



ALASKA
Department of Transportation
And Public Facilities

GEOLOGY FOUNDATION REPORT


Seward Hwy MP 18-25
Trail River Bridge No. 610

Project# STP-031-1(27)

AKSAS# 53919

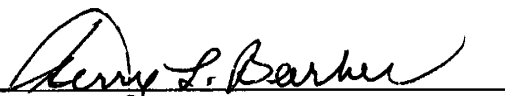
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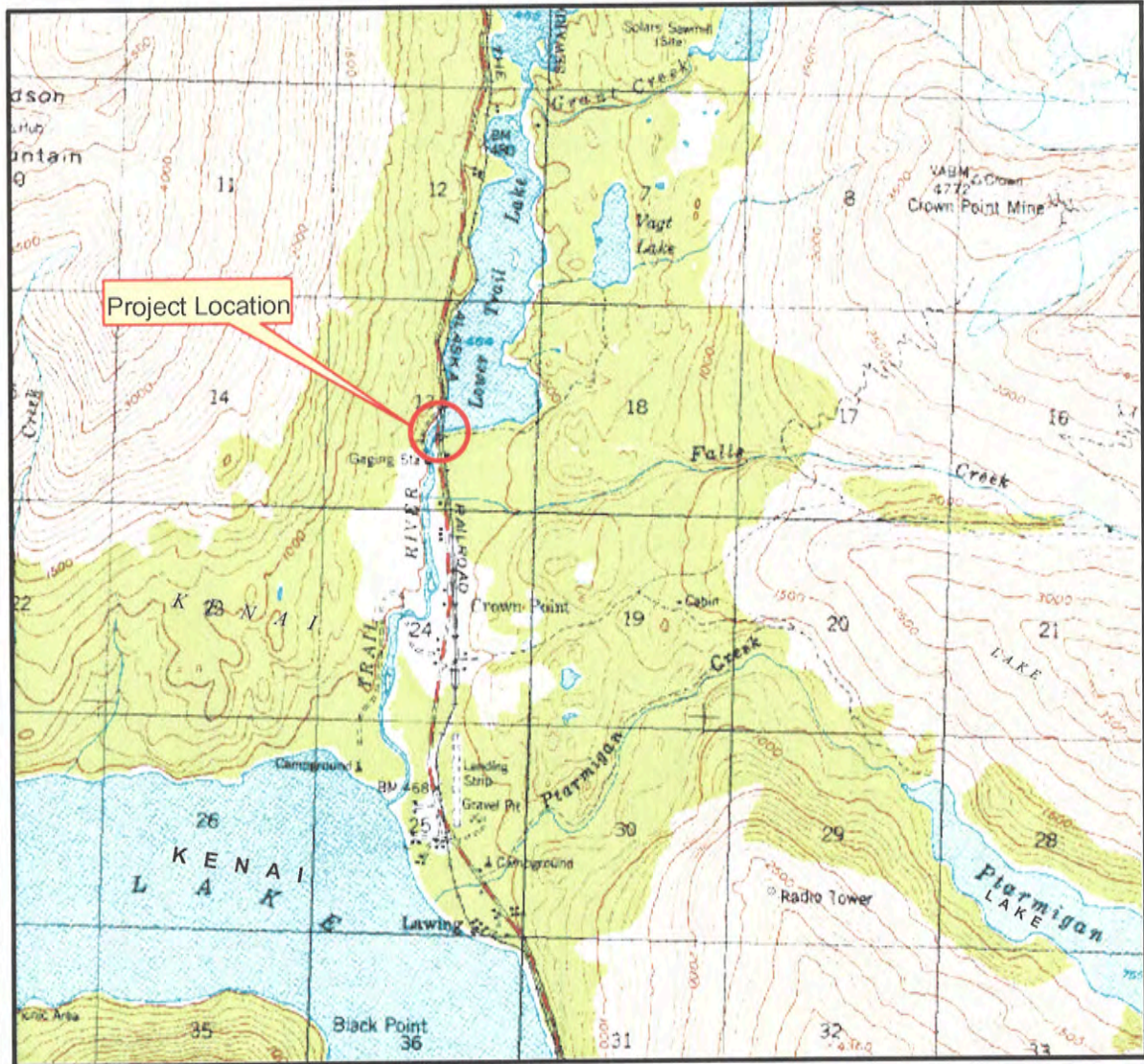
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0 0.7 1.4 Miles



Project Location

State of Alaska
 Department of Transportation
 and Public Facilities

VICINITY MAP

Seward Highway 18-25 Project
 Trail River Bridge
 STP-031-1(27)/53919

Source: USGS, Seward B-7 Quad, 1:63,360

INTRODUCTION

Purpose and Scope of Work

The Department of Transportation and Public Facilities (DOT&PF) plans to replace Trail River Bridge No. 610 at MP 25. The proposed new bridge will be shifted downstream of the existing bridge. At the request of the Design Project Manager, the DOT&PF Statewide Materials Section conducted a foundation investigation at the proposed site. The work was conducted under the field supervision of Engineering Geologists Craig Boeckman and Peter Ondra using DOT&PF personnel and equipment.



The purpose of the exploration was to develop a soil and rock profile for the bridge site for use in design.

This report describes the methods of exploration, sampling, and field procedures and general site conditions at the time of exploration.

General Geology and Topography

The project is located within the Kenai Peninsula two miles south of the city of Moose Pass. The Kenai Mountains are in a geologic region known as the Chugach Terrane. This region forms a long belt of sedimentary and metamorphosed rock that extends more than 2,000 km along the continental margin of southern Alaska. Two principal suites of rock contained in the Chugach Terrane are the McHugh Complex mélangé (blocks and fragments of rock in a sheared matrix) and the Valdez Group flysch (interbedded marine deposits of shale, conglomerates, coarse sandstone and graywacke). The rock type within this project site is the Valdez Group that consists of thick sequences of thin-bedded and rhythmically interbedded deposits of graywacke (dirty sandstone), argillite, siltstone, slate and phyllite (a metamorphic rock of intermediate grade between slate and schist). Regionally, this rock is intensely folded and faulted and has been subjected to low to moderate grades of metamorphism. The region was covered with glacial ice that left behind deposits of outwash and till as the ice retreated.

Trail River is located at approximate Latitude 60.261 and Longitude -149.224 in an area of high seismic activity. The surface trace of the Aleutian Megathrust subduction-zone is approximately 252 km to the southeast. The vast majority of the earthquakes have occurred along the

subduction zone that dips northward under the southwest Alaska Peninsula and Southcentral Alaska. The subduction of the Pacific plate beneath the continental North American plate has generated numerous large to great magnitude (magnitude M7.5+) thrust earthquakes along its interface contact zone with the overriding continental crust. The depth to the subduction zone at the site is 35.5 km (Youngs et al. SRL, 1997). The magnitude Mw 9.2 1964 Alaska earthquake, to the northwest of the site region, was an interface thrust mechanism event.

Locally, the smaller Johnstone Bay Fault (about 16 km in length) is located about 66 km southeast and the Hanning Bay/Patton Fault system (estimated from 16 to 48 km in length) is located about 122 km southeast of Trail River. The Johnstone Bay Fault is Holocene in age (within about 11,000 years old).

Climatological Data

The project is within the Transition Climatic Zone of Alaska. This zone has pronounced temperature variation throughout the day and year, relatively low amounts of precipitation, cloudiness, and humidity. Information regarding climate is available on the Alaska Climate Research Center website at <http://climate.gi.alaska.edu>. For current, site specific weather information, contact the National Oceanic and Atmospheric Administration (NOAA) at 6930 Sand Lake Road, Anchorage, Alaska 99502-2956, phone (907) 266-5105 or website at <http://pafc.arch.noaa.gov/>.

METHOD OF EXPLORATION

The field investigation for Trail River Bridge No. 610 was conducted between July 2000, April 2001 and May and June 2003. A total of three test pits were excavated, six penetrometers were driven, and 13 test holes were drilled for the proposed bridge. Two of the four penetrometers and 10 of the eleven test holes were located by survey. The three test pits TP 13, TP 14 and TP 15, test holes TH-17, TH-19, TH-20, and continuous penetrometers PEN 16, PEN 18, PEN 21 and PEN 22 were measured from established survey control points. Note the test hole and continuous penetrometers description numbers were modified from a bridge number (610), year, and hole number to only the a number for ease of reading. The test hole and continuous numbers were not modified in the Preconstruction Sample Summary sheets (Appendix D).

As part of that investigation, Statewide Materials Personnel:

- Drilled test holes with truck and track mounted CME model 75 drills with NW (76 mm I.D. x 89 mm O.D.) casing .
- Drove NW casing using a 155 kg CME automatic hammer with a 760 mm free fall.
- Performed standard penetration tests (SPT) about every 0.75 m or 1.5 m interval using a standard split barrel sampler (35 mm I. D. x 50 mm O. D.) driven by a 63.5 kg CME automatic hammer system that follows AASHTO T-206 (ASTM 1586). The number of blows required to drive the sampler into undisturbed soil for each 152 mm increment was

recorded. The total number of blows required to drive sampler through the second and third increments is referred to as the uncorrected “N” value. The “N” value is used to determine the relative density and a relative density descriptive term. Refusal for the SPT occurs when the blow counts to drive the sampler reaches 50 blows per 152 mm interval, or when 100 blow per 300 mm, or when there is no observed advance of the sampler during application of 10 successive blows of the hammer. The driving may continue to a higher blow count, or be terminated before the driving limit is reached at the discretion of the field geologist.

- Collected larger soil samples than the standard SPT using a 51 mm I.D. x 64 mm O.D. split barrel sampler driven by a 155 kg CME automatic hammer with a 760 mm free fall. The uncorrected blow counts from this sampling method using the larger split barrel spoon (designated as “SS”) were recorded on the field logs.
- Drove friction penetrometer soundings with a 64 mm diameter flush coupled, blunt-tipped steel rod with a 155 kg pound CME automatic hammer with a 760 mm free fall. Refusal occurs for the friction penetrometer when the blow counts reach 1000 blows per 300 mm.
- Performed penetrometer pullout tests to measure uplift resistance between the soil and the casing-rod. Pullout tests were done with the drill’s hydraulic feed/retract cylinder mechanism up to one hour after driving.
- Collected rock core samples using NQ size core barrel and wireline drilling methods with water for the circulation medium.
- Excavated test pits near Abutment No. 5 to determine the depth of bedrock using a Case 580 backhoe.
- Located test holes, continuous penetrometers, stationing and elevations using a level, rod and cloth tape from reference points provided by R&M Consultants.
- Photographed the rock core and the site conditions. See selected site photographs in Appendix A and the rock core photographs in Appendix B.

LABORATORY TESTING

The geologist visually classified soil samples based on the ADOT&PF Textural Soil Description Chart in Appendix C and described the rock core based on the Descriptions of Rock Properties tables in Appendix E. The soil and rock core samples were sealed and transported to the Engineering Geology Section office at Statewide Materials in Anchorage. The Foundation Geologist examined and soil and rock core samples at the Statewide Material office. Selected rock core samples were then submitted to contractor Donald Stevens for petrographic analysis.

The soil sample test results are shown on the Preconstruction Sample Summary sheets in Appendix D. The petrographic analysis test results on the rock core are in Appendix F. Untested rock and soil samples are available of inspection upon request at the DOT&PF’s Statewide Materials Geology Section office in Anchorage. Field and laboratory testing procedures followed the Alaska DOT&PF Geotechnical Procedures Manual, AASHTO or ASTM procedures.

GENERAL SITE AND SUBSURFACE CONDITIONS

Surface

The proposed bridge spans Trail River at the outflow of Lower Trail Lake. Abutment No. 1 is located on the southern shore of Trail river. The south side of the river is relatively flat with many cobbles and boulders found on the ground surface. The existing highway embankment rises about 4 m above the level of the river (see additional site photographs in Appendix A).

Pier's 2, 3 and 4 are located in the streambed of Trail River.



Abutment 5 is located at the base of a steep hillside west of the highway that rises about 25 m above Trail River. Abutment 5 encroaches the highway ditchline on the downstream side of the existing bridge. Steeply dipping bedrock is exposed near this location with overburden soils and debris covering the slope above the existing ditchline.

Exposed bedrock at Abutment No. 5 dips steeply towards the Seward Highway and Lower Trail Lake. The bedrock is a thinly bedded argillite and phyllite that has historically weathered and broken off in slabs and landed in the ditch line of the highway.

Rock Mapping Station 40+800 to 41+200

The rock cut next to the highway between station 40+800 and 41+200 was mapped for orientation and type of structure as part of the Seward Highway MP 18 to 25 centerline investigation.

The results of the rock structure analysis indicated that bedding planes are the dominant structure in the rock. The bedding dips east toward the road at an average angle of 48°. There are also two persistent joint sets that dip northeast and southwest at about 52° to 87°. A less persistent joint set dips west into the hillside at about 38° to 58°. Bedrock is thin to moderate bedded argillite and phyllite. See the collected data and petrographic graphic analysis reports in Appendix F. The following table summarizes the results of the structural analysis.

Structure Type (overall groups or sets based on rock mapping)	Average Orientation (Dip/Dip Direction)	Impacts to the Proposed Highway
Bedding	48° E	Bedding dips toward the road
Joints	70° NE or SW	Minor potential for wedge failure

Note: The current rock slope angle along the highway is about 53 degrees.

Vegetation

Generally the vegetation along Trail River consists of scattered spruce and birch trees with alder. On the steep slope near Abutment No. 5 the birch and spruce trees and brush cover the slope where rock debris and bedrock are not exposed.

Subsurface

Near End Abutment 1: Penetrometer PEN-3 hit refusal 23.9 m in depth. Test hole TH-4 located on the highway embankment, showed silty sandy gravel with cobbles to 3.6 m (highway embankment), sandy gravel and gravelly sand to 12.2 m, sandy silt to 28.6 m, over phyllite bedrock.

Pier 2: Test hole TH-5 showed gravelly sand and sand from the river bottom mud line to 12.2 m, sandy silt and silt to 28.6 m, gravelly sand to 29.8 m, over phyllite bedrock.

Pier 3: Penetrometer PEN 2 hit refusal at 24 m in depth. Test hole TH-1 showed gravelly sand from the river bottom mud line to 13.7 m, silty sand to 16.7 m, sandy silt to 23.7 m, gravelly sand to 26 m, over phyllite bedrock.

Pier 4: Penetrometer PEN 16 and PEN 18 hit refusal at about 2.7 m in depth. TH-17 showed sandy gravel with cobbles to a depth of 2.6 m over phyllite bedrock.

Abutment 5: Test pits TP-13 through TP-15 showed about 0.2 m of surface organics, over slightly organic silty gravelly silt with cobbles and boulders to 1.2 m, over 1 m of weathered bedrock, over thinly bedded phyllite bedrock.

TH-19 located in the Seward bound lane of the existing highway showed 75 mm of asphalt pavement over 1.2 m of silty sandy gravel fill over silty sandy gravel with seams of fine fibrous organics to 6 mm thick to 3.8 m in depth. At 3.8 m in depth severely weathered bedrock was encountered. The severely weathered bedrock transitioned to thinly bedded fractured, moderately hard, weathered argillite bedrock.

TH-20 was located in the Anchorage bound lane of the existing highway showed 75 mm of asphalt over silty sandy gravel fill 6.2 m in depth. At 6.2 m thinly bedded, slightly weathered, fractured, moderately hard argillite bedrock was encountered.

Penetrometers PEN 21 and PEN 22 were located in the Anchorage bound lane. PEN 21 located 18.2 m away from the existing abutment hit refusal at 9 m and depth. PEN 22 located 28 m away from the existing abutment hit refusal at 4.9 m in depth.

Surface Water and Groundwater

The surface water level at the site fluctuates seasonally due to rainfall, snowmelt, and the water level in Trail Lake. High water during the time of our geotechnical investigation flooded the southern stream bank around Abutment No. 1. During the time of our drilling the groundwater level at test hole TH-1 was about 6.7 m, before the influence of high water. Groundwater in test hole TH-4 was at 4.7 m below the asphalt pavement.

Utilities

Underground and overhead ground utilities are within the project limits. There are overhead power and communication lines located near the bridge. The contractor should contact the local utility companies to obtain detailed information on utilities in the area.

The reader should consult the Preconstruction Summary of Test Data and the Test Hole Log Location sheets of this report for a more complete detailed description of each test hole and continuous penetrometers at the proposed bridge site.

REFERENCES

1. Stanley, D.A., Geotechnical Report, Seward Highway M.P. 8-18, Project No. STP-031-(25)/52419, State of Alaska, Department of Transportation and Public Facilities, October 1999.
2. Staff, State of Alaska DOT&PF, Engineering Geology & Exploration Manual, May 1993.
3. Wahraftig, Clyde, Physiographic Divisions of Alaska, U.S. Geologic Survey Professional Paper 482, 1965.G.
4. Plafker, L.M. Gilpin, J.C. Lahr, Neotectonic Map of Alaska, The geological Society of America, 1993.USGS.
5. National Seismic Earthquake Hazards program, Interactive Deaggregations, 1996 at web site <http://eqintl.cr.usgs.gov/eq/html/deaggint.shtml>.AASHTO Acceleration Coefficient Contour Map, Standard Specifications for Highway Bridges, 1992, Fifth Edition.

APPENDIX A

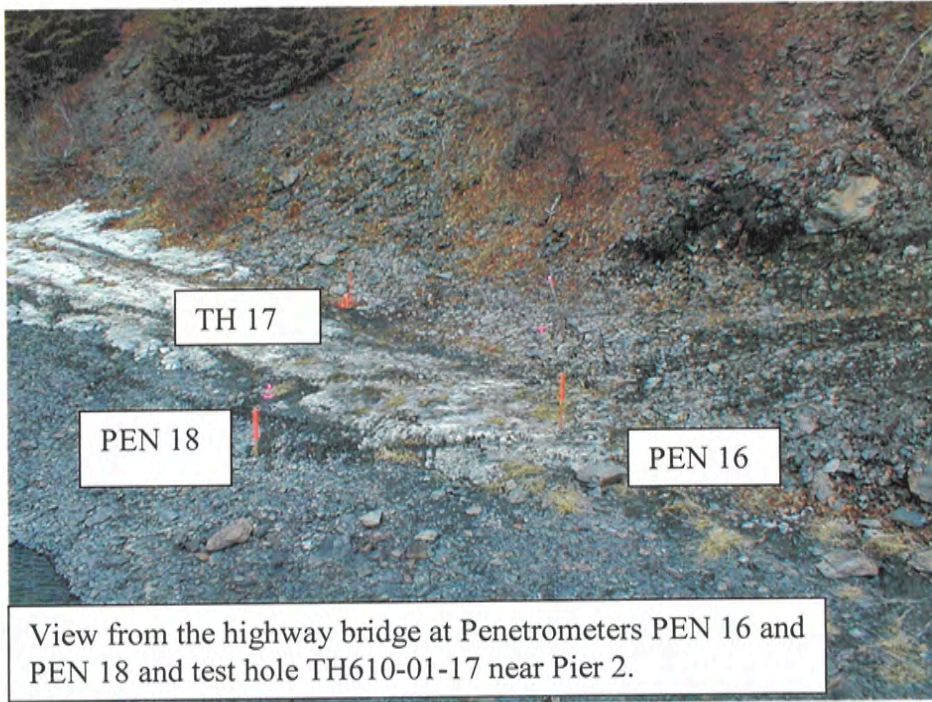
SITE PHOTOGRAPHS



Looking northwest at the Alaska Railroad bridge in front of the highway bridge. Overhead power lines span the river from the top of the hill in the background.



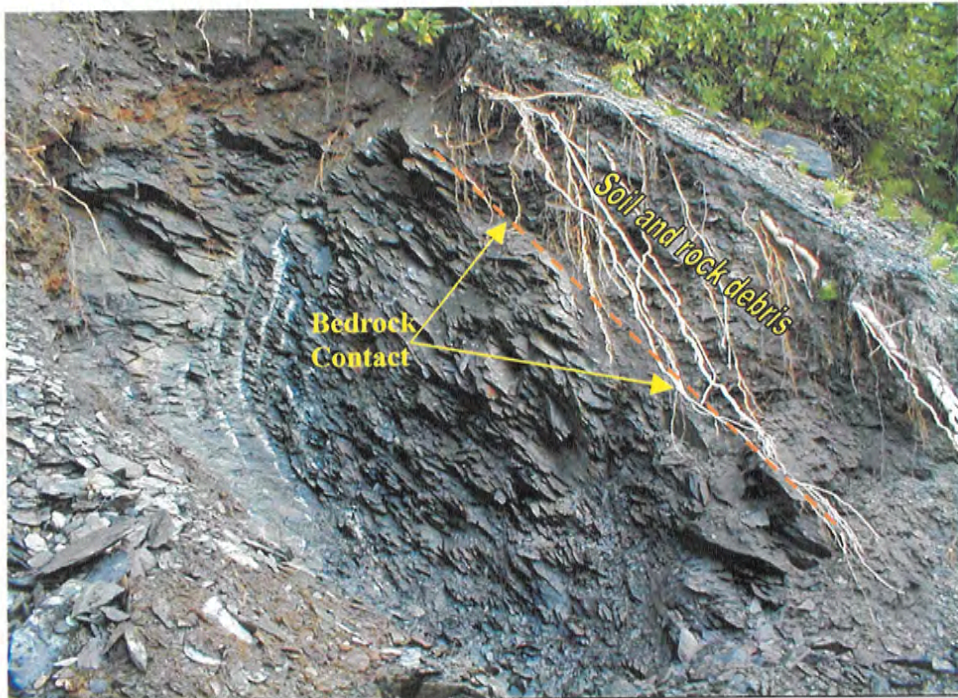
Looking west at the existing southern abutment of the highway and AKRR bridges. Only about 6 m separates the two bridges.



View from the highway bridge at Penetrometers PEN 16 and PEN 18 and test hole TH610-01-17 near Pier 2.



Looking at the proposed location of Abutment No. 5 from center of the existing bridge. The excavator is at the location of Test Pit 13.



Soil type and bedrock at Test Pit 13 near Abutment No. 5.



Excavator at Test Pit 13 near Abutment No. 5.



View of proposed Abutment 5. Note the very steep hillside debris and bedrock slope.

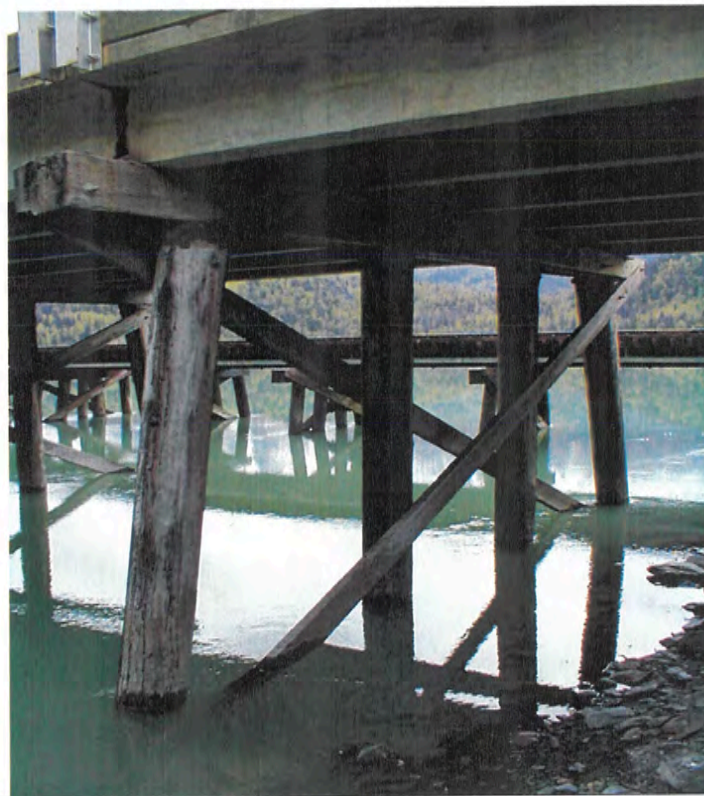


Photo showing the wood piling supports for the highway bridge. The Alaska Railroad bridge is in the background of the photo.

APPENDIX B

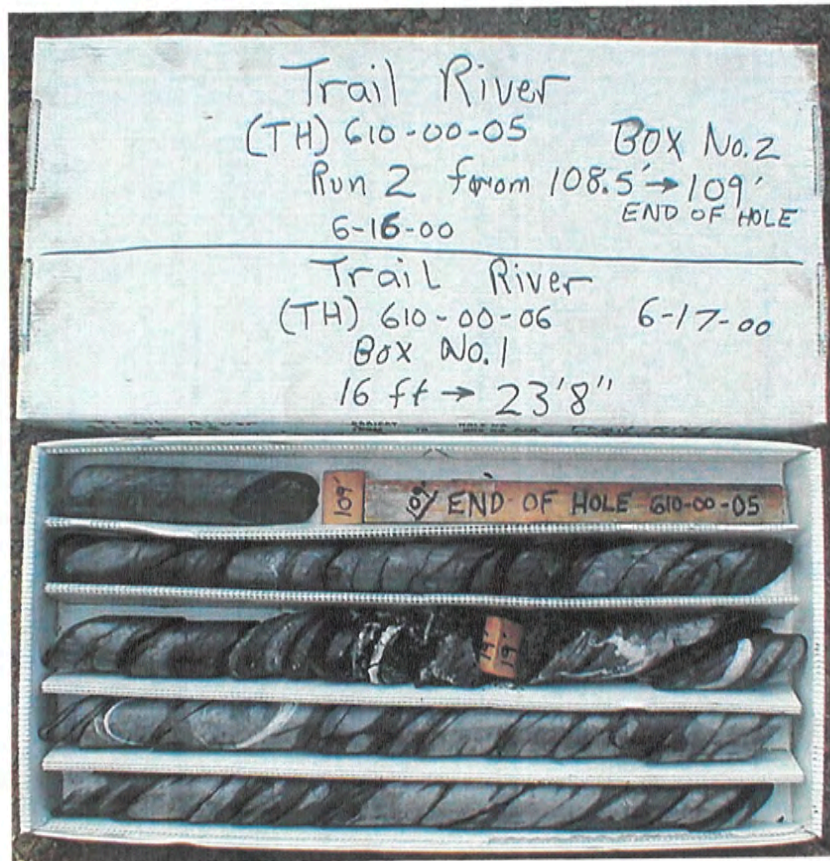
ROCK CORE PHOTOGRAPHS



Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919



Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919







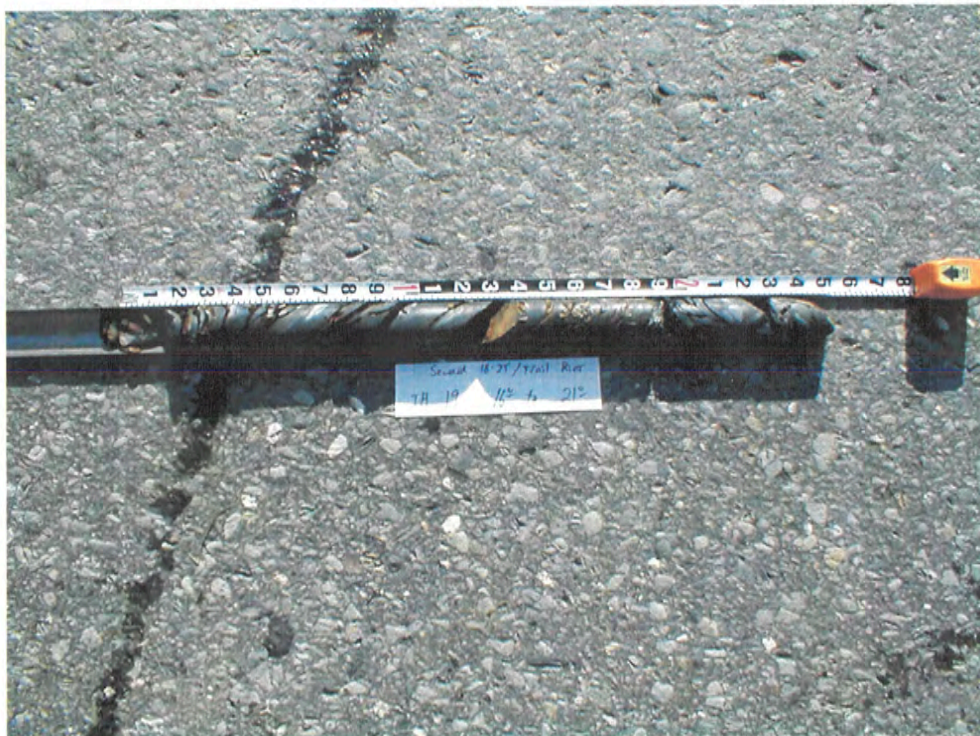
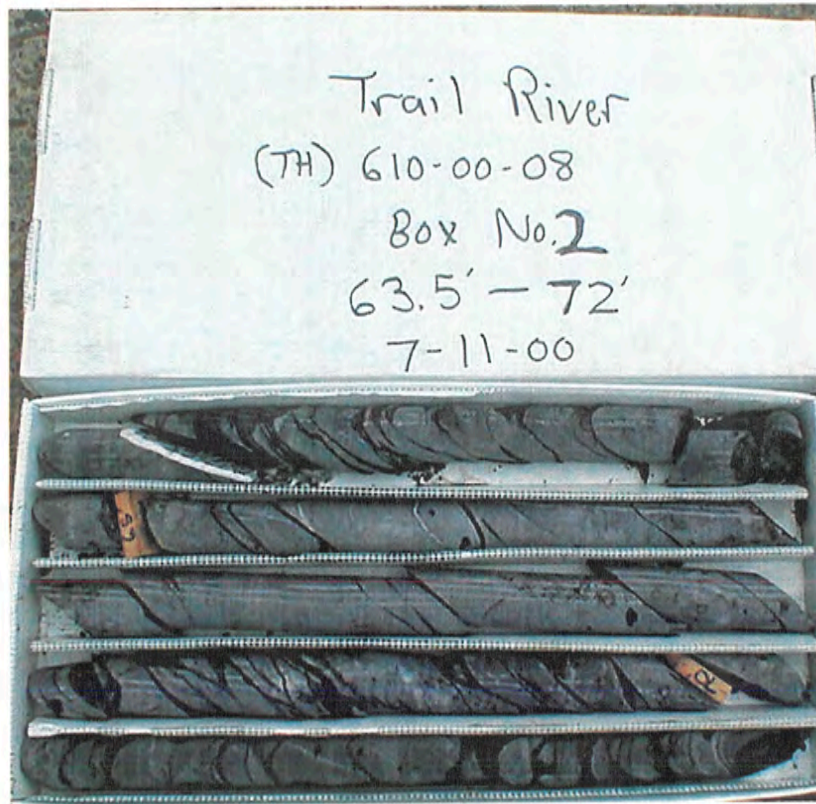
Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919



Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919



Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919



Abutment 5, TH 19 rock core from 4.87 m to 6.4 m in depth.

Seward Highway MP 18 - 25
Trail River No. 610
Project No. STP-031-1(27)/53919



Abutment 5, TH 19 rock core from 7.92 m to 9.45 m in depth.



Abutment 5, TH 19 rock core from 9.45 m to 10.97 m in depth.



Abutment 5, TH 20 rock core from 6.1 m to 7.01 m in depth.



Abutment 5, TH 20 rock core from 7.62 m to 9.14 m in depth.



Abutment 5, TH 20 rock core from 9.14 m to 10.67 m in depth.



Abutment 5, TH 20 rock core from 10.37 m to 12.19 m in depth.



Abutment 5, TH 20 rock core from 9.14 m to 10.67 m in depth.



Abutment 5, TH 20 rock core from 10.37 m to 12.19 m in depth.

APPENDIX C

AKDOT&PF TEXTURAL SOIL DESCRIPTIONS

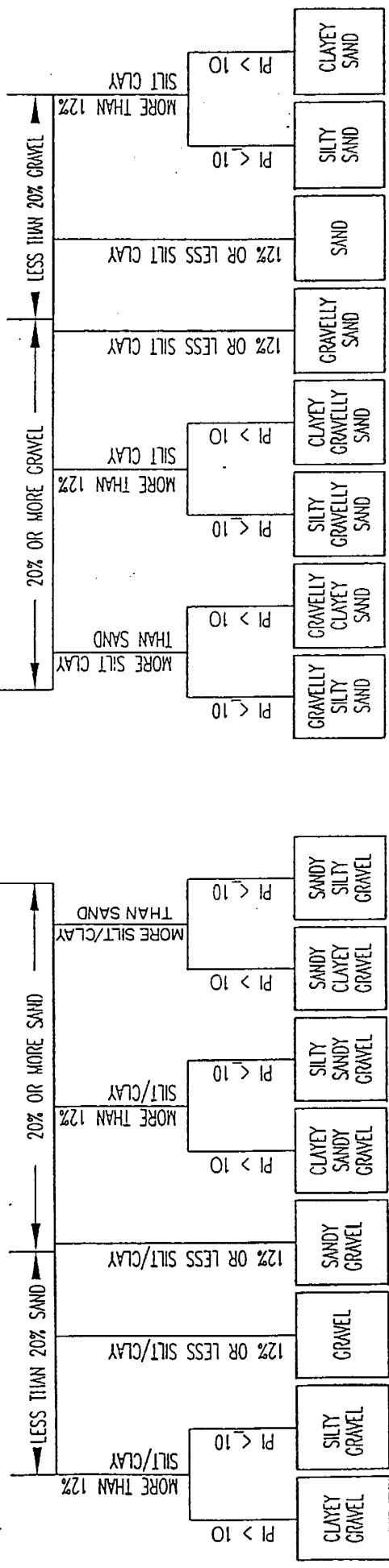
ALASKA DEPARTMENT OF TRANSPORTATION TEXTURAL SOIL DESCRIPTION

REVISED: APRIL 98

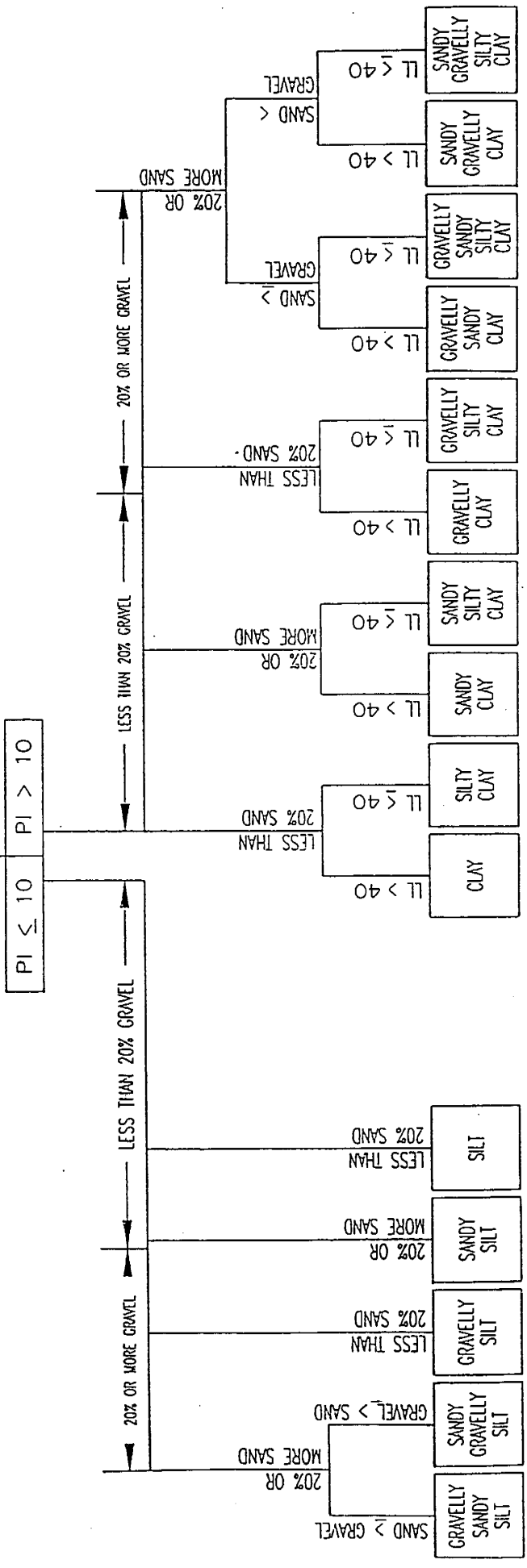
- NOTES: 1) ALL SILTS WITH A PLASTIC INDEX > 4 SHALL BE TERMED "SLIGHTLY CLAYEY".
 2) SANDS AND GRAVELS WITH 7% THRU 12% SILT AND/OR CLAY (0.075 mm) SHALL BE TERMED "SLIGHTLY SILTY" OR IF PLASTIC, (PI > 4) "SLIGHTLY CLAYEY" SAND OR GRAVEL.

(SILT/CLAY < 0.075 mm DIAMETER)
 (SAND 0.075 mm TO 2.0 mm DIAMETER)
 (GRAVEL 2.0 mm TO 75 mm DIAMETER)
 (COBBLES 75 mm TO 305 mm DIAMETER)
 (BOULDERS > 305 mm DIAMETER)

COARSE-GRAINED SOILS
 35% OR LESS SILT/CLAY



FINE-GRAINED SOILS
 MORE THAN 35% SILT/CLAY



APPENDIX D

**PERCONSTRUCTION SAMPLE SUMMARY
OF SOIL DATA**

PRECONSTRUCTION SAMPLE SUMMARY

Project Name Seward Hwy MP 18-25

Project No. 53919 Sampled By T. Barber Structure Trail River Bridge (#610)

Station Offset (feet) Depth (feet) Test Hole No. Field No. Date Sampled Lab No.	9.1-9.8 m TH 00-610-01 00-610-01-30 06/06/2000 00A-1560	12.2-12.8 m TH 00-610-01 00-610-01-40 06/06/2000 00A-1561	14.6-15.2 m TH 610-00-01 00-610-01-48 / 00A-2219	17.8-18.2 m TH 610-00-01 00-610-01-58.5 / 00A-2220	20.7-21.3 m TH 00-610-01 00-610-01-68 06/06/2000 00A-1562	23.8-24.4 m TH 00-610-01 00-610-01-78 06/06/2000 00A-1563
75						
50						
25.0	100					100
19.0	94					95
12.5	91					93
9.5	84					88
4.75	69	100				72
2.00	51	99	100	100	99	56
.425	23	76	98	97		27
.180						
.075	7.9	13.4	62.1	79.3	94.8	10.0
.020						
.002						
DOTTSD AASHTO Class FSV Class Unified Class Liquid Limit Plastic Index Moisture Content % Organic Content % % Gravel % Sand % Silt & Clay Max. Dry Density Opt. Moisture % Degradation Value L.A. Abrasion Loss Sulfate Soundness	Sl Si Sa Gr1 A-1-b(0)	Si Sa A-2-4(0)	Sa Si A-4(0)	Sa Si A-4(0)	Si A-4(0)	Sl Si Gr1 Sa A-1-b(0)
	NV NP	NV NP	NV NP 41.0	NV NP 47.0	NV NP	NV NP
	49 43 8	1 86 13	38 62	21 79	5 95	44 46 10
	/	/	/	/	/	/

Note: Gradation test based on minus 75 mm material. AASHTO class may be inappropriate if organic content > 5%.
The sampler used to take the above samples has an inside diameter of 35 mm or 50 mm, therefore soil particles with a diameter larger than 35mm or 51 mm was not recovered. See test hole logs for a field description of tested materials.

PRECONSTRUCTION SAMPLE SUMMARY

Project Name Seward Hwy MP 18-25

Project No. 53919 Sampled By T. Barber

Structure Bridge No.610

Station Offset (feet) Depth (feet) Test Hole No. Field No. Date Sampled Lab No.	2.4-2.8 m TH-00-610-4 00-610-04-8 06/13/2000 00A-1610	5.5-6.1 m TH 610-00-04 00-610-04-18 / 00A-2221	10.1-10.7 m TH 610-00-04 00-610-04-33 / 00A-2222	13.1-13.7 m TH-00-610-4 00-610-04-43 06/13/2000 00A-1611	19.2-19.8 m TH 610-00-04 00-610-04-63 / 00A-2223	22.2-22.7 m TH 610-00-04 00-610-04-73 / 00A-2224
75		100	100			
50	100	94	73			100
25.0	84	91	68			99
19.0	79	88	68			
12.5	75	85	58			98
9.5	62	71	37	100	100	97
4.75	47	52	18	95	97	94
2.00	27	28	6			
.425				40.6	74.4	81.2
.180	14.6	10.2	2.9			
.075						
.020						
.002						
DOTTSD	Sl Si Sa Gr I	Sa Si	Sa Si	Sa Si	Sa Si	Si
AASHTO Class	A-1-b(0)	A-4(0)	A-4(0)	A-4(0)	A-4(0)	A-4(0)
FSV Class						
Unified Class	NV	NV	NV	NV	NV	NV
Liquid Limit	NP	NP	NP	NP	NP	NP
Plastic Index	11.9	37.5	51.3	51.3	51.3	42.5
Moisture Content %						
Organic Content %						
% Gravel	53	48	82			3
% Sand	32	42	15	59	26	16
% Silt & Clay	15	10	3	41	74	81
Max. Dry Density						
Opt. Moisture %						
Degradation Value						
L.A. Abrasion Loss						
Sulfate Soundness						

Note: Gradation test based on minus 75 mm material. AASHTO class may be inappropriate if organic content > 5%.
 The sampler used to take the above samples has an inside diameter of 35 mm or 50 mm, therefore soil particles with a diameter larger than 35mm or 51 mm was not recovered. See test hole logs for a field description of tested materials.

APPENDIX E

DESCRIPTION OF ROCK PROPERTIES

DESCRIPTION OF ROCK PROPERTIES

DEGREE OF WEATHERING

DESCRIPTION

<u>Fresh</u>	Rock is fresh, crystals bright, a few joints may show slight staining in their surfaces. The rock rings under the hammer, if crystalline.
<u>Very Slight</u>	Rock is generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken faces are bright. Rock rings under the hammer, if crystalline.
<u>Slight</u>	Rock is generally fresh, joints are stained, and discoloration extends into the rock up to 1 inch (25mm). Joints may contain clay. In granitic rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under the hammer.
<u>Moderate</u>	Significant portions of the rock show discoloration and weathering effects. In granitic rocks, most feldspars are dull and discolored; some appear clayey. The rock has a dull sound when hit with a hammer and shows significant loss of strength as compared to fresh rock.
<u>Moderately Severe</u>	All the rock, except the quartz, is discolored or stained. In granitic rocks, all feldspars are dull and discolored and the majority show kaolinization. Rocks show severe loss of strength and can be excavated with a geologist's pick. Rocks go "clunk" when struck with a hammer.
<u>Severe</u>	All rocks, except quartz, are discolored and/or stained. The rock "fabric" is clear and evident, but the rock is reduced in strength to strong soil. In granitic rocks, all feldspars are kaolized to some extent. Some fragments of strong rock still remain. The rock can be broken by hand.
<u>Very Severe</u>	All rocks except quartz is discolored or stained. Rock "fabric" is discernible, but the mass is effectively reduced to soil with only fragments of strong rock remaining.
<u>Complete</u>	The rock is reduced to soil. Rock "fabric" is not discernible or discernible only in small scattered locations. Quartz may be present as dikes, veins or stringers.

1. Note information from Table 3-1 of the State of Alaska Department of Transportation and Public Facilities Engineering & Geology Procedures Manual, September 1992, Revised May 1993.

DESCRIPTION OF ROCK PROPERTIES

(Continued)

HARDNESS	DESCRIPTION
<u>Very Hard</u>	Cannot be scratched with a knife or sharp pick. Requires several hard blows with a geologist pick to break into hand specimens.
<u>Hard</u>	Can be scratched with a knife or pick only with difficulty. A hard blow of the hammer is required to detach a hand specimen.
<u>Moderately Hard</u>	Can be scratched with a knife or pick. Gouges or groves up to ¼ inch (6mm) deep can be excavated by a hard blow to the point of a geologist pick. Hand specimens can be detached by moderate blow of the hammer.
<u>Medium</u>	Can be grooved or gouged 1/16 inch (2mm) deep by firm pressure on a knife or pick point. Can be broken into small chips or pieces about 1 inch (25mm) maximum size by hard blows of a geologist pick.
<u>Soft</u>	Can be gouged or grooved readily with a knife or pick point. Can be broken into chips or fragment several inches in size by moderate blows of a geologist pick. Small thin fragments can be broken in the hand.
<u>Very Soft</u>	Can be carved with a knife. Can be easily excavated with a pick. Pieces 1 inch (25mm) or more in thickness can be broken with finger pressure. Can be scratched readily with a fingernail.

*Note: Hardness from engineering geology descriptions of rocks should not be confused with Moh's hardness scale of minerals.

JOINTING, BEDDING, FOLIATION/or other DISCONTINUITIES

SPACING	JOINTING	BEDDING
Less than 2 inches (51mm)	Very Close	Very thin
2 inch (51mm) to 1 foot (305mm)	Close	Thin
1 foot (305mm) to 3 feet (914mm)	Moderately Close	Medium
3 feet (914mm) to 10 feet (3.04 m)	Wide	Thick
More than 10 feet (3.04m)	Very Wide	Very Thick

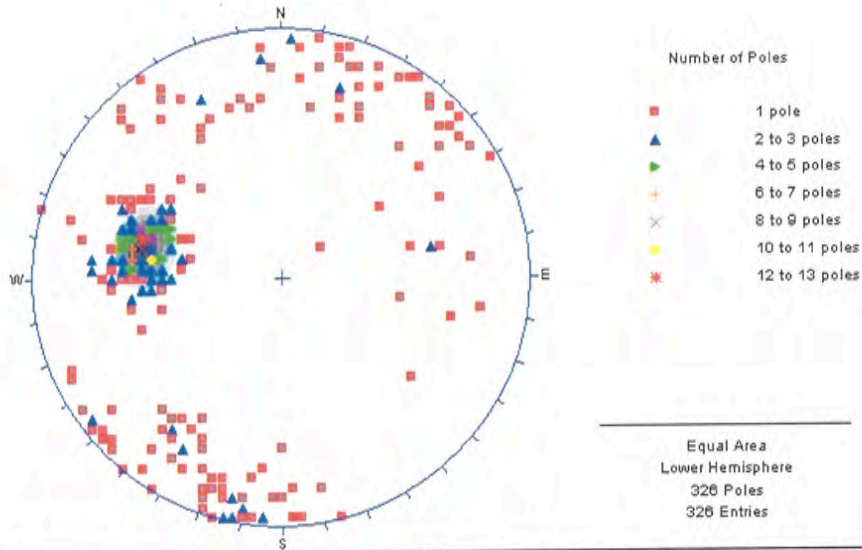
1. Note information from Table 3-1 of the State of Alaska Department of Transportation and Public Facilities Engineering & Geology Procedures Manual, September 1992, Revised May 1993.

APPENDIX F

ROCK SLOPE DATA and
PETROGRAPHIC ANALYSIS REPORTS

Rock Mapping data

The following stereonet graphically shows the orientation of the rock structure from rock mapping data collected along the existing cut next to the highway. The rock was mapped from about Station 40+800 to 41+200.



The rock mapping indicates that the eastward dipping bedding structure is the predominant structure for this area. The bedding dips toward the road at an average angle of 48 degrees. There have been large detached blocks resulting from this bedded structure. There are also some joints that will form wedge failures.

Seward Highway MP 18-25
 Rock Mapping Data
 Project #53919

Dip	Dip Direction	Approx. Station	Structure Type
89	19	40+801	J
51	99		B
50	95		B
52	109		B
85	220		J
44	100		B
45	105		B
31	105		B
48	110		B
74	36		J
81	148		J
54	119		B
49	92		B
82	135		J
45	109		B
44	114		B
86	12		J
31	114		B
54	113		B
45	125	40+825	B
59	33		J
39	108		B
59	34		J
62	36		J
60	118		B
68	30	40+828	J
71	23		J
51	104		B
55	101		B
54	115		B
45	117		B
71	185		J
75	31		J
48	110		B
48	113		B
89	145		J
55	29		J
60	115		B
61	38		J
76	350		J
67	32	40+840	J
48	112		B
66	37		J
44	98		B
69	30		J
33	104		B
38	110		B
60	189		J
60	165	40+849	J

Dip	Dip Direction	Approx. Station	Structure Type
44	120	40+849	B
52	100		B
34	110		B
39	110		B
81	185		J
57	1		J
88	31		J
45	112		B
76	106		B
87	51		J
75	147		J
61	244		J
44	113		B
57	99	40+860	B
43	118		B
46	108		B
81	137		J
53	110		B
57	150		J
74	135		J
47	112		B
49	100		B
43	115		B
37	110		B
48	109		B
56	150		J
52	84	40+866	B
59	98		B
49	101		B
64	25		J
62	91	40+871	B
67	156		J
59	89		B
56	90		B
79	10		J
54	90		B
60	175		J
49	101		B
68	144	40+877	J
54	104		B
49	113		B
90	13		J
85	20		J
49	101		B
50	100		B
51	102	40+888	B
65	263		J
89	189		J
54	108	40+890	B

Seward Highway MP 18-25
 Rock Mapping Data
 Project #53919

Dip	Dip Direction	Approx. Station	Structure Type
50	107	40+890	B
71	277		J
33	93		B
49	104		B
46	105	40+893	B
44	257		J
55	93		B
41	278		J
50	101		B
45	98		B
61	156	40+897	J
71	152		J
47	93		B
47	98		B
56	308		J
53	97		B
77	175		J
72	177		J
87	14		J
57	97	40+900	B
84	10		J
49	104		B
50	110		B
58	284		J
48	100		B
55	104	40+903	B
49	106		B
80	13	40+905	J
49	109		B
89	182		J
58	113		B
83	10		J
56	118		B
49	103	40+910	B
81	16		J
79	14		J
49	105		B
77	28		J
50	108		B
76	15		J
77	18		J
49	91		B
48	108		B
45	109		B
50	105	40+914	B
42	100		B
39	107		B
47	109		B
52	105	40+920	B

Dip	Dip Direction	Approx. Station	Structure Type
41	98	40+920	B
53	105		B
80	20		J
45	100		B
49	98	40+927	B
85	6		J
87	7		J
46	108		B
45	107		B
40	95		B
42	85	40+933	B
87	346		J
45	100		B
67	156	40+935	J
41	100		B
89	358		J
45	92		B
45	102		B
52	105		B
54	103		B
58	95		B
90	11	40+944	J
50	95		B
45	109		B
84	55		J
83	48		J
54	99		B
89	45		J
86	47		J
84	55		J
49	100		B
55	107		B
82	65		J
55	104		B
38	90	40+954	B
75	0		J
78	2		J
48	102		B
71	16		J
49	96		B
87	241	40+960	J
50	108		B
70	8		J
55	107		B
67	7		J
64	36		J
51	122		B
61	28		J
72	19	40+965	J

Seward Highway MP 18-25
 Rock Mapping Data
 Project #53919

Dip	Dip Direction	Approx. Station	Structure Type
44	99	40+965	B
44	114		B
40	139		B
17	230	40+967	J
40	237		J
41	122		B
50	104		B
42	91		B
62	43		J
50	80		B
40	117		B
49	92		B
65	92		B
66	35		J
40	100		B
41	85	40+980	B
89	16		J
35	90		B
50	101		B
85	355		J
74	358	40+985	J
33	103		B
54	99		B
47	106		B
49	100	40+992	B
84	36		J
44	103		B
45	87		B
86	229		J
48	95		B
48	92	41+000	B
49	96		B
50	260		J
46	100		B
45	102	41+005	B
85	213	41+110	J
66	116		B
53	259		J
44	88		B
55	93		B
54	98		B
49	70		B
80	231		J
51	99		B
46	122		B
81	235	41+127	J
45	120		B
82	67		J
86	216	41+130	J

Dip	Dip Direction	Approx. Station	Structure Type
90	40	41+130	J
75	52		J
47	134		B
90	56		J
85	225		J
54	124	41+135	B
48	85		J
56	91		B
85	206		J
50	103		B
50	260		J
54	260		J
78	222		J
70	100		B
54	111		B
85	50		J
44	113		B
46	116		B
44	95		B
60	233		J
42	115		B
48	115	41+147	B
40	90		B
78	228		J
75	227		J
42	85		B
43	98	41+155	B
72	230		J
52	92		B
76	174		J
83	176	41+161	J
55	102		B
51	101		B
89	4		J
85	195		J
47	105		B
50	109		B
73	203		J
70	196		J
50	84		B
80	200		J
80	195		J
59	88	41+171	B
86	12		J
36	92		B
82	210		J
87	197		J
50	105		B
74	209	41+174	J

Seward Highway MP 18-25
 Rock Mapping Data
 Project #53919

Dip	Dip Direction	Approx. Station	Structure Type
49	98	41+174	B
66	97	41+175	B
65	95		B
65	92		B
63	166		J
60	170		J
41	91		B
42	93		B
65	206		J
55	99	41+180	B
57	96		B
65	200		J
43	101		B
60	223		J
61	205		J
48	106		B
74	192		J
42	75		B
40	96		B
70	197		J
43	100		B
89	183		J
89	10		J
57	200		J
32	99		B
40	113	41+190	B
90	106		J
37	106		B
45	97		B
41	113		B
76	199		J
50	110	41+200	B

PETROGRAPHIC ANALYSIS REPORT

Client: Alaska Dept. of Transportation
Project Name: Seward Hwy., MP 18-25
Project Number: 53919

Thin Section Number: TH 610-00-04
Field Classification: Argillite

COMPOSITION

Constituent	Optical/Physical Properties	Estimated %
Rock		
Quartz	angular to subrounded clasts; ≤ 0.1 mm	15%
Plagioclase	most clasts slightly to moderately altered to clay	15%
Chlorite	Pennine variety; small flakes	<1%
Muscovite	small flakes	<1%
Sericite	parallel to subparallel to bedding	20%
Epidote	small clasts and some as possible alteration products	3%
Biotite	light brown; small flakes; some alteration to sericite	<1%
Sphene	rare small grains	<1%
Opaques	as grains and streaks along bedding planes	15%
Clay	matrix supporting clasts	30%
Hornblende	small clasts	<1%
Carbonate	small patches	<1%
Vein		
Carbonate	open space filling of low pressure flexures in veins	60%
Quartz	open space filling of low pressure flexures in veins	30%
Opaques	define closed trace of vein	10%

TEXTURES AND STRUCTURES

Grain Size: Max. = 0.1 mm; min. = 0.001 mm; average = 0.03 mm

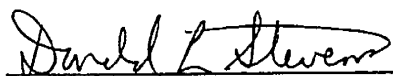
Textures: finely laminated with streaks of opaque material defining the bedding planes; elongate minerals are oriented parallel to bedding

Structures: several fractures cross-cut the bedding with later carbonate, quartz, and opaque minerals filling the available open space

PETROGRAPHIC CLASSIFICATION: Argillite

PETROGENESIS: Source area was probably volcanic terrane; deposition was in quiet marine basin; subsequent low grade metamorphism to lower greenschist facies

COMMENTS: Fractures and microfractures appear to have been "healed" by later minerals.


Petrographer

10/11/06
Date

PETROGRAPHIC ANALYSIS REPORT

Client: Alaska Dept. of Transportation
Project Name: Seward Hwy. MP 18-25
Project Number: 53919

Thin Section Number: TH610-00-07
Field Classification: Argillite

COMPOSITION

Constituent	Optical/Physical Properties	Estimated %
Rock		
Quartz	angular to subangular clasts; lenses; mosaics	10%
Carbonate	patches, lenses; in pressure shadows of rotated lithic clasts	3%
Epidote	small rounded clasts	<1%
Biotite	small brown flakes	2%
Plagioclase	clasts; twinned; some altered to sericite and clays	10%
Chlorite	green; in matrix from alteration of mafic minerals	15%
Sphene	small clasts	<1%
Clays	dominant matrix mineral	45%
Opauques	patches, grains, and "smears" on bedding & structural planes	<u>15%</u>
Veins		
Carbonate	dominant vein-filling mineral	60%
Sericite	more abundant along margins of veins	15%
Quartz	along margin of largest vein and disseminated in carbonate	20%
Opauques	as grains and smears	

TEXTURES AND STRUCTURES

Grain Size: Max.=0.1mm; min.=<0.001mm; average=0.01 mm


Textures: Intensely deformed by soft sediment deformation, and post-consolidation faulting in several directions

Structures: Many faults, fractures, slips, and an occasional bedding plane

PETROGRAPHIC CLASSIFICATION: Argillite

PETROGENESIS: Deposition of fine grained sediment in a low-energy marine environment; numerous episodes and styles of later deformation

COMMENTS: There are numerous microfractures.



Petrographer

10/11/00
Date

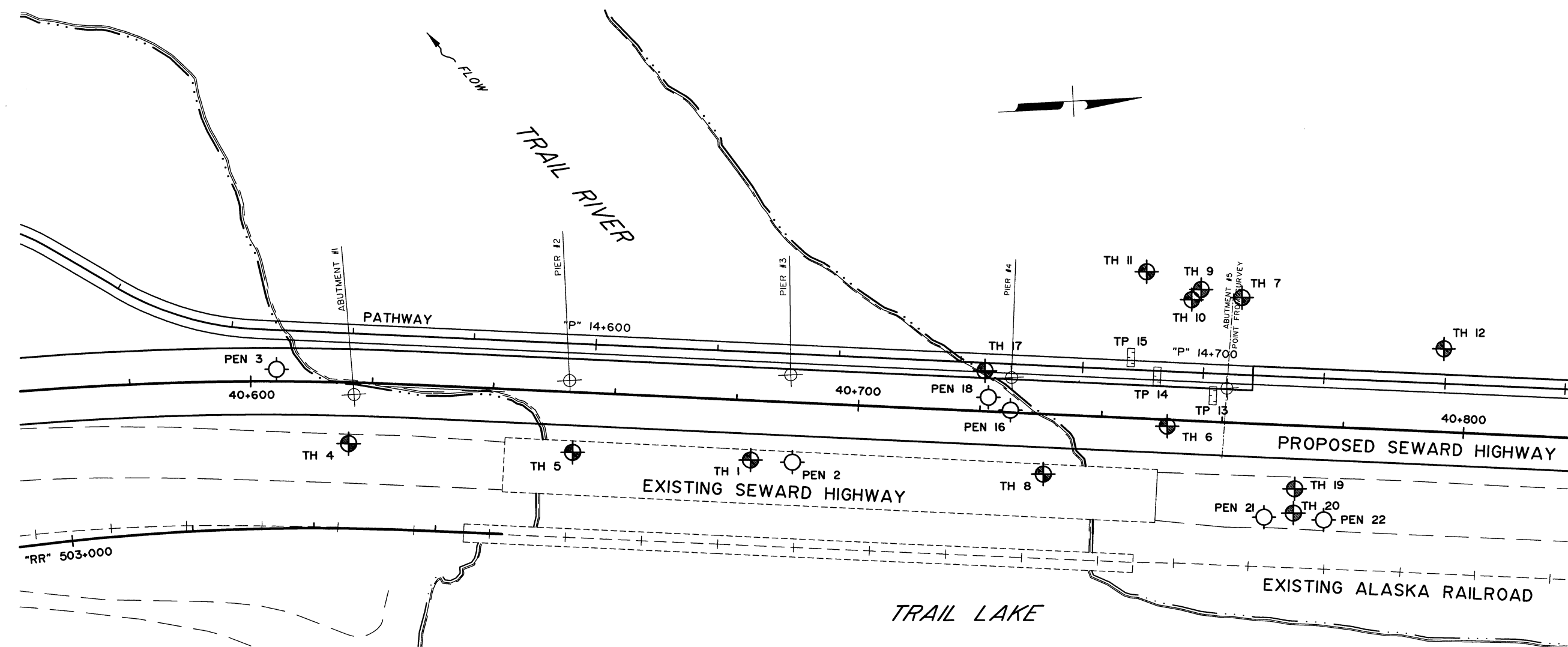
APPENDIX G

TEST HOLE LOCATIONS AND LOGS

GENERAL NOTES:

1. HORIZONTAL AND VERTICAL GEOMETRY WITH TOPOGRAPHIC DATA FURNISHED BY USING A CLOTH TAPE, SWING TIES FROM SURVEY STAKES PROVIDED BY THE DEPARTMENT OF TRANSPORTATION, CENTRAL REGION, LOCATION SECTION.

2. TEST HOLE AND CONTINUOUS PENETROMETER LOCATIONS ARE APPROXIMATE.



SUMMARY OF TEST HOLES

TEST HOLE DESIGNATION	STATION	OFFSET	NORTHING	EASTING	SOURCE
PEN 3	40+604.3	2.0 m LT.	46144.6295	16363.1014	SURVEY
TH 4	40+616.4	10.1 m RT.	46155.8±	16376.0±	SWING TIES
TH 5	40+653.5	9.9 m RT.	46192.5591	16379.4181	SURVEY
TH 1	40+682.7	9.8 m RT.	46221.6500	16382.2275	SURVEY
PEN 2	40+689.6	9.8 RT.	46228.5025	16382.9517	SURVEY
PEN 16	40+725.0	0.4 m LT.	46264.7±	16376.3±	SWING TIES
PEN 18	40+721.3	2.4 m LT.	46261.2±	16374.0±	SWING TIES
TH 17	40+720.5	6.7 m LT.	46260.9±	16369.6±	SWING TIES
TH 8	40+730.9	9.9 m RT.	46269.5376	16387.0886	SURVEY
TH 6	40+750.8	1.1 m RT.	46290.2894	16380.2958	SURVEY
TH 7	40+762.4	20.7 LT.	46303.9149	16359.7557	SURVEY
TH 9	40+755.5	21.8 m LT.	46297.1570	16358.0480	SURVEY
TH 10	40+754.0	20.0 m LT.	46295.4796	16359.6389	SURVEY
TH 11	40+746.2	24.2 m LT.	46288.2046	16354.6518	SURVEY
TH 12	40+796.0	13.7 m LT.	46336.7096	16370.0611	SURVEY
TP 13	40+758.1	4.3 m LT.	46298.0589	16375.6673	SURVEY
TP 14	40+748.6	7.1 m LT.	46288.8964	16371.9386	SURVEY
TP 15	40+644.2	10.0 m LT.	46284.7473	16368.6390	SURVEY
PEN 21	40+767.8	15.3 m RT.	46305.7±	16396.2±	SWING TIES
PEN 20	40+772.6	14.4 m RT.	46310.6±	16395.7±	SWING TIES
TH 19	40+772.6	10.4 m RT.	46311.0±	16391.8±	SWING TIES
TH 20	40+772.6	12.7 m RT.	46310.8±	16394.1±	SWING TIES
PEN 22	40+777.6	15.3 m LT.	46315.5±	16397.2±	SWING TIES

THESE STATION AND OFFSETS ARE BASED ON DESIGN CENTERLINE 8/1/03.

LEGEND

- TESTHOLE
- PENETROMETER
- TESTPIT

TAB
Reviewed by
Terry L. Barber, C.P.G.

TEST HOLE LOGS
AND LOCATIONS

SEWARD HIGHWAY
MP 18 TO MP 25

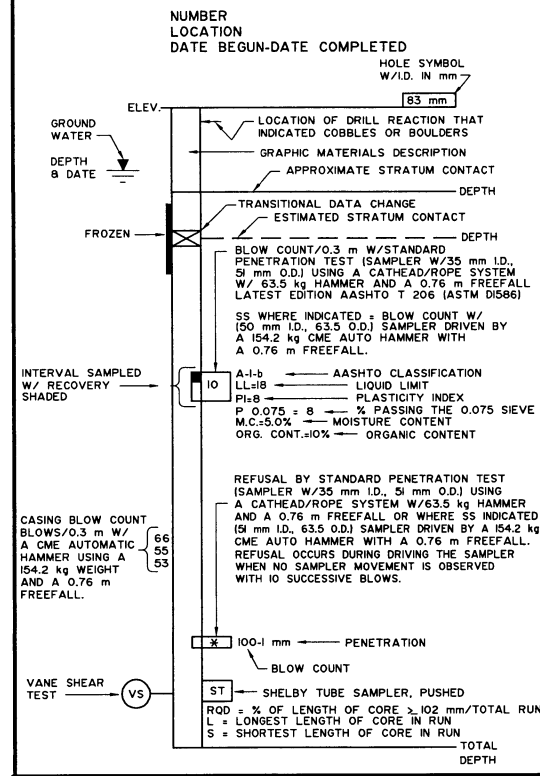
TRAIL RIVER
GENERAL LAYOUT

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND PUBLIC FACILITIES

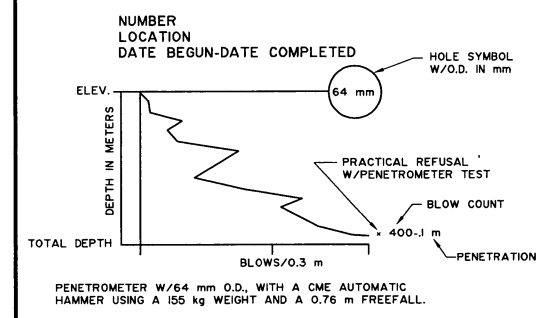
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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	STP-031-1(27) 53919	2000		

TYPICAL TEST HOLE LOG



TYPICAL PENETROMETER TEST LOG



TJB
Reviewed by
Terry L. Barber, C.P.G.

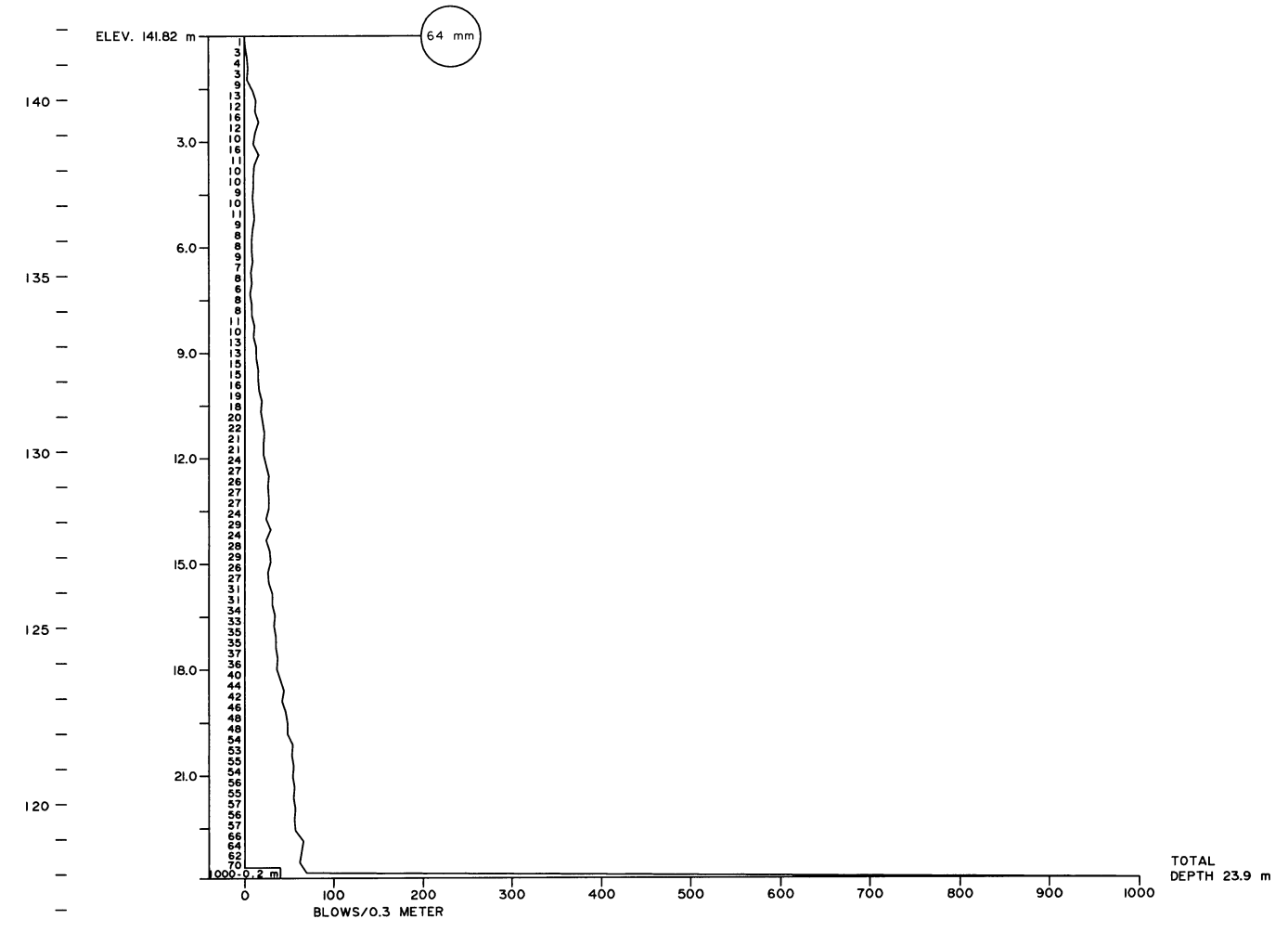
TEST HOLE LOGS AND LOCATIONS

SEWARD HIGHWAY
MP 18 TO MP 25

TRAIL RIVER BRIDGE
ABUTMENT 1

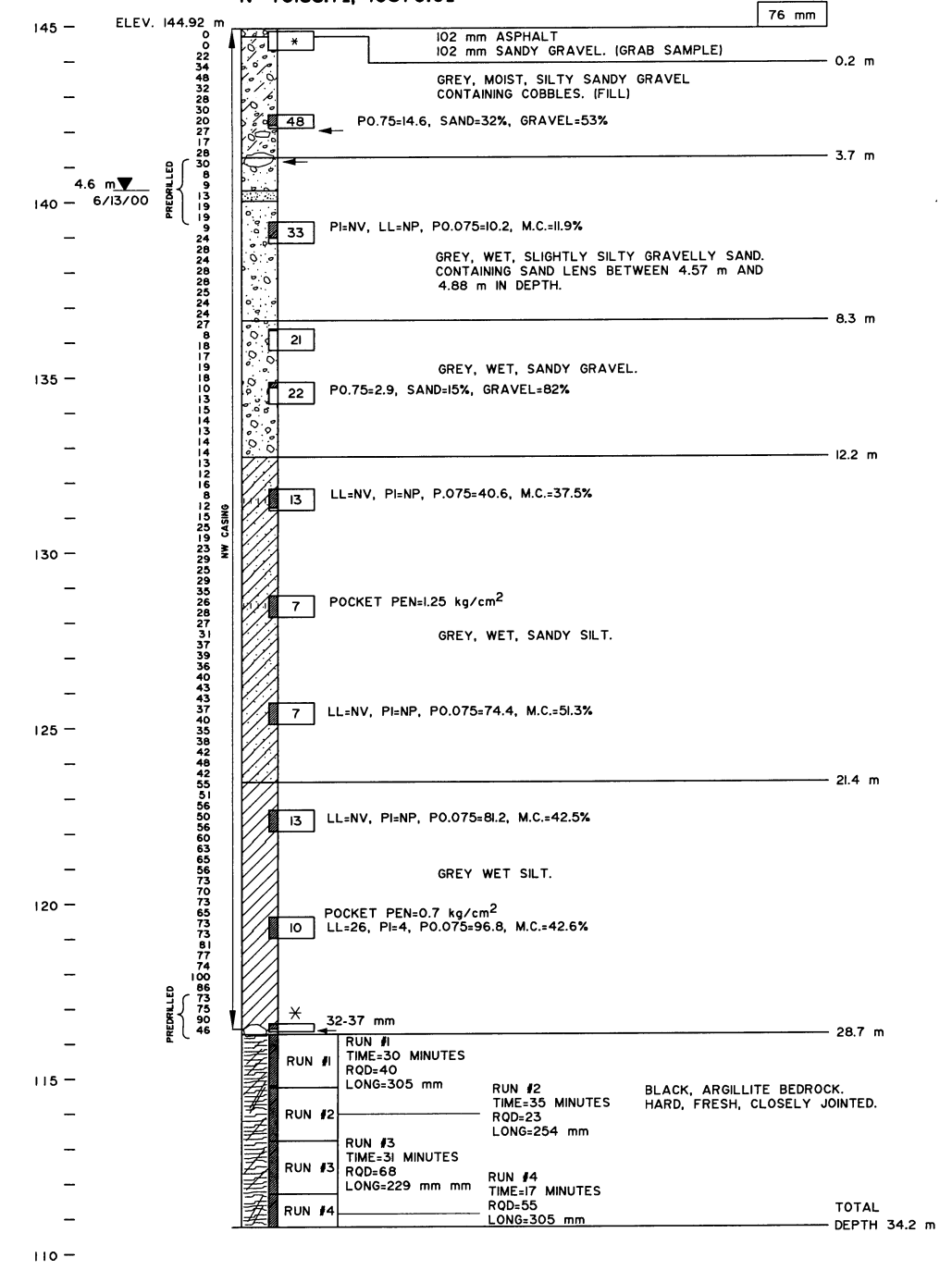
STATE OF ALASKA
DEPARTMENT of TRANSPORTATION
AND
PUBLIC FACILITIES

PENETROMETER 3
STA. 40+604.3, 2.0 m LT.
6/8/00-6/9/00
N 46144.6295, E 16363.1014



- NOTES
- RODS WON'T TURN USING A PIPE WRENCH.
 - PENETROMETER PULLOUT BREAK FORCE IMMEDIATELY AFTER DRIVING WAS 91.2 kN.

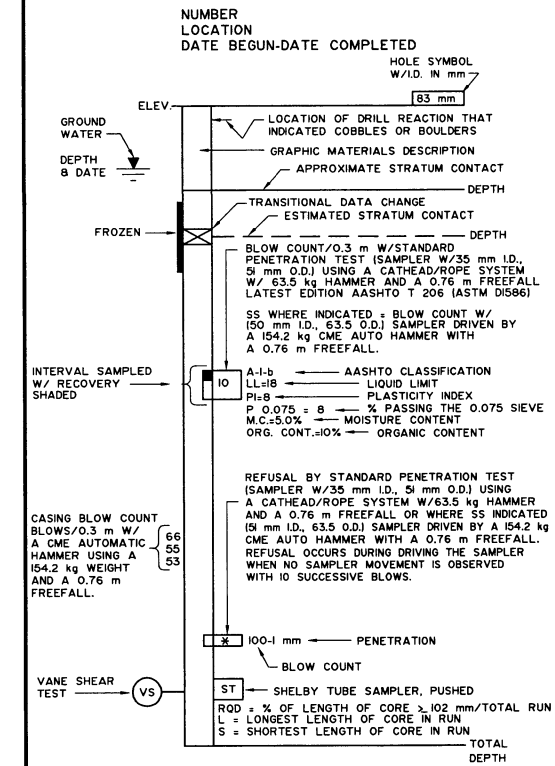
TEST HOLE 4
STA. 40+616.4, 6.3 m LT.
6/13/00-6/14/00
N 46155.7±, 16376.0±



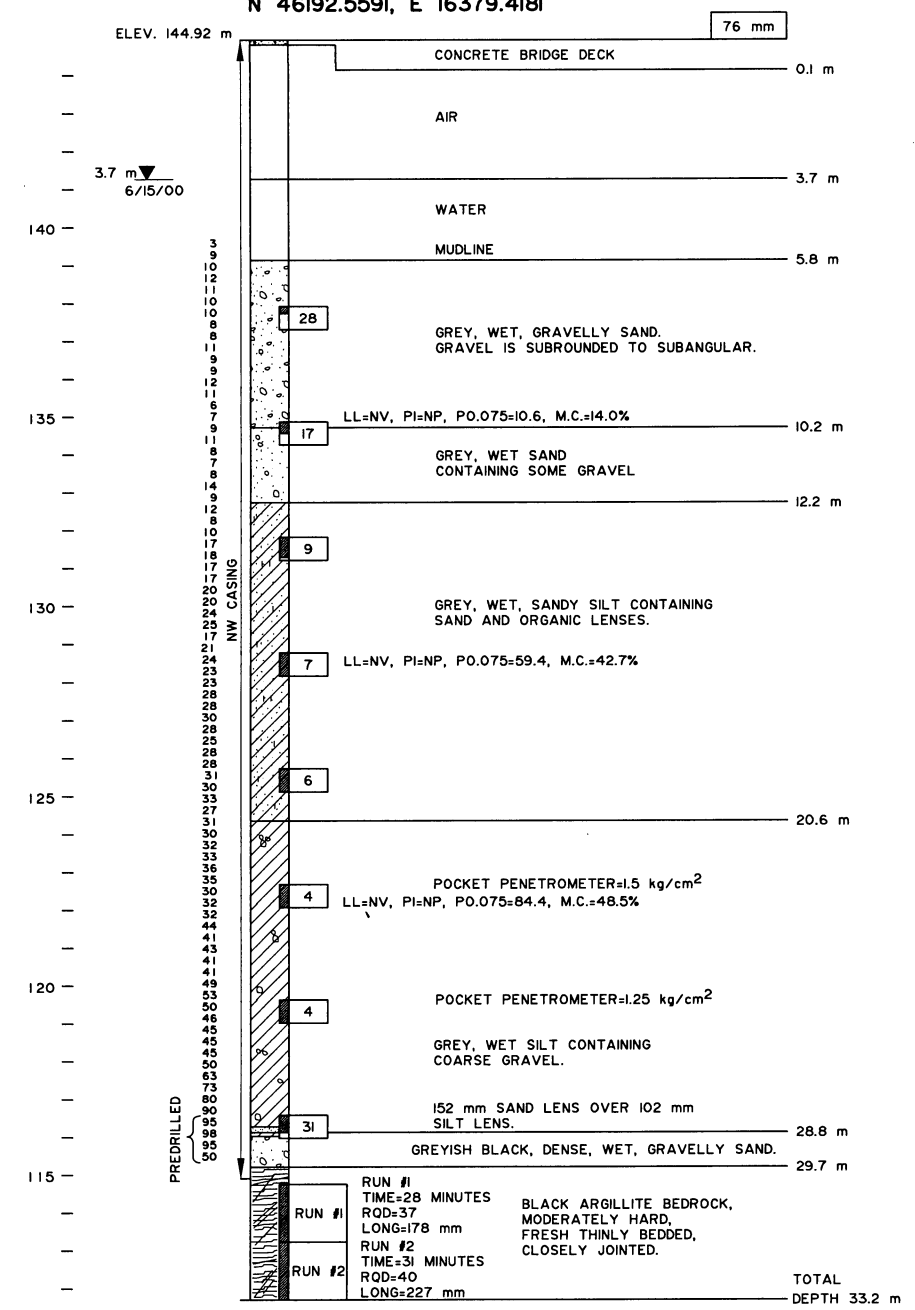
DRAWING NAME: C:\CAD\MATLIS\SEWARD02B-25\TRAIL\LOGS\TRAIL_VIEW 2 DATE: 10/24/03 SCALE: 1 = 10.0

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	STP-031-1(27) 53919	2000		

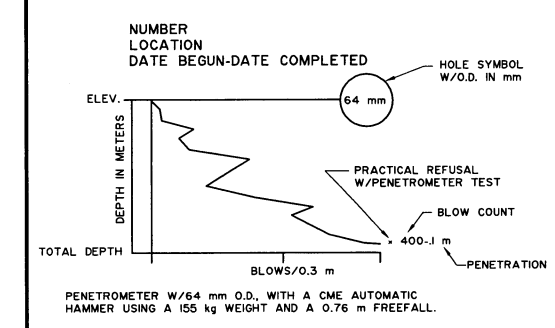
TYPICAL TEST HOLE LOG



TEST HOLE 5
STA. 40+653.5, 9.9 m RT.
6/15/00-6/16/00
N 46192.5591, E 16379.4181



TYPICAL PENETROMETER TEST LOG



Reviewed by
 Terry L. Barber, C.P.G.

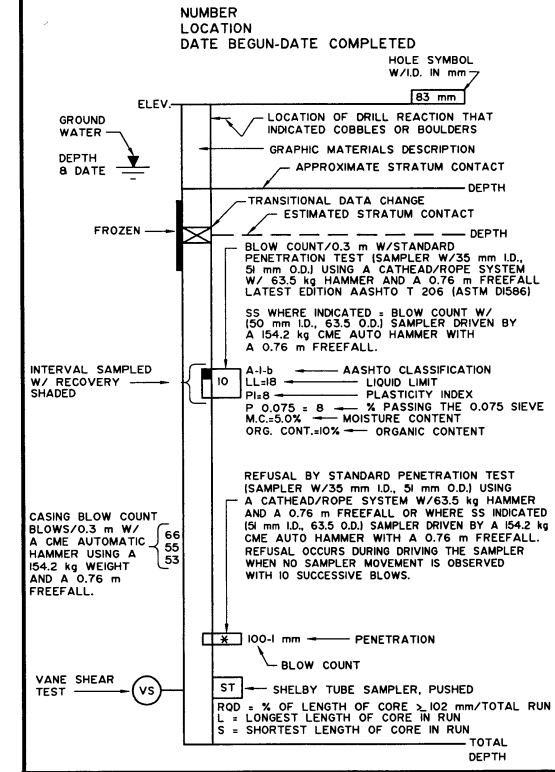
TEST HOLE LOGS AND LOCATIONS

SEWARD HIGHWAY
MP 18 TO MP 25
TRAIL RIVER BRIDGE
PIER 2

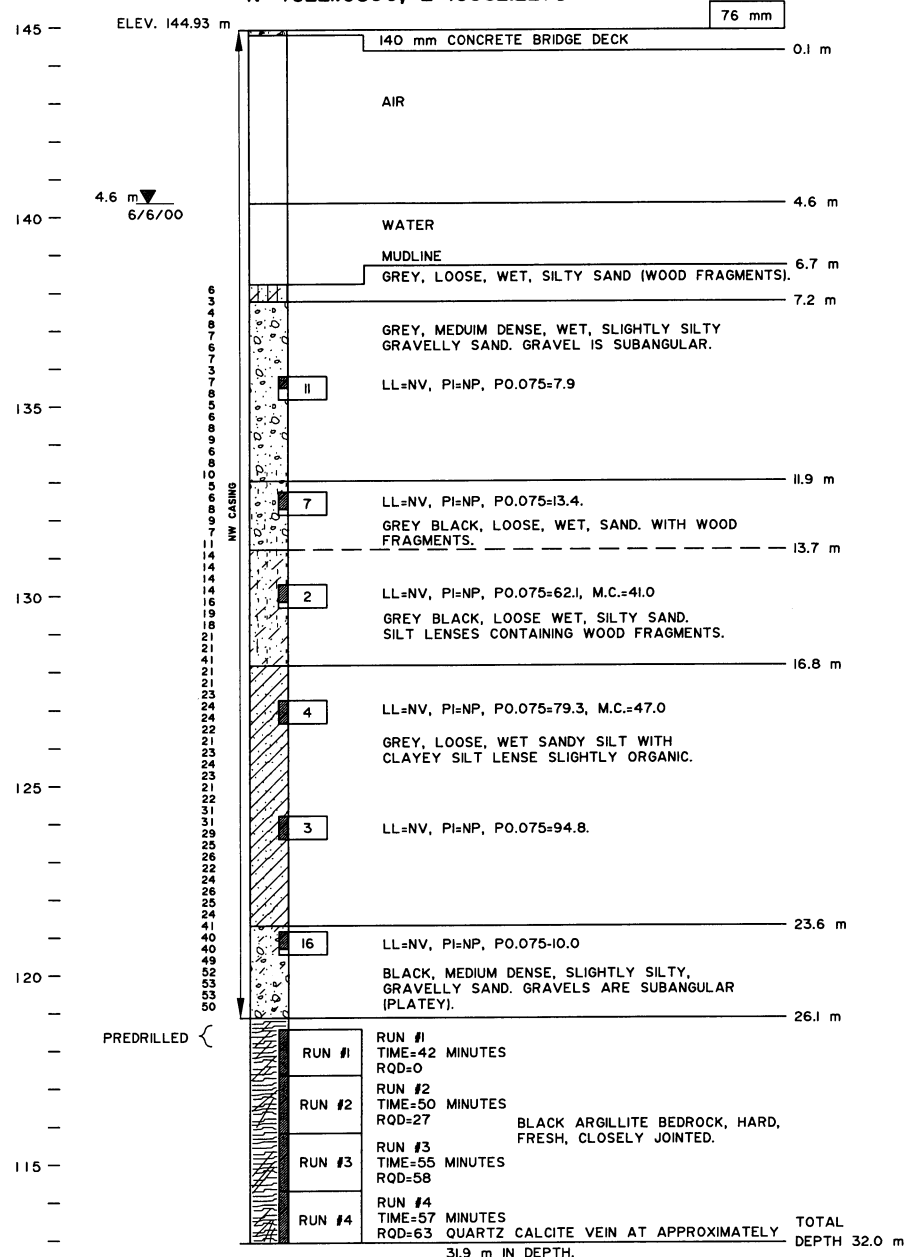
STATE OF ALASKA
 DEPARTMENT OF TRANSPORTATION
 AND
 PUBLIC FACILITIES

DWG NAME: C:\CAD\MAINT\SEWARD38-287\TRAIL\LOGS\TRAIL VIEW 3 DATE: 10/24/03 SCALE: 1 = 10.0

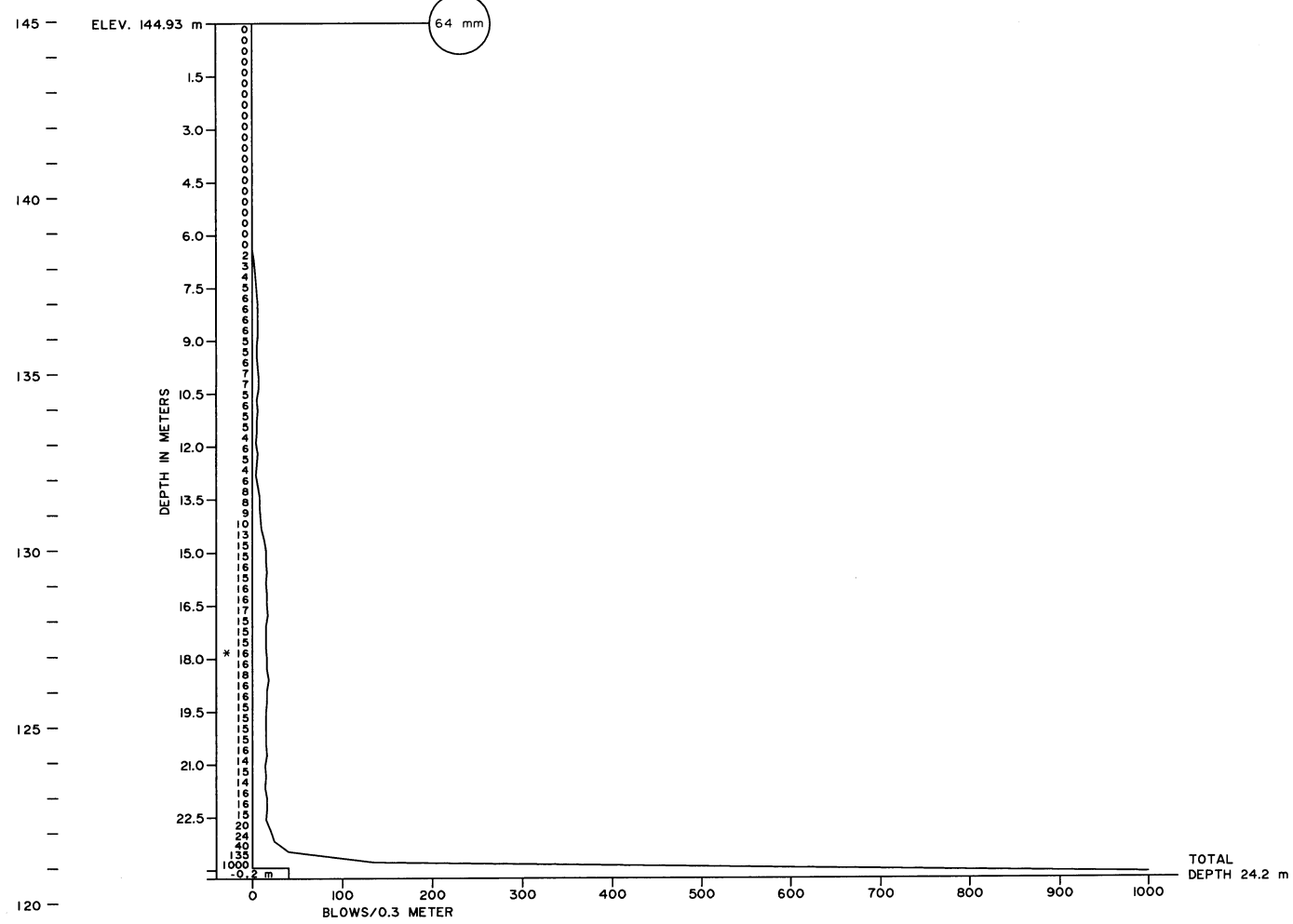
TYPICAL TEST HOLE LOG



TEST HOLE 1
 STA. 40+682.7, 9.8 m RT.
 6/6/00
 N 46221.6500, E 16382.2275

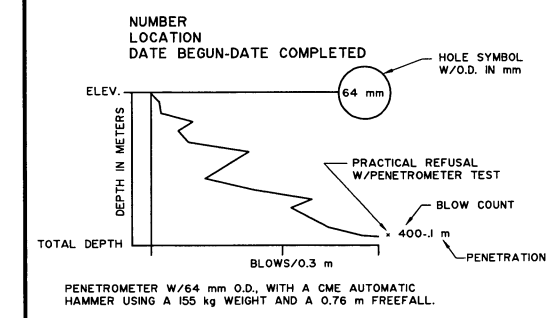


PENETROMETER 2
 STA. 40+689.6, 9.8 m RT.
 6/7/00-6/8/00
 N 462285.025, E 16382.9517



- NOTES**
- RODS WON'T TURN USING A PIPE WRENCH.
 - PENETROMETER PULLOUT BREAK FORCE IMMEDIATELY AFTER DRIVING WAS 37.7 kN.
 - PENETROMETER ROD LOWERED THROUGH EXISTING BRIDGE DECK AT ELEVATION 144.930 m TO MUDLINE AT ELEVATION 137.61 m.

TYPICAL PENETROMETER TEST LOG



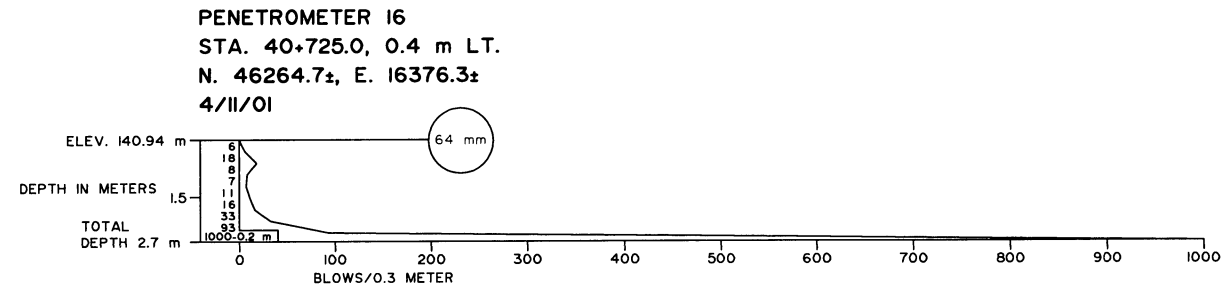
Reviewed by
 Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

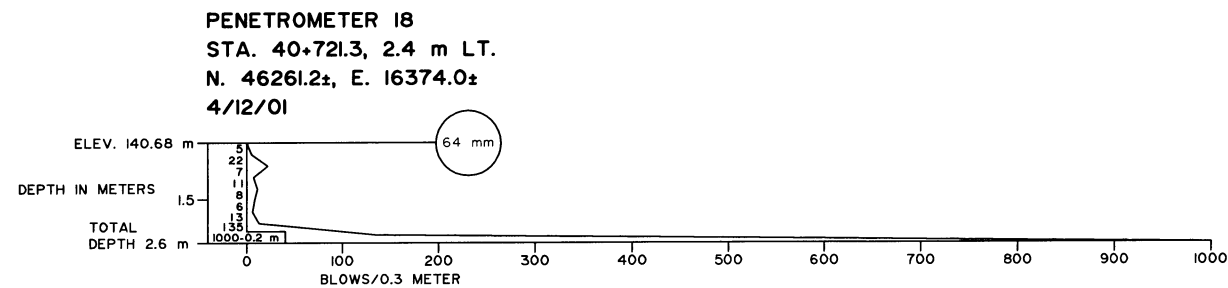
SEWARD HIGHWAY
MP 18 TO MP 25
TRAIL RIVER BRIDGE
PIER 3

STATE OF ALASKA
 DEPARTMENT of TRANSPORTATION
 AND
 PUBLIC FACILITIES

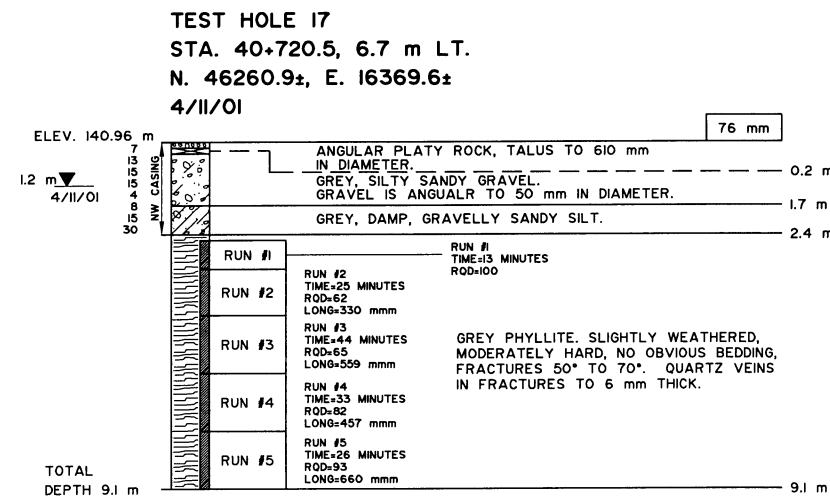
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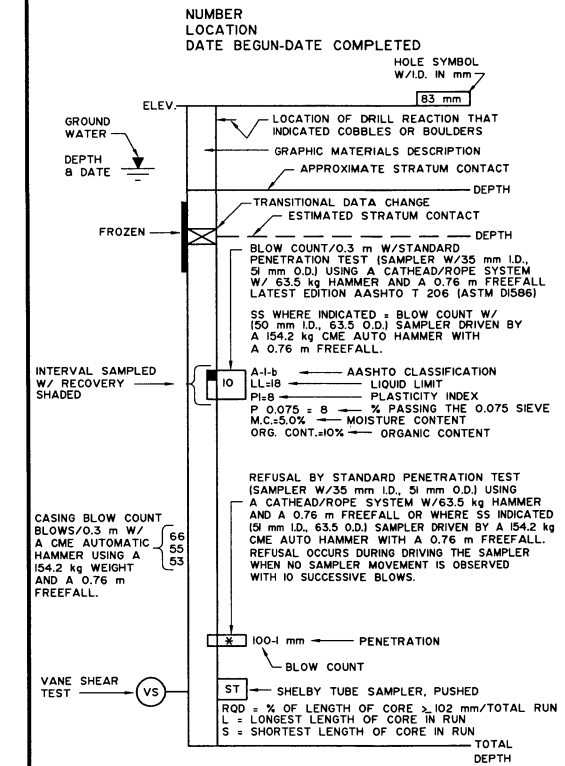
NOTES:
 I. PENETROMETER PULLOUT BREAK FORCE FROM 2.7 m IN DEPTH WAS 0 kN.



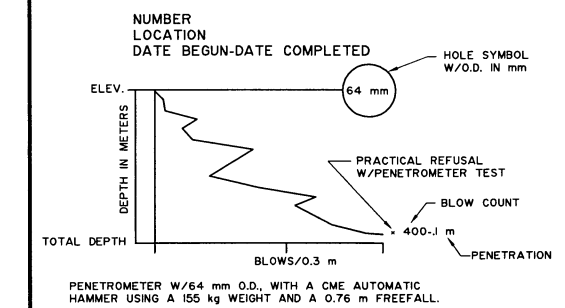
NOTES:
 I. PENETROMETER PULLOUT BREAK FORCE FROM 2.7 m IN DEPTH WAS 0 kN.



TYPICAL TEST HOLE LOG



TYPICAL PENETROMETER TEST LOG



Reviewed by
 Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

**SEWARD HIGHWAY
 MP 18 TO MP 25**

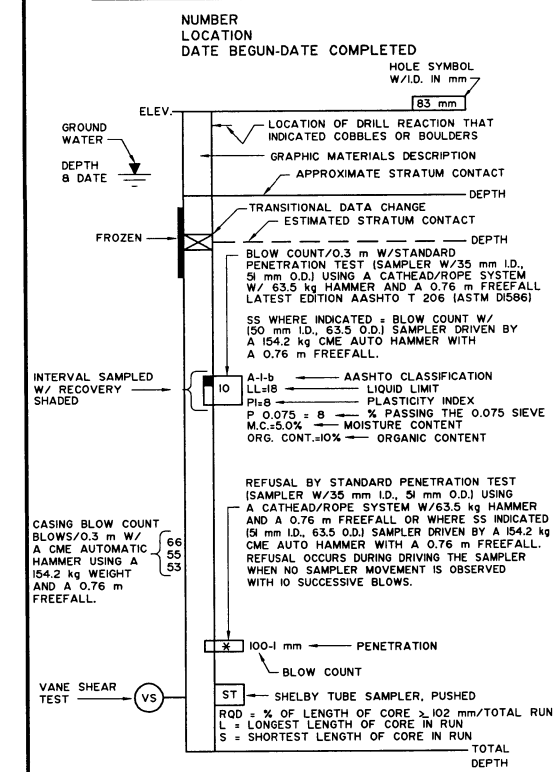
**TRAIL RIVER BRIDGE
 PIER 4**

STATE OF ALASKA
 DEPARTMENT of TRANSPORTATION
 AND
 PUBLIC FACILITIES

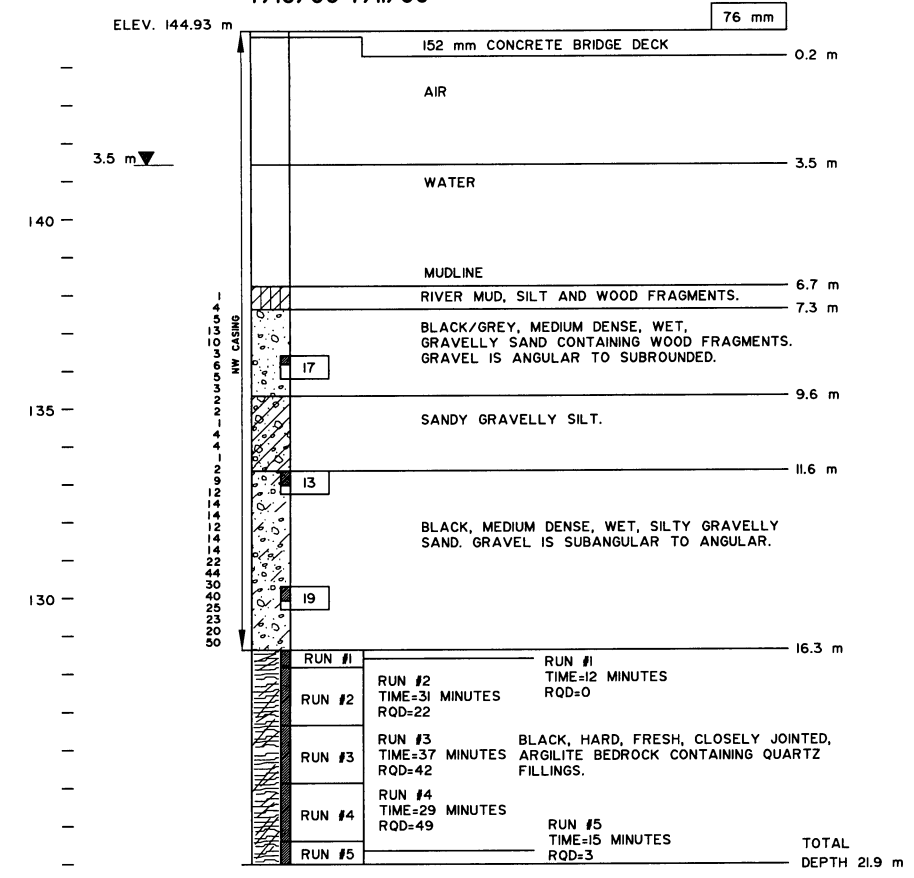
LWS: NAME: C:\CAD\MATLIS\SEWARD\48-25-TRAIL\LOGS-TRAIL_VIEW 7 DATE: 10/27/03 SCALE: 1 = 10.0

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	STP-031-1(27) 53919	2000		

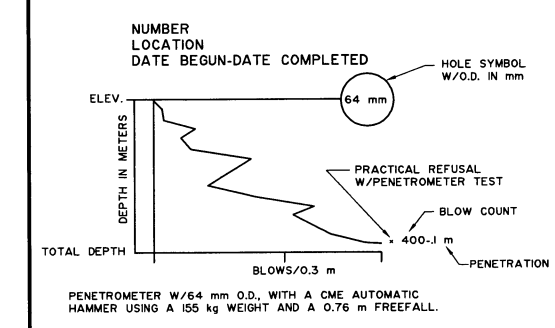
TYPICAL TEST HOLE LOG



TEST HOLE 8
STA. 40+730.9, 9.9 m RT.
N 46269.5376, E 16387.0886
7/10/00-7/11/00



TYPICAL PENETROMETER TEST LOG



T.L.B.
 Reviewed by
 Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

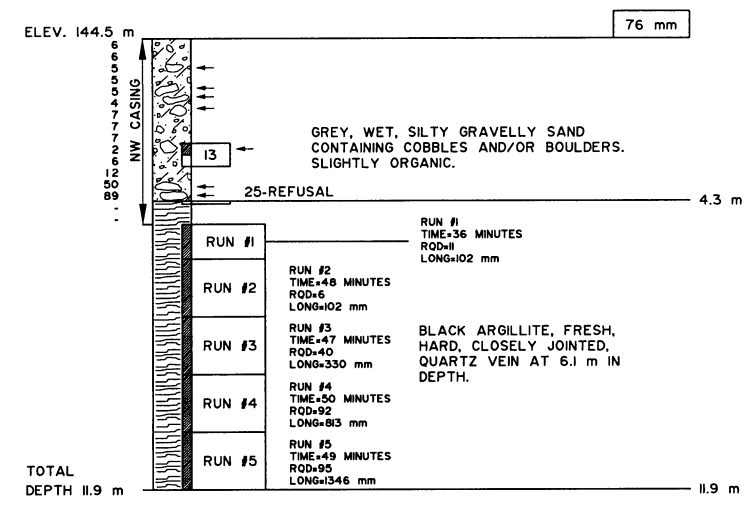
SEWARD HIGHWAY
MP 18 TO MP 25

TRAIL RIVER BRIDGE
PIER 4

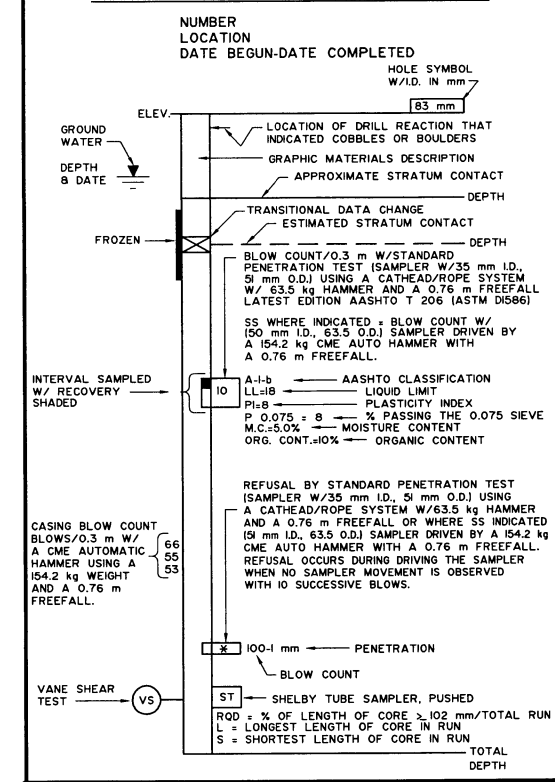
STATE OF ALASKA
 DEPARTMENT of TRANSPORTATION
 AND
 PUBLIC FACILITIES

DWG. NAME: C:\CAD\MATL\SEWARD\8-25\TRAIL\LOGS\TRAIL - VIEW 4 | DATE: 10/24/03 | SCALE: 1 = 10.0

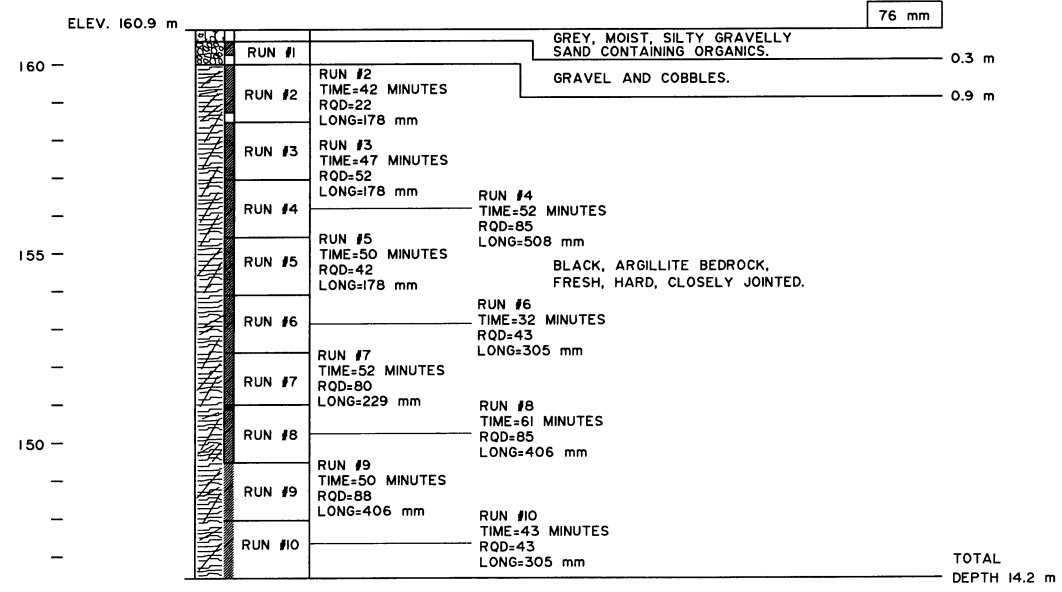
TEST HOLE 6
STA. 40+750.8, 1.1 m RT.
6/16/00-6/17/00
N46290.2894, E 16380.2958



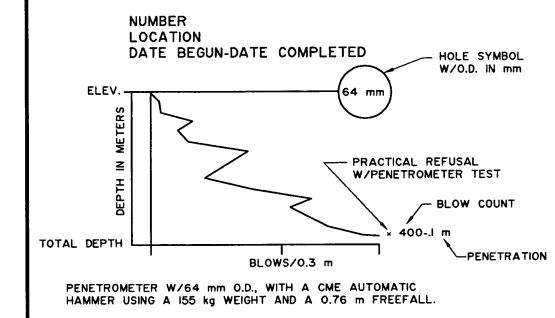
TYPICAL TEST HOLE LOG



TEST HOLE 7
STA. 40+762.4, 20.7 m LT.
N 46303.9149, 16359.7557
7/7/00-7/15/00



TYPICAL PENETROMETER TEST LOG



[Signature]
Reviewed by
Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

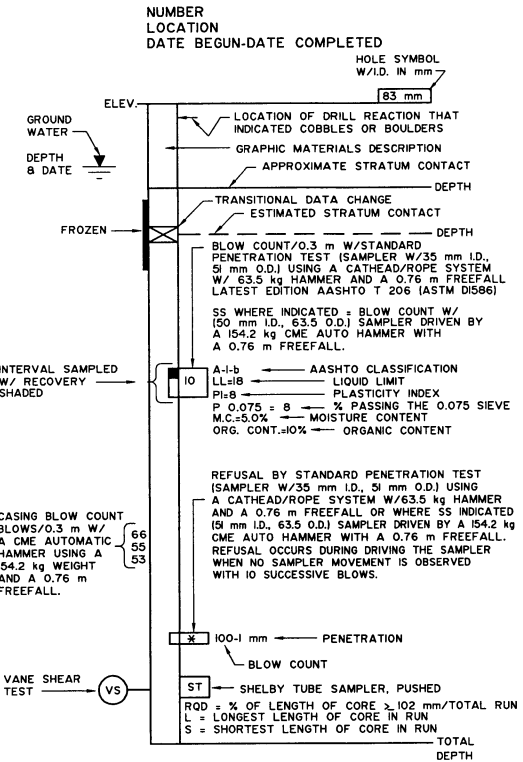
SEWARD HIGHWAY
MP 18 TO MP 25
TRAIL RIVER BRIDGE
ABUTMENT 5

STATE OF ALASKA
DEPARTMENT of TRANSPORTATION
AND
PUBLIC FACILITIES

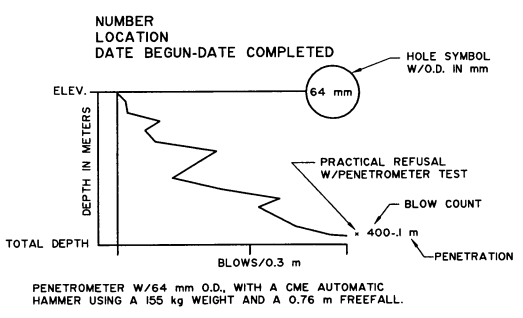
DWG NAME: C:\CAD\WATLS\SEWARD48-25\TRAIL\LOGS\TRAIL VIEW 6 DATE: 10/24/03 SCALE: 1:100

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	STP-031-1(27) 53919	2000		

TYPICAL TEST HOLE LOG



TYPICAL PENETROMETER TEST LOG



Reviewed by
Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

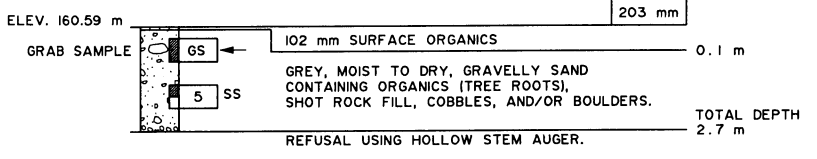
**SEWARD HIGHWAY
MP 18 TO MP 25**

**TRAIL RIVER BRIDGE
ABUTMENT 5**

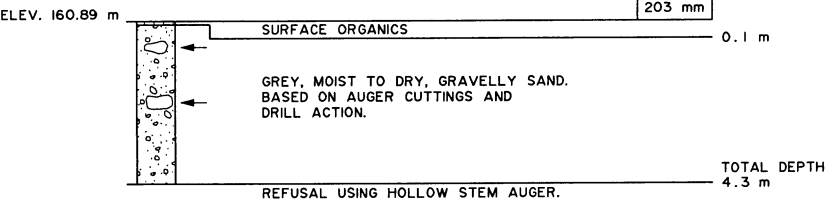
STATE OF ALASKA
DEPARTMENT of TRANSPORTATION
AND
PUBLIC FACILITIES

BRIDGE NO: 610
DRAWING NO: 8 OF 9

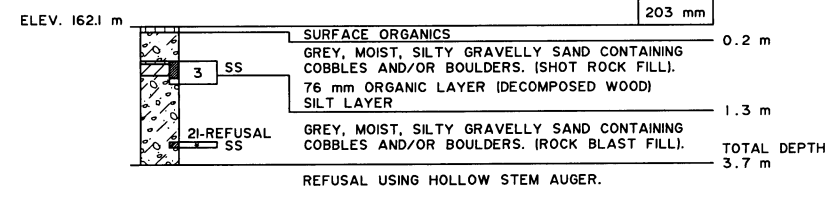
TEST HOLE 9
STA. 40+755.5, 21.8 m LT.
7/15/00
N 46297.1570, E 16358.0480



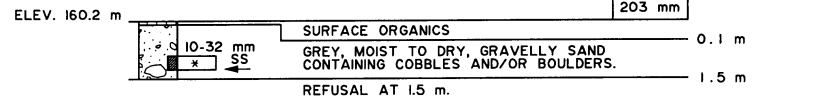
TEST HOLE 10
STA. 40+754.0, 20.0 m LT.
7/15/00
N 46295.4796, 16359.6389



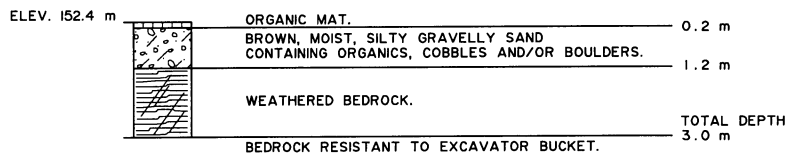
TEST HOLE 12
STA. 40+796.0, 13.7 m LT.
7/15/00
N 46336.7096, 16370.0611



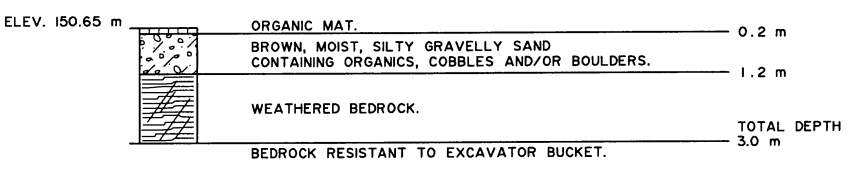
TEST HOLE 11
STA. 40+746.2, 24.2 m LT.
7/15/00
N 46288.2046, 16354.6518



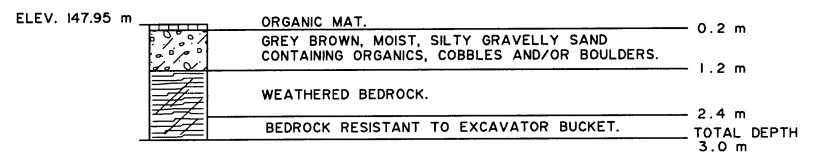
TEST PIT 13
STA. 40+758.1, 4.3 m LT.
7/20/00
N 46298.0589, E 16375.6673



TEST PIT 14
STA. 40+748.6, 7.1 m LT.
7/20/00
N 46288.8964, 16371.9386



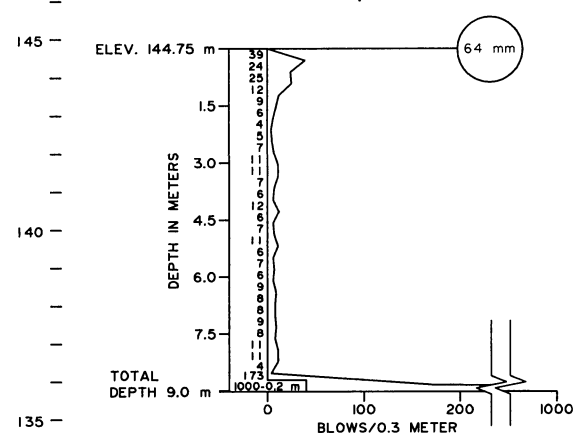
TEST PIT 15
STA. 40+644.2, 10.0 m LT.
7/20/00
N 46284.7473, E 16368.6390



SCALE: 1" = 100'
DATE: 10/24/03
VIEW 5
DWG NAME: C:\CAD\WATLS\SEWARD08-25\TRAIL\LOGS-TRAIL

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	STP-031-1(27) 53919	2000		

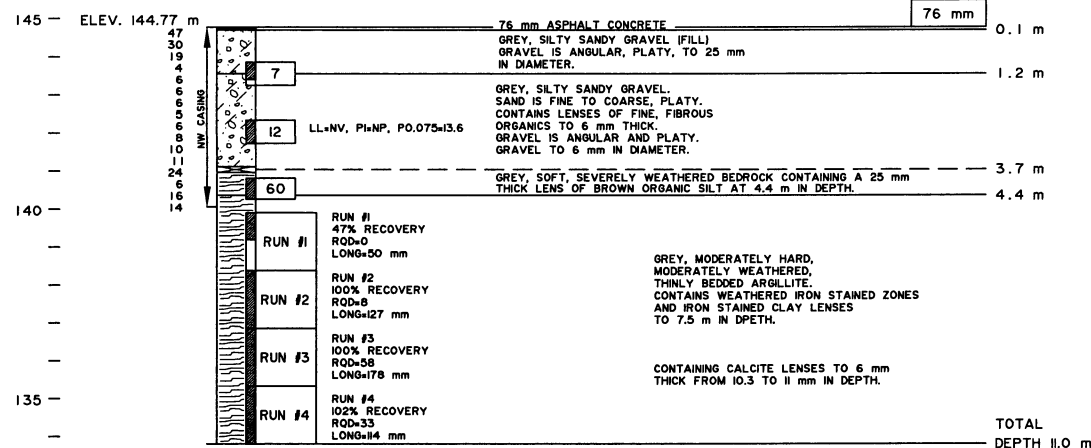
PENETROMETER 21
STA. 40+767.8, 15.3 m RT.
5/30/03-5/30/03
N 46305.7±, E 16396.2±



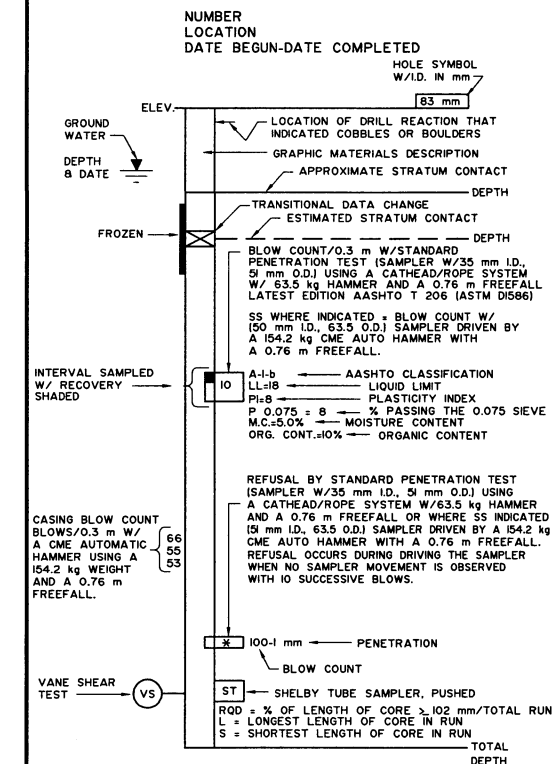
NOTES

I. PENETROMETER PULLOUT BREAK FORCE IMMEDIATELY AFTER DRIVING WAS 50 PSI.

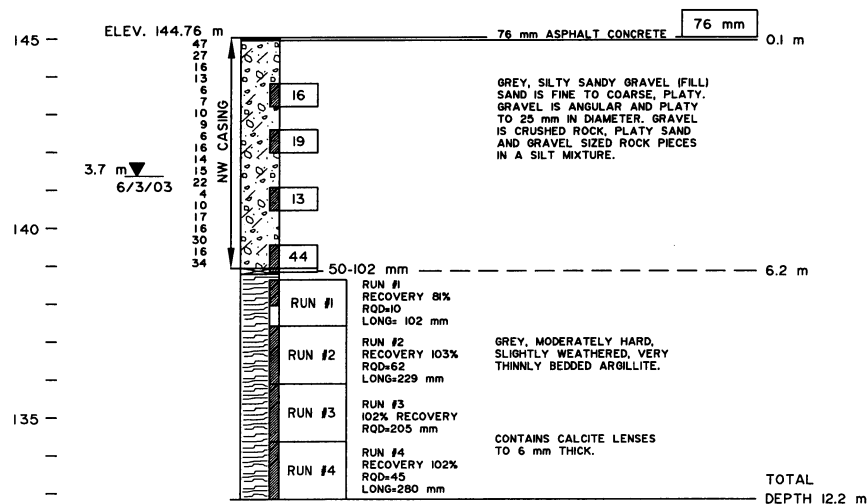
TEST HOLE 19
STA. 40+772.6, 10.4 m RT.
6/3/03-6/4/03
N 46311.0±, E 16391.8±



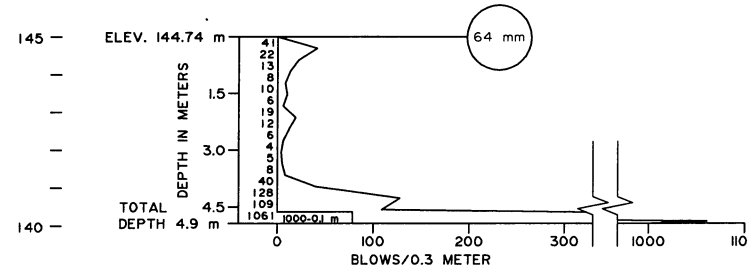
TYPICAL TEST HOLE LOG



TEST HOLE 20
STA. 40+772.6, 14.4 m RT.
5/30/02-6/3/03
N 46310.6±, E 16395.7±



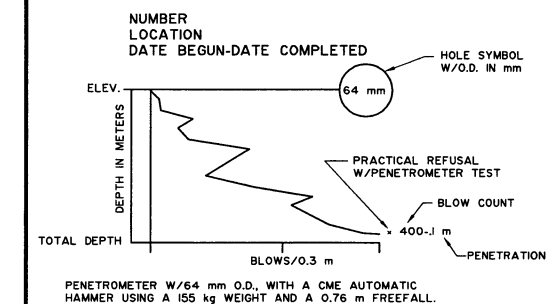
PENETROMETER 22
STA. 40+777.6, 15.3 m LT.
5/30/03
N 46315.5±, E 163397.2±



NOTES

I. PENETROMETER PULLOUT BREAK FORCE IMMEDIATELY AFTER DRIVING WAS 250 PSI.

TYPICAL PENETROMETER TEST LOG



TJB
 Reviewed by
 Terry L. Barber, C.P.G.

TEST HOLE LOGS AND LOCATIONS

**SEWARD HIGHWAY
 MP 18 TO MP 25**

**TRAIL RIVER BRIDGE
 ABUTMENT 5**

STATE OF ALASKA
 DEPARTMENT OF TRANSPORTATION
 AND
 PUBLIC FACILITIES

BRIDGE NO: 610
 DRAWING NO: 9 OF 9

DWG NAME: C:\CAD\MATLS\SEWARD48-25\TRAIL\LOGS-TRAIL VIEW IO DATE: 11/25/03 SCALE: 1 = 10.0