

October 25, 2019

Ms. Janine Boyette
Response and Remediation SME
Alyeska Pipeline Service Company
P.O. BOX 196660
Anchorage, AK 99519-6660

Re: Summary of Permafrost Conditions Near Pump Station PS05 and the Yukon Response Base

Dear Ms. Boyette,

At the request of Alyeska Pipeline Service Company (APSC), SLR International Corporation (SLR) has compiled the information in this letter report in support of the purpose and objectives described below.

PURPOSE

The purpose of this work is to provide a summary of permafrost conditions in the vicinity of Pump Station 5 (PS05) and the Yukon Response Base (YRB) to support the application of Alaska Department of Environmental Conservation (ADEC) Arctic Zone cleanup levels as defined by Title 18 of the Alaska Administrative Code (AAC), Chapter 75, part 990 (18 AAC 75.990). The definition of “Arctic Zone” requires the site be located north of latitude 68° North; and areas south of that latitude will be considered an “Arctic Zone” on a site-specific basis, based on a demonstration that the site is underlain by continuous permafrost. The application of Arctic Zone cleanup levels would apply to manmade roads and pads as noted in Table A2 of 18 AAC 75.341(b).

OBJECTIVES

The objective of this work was to review publicly available documentation of permafrost distributions at or near PS05 and the YRB and summarize the findings.

2019 DOCUMENT REVIEW

Key documents reviewed to prepare this letter report included the TAPS alignment soil borings presented in *TRANS ALASKA PIPELINE SYSTEM, Soil borings, Locations, and Summary of Laboratory Test Data* prepared by R&M Engineering-Geological Consultant (R&M) (R&M, 1969), and the *Alaska LNG Project Draft Environmental Impact Statement* (AK LNG DEIS) prepared by the Alaska Gasline Development Corporation (AGDC) (AGDC, 2019). These documents were reviewed for information regarding the distribution of permafrost in the vicinity of PS05 and the YRB. Geotechnical data reviews and engineering recommendation reports for PS05 and the YRB were reviewed for information on subsurface conditions.

Additional documentation reviewed included ADEC Contaminated Site summary and closure documentation for the Five Mile Airstrip site located 5 miles north of the Yukon River.

DOCUMENT REVIEW FINDINGS

Findings of the document review are discussed in the following sections. Maps, tables, and borehole logs of permafrost and soil conditions in the vicinity of PS05 and the YRB are presented in Appendices A through G.

AGDC Draft EIS Permafrost Summary

Section 4.2.2.1 of the Alaska LNG AK LNG DEIS document discusses permafrost extent, landforms, and associated soil types along the AK LNG proposed corridor. The map, Alaska Permafrost Extent & Ranges is presented in this section and is provided as Appendix A (AGDC, 2019). The permafrost extent map shows continuous permafrost conditions existing from Prudhoe Bay to south of the Yukon River just north of the community of Livengood. The locations of the PS05 and the YRB facilities are included in this mapped distribution of continuous permafrost.

1969 TAPS Alignment Borings Review

Prior to pipeline construction, the pipeline owners performed an evaluation of soil conditions along the proposed pipeline corridor. The soil borings were installed in 1969 by R&M Engineering and Geological Consultants (R&M). The summary document, *Trans Alaska Pipeline System, Soil Borings, Locations and Summary of Laboratory Test Data, Valdez to Prudhoe Bay* (R&M, 1969) mapped the locations of test holes between Valdez and Prudhoe Bay and provided borehole logs for each location.

TAPS Alignment Borings Near PS05

Locations of TAPS alignment test boreholes and test borehole data in the vicinity of PS05 are presented as Appendix B. Boreholes TH-4-74, TH-4-75, and TH-4-76 run from south to north across the location of PS05, with borehole TH-4-75 nearest to the present location of the facility.

Each of the boreholes show frozen conditions and ice lenses to the borehole total depths which ranged from 20.5 feet below ground surface (bgs) at TH-4-76, to 30 feet bgs at TH-4-75. In addition, the presence of ice lenses in each of these boreholes indicate permafrost since segregated ice accumulations are not associated with seasonally-frozen soil. Groundwater was not encountered in any of these three boreholes.

In addition to soil borehole information, it should be noted there is no water well at the PS05 facility. Due to the presence of continuous permafrost, the drinking water well was drilled approximately 0.75 miles from PS05 in gravels within the thaw bulb of the Jim River. The Jim River location was chosen due to the presence of permafrost in the vicinity of the PS05 pad. The Jim River has sufficient flow volume to flow throughout the entire year creating a lens, or bulb, of thawed soil adjacent to the river channel. A water supply pipe delivers water from the off-site well to the PS05 water treatment and distribution system.

TAPS Alignment Borings Near YRB

Locations of TAPS alignment test boreholes and test borehole data in the vicinity of the YRB are presented as Appendix C. Test boreholes TH-4-1 through TH-4-6 were installed north of the Yukon River and run north. Test boreholes TH-5-400 through TH-5-403 were installed south of the Yukon River and run south.

The boreholes north of the Yukon River ranged in depth from 15 feet bgs at borehole TH-4-3, to 30 feet bgs at boreholes TH-4-4, TH-4-5, and TH-4-6. Each of the boreholes showed frozen conditions to full depth and segregated ice was noted in boreholes TH-4-1 and TH-4-4. Groundwater was not encountered in any of these boreholes.

The boreholes south of the Yukon River ranged in depth from 16 feet bgs at borehole TH-5-400, to 30.6 feet bgs at borehole TH-5-403. Each of the boreholes showed frozen conditions to full depth and segregated ice was noted in boreholes TH-5-401, TH-5-402, and TH-5-403. Groundwater was not encountered in any of these boreholes.

In addition to soil borehole information, it should be noted there is no water well at the YRB. Due to the presence of continuous permafrost, a well was not drilled and drinking water for the facility is supplied from an off-site source at the former Five Mile Camp located approximately five miles north the Yukon River.

2019 AK LNG Project Potential Permafrost Disruption Summary

The development of the AK LNG DEIS included preparation of a summary of permafrost and soil conditions along the proposed pipeline alignment. The summaries of permafrost and soil conditions near the vicinity of PS05 and the YRB are provided in the following sections.

AK LNG Permafrost and Soils Near PS05

The proposed alignment for the AK LNG Project mainline corridor near PS05, along with the associated permafrost and soil conditions from the AK LNG DEIS are presented as Appendix D. This alignment section shows PS05 at approximately mile post 279 of the AK LNG mainline corridor. Appendix C of the DEIS shows this section of pipeline alignment, from mile 274.86 to mile 281.3, comprising 6.44 miles of continuous thaw-unstable permafrost. Appendix B of the DEIS shows soils along this section of alignment as comprised of Typic Histoturbels. Turbels have one or more horizons that show evidence of cryoturbation in the form of broken, irregular, or distorted horizon boundaries, involutions, organic matter accumulated above permafrost, ice or sand wedges, and oriented rock fragments. Turbels are the dominant soil order and make up the majority of Gelisols in Alaska. Gelisols consist of soils that are permanently frozen or contain evidence of permafrost within 6.6 feet (2.0 meters) of the soil surface. Turbels, and the various great groups within Turbels, represent the largest class of thaw-sensitive permafrost due to the high ground ice content (AGDC, 2019).

AK LNG Permafrost and Soils Near YRB

The proposed alignment for the AK LNG Project mainline corridor near the YRB, along with the associated permafrost and soil conditions from the AK LNG DEIS are presented as Appendix E. This alignment section shows the YRB at approximately mile post 358 of the AK LNG mainline. Appendix C of the DEIS shows this section of pipeline alignment, from mile 356.69 to mile 368.65, comprising 11.97 miles of continuous thaw-unstable permafrost. Appendix B of the DEIS shows soils along this section of alignment as comprised of Typic Histoturbels.

2004 Golder Associates Geotechnical Report for PS05

In 2004, Golder Associates Inc. (Golder) prepared a report titled *Geotechnical Data Review and Engineering Recommendations for Alyeska Pump Station 5* (Golder, 2004a). This report was prepared in advance of construction activities planned for the facility and summarized soil conditions, performance of existing structure foundations, and provided recommendations for future construction. The borehole data used to prepare the geotechnical findings were from six boreholes advanced in 1972 and four additional boreholes advanced at the facility in 1981.

Borehole data were compiled into facility maps (Figures 3 and 4) and cross sections (Figures 4 through 7) and are provided as Appendix F. Facility cross sections show frozen soil was encountered across the facility up to 70 feet beneath the placed-fill surface layer. Frozen soil was present to the full depth of each boring (Appendix F). Groundwater was not noted on any of the ten borehole logs for boreholes drilled at the PS05 facility. The active, seasonal thaw, layer was estimated to extend to 8 feet bgs. Below the active layer, the permafrost was estimated to extend to greater than 100 feet bgs (Golder, 2004a).

The geotechnical report noted that the findings of the initial 1972 geotechnical borings resulted in the recommendation that all permanent heated structures incorporate ground-thaw prevention in their design. As a result, heated permanent structure foundations at PS05 are either insulated and refrigerated, mounted on pilings or placed on skids to prevent subsurface soil thaw from the heated buildings. In addition, the buried mainline pipe entering and leaving the facility is insulated, and underlying soils are mechanically refrigerated using a circulating brine system to prevent the thaw of permafrost. The report recommended pre-drilled driven pile foundations for future construction at PS05. The report summarized findings of ground-thaw issues encountered at the nearby Prospect Creek Airport where annual maintenance and at least two rebuilds have been required to continue operation of the facility. The ground thaw at the Prospect Creek Airport was believed to result from its construction atop considerable ice-rich subsurface material which received solar gain after native vegetation removal.

2004 Golder Associates Geotechnical Report for YRB

In 2004, a review and summary of geotechnical information was performed by Golder for the YRB, referred to as PS06 at the time of publication (Golder, 2004b). The report, *Geotechnical Data Review and Engineering Recommendations for Alyeska Pump Station 6*, summarized the findings from vertical support

member (VSM) pile logs and borings from various subsurface investigations to prepare engineering recommendations in advance of new construction ramp down activities. The general background discussion section of the report describes the YRB area to have widespread permafrost reported to be continuous from within a few feet of the ground surface to more than 100 feet deep (Golder, 2004b).

Borehole data were compiled into facility maps (Figures 3 and 4) and cross sections (Figures 5 and 6) and are provided as Appendix G. Facility cross sections show frozen soil was encountered across the facility up to over 85 feet beneath the placed-fill surface layer. Frozen soil was present to the full depth of each boring (Appendix G). Groundwater was not noted on any of the borehole logs for boreholes drilled at the YRB facility. The active, seasonal thaw, layer was estimated to extend to 8 feet bgs. Below the active layer, varying thicknesses of frozen silty soils extend to underlying fine-grained igneous dunite bedrock (Golder, 2004b).

The report found high thaw settlement potential for the YRB attributed to thick deposits of thaw-unstable silts. The original geotechnical recommendations for construction included refrigerated foundations for permanent heated buildings and buried pipe, and thermosyphons for elevated pipe VSMs entering and leaving the facility.

ADEC Contaminated Sites Five Mile Airstrip Site Summary and Arctic Zone Determination

In 2011, SLR prepared a report documenting TAPS VSM borehole logs obtained during the installation of mainline pipe VSMs in the vicinity of the Five Mile Airstrip site (SLR, 2011). The report, *Five Mile Airstrip Permafrost and 1975 VSM Summary*, was prepared to document permafrost conditions along the southern end of the airstrip runway as part of a request for the application of Arctic Zone cleanup levels to the Five Mile Airstrip site. The VSM logs showed permafrost conditions along approximately 1,200 feet of mainline pipe spanning the length and width of the Five Mile Airstrip site. The report was reviewed by ADEC and, as a result, institutional controls were removed and the site was closed using Arctic Zone cleanup levels (ADEC; 2011, 2019).

CONCLUSIONS AND RECOMMENDATION

Borehole data collected along the TAPS alignment in 1969, recent YRB and PS05 facility geotechnical surveys, and soil conditions presented in the AK LNG DEIS clearly indicate continuous permafrost conditions are present at PS05 and the YRB. The presence of these conditions is supported by borehole data, observed soil types, the nearby elevation of TAPS mainline pipe, construction requirements for ground-thaw prevention, and the lack of observed or available groundwater for facility use at PS05 and the YRB. In addition, ADEC supported the use of Arctic Zone cleanup levels at the Five Mile Airstrip site five miles north of the Yukon River in 2011 based on a review of mainline pipe VSM soil boring logs traversing this area.


Based on the documented presence of continuous permafrost at PS05 and the YRB, SLR recommends the application of Method Two, Table B1 and B2 Arctic Zone cleanup levels established in 18 AAC 75.341 be applied to sites located on roads and pads at these facilities.

Please contact us at your convenience should you have any questions.

Sincerely,
SLR International Corporation



Carl Benson
Principal Scientist


for Scott Rose
Principal Geologist

- Enc Appendix A – Alaska LNG Project Section 4.2.2.1 – Alaska Permafrost Extent & Ranges Map
 Appendix B – 1969 TAPS Alignment Borings Near PS05
 Appendix C – 1969 TAPS Alignment Borings Near YRB
 Appendix D – AK LNG Draft EIS Contaminated Sites, Permafrost, and Soil Summaries PS05
 Appendix E – AK LNG Draft EIS Contaminated Sites, Permafrost, and Soil Summaries YRB
 Appendix F – Golder Associates Geotechnical Report Cross-Sections for PS05
 Appendix G – Golder Associates Geotechnical Report Cross-Sections for YRB

REFERENCES

- Alaska Department of Environmental Conservation (ADEC), 2011. Five Mile Airstrip Modification of Cleanup Complete Determination-Institutional Controls. November 8.
- ADEC, 2019. Contaminated Sites Site Report: Alyeska Five Mile Airstrip <https://dec.alaska.gov/Applications/SPAR/PublicMVC/CSP/SiteReport/25387>. October 7.
- Alaska Gasline Development Corporation, 2019. Alaska LNG Project Draft Environmental Impact Statement. June.
- Golder Associates, Inc. (Golder), 2004a. Geotechnical Data Review and Engineering Recommendations for Alyeska Pump Station 5. September.
- Golder, 2004b. Geotechnical Data Review and Engineering Recommendations for Alyeska Pump Station 6. September.
- R&M Engineering-Geological Consultants, 1969. Trans Alaska Pipeline System, Soil Borings, Locations and Summary of Laboratory Test Data, Valdez to Prudhoe Bay. November.
- SLR International Corporation, 2011. Five Mile Airstrip Permafrost and 1975 VSM Summary. July.

APPENDIX A

ALASKA PERMAFROST EXTENT & RANGES MAP

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019

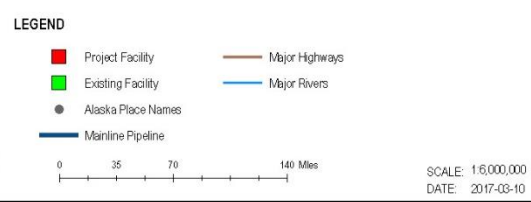
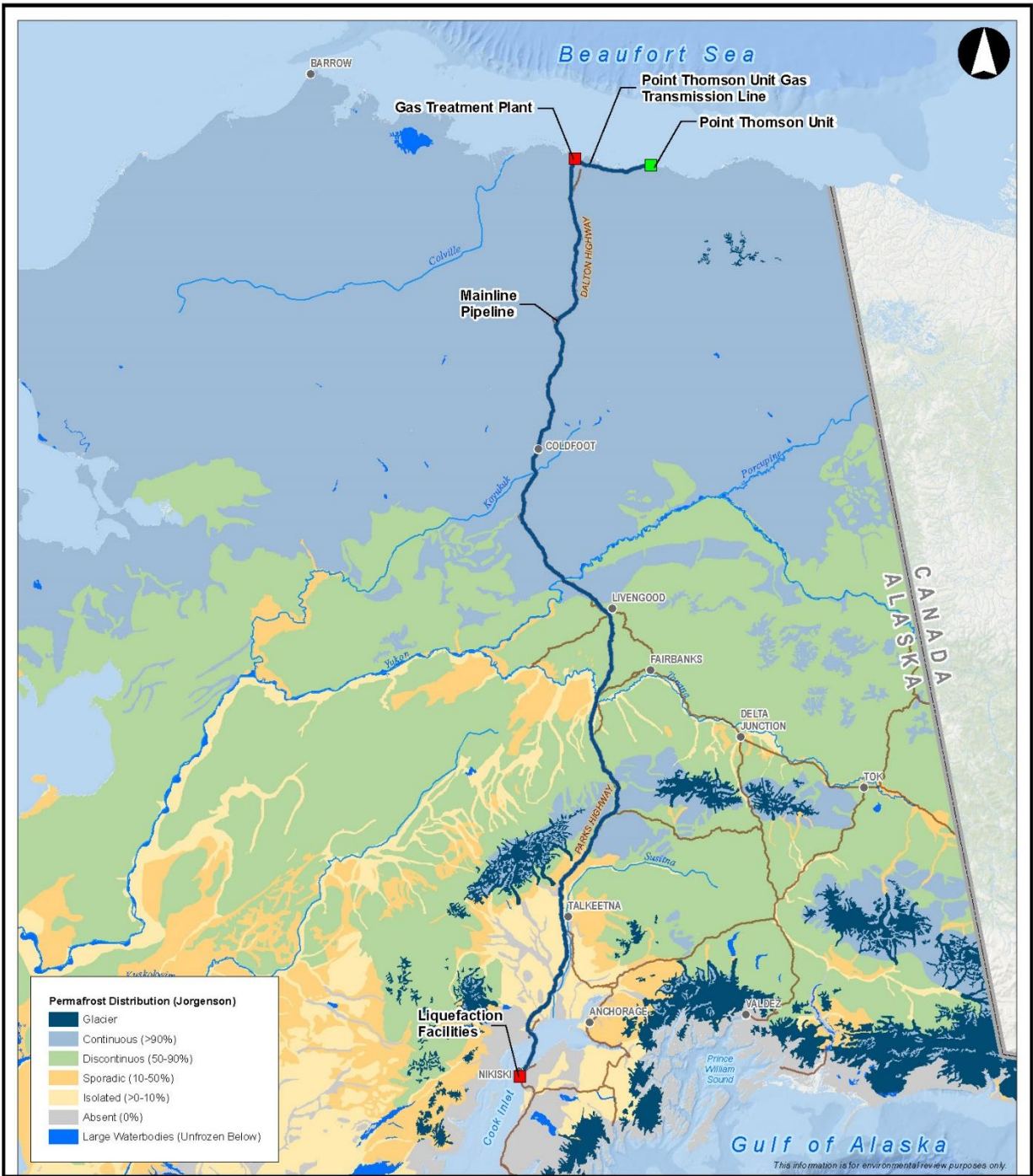


Figure 4.2.2-1
Alaska LNG Project
Alaska Permafrost
Extent and Ranges

Brown et al., 1997

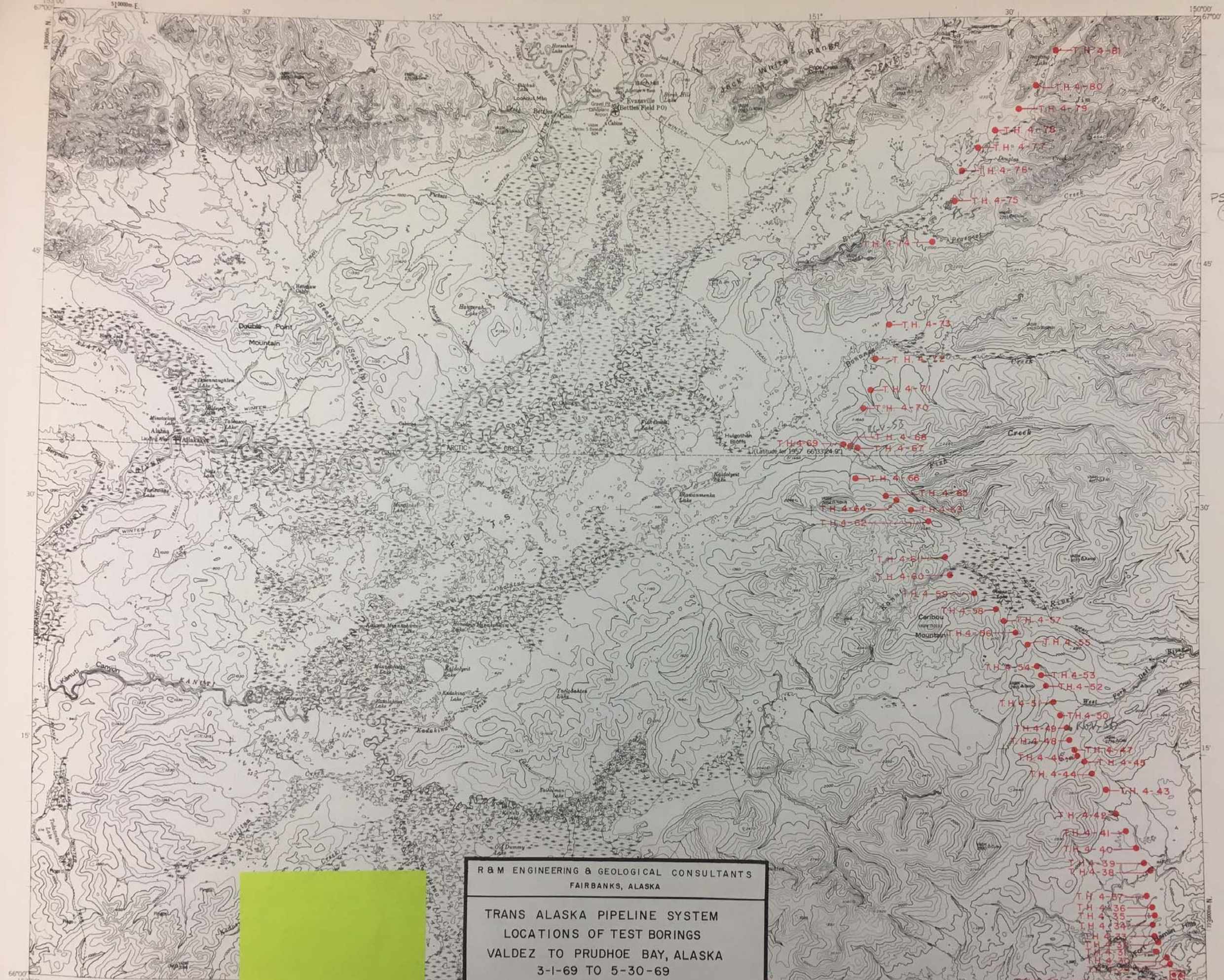
APPENDIX B

1969 TAPS ALIGNMENT BORINGS NEAR PS05

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019



PS5
(TH 4-75)

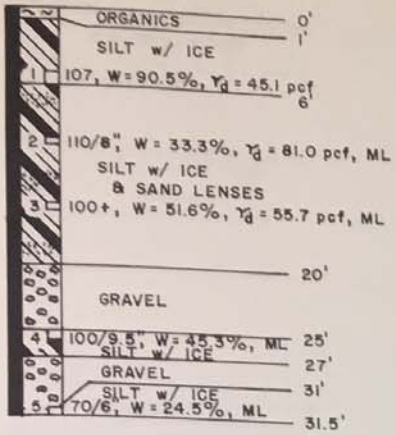
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R & M ENGINEERING & GEOLOGICAL CONSULTANTS
FAIRBANKS, ALASKA

TRANS ALASKA PIPELINE SYSTEM
LOCATIONS OF TEST BORINGS
VALDEZ TO PRUDHOE BAY, ALASKA
3-1-69 TO 5-30-69

DATE	11-6-69	SCALE	DRAWING NO.	7
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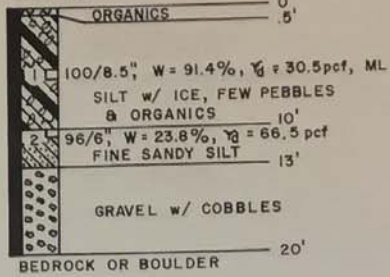
T.H. 4-67 (TAPS)
4-13-69



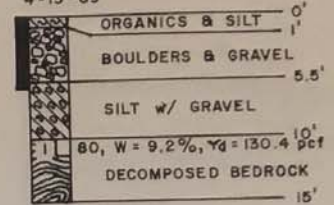
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4-13-69



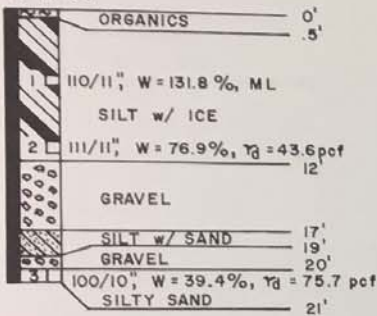
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4-14-69



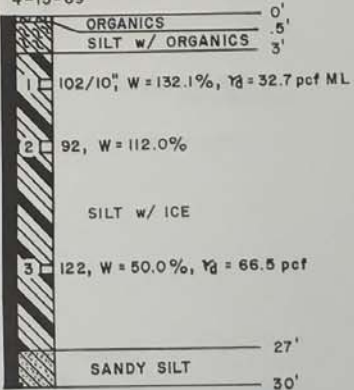
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4-15-69



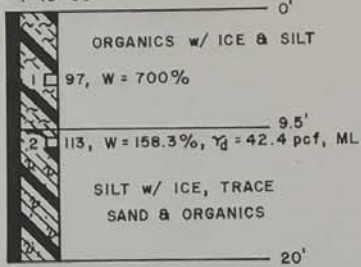
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4-15-69



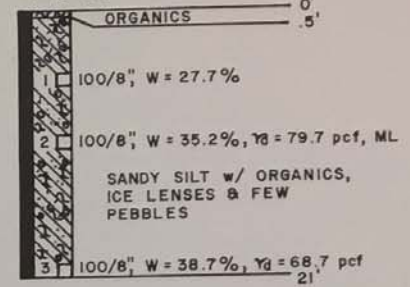
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4-15-69



T.H. 4-73 (TAPS)
4-16-69



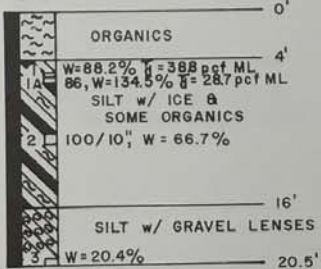
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4-16-69



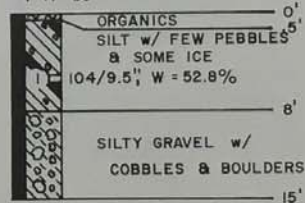
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4-16-69



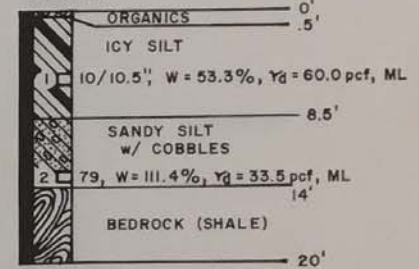
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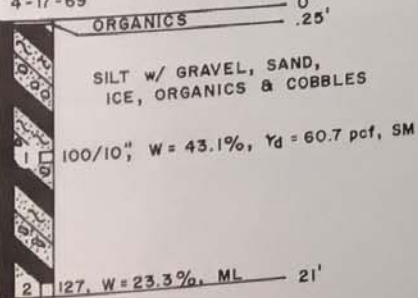
T.H. 4-77 (TAPS)
4-17-69



T.H. 4-78 (TAPS)
4-17-69



T.H. 4-79 (TAPS)
4-17-69



T.H. 4-80 (TAPS)
4-18-69



T.H. 4-75
Pump Station 5
drill depth 30'

<ul style="list-style-type: none"> ORGANICS ORGANIC SILT GRAVEL SAND SILT CLAY BEDROCK 	<p>T.H. 1-12 4-8-69</p> <p>DATE DRILLED</p> <p>STRATA CHANGE</p> <p>BLOWS / FT.</p> <p>WATER CONTENT</p> <p>DRY DENSITY</p> <p>UNIFIED CLASS</p> <p>GRD. WATER LINE</p> <p>DRILL DEPTH</p>	<p>R & M ENGINEERING-GEOLOGICAL CONSULTANTS FAIRBANKS, ALASKA</p> <p>TRANS ALASKA PIPELINE SYSTEM LOGS OF TEST BORINGS VALDEZ TO PRUDHOE BAY, ALASKA 3-1-69 TO 5-30-69</p>
	<p>11-6-69</p> <p>DATE</p>	<p>1" = 10'</p> <p>SCALE</p>

APPENDIX C

1969 TAPS ALIGNMENT BORINGS NEAR YRB

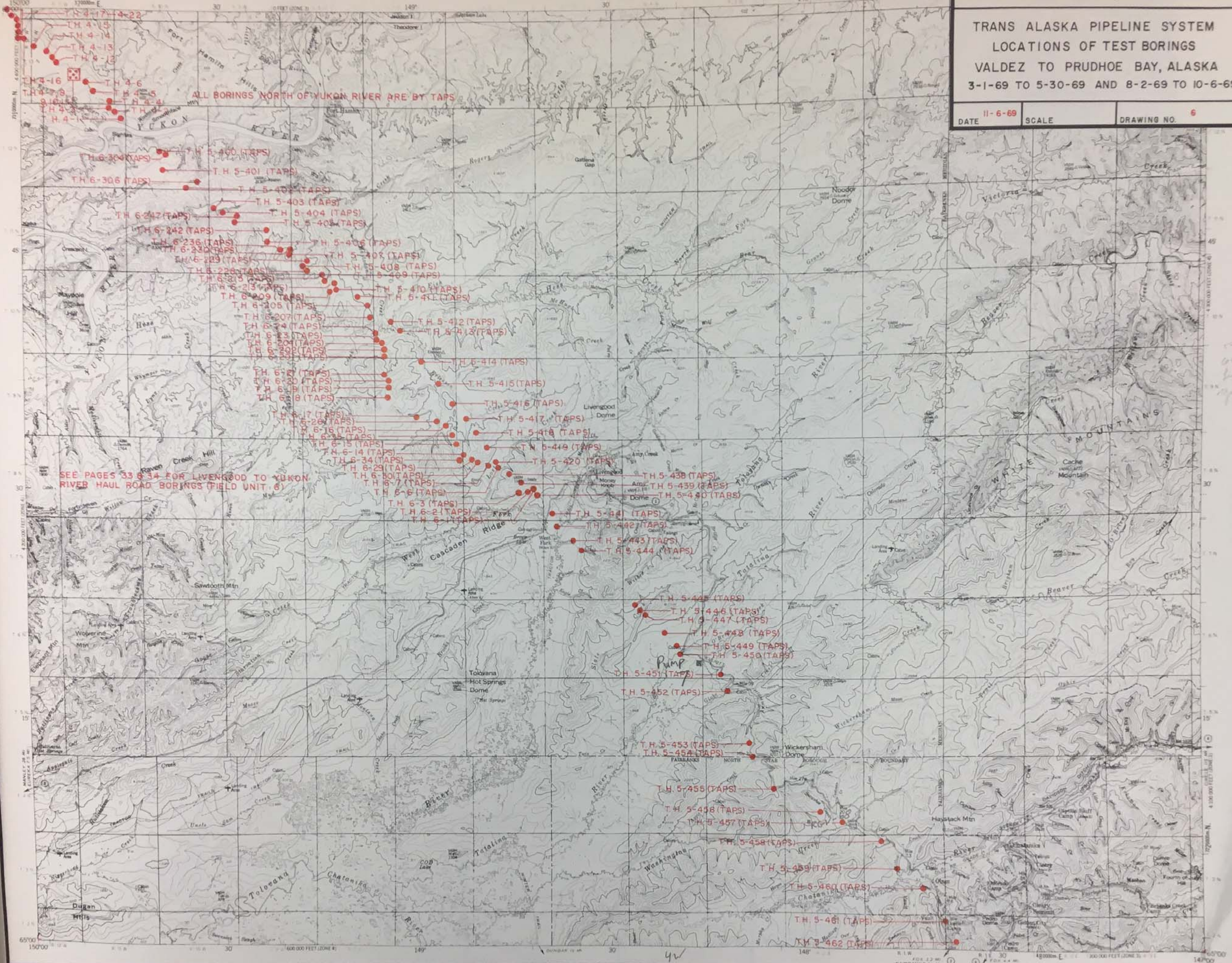
Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019

TRANS ALASKA PIPELINE SYSTEM
 LOCATIONS OF TEST BORINGS
 VALDEZ TO PRUDHOE BAY, ALASKA
 3-1-69 TO 5-30-69 AND 8-2-69 TO 10-6-69

DATE 11-6-69 SCALE DRAWING NO. 6



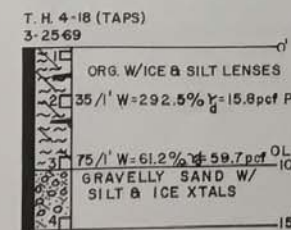
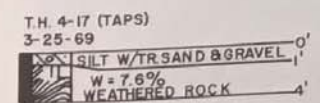
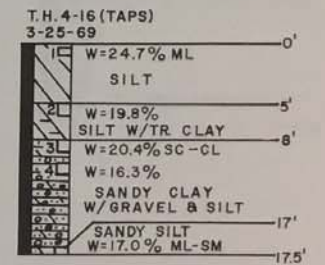
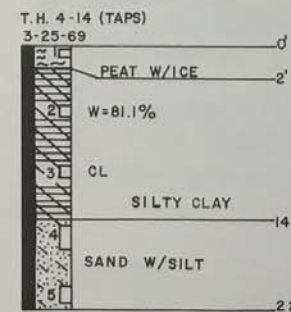
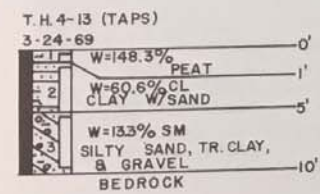
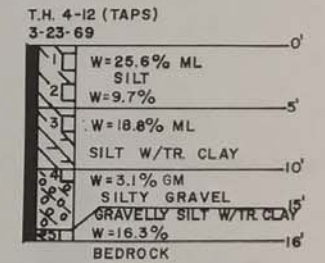
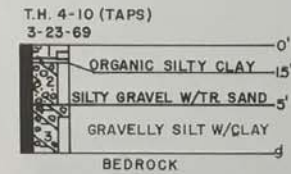
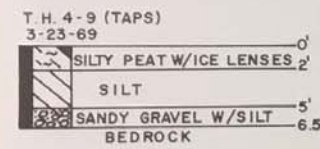
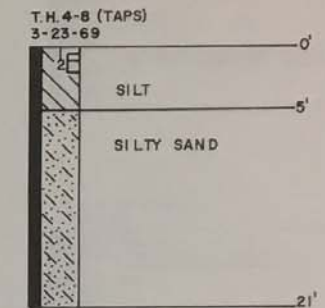
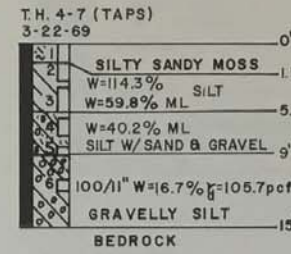
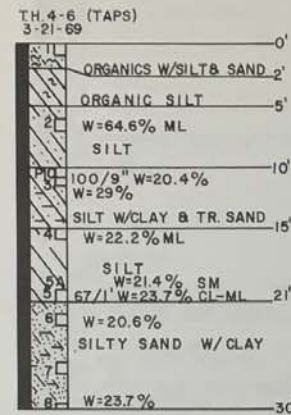
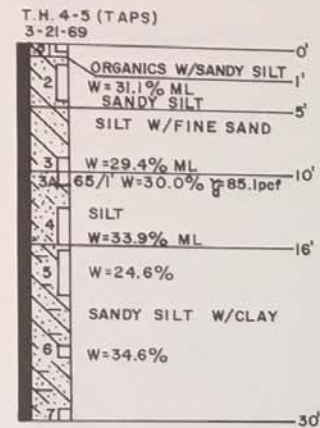
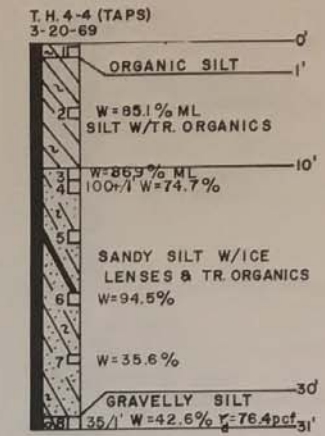
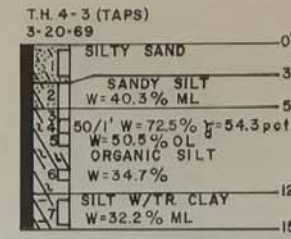
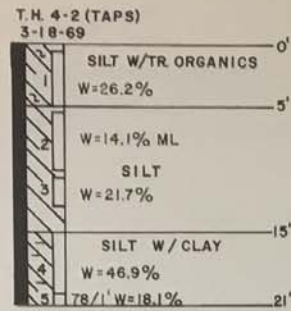
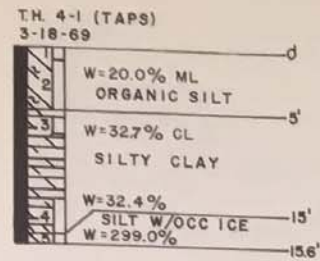
SEE PAGES 33 & 34 FOR LIVENGOOD TO YUKON RIVER HAUL ROAD BORINGS (FIELD UNIT 6)

ALL BORINGS NORTH OF YUKON RIVER ARE BY TAPS

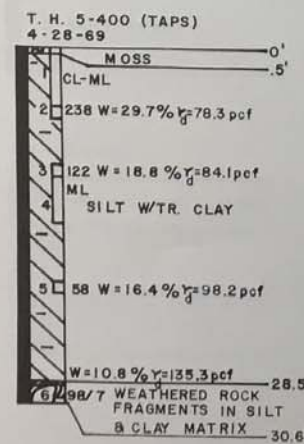
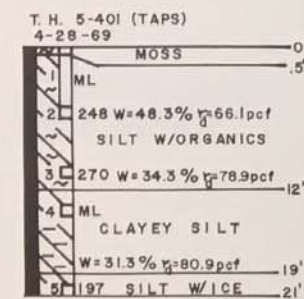
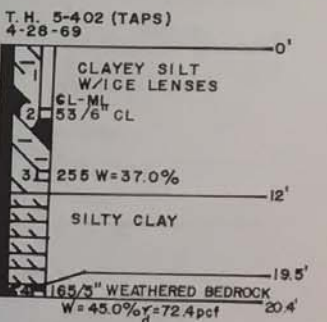
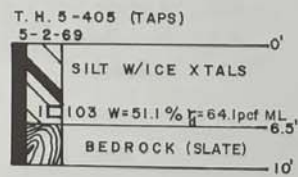
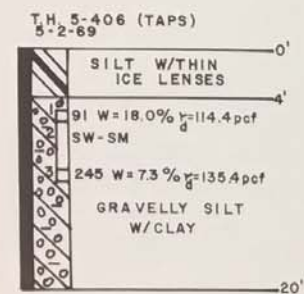
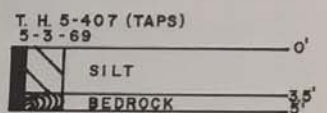
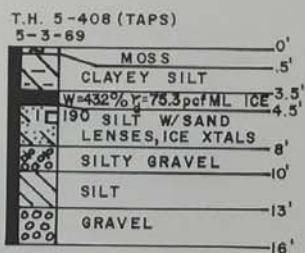
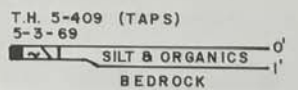
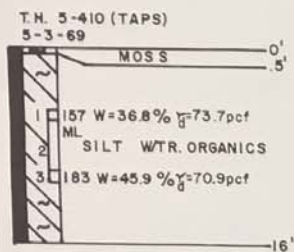
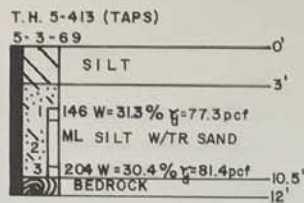
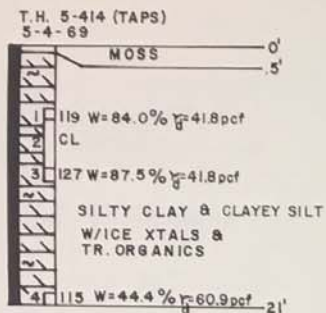
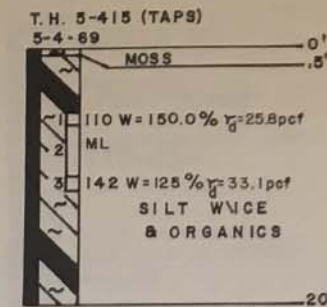
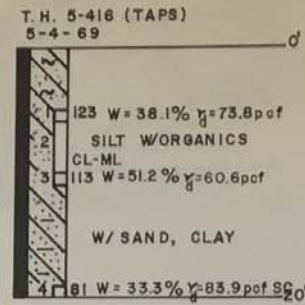
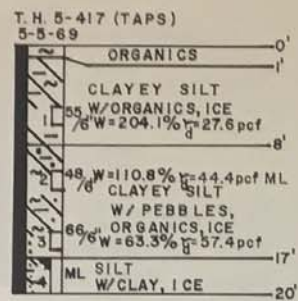
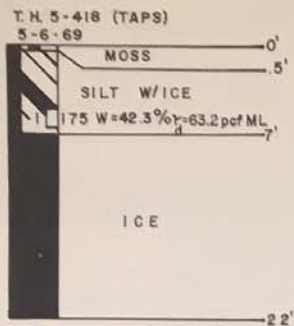
42

1:50,000 SCALE
 1" = 10,000 FEET
 1:50,000 SCALE
 1" = 10,000 FEET

15-3



		<p>R & M ENGINEERING-GEOLOGICAL CONSULTANTS FAIRBANKS, ALASKA</p> <p>TRANS ALASKA PIPELINE SYSTEM LOGS OF TEST BORINGS VALDEZ TO PRUDHOE BAY, ALASKA 3-1-69 TO 5-30-69</p>
	<p>DATE 11-6-69 SCALE 1" = 10' DRAWING NO. 21</p>	



		<p>R & M ENGINEERING-GEOLOGICAL CONSULTANTS FAIRBANKS, ALASKA</p> <p>TRANS ALASKA PIPELINE SYSTEM LOGS OF TEST BORINGS VALDEZ TO PRUDHOE BAY, ALASKA 3-1-69 TO 5-30-69</p>
	<p>DATE 11-6-69</p> <p>SCALE 1" = 10'</p> <p>DRAWING NO. 20</p>	

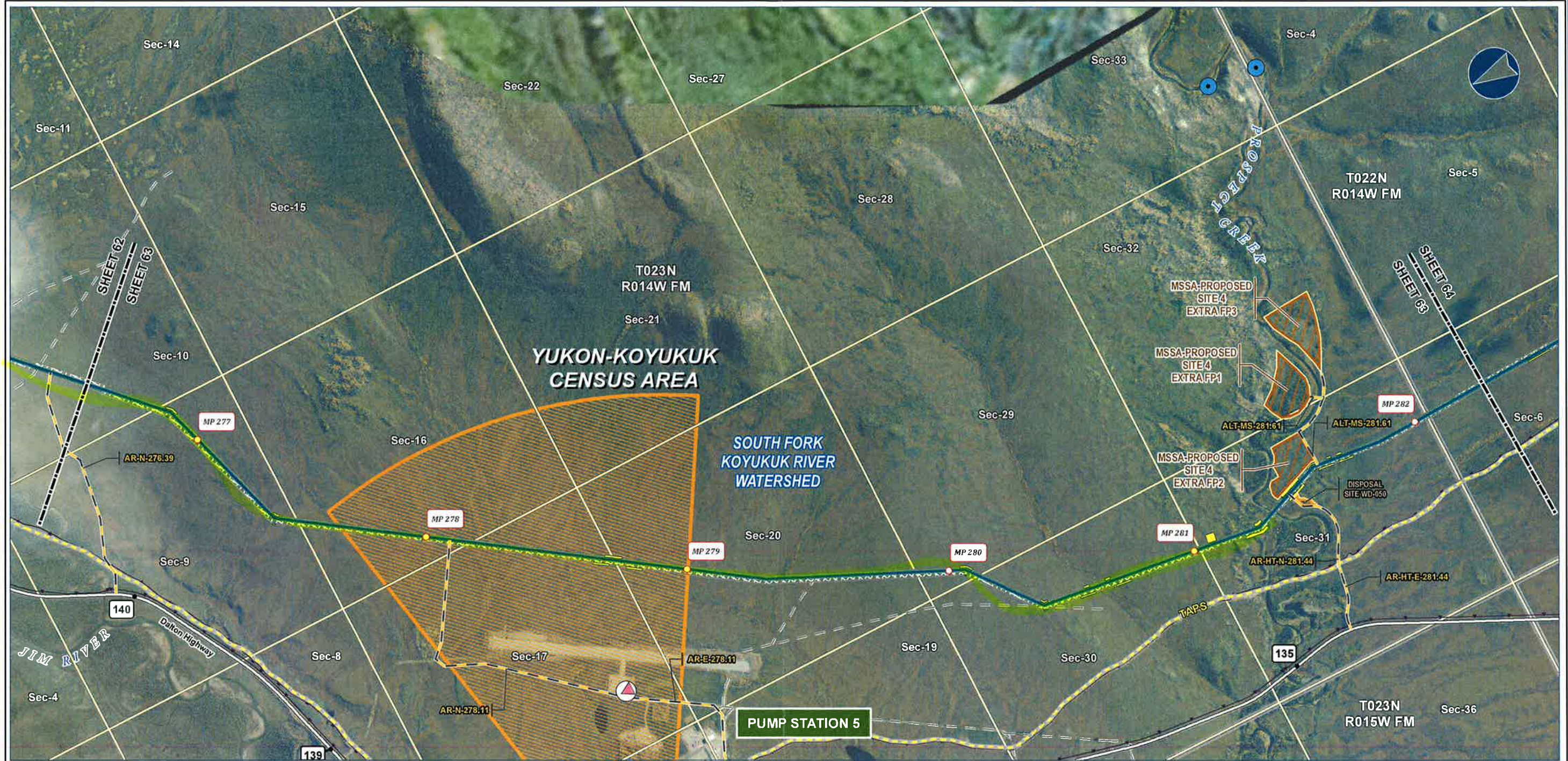
APPENDIX D

AKLNG DRAFT EIS CONTAMINATED SITES, PERMAFROST, AND SOIL SUMMARIES PS05

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019



Legend

Alaska LNG Rev C2 Route	Permanent ROW	Existing Roads	ADEC Contaminated Sites	Township
Access Road - Gravel	Construction ROW	Off Road Trails	Open	Surface Water Rights
	ATWS	TAPS		Drinking Water - Zone B
	Disposal Site	Buried Cable		
	Material Site Study Area (MSSA)			

ALASKA LNG PROJECT
Contaminated Sites
Mainline Rev C2 Route

CENSUS AREA: YUKON-KOYUKUK	DRAWN BY: AGDC	
STATE: ALASKA	CHECKED BY:	
REV. NO.:	REVISION	DATE
A	ISSUED FOR REVIEW	2017-03-23
PRELIMINARY		
1:24,000 0 1/4 1/2 Miles		
DATE: 2017-03-23	PROJECTION: NAD83 NRSR2007 ALASKAZONE4 FTUS 54382	

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DWG: RR8_APPENDIX_C2_MAINLINE_AERIAL_REV_C2_CL SHEET: 63

X:\AKLNG\Resource Reports\RR08\Appendix C\MAINLINE\RR8_APPENDIX_C2_MAINLINE_AERIAL_REV_C2_CL.mxd

TABLE 1							
Potential Permafrost Stability Disruption within the Alaska LNG Project Area							
Facility Name ^a	MP (To)	MP (From)	Length (mi)	% Permafrost Crossed ^b	Permafrost Mileage	Thaw Stability	Construction Spread-Season
						(Thaw Unstable/ Thaw Stable) ^b	
LIQUEFACTION FACILITY							
Mainline	271.75	272.1	0.35	0.7	0.24	TU	Summer
Mainline	272.1	272.31	0.22	0.05	0.01	TU	Summer
Mainline	272.31	272.46	0.14	0	0	NA	Summer
Mainline	272.46	272.55	0.09	0.25	0.02	TU	Summer
Mainline	272.55	272.56	0.02	0.7	0.01	TU	Summer
Mainline	272.56	274.65	2.08	1	2.08	TU	Summer
Mainline	274.65	274.67	0.03	0.75	0.02	TU	Summer
Mainline	274.67	274.68	0	0.7	0	TU	Summer
Mainline	274.68	274.7	0.02	0.15	0	TU	Summer
Mainline	274.7	274.86	0.16	0.7	0.11	TU	Summer
Mainline	274.86	281.3	6.44	1	6.44	TU	Summer
Mainline	281.3	281.36	0.05	0	0	NA	Summer
Mainline	281.36	281.44	0.08	0.3	0.03	TU	Summer
Mainline	281.44	282.49	1.05	1	1.05	TU	Summer
Mainline	282.49	283.82	1.34	1	1.34	TS	Summer
Mainline	283.82	283.9	0.08	0.25	0.02	TS	Summer
Mainline	283.9	283.91	0.01	0.35	0	TS	Summer
Mainline	283.91	284.21	0.3	0.7	0.21	TS	Summer
Mainline	284.21	284.24	0.02	0.7	0.02	TU	Summer
Mainline	284.24	284.85	0.61	0.25	0.15	TU	Summer
Mainline	284.85	285.99	1.15	1	1.15	TU	Summer
Mainline	285.99	286.1	0.1	1	0.1	TS	Summer
Mainline	286.1	286.8	0.7	1	0.7	TU	Summer
Mainline	286.8	286.98	0.18	0.7	0.13	TU	Summer
Mainline	286.98	287.04	0.06	0.05	0	TU	Summer
Mainline	287.04	287.51	0.47	0.2	0.09	TU	Summer
Mainline	287.51	287.56	0.05	0.25	0.01	TS	Summer
Mainline	287.56	287.61	0.05	0.9	0.05	TS	Summer
Mainline	287.61	287.85	0.24	0	0	NA	Summer
Mainline	287.85	288.18	0.33	0.25	0.08	TU	Summer
Mainline	288.18	288.35	0.17	0.7	0.12	TU	Summer
Mainline	288.35	288.37	0.02	0.65	0.01	TU	Summer

APPENDIX B - STATSGO2 SOIL METADATA																
Properties of Soils Crossed by the Project																
Facility Name ^a	Feature Type ^a	Approx. MP ^b	Distance (ft)	Acerage ^b	MUSYM	Map Unit Name ^b	Borough/Census Area	Surface Texture ^b	Drainage Class ^b	Slope (%) ^b	Wind Erosion Potential ^b	Water Erosion Potential ^b	Hydric Soil ^b	Compaction Potential ^b	Topsoil Depth ^b (Inches)	Depth to Bedrock ^b (feet)
Mainline	ATWS	274.39	105.00	0.04	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.44	63.36	0.24	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.59	62.50	0.02	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.64	121.90	0.58	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.65	72.51	0.08	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.78	80.18	2.27	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	274.92	120.88	0.59	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	275.46	68.43	0.08	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	275.46	105.00	0.04	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	275.75	113.29	0.32	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	275.81	67.48	0.30	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	275.84	112.72	0.33	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	276.11	97.30	0.02	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	276.12	64.99	0.21	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Access Road	276.64	1852.03	10.99	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Pipeline	276.80	-	-	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	276.85	65.07	0.18	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	276.86	108.15	0.02	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	277.41	65.08	0.09	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	277.42	110.01	0.04	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Access Road	278.47	2498.03	13.58	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	278.67	107.66	0.26	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	278.72	67.23	0.27	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	278.80	115.15	0.30	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Access Road	278.91	5948.12	0.28	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Camp	278.92	7196.97	35.24	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	PSY	278.94	6240.17	9.18	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Access Road	279.12	6486.26	3.93	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	Access Road	279.21	3060.07	10.51	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5
Mainline	ATWS	280.07	65.00	0.18	s9250	Typic Histoturbels-Typic Eutrocryepts-Typic Aquiturbels (s9250)	Yukon-Koyukuk	Peat	Very poorly drained	9	Slight	Slight	Yes	Severe	>20	> 6.5

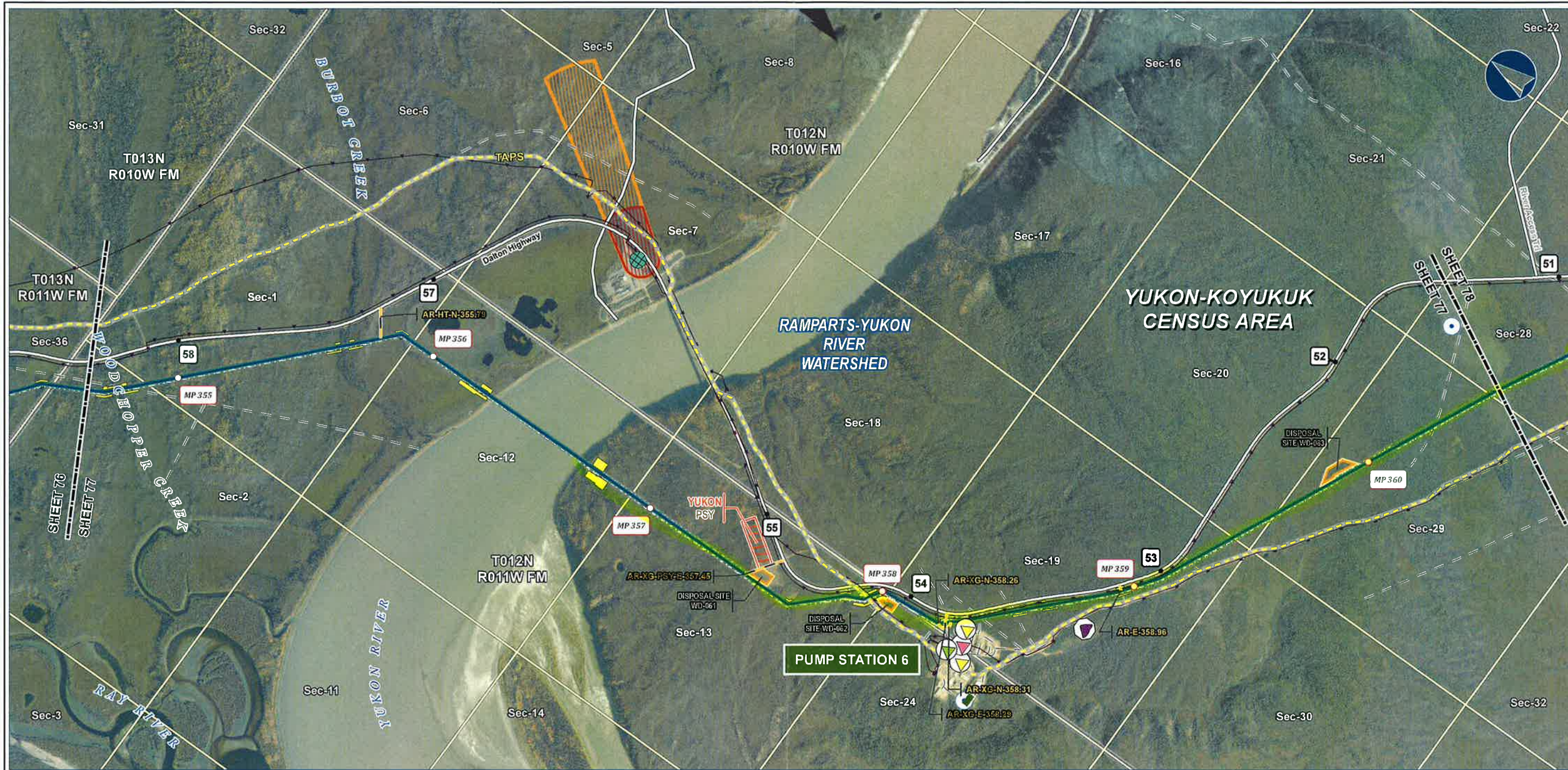
APPENDIX E

AKLNG DRAFT EIS CONTAMINATED SITES, PERMAFROST, AND SOIL SUMMARIES YRB

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019



Legend	
Permanent ROW	Existing Roads
Construction ROW	Off Road Trails
ATWS	TAPS
Pipe Storage Yard (PSY)	Buried Cable
Disposal Site	Alaska DOT Place Names
Section	Township
ADEC Contaminated Sites	Water Well Location (WELTS)
Cleanup Complete	Subsurface Water Rights
Cleanup Complete - Institutional Controls	Drinking Water - Zone A
Open	Drinking Water - Zone B
ADEC Solid Waste Site	
Retired	

ALASKA LNG PROJECT		
Contaminated Sites		
Mainline Rev C2 Route		
CENSUS AREA:	YUKON-KOYUKUK	DRAWN BY: AGDC
STATE:	ALASKA	CHECKED BY:
REV. NO.:	REVISION	DATE
A	ISSUED FOR REVIEW	2017-03-23
PRELIMINARY		
1:24,000	0 1/4 1/2 Miles	
DATE: 2017-03-23	PROJECTION:	NAD83 NRS2007 ALASKAZONE4 FTUS 54302

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DWG: RRB_APPENDIX_C2_MAINLINE_AERIAL_REV_C2_CL SHEET: 77

TABLE 1							
Potential Permafrost Stability Disruption within the Alaska LNG Project Area							
Facility Name ^a	MP (To)	MP (From)	Length (mi)	% Permafrost Crossed ^b	Permafrost Mileage	Thaw Stability	Construction Spread-Season
						(Thaw Unstable/ Thaw Stable) ^b	
LIQUEFACTION FACILITY							
Mainline	352.54	352.56	0.02	0.9	0.02	TU	Winter
Mainline	352.56	352.57	0.01	1	0.01	TU	Winter
Mainline	352.57	352.59	0.02	0.75	0.01	TU	Winter
Mainline	352.59	352.89	0.3	1	0.3	TU	Winter
Mainline	352.89	353.29	0.4	0.7	0.28	TU	Winter
Mainline	353.29	353.87	0.58	1	0.58	TU	Winter
Mainline	353.87	353.92	0.04	0.75	0.03	TU	Winter
Mainline	353.92	354.23	0.31	1	0.31	TU	Winter
Mainline	354.23	354.24	0.01	0.85	0.01	TU	Winter
Mainline	354.24	354.46	0.22	0.75	0.17	TU	Winter
Mainline	354.46	354.81	0.35	1	0.35	TU	Winter
Mainline	354.81	354.83	0.02	0.75	0.01	TU	Winter
Mainline	354.83	354.89	0.06	0.7	0.04	TU	Winter
Mainline	354.89	354.91	0.02	0.75	0.02	TU	Winter
Mainline	354.91	354.98	0.07	1	0.07	TU	Winter
Mainline	354.98	355.21	0.23	0.7	0.16	TU	Winter
Mainline	355.21	355.69	0.48	1	0.48	TU	Winter
Mainline	355.69	355.74	0.05	0.25	0.01	TU	Winter
Mainline	355.74	356.26	0.51	1	0.51	TU	Winter
Mainline	356.26	356.69	0.43	0	0	NA	Summer
Mainline	356.69	368.65	11.97	1	11.97	TU	Summer
Mainline	368.65	368.88	0.22	0.3	0.07	TU	Summer
Mainline	368.88	369.13	0.25	0.5	0.13	TU	Summer
Mainline	369.13	369.23	0.09	0.9	0.08	TU	Summer
Mainline	369.23	369.32	0.1	0.5	0.05	TU	Summer
Mainline	369.32	369.39	0.06	0.9	0.06	TU	Summer
Mainline	369.39	369.48	0.09	0.5	0.05	TU	Summer
Mainline	369.48	369.66	0.18	1	0.18	TU	Summer
Mainline	369.66	369.69	0.03	0.8	0.03	TU	Summer
Mainline	369.69	369.87	0.18	1	0.18	TU	Summer
Mainline	369.87	369.96	0.09	0.9	0.08	TU	Summer
Mainline	369.96	371.47	1.51	1	1.51	TU	Summer

APPENDIX B - STATSGO2 SOIL METADATA																
Properties of Soils Crossed by the Project																
Facility Name ^a	Feature Type ^a	Approx. MP ^b	Distance (ft)	Acerage ^b	MUSYM	Map Unit Name ^b	Borough/Census Area	Surface Texture ^b	Drainage Class ^b	Slope (%) ^b	Wind Erosion Potential ^b	Water Erosion Potential ^b	Hydric Soil ^b	Compaction Potential ^b	Topsoil Depth ^b (inches)	Depth to Bedrock ^b (feet)
Mainline	ATWS	357.85	109.44	0.02	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.85	64.32	0.17	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.91	120.00	0.52	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.92	73.60	0.11	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.93	94.49	0.04	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.97	73.20	0.19	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.98	102.50	0.28	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	357.99	68.27	0.19	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.02	82.48	0.02	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Disposal Site	358.05	184.31	1.47	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.24	65.14	0.06	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.25	94.35	0.05	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Access Road	358.26	124.93	0.17	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.27	65.00	0.11	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Access Road	358.28	155.77	0.17	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.28	99.16	0.27	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Access Road	358.28	102.83	0.22	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.56	91.42	0.27	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.57	70.15	0.10	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.63	67.62	0.08	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.65	79.45	0.09	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.67	87.71	0.26	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.95	65.00	0.11	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Access Road	358.95	102.16	0.10	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	358.95	88.73	0.22	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Disposal Site	359.87	187.49	3.42	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Access Road	363.47	610.39	2.29	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	Disposal Site	363.48	1325.54	1.40	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	363.49	65.13	0.11	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5
Mainline	ATWS	363.49	96.84	0.24	s9347	Typic Histoturbels-Typic Eutrocryepts-Typic Dystrrocryepts-Aeric Cryaquepts (s9347)	Yukon-Koyukuk	Silt loam	Well drained	43	Slight	Moderate	Yes	Severe	>20	> 6.5

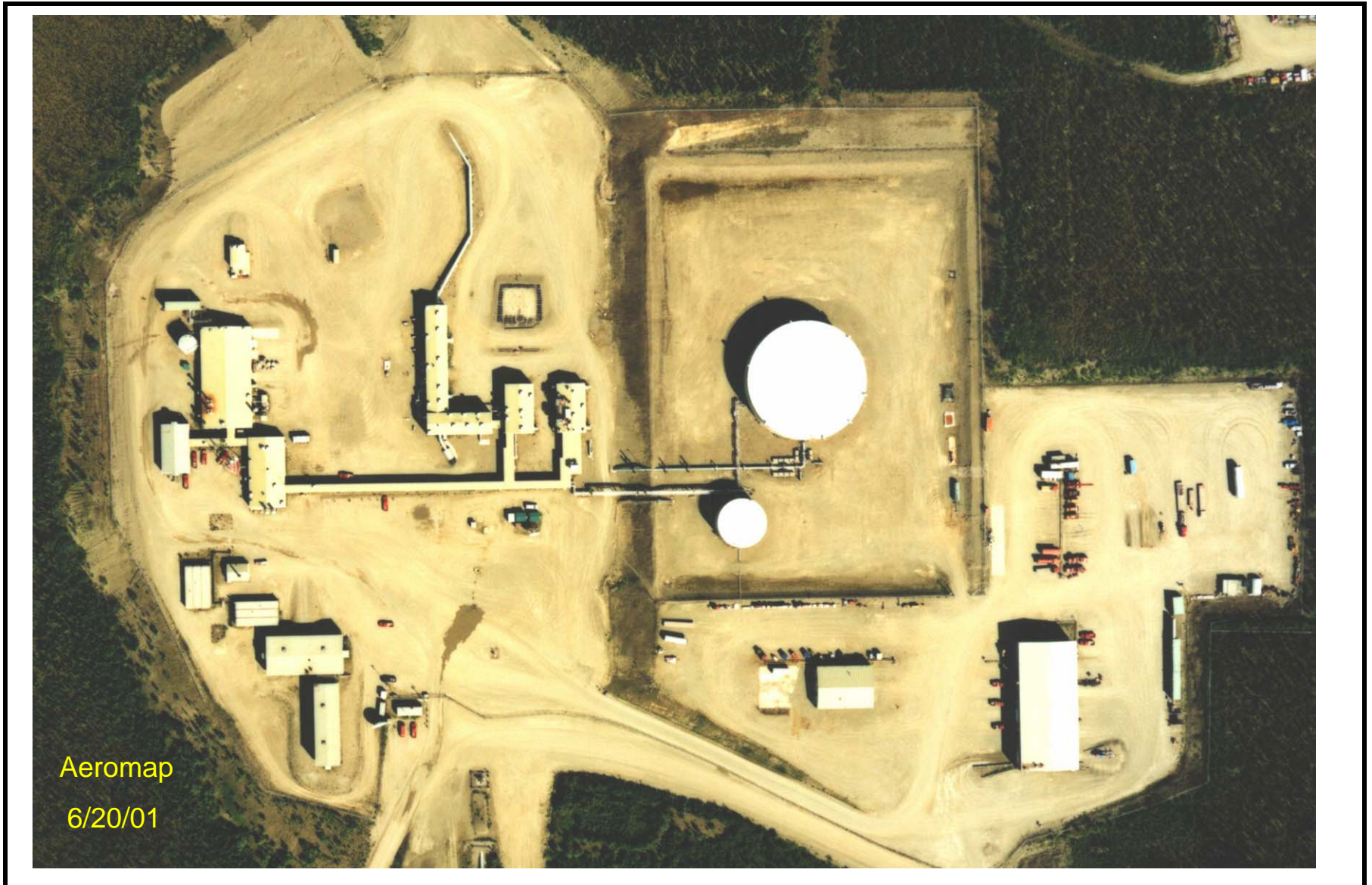
APPENDIX F

GOLDER ASSOCIATES GEOTECHNICAL REPORT CROSS- SECTIONS FOR PS05

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019



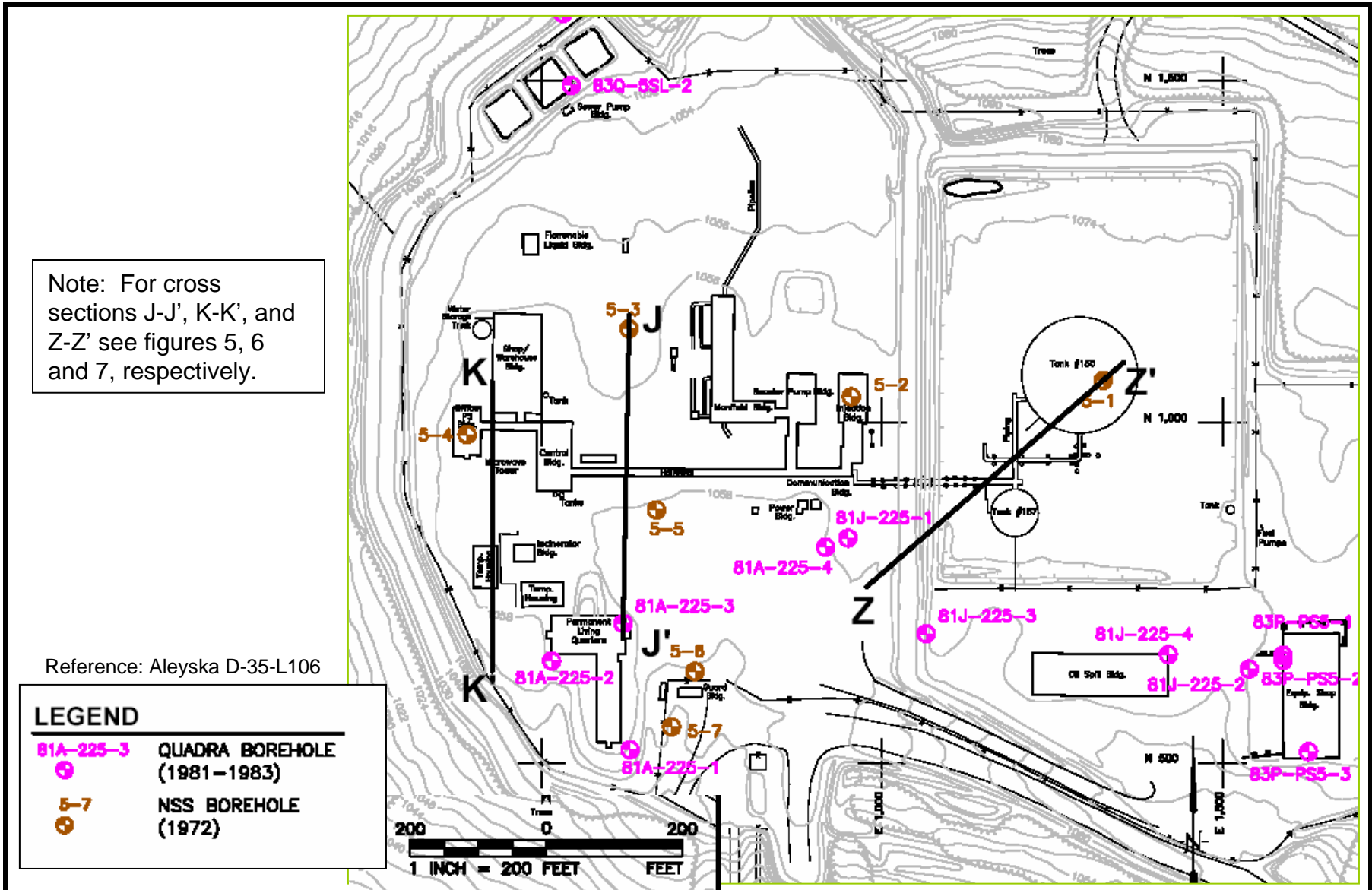
Aeromap
6/20/01



Pump Station 5
2001 Aerial Photo

Figure 3

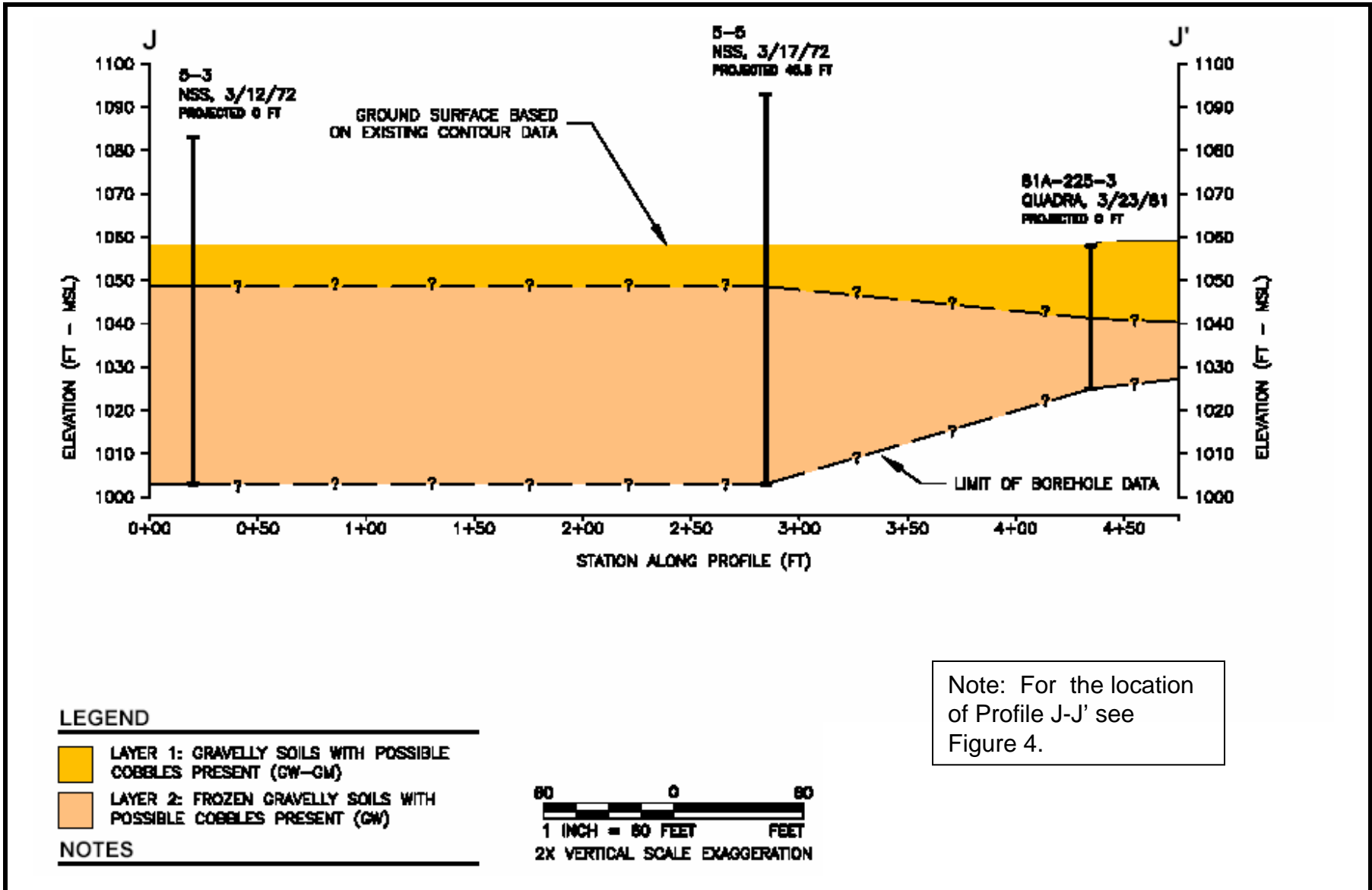
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Boring Locations and Cross Sections

Figure 4

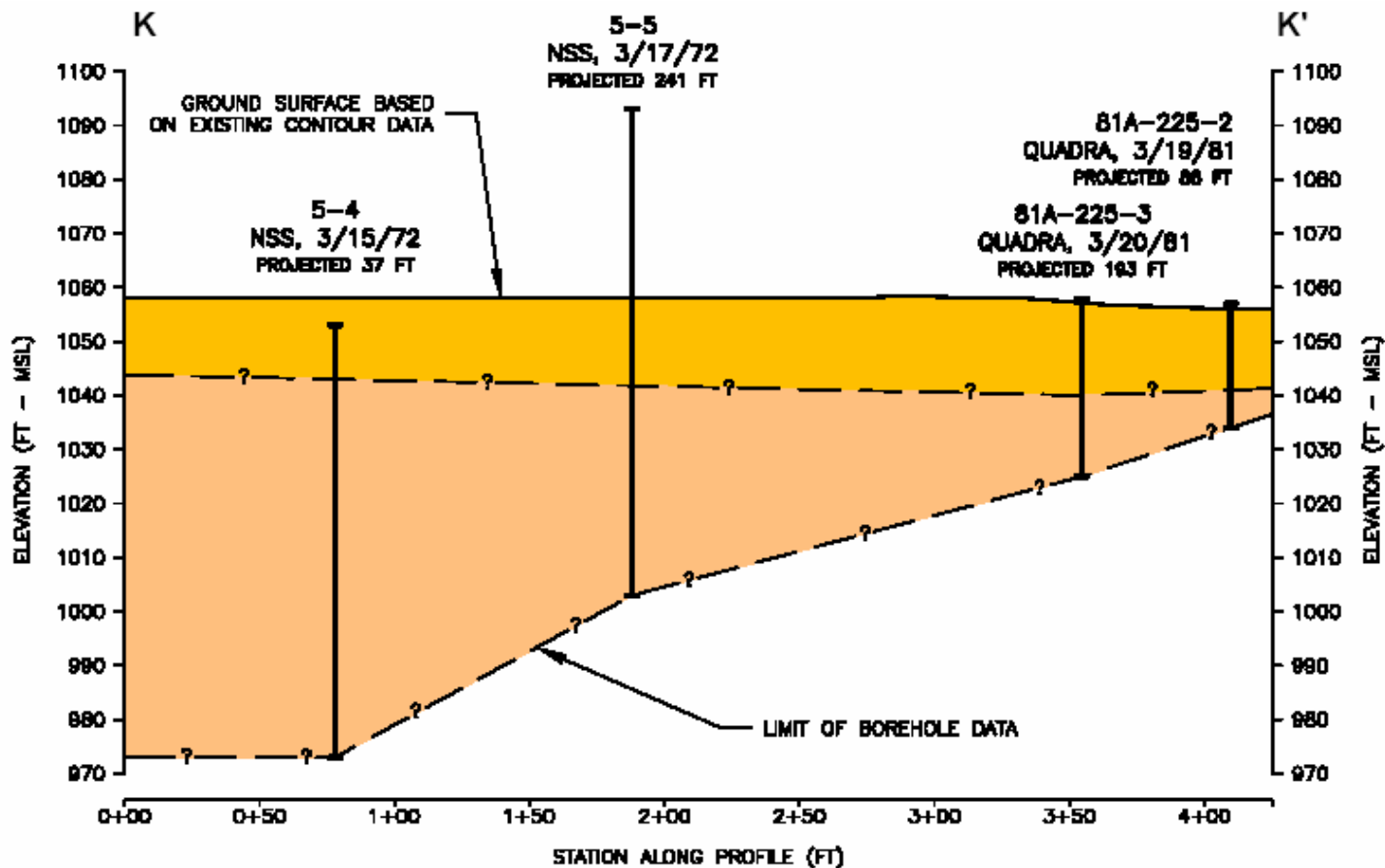




Profile J-J'

Figure 5





LEGEND

- LAYER 1: GRAVELLY SOILS WITH POSSIBLE COBBLES PRESENT (GW-GM)
- LAYER 2: FROZEN GRAVELLY SOILS WITH POSSIBLE COBBLES PRESENT (GW)

NOTES

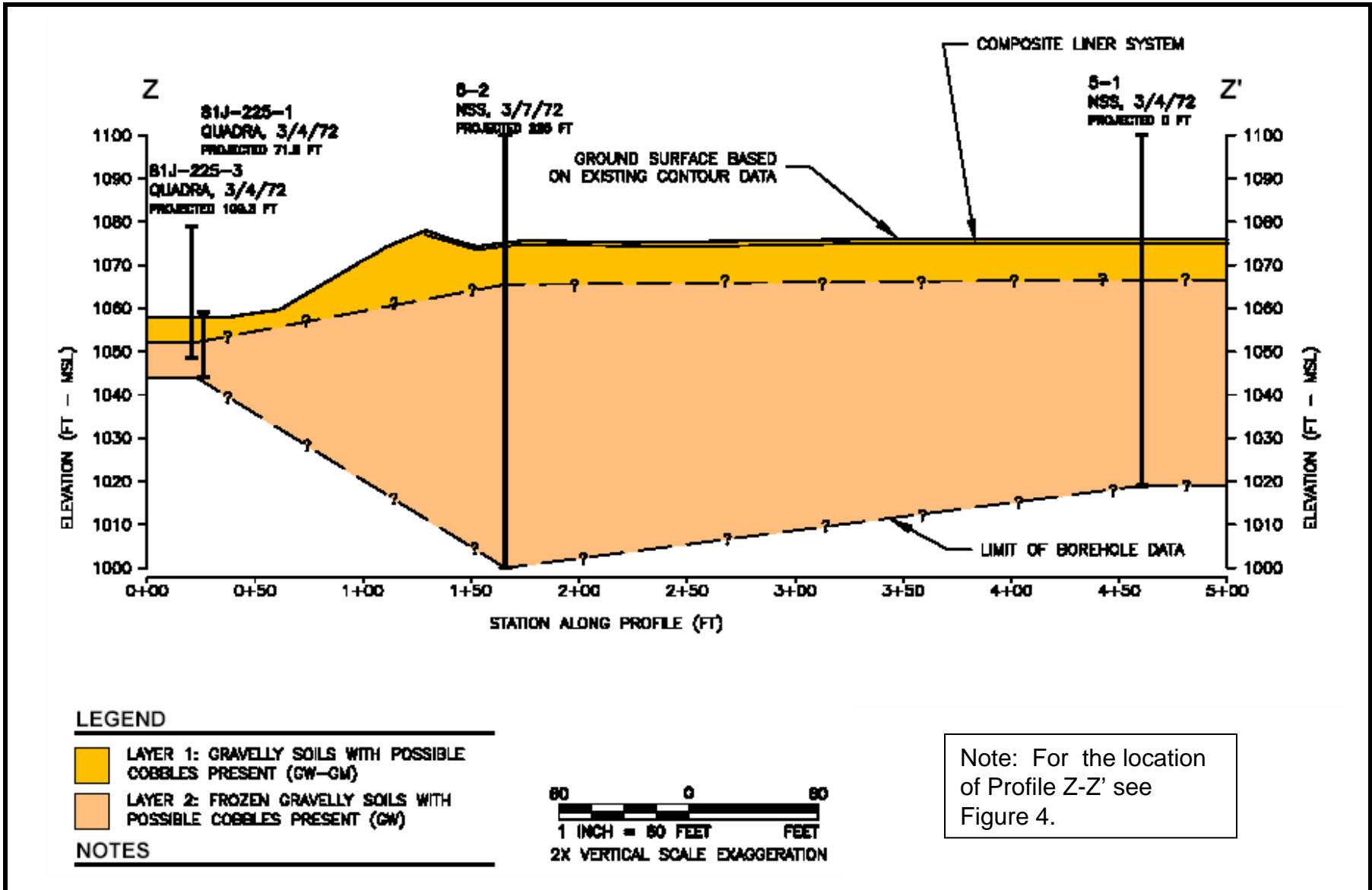


Note: For the location of Profile K-K' see Figure 4.



Profile K-K'

Figure 6



Profile Z-Z'

Figure 7



APPENDIX G

GOLDER ASSOCIATES GEOTECHNICAL REPORT CROSS- SECTIONS FOR YRB

Summary of Permafrost Conditions Near Pump Station PS05 and the
Yukon Response Base

Alyeska Pipeline **Service Company**
P.O. Box 196660
3700 Centerpoint Drive
Anchorage, Alaska 99519-6660

October 2019



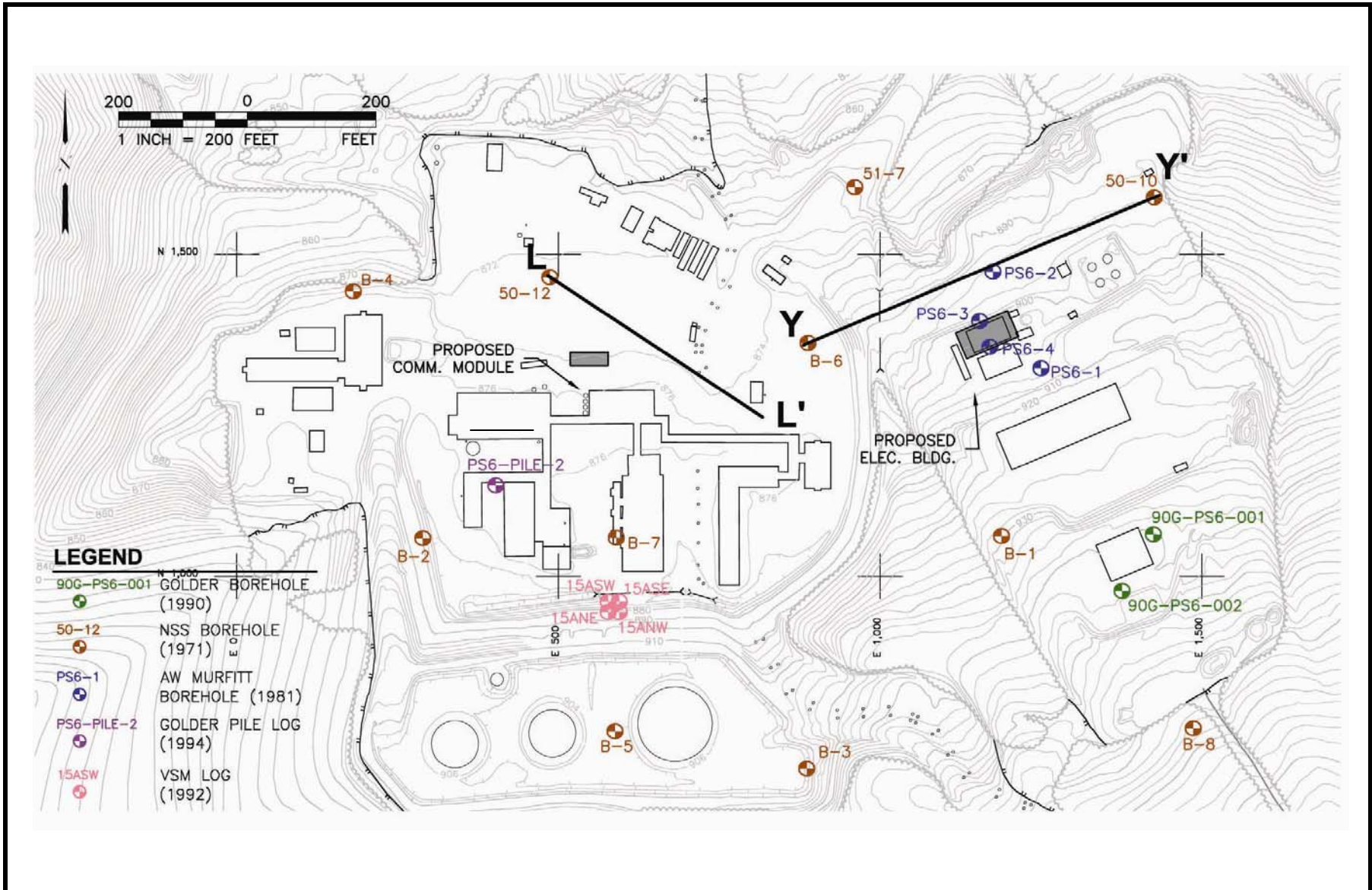
Aeromap
6/20/01



Pump Station 6
2001 Aerial Photo

Figure 3

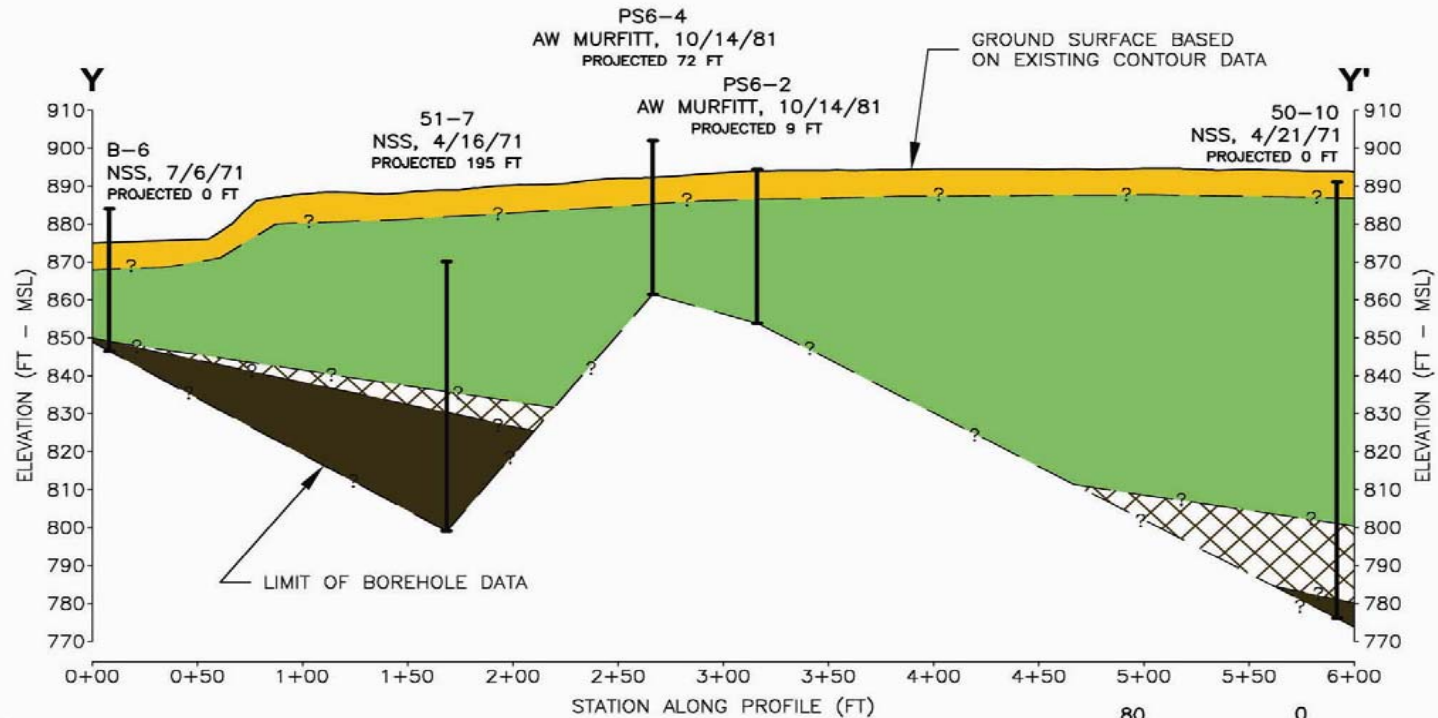
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Pump Station 6 Site Plan

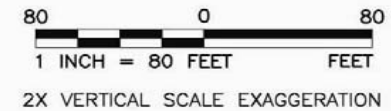
Figure 4





LEGEND

 LAYER 1: SILTY SAND AND GRAVEL FILL MATERIALS (SM to GM)	 LAYER 3: WEATHERED MUDSTONE BEDROCK
 LAYER 2: FROZEN SILTY SOILS (SM to ML)	 LAYER 4: MUDSTONE BEDROCK



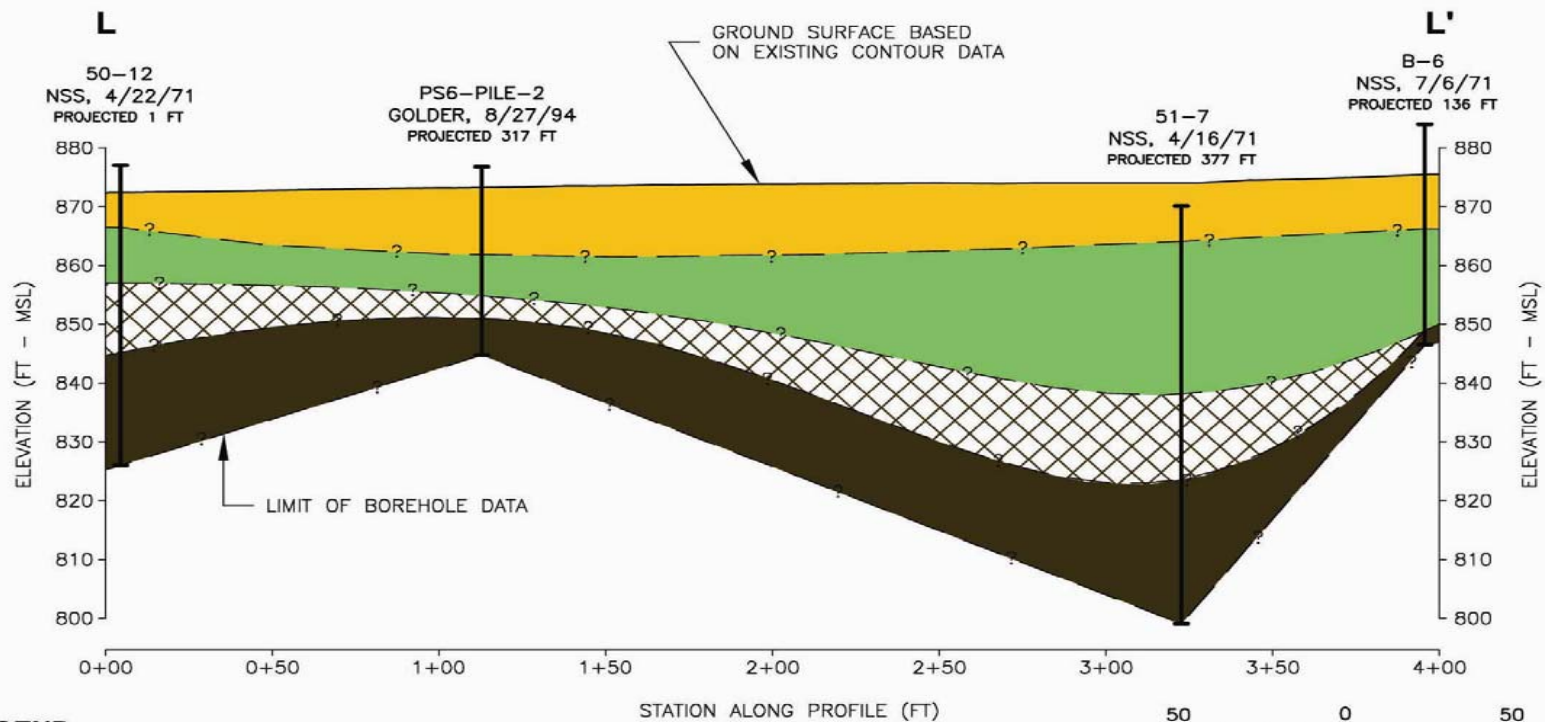
NOTES

1. ELEVATION OF BOREHOLES PS6-2 AND PS6-4 DETERMINED ASSUMING EXISTING GROUND SURFACE CONTOURS.
2. DEPTH OF ACTIVE LAYER UP TO 8 FT DEEP.
3. NO WATER ENCOUNTERED IN BOREHOLES.

Profile L-L'

Figure 5





LEGEND

- LAYER 1: SILTY SAND AND GRAVEL FILL MATERIALS (SM to GM)
- LAYER 2: FROZEN SILTY SOILS (SM to ML)
- LAYER 3: WEATHERED MUDSTONE BEDROCK
- LAYER 4: MUDSTONE BEDROCK

NOTES

1. BOREHOLE ELEVATION OF PS6-PILE-2 DETERMINED ASSUMING EXISTING GROUND SURFACE CONTOURS.
2. DEPTH OF ACTIVE LAYER UP TO 8 FT DEEP.
3. NO WATER ENCOUNTERED IN BOREHOLES.



Profile Y-Y'

Figure 6