.

The design criteria values from the DCM for an urban secondary (local) roadway typical section are summarized in TABLE 5 below. Typical sections alternatives are discussed in the following section.

Table 5 – DCM Table

AADT	Street Width[1]	Number of Lanes		Shoulder Width	Curb & Gutter Type	Pedestrian facilities[4]	Design Speed (mph)
		Moving	Parking[2]				
0-300	31’	2 – 10’	1 – 7’	3.5’	Type 2[3] (rolled)	5-foot wide, both sides	25

1. Street width is measured from back of curb to back of curb.
2. When off street parking is utilized, the parking lane may be eliminated and the street width reduced. Minimum 3.5’ shoulder sections are required if parking is eliminated.
3. Anchorage Municipal Code 21.08.050.G requires the use of Type 1 (vertical) curb and gutter.
4. Anchorage Municipal Code 21.07.060.E.2 also requires sidewalks to be installed on both sides of all streets in Class A zoning districts. The project area falls under Class A per 21.08.050.B, Table 21.08-1.

2. Typical Cross Section Alternatives

Two typical cross section alternatives will be analyzed in detail during the DSM phase for grading, access, drainage, lighting and other improvements. The proposed typical section alternatives were reviewed and discussed at the meeting with MOA PM&E, Traffic Engineering, and Street Maintenance and are shown in FIGURE 2 at end of this technical memorandum.

The typical sections aim to balance the context of the roadways with design criteria, driveway allowances and standards, and on-street parking demands. Each typical section includes pedestrian facilities. The typical sections will be presented to the public during the first open house of the project to gather comments and feedback while assembling the DSM.

3. Roadway Profile

The proposed vertical profile geometry will likely require forced high and low spots to increase the roadway grades to provide adequate drainage. The forced high and low spots will improve drainage but be located to minimize impacts to existing development. The vertical profile will be further analyzed and refined in the DSM and design phases.

4. Traffic Calming

Based upon the 85th percentile speeds from the traffic study, no traffic calming will be proposed for this project.

E. Proposed Storm Drainage

A full drainage analysis and preliminary storm drain design will be included in the DSM.

F. Design Variances

Design variances will be required from MOA Traffic Engineering & the Municipal Engineer for those items which do not adhere to the DCM or Title 21. Design variances are anticipated for:

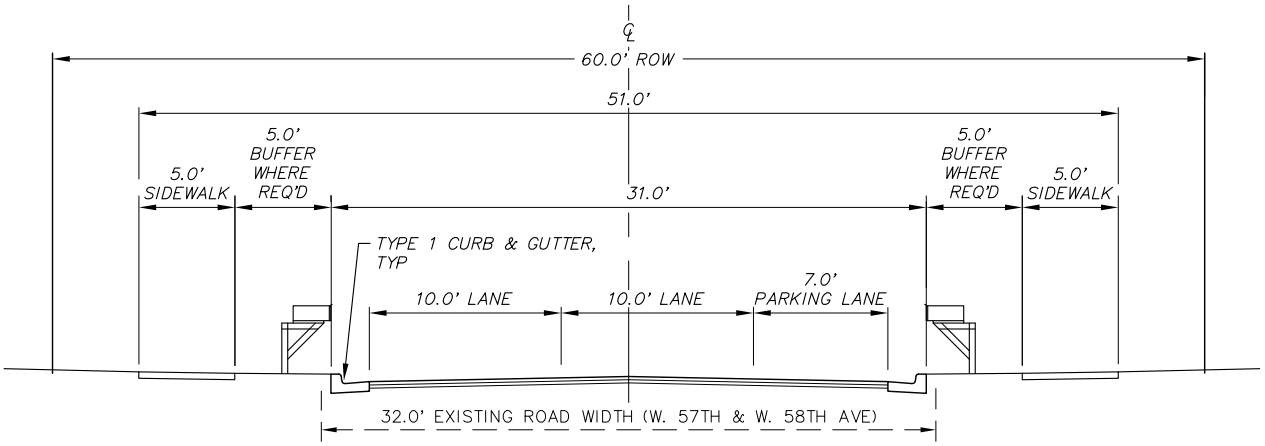
- Curb type: Type 1 curb and gutter is proposed for the sections (DCM requires Type 2).
- Driveway widths: some proposed driveway widths if approved by MOA Traffic Engineering may be allowed to exceed the maximum allowable widths.
- Driveway landings: some proposed driveways may not be able to provide landings to meet the DCM.
- Depending on the typical section chosen if only one sidewalk is installed a design variance would be required since sidewalks are required on both sides of the roadway per the DCM and Title 21.

G. Cost Estimate

A cost estimate for each alternative will be prepared for the DSM.

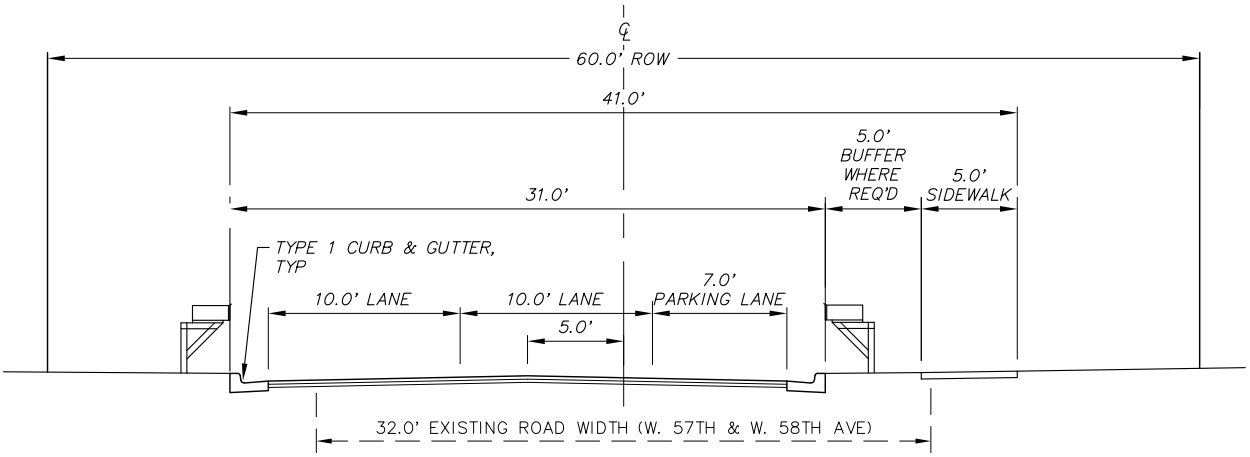
H. Summary and Next Steps

Review comments received from MOA PM&E, Traffic Engineering, and Street Maintenance on this Draft Technical Memorandum will be incorporated into the Final Technical Memorandum. The Draft DSM will be prepared based upon the support from MOA PM&E, Traffic Engineering, and Street Maintenance of the proposed typical sections. The DSM will analyze the proposed typical section alternatives further and include recommended improvements.



ALTERNATIVE 1

OPTION 1 FEATURES:
- PER DCM REQUIREMENTS
- 10 FOOT LANES
- SIDEWALKS ON EACH SIDE OF THE ROAD
- ONE, 7' PARKING LANE (LOCATION VARIES)
- NO ROADWAY MARKINGS



ALTERNATIVE 2

OPTION 2 FEATURES:
- 10 FOOT LANES
- SIDEWALK ON ONE SIDE OF THE ROAD
- ONE, 7' PARKING LANE (LOCATION VARIES)
- NO ROADWAY MARKINGS

CRW ENGINEERING GROUP, LLC
3940 ARCTIC BLVD. SUITE 300
ANCHORAGE, ALASKA 99503
PHONE: (907) 562-3252
#AECL882-AK

MUNICIPALITY OF ANCHORAGE

NORANN SUBDIVISION AREA ROAD RECONSTRUCTION

PM&E PROJECT NO. 20-14

TYPICAL SECTION ALTERNATIVES

Project No:	10149.00
Drawn By:	RWB
Scale:	NTS
Date:	JUNE 2021
Figure:	2

FILE NAME: J:\JobsData\10149.00 Norann Subdivision Road Reconstruction\00 CADD 2019\02 Figures\01 DSR\01 Typical Section Options\10149 Norann Typical Sections.dwg