

GEOTECHNICAL REPORT PARKS HIGHWAY MIILEPOST 315-325 **RECONSTRUCTION: PHASE 3 PROJECT NO: Z606570000** FEDERAL NO: 0A45028 AUGUST 2021

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TABLE OF CONTENTS

LIST OF FIGURES	. iii
LIST OF TABLES	. iii
INTRODUCTION	2
SUMMARY	2
OTHER REPORTS AND INVESTIGATIONS	3
PHYSICAL SETTING	4
Climate	4
Physiography and Topography	5
Geology	5
Seismicity	5
FIELD INVESTIGATION	8
SUBSURFACE FINDINGS	8
Realignment/Cut (Figures 4 and 5)	8
Seismic Refraction Survey Correlation to Realignment/Cut Test Holes:	12
Realignment/Fill (Figure 6):	14
COMMENTS AND RECOMMENDATIONS	17
Realignment/Cut	17
Realignment/Fill	17
REFERENCES	19
APPENDIX A-TEST HOLE LOGS	20
APPENDIX B-GEOPHYSICS: SEISMIC REFRACTION SURVEY	48
2019 Seismic Refraction Surveys:	49
2021 Seismic Refraction Survey:	53
Seismic Refraction Survey Correlation to Realignment/Cut Test Holes:	55
APPENDIX C-SYMBOLS AND DEFINITIONS	58

LIST OF FIGURES

Figure 1. Phase 3 Test Hole Locations	1
Figure 2. Geologic Map of Project Area	6
Figure 3. Seismic Map of Project Area	7
Figure 4. Realignment/Cut TH21-015 Location	10
Figure 5. Realignment/Cut TH21-016 to TH21-018 Locations	11
Figure 6. Realignment/Fill TH21-006 to TH21-014 Locations	15

LIST OF TABLES

Table 1. Climate Summary Data for Nenana, Alaska from 1981 to 2010	4
Table 2. Thawing and Freezing Indices for Nenana, Alaska	4
Table 3. Realignment/Cut Test Hole Descriptions	9
Table 4. Realignment/Fill Test Hole Descriptions	16



Figure 1. Phase 3 Test Hole Locations.

INTRODUCTION

This report documents physical site and subsurface conditions, provides interpretation of anticipated site conditions, and recommends design and construction criteria for the project. This report is intended to serve as a geotechnical guide during project design and a geotechnical reference during construction.

The Alaska Department of Transportation and Public Facilities (DOT&PF) is planning to reconstruct the Parks Highway from MP 315 to 325. This project will include construction of major realignments involving deep cuts and fills, along with grade changes and drainage improvements. This preliminary memorandum has been prepared to summarize the third phase of a geotechnical investigation for this project.

This phase of the investigation was performed to gather more detailed information where the major realignments will occur (Figure 1). These realignments have changed slightly since 2019 when the first phase of the investigation took place. Northern Region Material Sections cored four test holes where large cuts will take place in bedrock to confirm the presence of non-rippable bedrock seen in seismic refraction surveys performed in 2019 and 2021. Nine test holes were also drilled to determine the thickness of silt overburden in an area of the realignment where large amounts of fill will be placed.

SUMMARY

This geotechnical investigation took place in June and July 2021 and included coring several test holes in the large bedrock cut areas and drilling several shallow test holes in a large fill area. During Phase 1 of this investigation in 2019, both the large cut and fill areas were drilled. Since the first investigation, these realignments have changed slightly, and it was determined additional drilling would be beneficial for the following reasons:

1. Large cuts in bedrock are planned in three areas of the realignment. During the 2019 investigation, rock coring took place in the three areas where the deepest cuts were planned. TH19-022 experienced difficult drilling before reaching depth, the core tooling then became lodged in the test hole at approximately 138 feet. TH19-023 was able to reach the depth needed, 90 feet. TH19-024 started experiencing the same difficult drilling as seen in TH19-022 before depth was reached and drilling was stopped. Seismic refraction surveys were performed along sections of the realignment for TH19-022 and TH19-023 in 2019. The location of these surveys were on the previous realignment between former Station 1553+00 to 1570+00 and former Station 1577+00 to 1590+00. The results of these surveys showed TH19-022 terminated in bedrock that increased in seismic velocity. This higher seismic velocity may indicate more competent bedrock which is believed to be what caused the difficult drilling. Seismic velocities in the bedrock where TH19-023 was drilled were consistent, as the coring results confirmed; however, the survey did show higher seismic velocity in bedrock surrounding the test hole. An additional seismic refraction survey was performed in June 2021 along the realignment where TH19-024 was drilled. The results of this survey showed the difficult drilling experienced in this test hole location was most likely for the same reason as in TH19-022, a transition into more competent, higher seismic velocity bedrock from the

highly weathered, lower seismic velocity schist that the rest of the test hole encountered. The higher seismic velocity bedrock identified by the seismic refraction survey is considered marginally rippable to non-rippable material. NRMS felt additional coring in these areas would be beneficial in confirming the presence of potentially non-rippable material.

2. There are two areas of this realignment where large fills will be constructed. In the final Geotechnical Report that included data and recommendations for Phase 1 and 2 of this investigation recommendations for these large fills included removal of the loose, relatively high moisture-content silty overburden as it may be susceptible to consolidation, lateral spreading, and downslope movement in areas with steep gradients. Revisions of the realignment have moved one section of the large fill slightly downslope. Due to this revision, NRMS drilled additional test holes using a Tanaka hand auger to verify whether the thickness of the silty overburden was consistent with what was encountered on the previous realignment.

The following summarizes the subsurface conditions encountered in this investigation:

Realignment/Cut (Stations 1485+00 to 1509+00 and 1550+00 to 1592+00, Figures 4 and 5):

Four test holes, TH21-015 to TH21-018, were cored in the bedrock cuts for the realignment. These test holes encountered 2 to 3 inches of organic mat, 3 inches to 1.75 feet of silt, and schist bedrock. The mineral composition of the schist bedrock included varying mixtures of muscovite, graphite, garnet, and biotite. The presence of non-rippable material was confirmed with this coring and the seismic refraction surveys performed in 2019 and 2021.

Realignment/Fill (Station 1520+00 to 1540+00, Figure 6):

Nine test holes, TH21-006 to TH21-014, were drilled to determine the thickness of silty soil overlying weathered bedrock. These test holes encountered 2 to 6 inches of organic mat underlain by 2 to 5 feet of silt. The silt overlies highly to completely weathered micaceous schist. The results of this drilling are consistent to the drilling performed in Phase 1 of this investigation.

OTHER REPORTS AND INVESTIGATIONS

Simpson, J., 2021, Parks Highway Milepost 315-325 Reconstruction Project No. Z7606570000, Federal No. 0A45028. Geotechnical Report, Alaska Department of Transportation and Public Facilities, 214p.

Speeter, G., 2021, Rippability and Shrink/Swell Estimate: Parks Highway Milepost 315-325 Reconstruction. Memorandum, Alaska Department of Transportation and Public Facilities, 3p.

PHYSICAL SETTING

Climate

The project site is located within the continental subarctic climatic zone of Alaska (Hartman and Johnson, 1984), characterized by short, warm summers, long, very cold winters, and low precipitation and humidity. Climate data for Nenana, Alaska was obtained from the Western Region Climate Center (https://wrcc.dri.edu) (Table 1). Air freezing and thawing indices were calculated based on data also obtained from WRCC. The air thawing index, or degree-days above freezing, can be used to calculate the depth of thaw during the year. The air thawing index listed below takes the annual thawing-degree-days (TDD) for the last thirty years and averages them. The design thawing index takes the average of the three warmest (highest) TDD over the last twenty-five years. Likewise, the air freezing index, or degree-days below freezing, can be used to calculate the depth of ground freezing during winter. The air freezing index listed below averages the annual freezing-degree-days (FDD) for the past thirty years. The design freezing index averages the three coldest (highest) FDD for a shorter period, 1986 to 2010, due to missing data prior to 1986. This data is summarized in Table 2.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	2.9	8.3	24.2	42.2	60.6	71.7	72.8	65.6	52.4	30.1	9.8	5.9	37.3
Average Min. Temperature (F)	-14.7	-12.4	-1.2	17.5	34.7	44.9	49.2	44.0	33.4	14.4	-6.2	-11.6	16.1
Average Total Precipitation (in.)	0.45	0.37	0.25	0.13	0.51	1.01	1.93	1.83	1.10	0.74	0.72	0.55	9.59

Table 1. Climate Summary Data for Nenana, Alaska from 1981 to 2010.

Table 2. Thawing and Freezing Indices for Nenana, Alaska.

Index	Value
Air Thawing Index	3261 Fahrenheit Degree-days ¹
Air Freezing Index	5429 Fahrenheit Degree-days ¹
Design Thawing Index	3752 Fahrenheit Degree-days ²
Design Freezing Index	6334 Fahrenheit Degree-days ²

1) Calculated from 1981 through 2010 daily average temperatures

2) Calculated from monthly average temperatures from 1986 through 2010 due to missing data prior to 1986

Physiography and Topography

The project is located in the Northern Plateau province called the Yukon-Tanana Upland (Wahrhaftig, 1965). The Upland is characterized by rounded ridges, with gentle side-slopes. Compact, rugged mountains are located in the western and eastern part of the Upland. Valleys are generally flat, alluvium floored, and one-quarter to one-half mile wide. Most streams follow the structural trends of the bedrock, which includes sharp bends and direction reversals around ridges and hard rock. The few lakes in the Upland are mainly thaw lakes in valley floors and low passes. Discontinuous permafrost underlies the entire Upland. There is active periglacial mass-wasting at high altitudes. Ice wedges and pingos are common in valley floors and lower hill slopes (Wahrhaftig, 1965).

Geology

The geology of the Yukon-Tanana Upland in the vicinity of the project site is mainly schist and gneiss of possibly Precambrian age. Small, scattered granitic intrusions are present in the northwest portion of the Upland, and large, irregular batholiths make up much of the southeastern part. Thick deposits of windblown silt overlie the lower slopes of hills and deeper stream gravels in valleys. Alluvial deposits of gold and other metals are common throughout the Upland (Wahrhaftig, 1965). In 2015, the United States Geological Survey (USGS) published a compiled geology map for the state of Alaska. This map shows unconsolidated surficial deposits and pelitic schist and quartzite bedrock in the immediate project vicinity (Figure 2).

Seismicity

The project area is located within the Minto Flats seismic zone, an area of high seismic activity. In the Fairbanks vicinity, a series of north-northeast-trending, left-lateral strike-slip seismic zones have been identified (Rampart, Minto Flats, Fairbanks, Salcha), which are the source of numerous earthquakes each year. Each zone is capable of producing earthquakes greater than magnitude 6.0. The Minto Flats seismic zone is associated with two distinct lineaments of seismicity across the Nenana basin. Figure 3 illustrates USGS reported earthquakes in the last 100 years. According to the USGS Earthquake Hazards Program, a peak ground acceleration of 0.272 g can be expected for the project site.







Figure 3. Seismic Map of Project Area.

FIELD INVESTIGATION

Fieldwork was conducted between in June and July of 2021 by Northern Region Materials Section (NRMS) Engineering Geologist J. Simpson and Drillers P. Lanigan, M. Sousa, T. Hartford, T. Babin, and G. Nelson. Drilling was conducted utilizing a track-mounted CME 850 drill rig with rotary-wash tri-cone and 2 inch rock-core barrels and a Tanaka hand auger with 2 inch solid augers. Samples were collected from split-spoons samplers and rock core barrels. Test hole conditions were logged in the field in accordance with the Unified Soil Classification System (USCS). Test hole locations were recorded with a handheld Garmin GPS 64st, using the North American Datum (NAD) 83, with an accuracy of 50 feet.

Other field investigations included a seismic refraction survey where a realignment of the highway will require large cuts in the bedrock. The survey took place between from approximate Station 1493+40 to 1502+90. This survey was completed by Logic Geophysics and Analytics.

SUBSURFACE FINDINGS

A total of 13 test holes were drilled for this investigation. This included 4 cored test holes and 9 shallow test holes. Figures 2 and 3 show the locations of the cored test holes for the large cut areas and Figure 4 shows the shallow test holes for the large fill areas. Table 3 outlines the subsurface findings from the test holes cored in bedrock. Table 4 outlines the subsurface findings for the shallow test holes showing the amount of silt overlying bedrock.

Realignment/Cut (Figures 4 and 5):

Four test holes were cored to determine the bedrock conditions and confirm the presence of nonrippable material along the revised realignment. These test holes were drilled to depths from 81 to 111 feet below ground surface (bgs). All test holes encountered schist bedrock composed of varying amounts and combinations of graphite, garnet, muscovite, and biotite. Table 3 describes these test holes and Figures 4 and 5 show their locations.

<u>Test Hole</u> <u>Number</u>	<u>Depth</u> <u>(ft)</u>	Description	<u>Comments</u>
TH21-015	111	 3" organic mat 4" silt ~110.5' schist bedrock 	 bedrock composition consisted of varying combinations of graphite, muscovite, quartz, and biotite biotite and quartz contents increased with depth bedrock was slightly to completely weathered and generally weak with close fracture spacing RQD ranged from very poor to good
TH21-016	93.66	 2" organic mat 1.67' silt ~92' schist bedrock 	 bedrock composition consisted of varying combinations of graphite, muscovite, garnet, quartz, and biotite bedrock was slightly to completely weathered and generally medium weak to weak with close fracture spacing RQD ranged from very poor to fair
TH21-017	81	 2" organic mat 1.8' silt 79' schist bedrock 	 bedrock composition consisted of varying amounts of muscovite and graphite majority of bedrock was highly to completely weathered with small areas of slightly to completely weathered generally very weak with very to extremely close fracture spacing RQD ranged from very poor to poor
TH21-018	81	• 3" • 15" silt • 79.5' schist bedrock	 bedrock composition consisted of varying combinations of muscovite, quartz, graphite and garnet bedrock was slightly to completely weathered, generally medium weak to weak with close fracture spacing RQD ranged from very poor to fair

Table 3. Realignment/Cut Test Hole Descriptions.



Figure 4. Realignment/Cut TH21-015 Location.



Figure 5. Realignment/Cut TH21-016 to TH21-018 Locations.

Seismic Refraction Survey Correlation to Realignment/Cut Test Holes:

Three seismic refraction surveys were performed for this project. The most recent survey, performed in June 2021, was located where TH19-024 and TH21-015 were drilled (Figure 4). The current realignment in this area only slightly differs from its original location. This survey showed that TH19-024, which was terminated early due to difficult drilling conditions, showed a transition into relatively more competent material with higher seismic velocity material at this depth. Two seismic refraction surveys were performed in 2019 on portions of the previous alignment where TH19-022 and TH19-023 were drilled (Figure 5). These surveys showed a high correlation with what was encountered in these test holes, lower seismic velocities in highly to completely weathered and weak to extremely weak bedrock. The survey performed where TH19-022 was terminated due to difficult drilling conditions which resulted in the tooling getting lodged in the test hole also showed a transition into relatively more competent material with a higher seismic velocity at this depth. While these survey locations no longer reflect the current realignment location, an attempt was made to locate higher seismic velocity material, which will likely be non-rippable, along the current realignment based on these surveys (Figure 3, TH21-016 to TH21-017). The seismic refraction survey results including test hole locations can be found in Appendix B.

In an effort to correlate the subsurface findings in the four test holes cored in July 2021 with the seismic refraction surveys, the characterizations of the rock core properties (weathering, strength, fracture spacing, and RQD (rock quality designation)) were assigned values, e.g. completely weathered was given a value of 1, highly weathered a value of 2, etc. Seismic velocity contours from the surveys were matched with the corresponding depths from the test holes. A weighted average of the properties characterized in the rock core was then calculated for the depth ranges associated with the seismic velocities. These values were then graphed to determine what correlations exist between the rock core properties and the seismic velocities. The assigned values for the rock core properties and the graphs are included in Appendix B.

TH21-015 was drilled along the current realignment and the seismic refraction survey line. The survey showed steadily increasing seismic velocities with depth. The characterization of the rock core properties were slightly variable in the lower seismic velocities (4000-6000 ft/s); however, once marginally rippable (6000-8000 ft/s) and non-rippable (8000+ ft/s) seismic velocity depths were encountered a relatively steady increase of characterization values and competency of the rock was seen. At these depths and higher seismic velocities there was less weathering, less fracturing, and higher RQD values indicating that the seismic refraction data correlates well with the drilling data and can reliably assess the rippability of material in the subsurface.

TH21-016 was drilled on the current realignment, slightly downhill and to the east of TH19-022. This test hole was drilled in an attempt to locate higher seismic velocity material that appears at a shallower depth according to the seismic refraction survey performed in 2019 along the former realignment. The rock core properties that correspond to lower seismic velocities were variable, especially weathering and fracture spacing. In the approximate marginally rippable to non-rippable seismic velocity zones all properties showed higher values associated with competency until the transition into a zone of ~8000 ft/s. At this depth the core barrel suddenly dropped approximately one foot, followed by intense shaking and another sudden one foot drop. At this

time, water circulation ceased as all water was lost in the test hole and was no longer being recovered. Recovery from this core run was minimal, however; the recovery was sufficient enough to show a significant decrease in the rock core properties. The drill reaction experienced at the bottom of this test hole was the same reaction experienced in TH19-022 at depths also corresponding to ~8000 ft/s seismic velocities. Since this reaction caused the core tooling to become lodged and unrecoverable in TH19-022, drilling of TH21-016 was stopped. The cause of this reaction is unknown.

In order to avoid rippability versus non-rippability disputes during construction, TH21-017 was drilled in an attempt to find a localized shallow anomaly of higher seismic velocity material, located slightly downhill and to the west of TH19-022. NRMS geologists attempted to extrapolate the location of TH19-022 downtrend to the current alignment to drill this through anomaly of higher velocity material. To accomplish this, NRMS personnel attempted to project the high velocity anomaly in the seismic data down the structural trend to where it would be located beneath the current realignment. However, TH21-017 appears to have been drilled on the outside margin of this anomaly because it encountered rock properties consistent with mid-range seismic velocity values that extend out of this anomaly of higher seismic velocity values. Since this test hole was not drilled on the exact survey location, small, localized areas should still be expected on the current alignment but may differ in depth, thickness, etc.

TH21-018 was drilled on the current realignment, slightly downhill and to the west of TH19-023. This location was anticipated to have shallower non-rippable material based on seismic data. Characterization of rock core properties showed a trend of less weathering and fracturing with increasing seismic velocities while the strength of the rock core was relatively consistent and the RQD was variable. This material was relatively competent and could generally be considered non-rippable.

To further expand on the correlation of the seismic refraction surveys, test hole findings, and rippability, the seismic velocities at any one point as presented in this report reflect the lithological properties (lithology/composition) and the physical properties (weathering, strength, fracture spacing, and RQD) of the rock. To achieve the higher seismic velocities, generally greater than 8000 ft/s, the rock would need to have relatively competent lithological and physical properties. Lower seismic velocities, generally less than 6000 ft/s, can be achieved by a combination of the conditions of these properties, either lithological properties that are moderately competent with less competent physical properties or less competent lithological properties and more competent physical properties. Mid-range seismic velocities, generally 6000-8000 ft/s, can reflect a relatively wide range of lithological or physical property conditions that are uniform in at least one aspect and this may result in rippable material. In summary, as the seismic velocities reflect combinations of the lithological and physical properties of the rock, when considering the areas to be cut as a whole it should not be assumed that all low seismic velocities suggest completely to highly weathered rock or that strength will always notably increase with an increase in seismic velocity, etc.

Realignment/Fill (Figure 6):

Nine shallow test holes were drilled to determine the silt overburden thickness in this section of the revised realignment. Table 4 describes these test holes and Figure 6 shows their locations.

<u>Test Hole</u> <u>Number</u>	<u>Depth</u> (ft)	Description	<u>Comments</u>
TH21-006	7	 3" organic mat 4.75' silt 2' bedrock 	
TH21-007	5	 6" organic mat 3' silt 1.5' bedrock 	
TH21-008	4.5	 3" organic mat 3.75' silt 0.5' bedrock 	
TH21-009	6	 3" organic mat 4.75' silt 1' bedrock 	• silt was moist or moist to wet and
TH21-010	4.5	 3" organic mat 3.25' silt 1' bedrock 	 Inay have contained some seasonal frost bedrock was micaceous schist that was highly to completely weathered to
TH21-011	7	 3" organic mat 4.75' silt 2' bedrock 	silty/sandy soil with some small gravel sized pieces
TH21-012	6	 3" organic mat 3.25' silt 2.5' bedrock 	
TH21-013	4	 3" organic mat 2.25' silt 1.5' bedrock 	
TH21-014	6.5	 3" organic mat 5.25' silt 1' bedrock 	

Table 4. Realignment/Fill Test Hole Descriptions.

Overburden thickness in these test holes was consistent with the findings from the test holes drilled in 2019 along the former realignment.



Figure 6. Realignment/Fill TH21-006 to TH21-014 Locations.

COMMENTS AND RECOMMENDATIONS

This investigation took place to gather additional information due to the revised realignment with both large cut and fill areas. Recommendations for the large cut and fill portions of the realignment are as follows:

Realignment/Cut:

Drilling on the realignment cut sections in 2019 encountered mostly highly weathered schist bedrock. While construction equipment used on large excavations is expected to be able to excavate most of this material without ripping, seismic refraction survey results showed more competent material is some of these areas. The seismic velocities indicated (per Caterpillar rippability tables) some material will require ripping and the remainder may require blasting. An additional seismic refraction survey and drilling performed in this investigation confirmed the presence of this more competent material that will be marginally rippable to non-rippable. Consider including a pay item for Unclassified Excavation and one for Rock Excavation, with note in Plans that Rock Excavation is expected to require drilling and blasting.

The seismic survey completed in June 2021 is the only seismic data that reflects the current realignment and therefore is the only area where percentages of rippable versus non-rippable material can be determined. This survey was completed between approximate Stations 1493+40 and 1502+90. The percentage of rippable, marginally rippable, and non-rippable material in this cut section has been estimated at:

Rippable: 56% Marginally Rippable: 25% Non-Rippable: 19%

Field and seismic data show weathered to highly weathered schist bedrock in this area that would likely be considered 75% rock and 25% earth. Based on this data and referencing Federal Highway Administration Shrink/Swell Factors (FHWA, 2020), we estimate approximately 30% swell of the bedrock once excavated.

Realignment/Fill:

The investigation performed in 2019 indicated the foundation soils in the sections of the realignment requiring large fills (approximate Stations 1462+00 and 1483+00, and 1524+00 and 1539+00) consisted of loose, relatively high moisture-content silty soils underlain by highly weathered schist bedrock. The thickness of this silty overburden ranged from 3 feet to 5 feet. One section of this realignment was revised and has shifted slightly downslope from its original location. Additional test holes were drilled along this revised section and the thickness of the overburden was consistent to the findings from the previous investigation.

We believe this relatively wet, loose silt may be susceptible to consolidation and lateral displacement under the load of a large fill. In addition, we believe loading such foundation soils on a hillslope may lead to down-slope movement.

The previous recommendations for these large fills stated that if the geometry of the existing ground was relatively flat, embankment distress would be partially mitigated by placing one or more layers of geotextile, reinforcement low in the embankment and excavating silty overburden prior to backfilling where the geometry is relatively steep to mitigate downslope movement. However, following a review of historic data on similar projects, we believe these recommendations should be revised. We now recommend removing all the silt overburden in the large fill sections of the realignment, regardless of the geometry and slope of the existing ground, to avoid consolidation and lateral displacement under the load of a large fill.

The percentage of shrink/swell of the in-situ silt was estimated using blow counts and moisture contents obtained from Phase 1 of this investigation in 2019. Laboratory tests that determine the maximum density and optimum moisture contents (Proctor testing) from nearby projects wre used to assist in these calculations. Based upon the value obtained in the field and the relationship between the in-place density and maximum density for silt, we estimate that the maximum consolidation for the silt is approximately 30% and the maximum swell is approximately 15%.

REFERENCES

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APPENDIX A-TEST HOLE LOGS

TRANSPORT	NN & PUBL	SPROILITIES	STA Norti Geol	TE OF A hern Reg logy Sed	ALASI gion M ction	KA l later	DOT / rials	ΈF			FINAL TEST HOLE LOG	
Fiel Fiel	d Geo d Crev	logist w	J. M	<u>SIMPSO</u> . Sousa, (N G. Nels	son			Pr Pr Ec	oject oject l quipmo	Parks Highway MP 315-325 Reconstruction Number Z606570000 ent Type Hand Auger r Cloudy 555	Test Hole Number <u>21-006</u> Total Depth <u>7 feet</u> Dates Drilled <u>6/9/2021 - 6/9/2021</u> Station, Offset
ТН	Finaliz	zed By	/J.	Simpsor	۱				Ve	egetati	ion	Elevation
Drilling Method	Depth in (Feet)	Casing Blows / ft	Aethod	Sam	Blow Count (raw)	Sample Interval	Jncorrected N-Value	Embankment Height	rozen	Braphic Log	Ground Water Data GENERAL CO While Drilling After Drilling GENERAL CO Depth in (ft.) Image: Colspan="2">Time Date Image: Colspan="2">Colspan="2" Date Image: Colspan="2">Colspan="2" Symbol Image: Colspan="2">Colspan="2"	MMENTS: /Fill Silt Overburden Thickness
T - APRIL 2020.GDT 8/19/21 Hand Auger	1 - 1 - 2 - 3 - 4 - 5 - 6 -	Casi	Met	Num		Sam		Emp	Froz	Construction of the second s	Symbol SUBSURFACE MATERIAL ORG MAT 3" organic mat Tn-Bn SILT moist Tn Soft BEDROCK, soft(Muscovite Schist) highly/completely weathered micaceous bedrock	TEST RESULTS 0 1 - 1 - 2 - 3 - 4 - 5 - 6 -
.GPJ AK DO	7 -										ВОН	7 -
R AKDOT TEST HOLE LOG - USCS PARKS 315-325_2021.	Intess of	thonvis	a note	1 all camp	eles are t	aken	with 1	-3/8. ir		Standa	rd Benetration Sampler driven with 140 lb, hammer with 30-in, drog	CME Auto Hammer

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	OF ALL							Project	Parks Highway MP 315-325 Reconst	struction	Test Hole Number	21-007
Field	d Geo	loaist	J. SI	MPSON				Project	Number <u>Z606570000</u>		Total Depth Dates Drilled	5 feet 6/9/2021 - 6/9/2021
Field	d Crev	N	M. S	ousa, G. Nels	son			Equipm	ent Type_Hand Auger		Station, Offset	0,0,1021 0,0,2021
	- :							Weathe	Cloudy, 55F		Latitude, Longitude	N64.70128°, W148.7333°
ТН	Finaliz	zea By	/J. Si	mpson				vegetai	lion		Elevation	1250.0
illing Method	epth in (Feet)	asing ows / ft	ethod	ow Count (raw)	mple Interval	ncorrected Value	nbankment Height	ozen aphic Log	While Drilling After Drilling Re Depth in (ft.) Image: Comparison of the provided state	ealignment/Fi	Il Silt Overburden Thick	kness
Ğ		ΰĒ	Ň	n z	Š	Σż	шı	Ξ Ū	SUBSURFACE MATERIAL	L	TEST RE	SULTS 0
Hand Auger	0 - 1 - 2 - 3 - 4 -								Tn Soft BEDROCK, soft(Muscovite highly/completely weathered, micaceous bedrock	e SChist)		0 - - 1 - - 2 - - 3 - - 4 - - - 5 -
Note: U	Jnless o	therwise	e noted, al	Il samoles are t	aken	with 1-1	3/8-in	ID Standa	BOIN	th 30-in, drop.	CME Auto Hamme	er 🗌 Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS PARKS 315-325_2021.GPJ AK DOT - APRIL 2020.GDT 8/19/21



	TRANSPORT	N & PUBL	CERCILITIES .	STA Nortl Geol	TE OF / hern Reg ogy Sect	LASK iion Ma tion	A L ateri	DOT// ials	PF			FINA	L٦	IEST H	IOL	E LO	G						
		OF ALAS								Pro	oject		Park	sHighway	MP3′	5-325 Re	econs	struction	_ Test Hole Nu	umber _.	21-009		
	Field	l Geol	logist	J.	SIMPSO	N				Pro	oject i	Number_	Z606	6570000					 I otal Depth Dates Drilled 		6 feet 6/9/202	1 - 6/9/20	21
	Field	Crev	v	Μ	. Sousa, G	G. Nelso	n			Eq	uipm	ent Type_	Hand	d Auger					_ Station, Offs	et	NIC4 70	450° \N/4	40.7000 ⁰
	TH F	inaliz	ed By	/	Simpson					Ve	getati	ion _	CIOU	idy, oor					_ Elevation	igitude.	1178.0	158, W1	48.7309
ľ					Sam	ole Data			ght					Ground Wat	ter Data	a fter Drilling	GE	ENERAL COM	MENTS:				
	ing Method	th in (Feet)	ing vs / ft	poq	nber	v Count (raw)	nple Interval	orrected alue	oankment Hei	zen	phic Log	Depth in (f Time Date	ft.)				– K	eaugnment/	-III SIIT Overburd	en inick	ness		
	Drill	Dep	Cas Blov	Met	Nun	Blov	San	N-V-N	Emt	Froz	Gra	Symbol		SUBSUR	FACI		RIA	ı T	TF	ST RF	SULTS	3	0
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	Note: I	nless of	therwise	noter	l, all sample	es are ta	ken v	with 1-	3/8-ii	n. ID	Standa	rd Penetratio	on Sa	mpler driven v	with 14) lb. hamme	er wit	h 30-in drop	CMF Aut	o Hamme	er 🗖 i	Cathead Ro	ope Method
zL	. NOLE. U	1033 0			, an sample	oo are ta	NGI I		J, U-1	<i>D</i>	Janua		JII Jdl	inplor unvert v	anar 14	אווווואני. ישר א	U WIL	oo-in. urop.					

-ield	Geo	logist	J. :	SIMPSC	N				Pr Pr	oject oject l	Parks Highway MP 315-325 Reconstruction	<pre>_ Test Hole Number _ Total Depth Dates Drilled</pre>	21-010 4.5 feet
-ield	Crev	v	Μ.	. Sousa,	G. Nels	son			Ec	quipmo	ent Type Hand Auger	Station, Offset	
TH F	inaliz	ed B	/ J.	Simpsor	n				VV Ve	eathe eaetati	r <u>Cloudy, 55F</u>	Latitude, Longitude	<u>N64.70177°, W148.730</u> 1164.0
				Sam	nple Data	a		t		•	Ground Water Data GENERAL COMM	IENTS:	
Drilling Method	O Depth in (Feet)	Casing Blows / ft	Method	Number	Blow Count (raw)	Sample Interval	Uncorrected N-Value	Embankment Heig	Frozen	Graphic Log	Depth in (ft.) Nume bining Nume bining Realignment/Fi Time	TEST R	ESULTS
	1 -										Tn-Bn SILT moist		
	2 -												
	3 -										Tn Soft BEDROCK, soft(Muscovite Schist)		
	4 -										BOH		

	AND	A & PUBL	CTROLLITIES .	STA1 North Geolo	TE OF A ern Reg ogy Seci	ALASP gion Ma tion	(A I ater	DOT / ials	PF			FINAL TEST HOLE LOG	
	Field	Geol	logist	<u>J. S</u>	Sousa (N Nels	20			Pr Pr Fr	oject oject l	Parks Highway MP 315-325 Reconstructi	ion Test Hole Number 21-011 Total Depth 7 feet Dates Drilled 6/9/2021 - 6/9/2021 Station Offset
			v 		3005a, 0	5. INCIS.				W	eathe	Cloudy, 55F	Latitude, Longitude <u>N64.70182°, W148.72876</u>
-	нн	Inaliz	ed By	/ <u>J.</u>	Simpson Samp	ple Data			t	Ve	egetati	ON Ground Water Data GENER	Elevation
	Drilling Method	Depth in (Feet)	Casing Blows / ft	Method	Number	Blow Count (raw)	Sample Interval	Uncorrected N-Value	Embankment Heigh	Frozen	Graphic Log	While Drilling After Drilling Depth in (ft.) Image: Comparison of the prime of the prima of the prime of the prima of the prime of the primo o	nment/Fill Silt Overburden Thickness
-		0 -										SUBSURFACE MATERIAL ORG MAT 3" organic mat Bn SILT moist to wet	TEST RESULTS 0
_	nd Auger	2 -			-							Tn moist	2 -
_	Har	3 -			-								4 -
20.GDT 8/19/21		5 _			-							Tn Soft BEDROCK, soft(Muscovite Scl highly/completely weathered micaceous bedrock	hist) 5 .
PJ AK DOT - APRIL 20: 1 1		6 -			-								6 -
AKDOT TEST HOLE LOG - USCS PARKS 315-325_2021.G												BOH	

TRANSP.	STATE	A & PUBL	C PROILITIES	STA Norti Geol	TE OF A hern Reg logy Sec	ALASI gion M tion	KA I ater	DOT / rials	ΡF			FINA		EST	HO	LE L	-00	3					
										Pr	oject		Park	s Highwa	уMР	315-32	5 Rea	onstruction		Test Hole Number	21-012	2	
	hlai	Geo	loaist		SIMDSO	N				Pr	oject l	Number	Z606	6570000						Total Depth	6 feet	21 - 6/9/202	
F	ield	Crev	V	J. M	. Sousa, (G. Nels	on			Ed	quipme	ent Type	Hano	d Auger						Station, Offset	0/3/202	21-0/3/202	
										W	eathe	r	Clou	ıdy, 55F						Latitude, Longitude	N64.70	0182°, W14	8.7276°
Т	ΉF	inaliz	ed By	/J	. Simpson	1				Ve	egetat	on						1		Elevation	1155.0)	
					Sam	ple Data			ght					Ground W While Dril	ling	ata After Dri	illing	GENERAL (COMM	ENTS: Il Silt Overburden Thic	knoss		
hodtod Mathia		epth in (Feet)	asing ows / ft	ethod	umber	ow Count (raw)	ample Interval	ncorrected Value	nbankment Hei	ozen	aphic Log	Depth in Time Date Symbol	(ft.)					, in the second s	GIUTT		KI COS		
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NR AKDOT TEST HOLE LOG - USCS PARKS 315-325_2021.GPJ AK DOT - APRIL 2020.GDT 8/19/21

THE REAL PROPERTY OF	E OF AL	CERCILITIES .	STA Nort Geo	TE OF A hern Reg logy Sect	LASI ion M ion	KA I later	DOT /I ials	PF			FINAL	. TES	т нс	DLE LO	DG	i					
									Pro	ject	<u> </u>	ParksHigh	nway MI	P 315-325 F	Reco	nstruction	_ Te	est Hole Number	<u>21-0</u>	13	
Fiel	d Geol	ogist	J.	SIMPSON	N				110	jeci		-0003700	00				_ To	ates Drilled	6/9/2	: 1021 - 6/9/	2021
Fiel	d Crew	V	N	I. Sousa, G	6. Nels	on			Equ	iipm athe	ent Type <u>⊦</u>	Hand Aug	er SF				_ St	ation, Offset titude Longitude	N64	70194° \	
ТН	Finaliz	ed By	/J	. Simpson					Veg	getat	ion _	Joudy, Jo	,				_ EI	evation	1163	.0	140.72000
				Samp	ole Data			ght				Grour While	nd Water e Drilling	Data After Drilling	g (GENERAL CON		S:	knocs		
Drilling Method	Depth in (Feet)	Casing Blows / ft	Method	Number	Blow Count (raw)	Sample Interval	Uncorrected N-Value	Embankment He	Frozen	Graphic Log	Depth in (ft. Time Date Symbol)									
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Geo Geo Crev	KA.	00000	y Seclio									
l Crev	loaist	I SI	MPSON				Pro Pro	oject oject	<u>Parks Highway MP 315-325 Reco</u> Number <u>Z606570000</u>	onstruction	_ Test Hole Number _ Total Depth _ Dates Drilled	21-014 6.5 feet 6/9/2021 - 6/9/2021
	v	M. S	Sousa, G. I	Nelson			Eq	uipm	ent Type_Hand Auger		_ Station, Offset	0/3/2021 0/3/2021
							We	eathe	Cloudy, 55F		_ Latitude, Longitude	N64.7019°, W148.72545
-inaliz	ed By	/J. S	impson				Ve	getat	on		_ Elevation	1163.0
Depth in (Feet)	Casing Blows / ft	Method	Number	Blow Count (raw) I Blow Count (raw) Blow Count Blow Count (raw)	Uncorrected	Embankment Height	Frozen	Graphic Log	While Drilling After Drilling Depth in (ft.)	Realignment/F	MENIS: Fill Silt Overburden Thick	ness
0 -									SUBSURFACE MATERI	AL	TEST RE	SULTS 0
- 1 -			_		-				Bn-Tn SILT moist			1
2 -			_		-				high amount of organizes (wood a	bovingo)		2
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5 -												5
6 -									In Soft BEDROCK, soft(Muscovi highly/completely weathered micaceous bedrock	ite Schist)		6
	(feed) in the set of t	nless otherwise	(ie) i i i i i i i i i i i i i i i i i i	Image: Sample state of the	Sample Data (initial strain of the st	Sample Data (1)	nless otherwise noted, all samples are taken with 1-3/8-i	Image: Sample Data Image: Sample Data Image: Sample	Image: construction of the second	Ground Water Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data Image: Semple Data	Image: Sumple Data Image: Su	Image: Same Data Image: Same Data <td< td=""></td<>

TRANSA			SPOLITIES .	STA North Geole	TE OF hern Re ogy Se	FALA egion ection	SKA Mat	A DO Terials	T/PI	F			FIN	IAL	TE	EST	HOLE LOG Sheet 1 of 5
	ATE	OF ALAS								Ρ	roje	ct		Pa	arks	Highwa	ay MP 315-325 Reconstruction Test Hole Number
-	Field	Geol	oaist	1	SIMPS	ΩN				Ρ	roje	ct N	umb	er_ <u>Z</u> 6	6065	70000,	AKSAS Total Depth <u>111 feet</u> Dates Drilled 7/7/2021 - 7/10/2021
F	Field	Crew	/	P.	Laniga	n, T. ⊦	lartf	ord		_ E	quip	mei	nt Ty	pe Cl	ME	850	Station, Offset
										N	/eat	her		pa	artly	cloudy,	60-65F Latitude, Longitude <u>N64.70034°</u> , W148.70952
		inaliz	ed By	J.	Simps	on			<u> </u>		ege	tatio	n			1	Elevation1379.0
					S	ample L	Jata		+	۰ ۱	lun Da	ata					Ground Water Data While Drilling After Drilling Real ignment/Cut
	thod	eet)	Ð			+	erval		e	ites)			. (in.	Data		D	Depth in (ft.)
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1	Drillin	Dept	Casir Blows	Metho	Numk	Blow	Samp	N-Val	Run	Time	RQD	Reco	Longe	Struc	Froze	Graph	Symbol
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		-				2										4	Th SILT
-		1 -		SPT		3										10	moist, <i>sl Org</i> 1
		-		0,		5										0/	Tn Silty SAND w/ Gravel
-		2 -				-										1/1	muscovite schist completely weathered to silty sand ²
		-														1.6	with 1/2"- gravel sized pieces, highly micaceous
-		3 -														1.0/	3
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F,		4 -				7										19	4
io.	Ê	5		F		11											Tn-Gy Soft BEDROCK(Graphite Muscovite Schist)
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s.		-		S													
SN-	_	11 -							-								11 Tn-Gv Soft BEDROCK(Graphite Biotite Muscovite Schist)
CON		-					-										moderately to highly weathered, weak, close to
BRE-		12 _														$\langle \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} $	extremely close fracture spacing 12
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5-326	<u>م</u>	- U															
S 31	3	16														$\langle \tilde{\boldsymbol{v}} \rangle \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} \tilde{\boldsymbol{v}} $	16
ARK																	highly weathered, close to very close fracture spacing
CS F		17														/	17
- US																	
LOG		18 –															18
ORE		-					_		2	7.8	30	25	4.5				
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No No	ote: Ur	nless ot	herwise	noted	l, all san	nples ar	e tak	en with	1-3/8	3-in. Il	D Sta	ndard	Pene	tration	Samp	oler drive	n with 140 lb. hammer with 30-in. drop. CME Auto Hammer Cathead Rope Method

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Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	SUBSURFACE MATERIAL	20
_	20 -	-														Gy-Tn Soft BEDROCK(Graphite Muscovite Biotite Schist)	20
-	22 -	-														highly weathered, weak, close to extremely close fracture spacing	22
-	23 -	-						3	7.6	0	20	3.75					23 24
_	- 25 -	-														2	25
-	26 - 27 -	-														Gy-Tn Soft BEDROCK(Muscovite Biotite Schist) moderately weathered, weak, moderate to close fracture spacing	26 27
_	28 -	-						4	7.25	79.3	48.3	10.75					28
-	29 - - - - -	-															29 30
T 8/19/21 Coring	31 -	•														moderately to highly weathered, close to extremely close fracture spacing	31
06_28_07.GD	32 - - - - -	-															32 33
	34 -	•						5	7.6	10.4	88.3	5.5					34
R_AKDOT_PR	35 - - 36 -	-														minor quartz weak to verv weak, moderate to extremely close fracture	35 36
2021.GPJ N	37 -	-														spacing, slight increase in quartz content	37
ARKS 315-325	38 -	-						6	7.75	35	80.8	11.5					38 39
	40 -	•															40
TEST CORE L	41 -	•															41 42
R AKDOT	-)	

STATE OF ALASKA DOT/PF Northern Region Materials Geology Section Sheet 2 of 5

Test Hole Number 21-015

	Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log		
F	-	43 -							-	0.5	04.0	05	5 75				4.	3 -
	-	- 44 _							1	9.5	21.6	85	5.75				4	- 4 _
		45																-
	-	40 -															1" quartz vein	с – с
-	-	46 -															4 very weak, very close to extremely close fracture spacing	6 –
-	-	47 _															4	7 _
	-	- 48 _															4	- 8-
		-							8	8	10.5	75	4.75					-
-	-	49 _															4	.9 _
-	-	50 –															Gy-Tn Soft BEDROCK(Biotite Muscovite Schist) 5	0 -
-	-	- 51 _															highly to completely weathered, extremely weak, extremely close fracture spacing 5	1 _
		52															5	2
	-	- 30																
	-	53 -							9	10.6	0	41.7	2.5				5:	3 -
8/19/21	ring	54 –															5 Gy-Tn Soft BEDROCK(Graphite Muscovite Biotite Schist)	4 -
CGDT	ů	- 55 –															moderately to highly weathered, very weak, very close fracture spacing 5.	5 -
6_28_0		-															5	6
ISCS_0	-	- 50																- 0
CON	-	57 _															5	7 -
DT_PRE	-	58 -															5	8 -
AKDO	-	- 59 –							10	14.4	0	85.8	3.75				5	- 9 -
GPJ NF		-																-
2021.	-	- 00																U _
315-329	-	61 -															6	1 -
PARKS	-	62 –															6	2 -
nscs -	-	- 63 –															6	- 3 -
- 901		-							11	10.6	50.4	90	11.75				Tn-Gy Soft BEDROCK(Biotite Muscovite Schist) highly weathered, very weak, very close to	1
CORE	-	- 64															6.	4 -
TTES1	-	65 –					$\left \right $										6	5 -
IR AKDC																/	4	_

STATE OF ALASKA DOT/PF Northern Region Materials Geology Section

Sheet 3 of 5

Test Hole Number 21-015

Number Decision Subsection Visitive Decision Subsection Subsection Visitive Decision Subsection Subsection Subsection Visitive Decision Subsection Subsection Subsection Subsection Visitive Decision Visitive Decision Subsection Subsection Subsection Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Decision Visitive Deci	SELAT	NON & PUBL	IC PAC	574		- 11 1	SKA	יסק ו	7/P	F			FIN	IAL	TE	EST	HOLE LOG Sheet 4 of	5
B B	TRANSP.	TE OF ALN	CHATTLESS .	Nortl Geol	nern R ogy Se	egion ection	Mate	erials		F							Test Hole Number _21-015	
66 5055004 ALE MATERIAL 66 67 68 69 69 67 68 69 69 69 69 69 69 69 69 70 <th>Drilling Method</th> <th>Depth in (Feet)</th> <th>Casing Size Blows / ft</th> <th>Method</th> <th>Number</th> <th>Blow Count</th> <th>Sample Interval</th> <th>N-Value</th> <th>Run Number</th> <th>Time (minutes)</th> <th>RQD</th> <th>Recovery</th> <th>Longest Pc. (in.)</th> <th>Structural Data</th> <th>Frozen</th> <th>Graphic Log</th> <th></th> <th></th>	Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log		
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Sheet 4 of 5

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TRANSPORT	TE OF ALN	ACTUTTIES .	STA Nortl Geol	TE OF nern R ogy Se	= ALA legion ection	SKA Mate	DO Do trials	T/Pi	F						_	Test Hole Number <u>21-015</u>
Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	
	80					\square									/	SUBSURFACE MATERIAL
	09 -															
-	90 -					$\left \right $										90
-	91-															slightly to moderately weathered, 3/4" to 1" quartz veins
-	92 -															92
	93 -							17	13	37.1	100	14 25				93
_	94 -															94
						$\left \right $										
-	95 -															95
_	96 -															96
	.					$\left \right $										close to extremely close
-	97 -															97
_	98 -															98
						$\left \right $		18	12.5	10	96.7	5.75				
-	99 -															99
oring	100-															100
C BDT																
- 02.	101_															Gy Soft BEDROCK(Graphite Biotite Schist)
90	102_															slightly to highly weathered, weak to very weak, close to very close fracture spacing 102
nsce																
	103-															103
PRI	104							19	14.25	56.2	100	9.5				104
AKDO																
R -	105-															
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1	100-															
315-32	107_															107
ARKS																
S L	108_							20	122	52 5	98.3	15				Gy Soft BEDROCK(Quartz Biotite Schist)
- 0 - 1	109-					\square										fracture spacing 109
ZE LO						$\left \right $										
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Sheet 5 of 5

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F	ield	Crew	/	G.	Nelsor	n, T. Ha	artfo	rd		_ E	quip	mer	nt Ty	pe Cl	ME	850			Stat	ion, Offset		
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					S	ample L	Jata		-	۲ 	kun D	ata						While Drilling	After Drilling	GENERAL COI	MMENTS: /Cut	
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		Dept	Casir Blows	Meth	Numt	Blow	Samp	N-Va	Run	Time	RQD	Reco	Long	Struc	Froze	Grapl	Symbol					
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+		2 -															ŧ – – –	Tn Soft BED	ROCK(Mu	scovite Schist)	2
		-															ł	complet	ely weathe	red to silt/san	, d with 1/2" grave	el -
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The second sec	TRANSFA	TE OF ALS	SNOTLITIES .	STA Norti Geol	TE O hern F logy S	F ALA Region Section	SKA Mat	A DO erials	T/Pi	F				., .=		_01	Test Hole Number <u>21-016</u>	
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- 22 - 0 97. 3 3° quartz vein - 23 - <td>_</td> <td>21 -</td> <td></td> <td>2</td>	_	21 -																2
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28 3 3 0 5 35 29 30 3 0 5 35 30 3 0 5 35 31 3 0 05 35 33 3 0 05 35 33 3 0 05 35 33 3 0 00 375 34 35 36 37 36 37 38 5 49 0 45 325 39 39 38 38 5 49 0 45 325 41			-				_										to extremely close fracture spacing	_
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31 -	-	30 -	-														2" quartz vein	3
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See 33 33 4 103 0 90 3.75 1 <td< td=""><td>Cor 8</td><td>32 -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>iracture spacing</td><td>3</td></td<>	Cor 8	32 -															iracture spacing	3
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34 - 35 - 36 - 36 - 5 4.9 0 45 3.25 Tn-Gy Soft BEDROCK(Quartz Graphite Muscovite Schist) 37 - 38 - 5 4.9 0 45 3.25 Stremely close fracture spacing Stremely close fracture spacing 38 - 40 - 5 4.9 0 45 3.25 Tn Soft BEDROCK(Quartz Muscovite Schist) Stremely close fracture spacing 39 - 40 - 5 4.9 0 45 3.25 Tn Soft BEDROCK(Quartz Muscovite Schist) Stremely close fracture spacing 30 - 41 - 41 - 41 - Stremely close fracture spacing Stremely close fracture spacing 42 - 42 - 42 - 44 - 44 - 44 - 44 -	scs_06		-						4	10.3		90	3.75					_
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36 - 36 -	DT_PRE	35 -	-															3
ar ar ar ar ar br br <td< td=""><td>AKDC</td><td>36 -</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Tn-Gy Soft BEDROCK(Quartz Graphite Muscovite Schist)</td><td>3</td></td<>	AKDC	36 -															Tn-Gy Soft BEDROCK(Quartz Graphite Muscovite Schist)	3
38 38 5 4.9 0 45 3.25 39 - <t< td=""><td>GPJ NF</td><td>37 -</td><td>-</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>highly weathered, weak to very weak, close to extremely close fracture spacing</td><td>3</td></t<>	GPJ NF	37 -	-														highly weathered, weak to very weak, close to extremely close fracture spacing	3
38 - 38 -	2021.0		-															
SNA 39 - - <td>315-325</td> <td>38 -</td> <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>5</td> <td>4.9</td> <td>0</td> <td>45</td> <td>3.25</td> <td></td> <td></td> <td></td> <td></td> <td>3</td>	315-325	38 -	-						5	4.9	0	45	3.25					3
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The second se	- DOG -	41 -	-						-									_ 4
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	T CORE		-			\vdash											Tn Soft BEDROCK(Quartz Muscovite Schist) highly to moderately weathered, weak, close to very	'
	DT TES	42 -															ciose tracture spacing	4

Sheet 2 of 5

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OF ALASKA

STATE OF ALASKA DOT/PF Northern Region Materials Geology Section

FINAL TEST HOLE LOG

Sheet 3 of 5

Test Hole Number 21-016

Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	
-	- 43 - 44 - 45 -	-						6	6.3	10.6	70.8	4.5				Tn Soft BEDROCK(Quartz Garnet Muscovite Schist) highly weathered, weak, very close to extremely close fracture spacing
_	46 - 47 - 48	-														Tn Soft BEDROCK(Garnet Muscovite Schist) highly weathered, weak to very weak, very close to extremely close fracture spacing Tn-Gy Soft BEDROCK(Graphite Quartz Muscovite
-	49 - 50 -	-							5.6	0	75	3.5				Schist) moderately to highly weathered, medium weak to weak, close to very close fracture spacing
21 1 1 1	51 - 52 - 53 -	-						8	5	7.1	100	4.25				highly weathered, weak, very close fracture spacing
SCS_06_28_07.GDT 8/19/ 1 1 1 Coring	54 - 55 - 56 -	-														Tn Soft BEDROCK(Quartz Garnet Muscovite Schist) moderately to highly weathered, medium weak to weak, moderate to very close fracture spacing
NR_AKDOT_PRECON_U	57 - 58 - 59 -	-						9	6.5	32.1	93.3	7				
tks 315-325_2021.GPJ	60 -	-														
ORE LOG - USCS PAR	62 - 63 - 64 -	-						10	5.5	23.7	80.8	11.5				small amount of biotite highly weathered, very close fracture spacing
IR AKDOT TEST C	65 -	-														Tn-Gy Soft BEDROCK(Garnet Biotite Quartz Muscovite Schist)

a Strain	ION & PUBL	IC FAC	STA	TE OF	= ΔΙ Δ	SKA	מ ו	T/P	F			FIN	IAL	TE	EST	HOLE LOG Sheet 4 of 5
TRANS	TE OF AL	ALTIES .	Norti Geol	hern R logy S	egion ection	Mate	erials	,,,,,								Test Hole Number
Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	
-	66 -							-								moderately to highly weathered, medium weak to 66
_	67 -	-														weak, moderate to very close fracture spacing
	68	-														88
								11	6.5	19.5	91.7	6				
-	69 -															69
_	70 -	-														70
	71 -							┢	-							71
		-														
-	12 -															12
-	73 -	-						12	5.6	30.5	94.2	9.5				73
_	74 -															74
	75 -															75
		-														
- -	76 -															76
oring	77 -	-														77
04.GD1	78 -							13	6.3	34.2	100	11				78
06_28	79 -															Gy-Tn Soft BEDROCK(Garnet Quartz Muscovite Biotite
Inscs		-														slightly to moderately weathered, weak, moderate to very close fracture spacing, altered biotite
SECON	80 -															80
100 100	81 -	-														81
	82 -															82
1.GPJ	83									05.5	07.5	_				Gy-Tn Soft BEDROCK(Garnet Quartz Muscovite Biotite Schist) 83
25_202		-						14	8.6	35.5	97.5	<i>'</i>				moderately weathered, medium weak to weak, moderate to close fracture spacing
S 315-0	84 -															84
PARK	85 -	-			<u> </u>											85
- USC	86 -	-						╞			\square					86
RE LOG	87				E											Q7
		-														
	88 -							15	7	60.4	100	11				88
	1										1					1

TATION & PUBLIC

Sheet 4 of 5

	TATION	& PUBLI	0.61	OT 4 -			<u> </u>		T/D/	-			FIN	IAL	TE	EST	HOLE LOG Sheet 5 of 5	5
TRANSP.	STATE O	F ALASH	CALIFIES .	STA North Geolo	nern R ogy Se	egion ection	S N A Mate	erials	1/P1	-							Test Hole Number _21-016	_
rillina Method	2	epth in (Feet)	asing Size lows / ft	ethod	umber	low Count	ample Interval	-Value	un Number	ime (minutes)	00 D	ecovery	ongest Pc. (in.)	tructural Data	rozen	raphic Log		
	_		ОШ	Σ	z		ő	Ż	2		Ω.	Ŕ	Ĕ	ũ	Ē	0 /~~~~	SUBSURFACE MATERIAL	
-		89 –															89)_
-		90 -															90)_
Coring		91 _												-			Gy-Tn Soft BEDROCK(Biotite Muscovite Schist) highly weathered, weak, close to very close fracture spacing	
-		92 -							16	4	0	69.4	3.9				92	2 -
		93 -															93	, _
		-														$\langle \tilde{\boldsymbol{v}} \rangle \tilde{\boldsymbol{v}} \rangle \tilde{\boldsymbol{v}} \rangle$	вон	-
1.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 8/19/21																	Drilling Notes: At approximately 91.5 feet bgs a void was encountered and the core barrel dropped at least 2 feet and we began losing all of our water. This is the same reaction that was experienced in TH19-022 when tooling became stuch in the test hole. To avoid the same situation, drilling was stopped.	
15-325_202		_																-
RKS 31																		
CS PA		-																_
G - US		_																
DRE LO																		-
EST CO		_																-
		-																-
NR AK									1						1			_

	THANSon PAR	NON & PUBL	S PROLITIES	STA Nortl Geol	TE OF hern Re ogy Se	ALA egion ection	SKA Mate	DO Dorials	T/PI	=			FIN	IAL	. TI	EST	Hole L	.OG					Sheet 1 of 4
	2747	EOF ALAS	Ka							P P	roje roje	ct ct N	umb	_ <u>Pa</u> er_Z	arks 6065	Highwa 570000,	<u>y MP 315-325 AKSAS_</u>	5 Reconstructio	n <u> </u>	est Hole otal Dept	Number th	21-017 81 feet	
	Fiel	ld Geol	logist	J.	SIMPS	ON													Da	ates Dril	led	7/14/2021 -	7/15/2021
	Fiel	ld Crev	V	<u> </u>	Laniga	in, T. B	abin			- E W	quıp /eat	mer her	nt Iy	/pe <u>C</u> cl	ME oud\	<u>850</u> /. rainv.	windv. 60F		St La	tation, O atitude. L	ffset _onaitude	N64.69814	°. W148.74876°
	ΤН	Finaliz	ed By	J.	Simpso	on				_ V	ege	tatio	n			,,,			El	levation		1296.0	,
					S	ample D	Data			R	lun Da	ata						Ground Water	Data	GEN	IERAL COM	IMENTS:	
	р	et)					val			(se			(in.)	ita			Depth in (ft.)	write Dritting	Alter Dhin	Rea	alignment/(Cut	
	Meth	n (Fe	Size		-	ount	Inter	¢)	Imbel	ninute		کر ا	t Pc.	ral De		c Log	Time						
	rilling	epth	asing	lethoc	nmbe	low C	ample	-Valu	nn Nı	ime (r	gD	ecove	onges	tructu	rozen	raphi	Symbol						
	Δ	0 -	о m	Σ	z	8	0	z	2	⊨	2	2	Ľ	Ó	Ē	0			SUBSU	JRFACE	MATER	IAL	0 _
		-				0.5										1							
		1 -		F		2												moist					1 -
		-		S		2	\square										ł						-
-		2 -				3												Tn Soft BED		Auscovit	e Schist)		2 _
																		complet	ely weath	hered to	silty and	clay-like so	oil, small -
-		3 -					\square										ł	graph	ite contei	nt			3 -
		-																					-
		4 -				8											ł						4 -
		5				6																	5
						5											ł						0 -
-		6 -				6																	6 –
	ß	7 _																					- 7
-	& Cas	8 -																					- 8 -
- 8/19/2	-cone	-																					-
07.GD1	Η	9 -				5																	9 -
06_28_		10 -		SPT		5 11																	10 –
		11 _				18																	- 11
RECON		12 _																					- - 12
KDOT		13 -																					- 13 -
J NR_A		-																					-
021.GP		14 -		L L		41																	- 14
5-325_2		15 _		5		50																	15 _
RKS 31		16 _					\square											Tn Soft BED	ROCK(M	Auscovite	e Schist)		16 _
SCS PA		17 _																very thir	n quartz v	veins, co	ompletely	weathered	- - 17
- 0G - U	ing	18																					- 18
COREL	Co	-							1	11.2	0	6.7	1.5										- 01
T TEST		19 _					\square																- 19 -
AKDO		20 -														/*******	, ,						20 -
R	Note:	Unless of	therwise	noted	l, all sam	nples are	e take	en with	1-3/8	3-in. 1[) Sta	ndard	Pene	tration	Sam	pler drive	n with 140 lb. ha	ammer with 30-in.	drop.	CME	Auto Hamm	er 🗌 Cath	ead Rope Method

ostan	ION & PUB	HC RAC	STA	TE OI	F AL A	SKA	A DO	T/P	F			FIN	IAL	TE	EST	HOLE LOG Sheet 2	of 4
TRANS	E OF ALS	ALTERS .	Nortl Geol	nern R ogy S	Region ection	Mat	erials									Test Hole Number <u>21-017</u>	
Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log		
	- 20 -										-				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	SUBSURFACE MATERIAL	20 -
_	21 -												-		/~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		21 .
_	22 -	-														highly to completely weathered, weak to extremely weak, very close to extremely close fracture spacing	22 -
-	23 -	-				_											23 -
-	24 -	-						2	7.2	0	70	3.75					24 -
_	25 -	-															25 -
	26	-															26
	20 -																20 -
-	27 -	-															27 -
_	28 -																28 -
		-						3	8.4	0	20	2.5					
-	29 -																29 -
-	30 -	-															30 -
21	31 -																31 .
Coring		-														completely weathered	•
07.GD	32 -	-															32 -
06_28	33 -]															33 -
- SOSL	24	-						4	6.6	0	0.8	0.5					24
	- 54 -																54 -
T_PRE	35 -	-															35 -
AKDO	36 -												-				36 -
NR Co		-															
021.GI	37 -																37 -
-325_2	38 -	-															38 -
KS 315	39							5	3.5	0	33.3	1					39
S PAR																	00 -
- USC	40 -	-															40 -
E LOG	41 -]															41 -
T COR		-															15
DT TES	42 -	1															42 -
															/:`•`;`•`;`		
Ч́Х																	

Sheet 2 of 4



STATE OF ALASKA DOT/PF Northern Region Materials Geology Section

FINAL TEST HOLE LOG

Sheet 3 of 4

Test Hole Number 21-017

Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	
-	43 -	-						6			60.0	2.05				SUBSURFACE MATERIAL
-	44 _							0	0		09.2	3.20				fracture spacing
_	- 45 -															
	-	-														
-	46 -	-														Tn Soft BEDROCK(Muscovite Schist) completely weathered
-	47 _	-														
-	48 -															
_	- 49 -							7	7.33	0	0.8	0.5				
	-	-														
-	- 50															
-	51 _	-														
-	52 -	-														
_	- 53 –	-														
- 5	-	-						8	4.5	0	23.3	0				
Coring	- 54	-														
	55 -															
	56 -	-														
, _	- 57 -															
	- 50	-														
	- 50							9	4.5	0	40	0				
	59 -															
	60 -	-				$\left \right $										
	- 61 -															rocovery included 2 intert pieces (4" 2 E" E") highly
	62															weathered, all other recovery was completely weathered to soil
	- 20															
	63 - -							10	5	13.9	60	5				
	64 -	-				$\left \right $										
	- 65 -															
	-	-				\square										

IL STAT	OF ALAS	LITLES .	Norti Geol	hern F ogy S	Region ection	Mate	erials									Test Hole Number <u>21-017</u>
Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log	
	66 -							_						-		SUBSURFACE MATERIAL
	- 67 _															completely weathered except 2- 1 pieces
	- 68							11	5.8	0	15	1				
	69 - -															
	70 _															
	71 - - 72 -															Tn-Gy Soft BEDROCK(Graphite Muscovite Schist) moderately to highly weathered, weak, close to very close fracture spacing
bui	- 73 –															
J D	- 74 _							12	5.66	38	70	6.75				
	- 75 –															
	- 76 -															highly to completely weathered, weak to very weak, close to extremely close fracture spacing
	77 - - 79															
	- 70 - 79							13	6.2	25	30	4.5				
	- - 80															
	- - 81															3OH
	-															
	_															
	_															
	_															
	_															
	_	-														

STION & PUBLIC

Sheet 4 of 4

TRANSPORT		SPOLITIES .	STA North Geol	TE OF hern Re ogy Se	ALA egion ection	SKA Mate	DO Do trials	⊺∕P I	=			FIN	IAL	TI	EST	HOLE L	.OG				Sheet 1 of 4
Fiel	CE OF ALAS	ogist	.1	SIMPS	ΩN				P P	roje roje	ct ct N	umb	_ <u>Pa</u> er_ <u>Z</u>	arks 6065	Highwa 570000,	<u>y MP 315-325</u> AKSAS	5 Reconstructio	n Test I Total Dates	Hole Numbe Depth	er <u>21-018</u> <u>81 feet</u> 7/17/2021	- 7/19/2021
Fiel	d Crew	/	P.	Laniga	in, T. H	lartfo	ord		_ E	quip	mer	nt Ty	pe_C	ME	850			Statio	on, Offset		
ТН	Finaliz	ed By	J.	Simps	on				V V	/eat ege	her tatio	n	_SL	inny,	, 70s			Latitu Eleva	de, Longitud ition	de <u>N64.6982</u> 1189.0	<u>8°, W148.76253</u>
		,		S	ample D	Data			– R	lun Da	ata						Ground Water	Data	GENERAL CC	MMENTS:	
р	et)					val			(se			(in.)	ata			Depth in (ft.)	While Drilling	After Drilling	Realignmen	t/Cut	
l Meth	in (Fe	J Size / ft	5	5	count	e Intei	Ð	umbei	minute		ery	st Pc.	ıral Da		ic Log	Time Date			-		
Drilling	Depth	Casing Blows	Metho	qun	Blow (Sampl	N-Valı	Sun N	Lime (gD	Recov	-onge	Structi	-rozei	Graph	Symbol					
	0 -		-		2		_	-		_	-	-		+		-	ORG MAT	SUBSURF	ACE MATE	RIAL	0
	-		┝		2	\square											Tn-Bn SILT				
-	1 -		Ъ.		2											ł	moist, <i>s</i>	l Org			1
asing	2 _				7												Tn Soft BED highly to	ROCK(Muso completely	covite Schis weathered	t) to silt	2
-~~	3 -															ł					3
cone	-					\square															
Ξ	4 -															ł					4
-	5 _		SPT		54																5
	6 -															ł 	0				
	-					\vdash										ļ	Gy-In Soft E Schist	t)	Quartz Musc	ovite Graph	ite
-	7 -																highly to extren	o completely nemly close	weathered, fracture spa	weak, very acing	close to 7
1 8/19/21	0 - 0 -							1	11.6	0	41.7	2.25									0
28_07.6	10 _																				10
	11 -																				11
	12 _																				12
	-					\square										ļ					
Cori-A	13 -							2	81	18.2	98.3	6 25				ţ	Tn-Gy Soft E	BEDROCK(G	Garnet Grapl	hite Muscov	rite 13
	14								0.1	10.2	0.0	0.20				ł	Schist highly w	veathered, ve	ery weak, clo	ose to very o	close 14
2021.(-					\parallel										1	tractu	re spacing			
2 47.97	15 -					H										ł					15
1	16 -																Gy-Tn Soft E	BEDROCK	Quartz Musc	ovite Graph	16
	17 _																Schist slightly t close	t) to moderatel fracture spa	y weathered	l, weak, clos	se to very 17
	18 _								0.75		100	5 75									18
	19 _					\square		3	9.75	9.6	100	5.75									19
	20 -																				20

-	Drilling Method)epth in (Feet)	asing Size lows / ft	fethod	lumber	slow Count	ample Interval	I-Value	tun Number	ime (minutes)	tab	tecovery	ongest Pc. (in.)	tructural Data	rozen	Braphic Log	
-		20 -		2	2		S	Z		-				S			SUBSURFACE MATERIAL 3" section with small biotite content
	-	- 21 _															
-	-	- 22															moderate to close fracture spacing
	-	- 23 –															
		-							4	9.4	57.9	100	9.25				
	-	- 24															
-	-	25 –															
	-	- 26 –															
		- 27															
	-	- 12															
	-	28 -							5	95	53.8	98.3	75				increase in quartz content
-	-	29 _															
	_	- 30 –															
_		-															
8/19/2	oring	31 -															medium to very weak
7.GDT	Ŭ	32 –															
06_28_0	-	- 33															
USCS_(- 34							6	8	30	100	5				
CON	-	- +0															
DT_PRI	-	35 –															
R_AKD(-	36 -															
GPJ NI	_	- 37 –															
5_2021.		-															
315-325	-	- 38							7	7.1	41.7	96.7	6.5				
ARKS	-	39 –					\square										
JSCS F	-	- 40 -															
1-901		-															
CORE	-	41 _												ŀ			slight increase in muscovite
T TEST	-	42 –															
AKDO																	
RN																	

STATE OF ALASKA DOT/PF Northern Region Materials Geology Section

Sheet 2 of 4

_20

Test Hole Number 21-018

	Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.)	Structural Data	Frozen	Graphic Log		
	-	43 -														/~~~~ /~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		- 43 -
	_	- 44 _							8	8.8	49.6	100	6					44 _
		-																-
	-	45 -															4 4 4	45 -
	-	46 -															close to very close fracture spacing	46 -
	_	- 47 _																47 _
		-																-
	-	48 -							9	8.9	27.1	100	6.5					48 -
	-	49 –																49 –
	-	- 50 -																- 50 -
		51																51
	_	- 10																- 10
	-	52 –																52 -
	-	53 _															moderately to highly weathered moderate to year close	53 -
9/21	g	- 54							10	7.5	55.8	100	8.25				fracture spacing	- 54 -
DT 8/19	Corin	-																-
3_07.GI	-	55 -																55 -
s_06_2	-	56 –															slightly to highly weahtered, medium weak to weak	56 –
N_USC	_	- 57 –																- 57 -
RECO		-																-
(DOT_F	-	- 58							11	9.9	64.2	100	9.25					58 -
NR_A	-	59 –																59 –
21.GPJ	-	60 _																- 60 -
325_202		61															v v v	61
S 315-3	_	- 10															slightly to completely weathered, medium weak to very weak, close fracture spacing	- 10
PARK	-	62 –																62 -
- USCS	-	63 _																63 -
E LOG	_	- 64							12	7	63.3	100	7.5					64 _
ST COR		-																-
OT TES	-	65 -																65 -
NR AKD																,*,*, * ,*	4	

Test Hole Number <u>21-018</u>

Sheet 3 of 4



Drilling Method	Depth in (Feet)	Casing Size Blows / ft	Method	Number	Blow Count	Sample Interval	N-Value	Run Number	Time (minutes)	RQD	Recovery	Longest Pc. (in.	Structural Data	Frozen	Graphic Log	
-	66 - 67 - 68 - 69 - 70 - 71 -							13	8.5	63.3	87.5	16.5				SUBSORFACE MATERIAL moderately to completely weathered, weak to very weak, moderate to very close fracture spacing 6 7 7 7 7 7 7 7 7 7 7
- Coring	72 - 73 - 74 - 75 - 76 -							14	6.5	0	55	3.5				7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
TT_PRECON_USCS_06_28_07.GDT_8/19/21	77 - 78 - 78 - 79 - 80 - 80 - 81 -							15	7.9	0	71.7	3.75				7 7 7 8 8 8
EST CORE LOG - USCS PARKS 315-325_2021.GPJ NR_AKDC																

Test Hole Number 21-018



STATE OF ALASKA DOT/PF Northern Region Materials Geology Section

APPENDIX B-GEOPHYSICS: SEISMIC REFRACTION SURVEY

2019 Seismic Refraction Surveys:



P-Wave Velocity (feet per second)





1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000 P-Wave Velocity (feet per second)



2021 Seismic Refraction Survey:





	Rock Co	ore Properties		
Weathering	Strength	Fracture Spacing	RQD	AssignedValue
Completely	Extremely Weak	Extremely Close	0	1
Highly	Very Weak	Very Close	1-25% Very Poor	2
Moderately	Weak	Close	25-50% Poor	3
Slightly	Medium Weak	Moderate	51-75% Fair	4

Seismic Refraction Survey Correlation to Realignment/Cut Test Holes:









APPENDIX C-SYMBOLS AND DEFINITIONS

SYMBOLS AND DEFINITIONS

<u>BASIC MA</u>	ATERIAL SYMBOLS	TYPICAL LOG
	ASPHALT LAT/LONG OR	R-HOLE NUMBER 05-41 STATION, OFFSET ① Sto 210+53, Lt 3 ELEVATION (ft) Elev 375
	PEAT	DATE LOGGED 16 JUN
	CLAY (CI)	WATER 24 S N VALUE : ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;
	ICE	FROZEN ~ 75% PERCENT VISIBLE ICE * 100%
	SILT (Si)	DEPTH SAMPLE INTERVAL (FEET) 15.0 S S STRATA CONTACT
	POORLY GRADED SAND (So)	POSSIBLY W.D. AUGER REACTION)
0°°° •00	POORLY GRADED GRAVEL (Gr)	(1) Station value may also be on centerline e.g. Sta 210+53, CL
	WELL GRADED SAND	or lat—long format e.g. N64.56789', W145.67890' ② W.D.= WHILF DRILLING, A.D.= AFTER DRILLING
	WELL GRADED GRAVEL	(3) "N VALUE" INDICATES STANDARD PENETRATION TEST (1.4" I.D., 2.0" O.D. SAMPLER DRIVEN WITH 140 LB. HAMMER, 30" FREE
	BEDROCK (Bx), soft(Type)	FALL) AND IS SUM OF 2nd AND 3rd 6" OF PENETRATION.
	BEDROCK (Bx), hard(Type)	PLAN VIEW SYMBOLS
SOFT OR HA	ARD BEDROCK BASED ON DRILLING RATE	 Ø POWER AUGER TEST HOLE (TH) ☐ HAND AUGER TEST HOLE (TH)
<u>NUTE</u> MAIN COMPO	NENT (UPPER CASE SOLID LINES)	€③ EXPOSED MATERIAL → PROBE
MINOR COM	PONENT (Title Case DASHED LINES	HAND DUG TEST PIT (TP)
OR SPARSEF	R PATTERN)	\sim BODY OF WATER
<u>USCS SIZ</u>	ZE DEFINITIONS	FLOW DIRECTION
BOULDERS ((Boulders) 12"+	AT BANK
GRAVEL	#4 TO 3"	¥ ¥ SWAMP
ANGULAR FR	RAGMENTS #10 +	TREELINE
SILT	#200 TO #4 #200 TO 0.005 mm	· · · · · · · · · · · · · · · · · · ·
CLAY	MINUS 0.005 mm	SOIL DENSITY/CONSISTENCY DESCRIPTORS
TEST	RESULTS	RELATIVE BLOWS/FOOT BLOWS/FOOT
%-200	= % PASSING #200 SIEVE	DENSITY (N) VALUE CONSISTENCY (N) VALUE
NM%	= NATURAL MOÏSTURE	VERY LOOSE < 4 VERY SOFT < 2
URG% SSc	= ORGANIC CONTENT = SODIUM SUITEATE LOSS(course)	MEDIUM DENSE 11–30 FIRM 5–8
SSf _	= SODIUM SULFATE LOSS(fine)	DENSE 31–50 STIFF 9–15
LA _	= LOS ANGELES ABRASION	VERY DENSE > 50 VERY STIFF 16-30
DEG	= DEGRADATION	HARD > 30
LL PI	= LIQUID LIMII (NV = no value) - PLASTIC INDEX (NP - pop-plastic)	COLOR
· ·		Bk = BLACK $Gy = GRAY$ $Tn = TAN$
<u>MISC.</u>		$BI = BLUE \qquad Or = ORANGE \qquad Wh = WHITE$
Tr	= TRACE	Bn = BROWN Rd = RED Yw = YELLOW Gn = GREEN
sı hi	= SLIGHTLY = HIGHTY	
 w/	= WITH UNSPECIFIED AMOUNT	
X'tls	= CRYSTALS	ary = < UPTIMUM* DUSTY, DRY TO THE TOUCH
TH	= TEST HOLE	wet = > OPTIMUM* VISIBLE FRFF WATER
II TP	= IESI IRENCH = TEST PIT	* OPTIMUM MOISTURE FOR MAYIMUM DENSITY
11	- ILJI I II	



and a set of the											Г
Phase (a) (Independent of				DESCF	RIPTIC	NA NO		ASSIFICATION OF F	ROZEN	SOILS	
	Major	Group	Sub-Gi	roup					Guide for Construct	ion on Solls Subject to Freezing and Theming	T
	Description (2)	Designation (3)	Description (4)	Designation (5)	Fie	Id Identificati	on (6)	Pertinent Properties of Frozen Materials which may be measured by physical tests to supplement field identification. (7)	Thaw Characteristics (8)	Criteria (9)	
		e = 29	Poorly Bonded or Friable	N.	Identify by vis determine pre	ual examinat sence of exc	ion. To ess ice, use	In-Place Temperature Density and Voit Ratio a) In Frozen State		The potential intensity of ice segregation in a soil is dependent provide degree on its vois sizes and may be expressed as an empirior function of an of chings of chings.	t to
	Segregated ice is not visible by eye (b)	Z	No excess ice Well Bonded	Nb Nb	procedure un magnifying le not fully satur saturation: Me	ider note (c) t ins as necess ated, estimat edium, Low. h	elow and han ary. For soils e degree of ict Vote presence	d b) After Thawing in Place Water Content (Total H ₂ 0, including ice) a) & Average ^a b) Distribution	Thaw-Stable	empinoal introduct of grain size as follows. Most inorganic soils containing 3 percent or more of grains fine than 0.02 mm in diameter by weight are frost-susceptible. Gravels well-marked eards and tilly sonds arranding the	e
Part II			Excess ice		larger particle	S.		Strength a) Compressive	•	approaching the theoretical maximum density curve, which contain 1.5 to 3 percent finer than 0.02 mm by weight without	
Description of Frozen Soil			Individual ice crystals or inclusions	Vx	For ice phase	, record the fi	ollowing as	d) Adfreeze		pering trost-succeptible. However, their tendency to occur interbedded with other soils usually makes it impractical to consider them separately.	
	Segregated ice		Ice coatings on particles	Vc	applicable: Location	Size		Elsefic Droventing		Soils classed as frost-susceptible under the above criteria are likely to develop significant ice segregation and frost heave if	
	is visible by eye. (Ice 1 inch or less in thickness) (b)	>	Random or irregularly oriented ice formations	Vr	Orientation Spacing Length Hardness }	Pattern of	ickness arrangement	Plastic Properties Thermal Properties	Usually Thaw-Unstable	frozen at normal raises with free water readily available. Soils s frozen will fall into the thaw-unstable category. However, they i they to be classed as thaw-stable if frozen with insufficient water normi is a convension.	ç a o
			Stratified or distinctly oriented ice formations	Vs	Structure } Color } Estimate volui present as per	per part I me of visible rcent of total	II Below segregated ict sample volum	lee Crystal Structure (using optional e instruments.) re al Orientation of Axes		por muce acquegenon. Soils classed as non-frost-susceptible ("NFS) under the above criteria rusually norma without sciencificant ice servations and ac	a s
Part III	<u>8</u>	IC	Ice with soil inclusions	Ice + Soil Type	Designate ma descriptive ter item from eacl	aterial as ICE rms as follow: h group, as a	(d) and use s, usually one pplicable:	b) Crystal size c) Crystal shape d) Pattern of Arrangement		exceptions may be indequate for some structure applications may be indequate for some structure applications exceptions may also result from minor soil variations.	suo:
Description of Substantial Ice Strata	(Greater than 1 inch in thickness)		Ice without soil inclusions	Ice	Hardness Sti Hard C Soft CI Soft CI (mass, Pt not indi- C crystals) Gr	ructure Colo lear e.g.: loudy Colo orous less andled Gray anular Blue	r Admixtures e.g.: r- Contains Thin Silt Inclus- ions	Same as Part II above, as applicable, with special emphasis on Ice Crystal Structure.		In permafrost areas, ice wedges, pockets, veins, or other ice bodies may be found whose mode or origin is different from the described above. Such ice may be the result of long-time surfa expansion and contraction phenomena or may be glacial or oth ice which has been buried under a protective earth cover.	at her
DEFINITIONS: Ice Coatings on P: particles in a froze crystals. which hav	articles are disce. In soil mass. The ve grown into vo	ermible layers of ay are sometime	ice found on or belo is associated with hr v the freezing action	w the larger soil oarfrost	Well-bonded s possesses rel:	signifies that t atively high re	the soil particle esistance to ch	Interpret the interpret of the interp	t the frozen soil	NOTES:	1
<u>Ice Crystal</u> is a vei Crystals may be p	ry small individua vresent alone or ir	al ice particle vis n a combination	sible in the face of a with other ice forms	n soil mass. ations.	Poorly-bondet consequently	dsignifies tha has poor resi	it the soil partic stance to chip	icles are weakly held together by the ice and th oping or breaking.	at the frozen soil	(a) When rock is encountered, standard rock classification leminology should be used. (b) Frozen soils in the N cruzin may on close examination indic	ţ
Clear ice is transp Cloudy Ice is trans Porous Ice contair from melting at air materials in the wa	barent and contait slucent, but esser ns numerous void r bubbles or along	ns only a mode. ntially sound an ds, usually inter g crystal interfac	rate number of air bu Id non-pervious connected and usua ces from presence o	ubbles.(e) ally resultinç of salt or other	Friable denote Thaw-Stable finder nor produce de	es a condition rozen soils du etrimental sel	i in which mate o not, on thawi ttlement.	terial is easily broken up under light to moderate ing, show loss of strength below normal, long-ti	e pressure. ime thawed values	reserve of ice within the voids of the material by crystalline reflections of by a sheen on fractured or timmed surfaces. However, the impression to the unaided eye is that none of the fozen water occupies space in excess of the original voids in t	the
mass retains its st <u>Candled ice</u> is ice very loosely bonde	tructural unity. which has rotted ed together.	l or otherwise fo	irmed into long colur	mnar crystals,	Thaw-Unstabl values and/or	le frozen soils significant se	show on thav ttlement, as a	wing, significant loss of strength below normal, I a direct result of the melting of the excess ice in	long-time thawed the soil.	soil. The opposite is true of frozen soils in the V group. (c) When visual methods may be inadequate, a simple field tes aid evaluation of volume of excess ice can be made by plac some frozen soil in a small isr allowing it to mails and Ascension.	cing at
<u>Granular Ice</u> is con weakly bonded to <u>c</u> <u>Ice Lenses</u> are len other, generally no	mposed of coarst gether. Iticular ice format ormal to the direct	e, more or less tions in soil occu tion of heat loss	equidimensional, icc urring essentially pa- s and commonly in r	e crystals irallel to each 'epeated layers.	Modified from Frozen Soik	r: Linell, K. A. s, Proc. Inter I.S. National J	. and Kaplar, (national Confe Academy of Sc	C. W., 1966, Description and Classification of srence on Permafrost (1963), Lafayette, IN, iciences, Publ. 1287, pp 481–487.		the quantity of supernatant water as a percent of total volume. (d) Where special forms of ice, such as hoarfrost, can be	0
Ice Segregation is and masses in soil direction of heat lo	the growth of ice ils, commonly but ss.	e as distinct lens t not always orie	ses, layers, veins ented normal to	-						usunguished, more explicit description should be given. (e) Observer should be careful to avoid being misled by surfact scratches or frost coating on the ice.	ø