## SUSITNA HYDROELECTRIC PROJECT

1980 - 81 GEOTECHNICAL REPORT

VOLUME 2
APPENDIX A-F
FINAL DRAFT

Prepared by:



\_ ALASKA POWER AUTHORITY \_\_\_\_

### VOLUME 2

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APPENDIX A SELECTED BIBLIOGRAPHY OF PREVIOUS INVESTIGATIONS

### SELECTED BIBLIOGRAPHY OF PREVIOUS INVESTIGATIONS

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APPENDIX B WATANA DIAMOND CORE DRILLING LOGS

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO. : BH-1

SITE:

Watana (North Bank)

SHEET NO. 1 OF 10

CONTRACTOR:

Interstate Exploration Inc. DRILLING DATES: August 10 To August 14, 1981

LOGGED BY R.R. Henschel DATE: September 1981

DRILLING METHOD: LOCATION SOIL ROCK

Casing Advancer Diamond Core - Triple Tube

CASING DIAMETER: NW (3.0") I.D. CORE DIAMETER: NO (1.75") O.D.

LATITUDE N3,227,942

MSL, A.S.P.C., Zone 4 ELEVATIONS: DATUM

DEPARTURE E743,085 AZIMUTH 030°

GROUND SURFACE 2049.7 ROCK SURFACE BUTTOM OF HOLE 1767.9

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	RUN LENGTH	REC (RQD)
Overburden			
l- j			
	TOP OF ROCK		
Ouartz Diorite	Medium gray to medium green-gray, medium grained crystalline rock, non-foliated with 10-15% mafics (biotite/hornblende), 10-15%	Run 1 18.7- 21.0	100 (87)
	Overburden	Overburden  TOP OF ROCK  Ouartz Diorite  Medium gray to medium green-gray, medium grained crystalline rock, non-foliated with	Overburden  TOP OF ROCK  Ouartz Diorite  Medium gray to medium green-gray, medium grained crystalline rock, non-foliated with 18.7-

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

ALASKA POWER AUTHORITY CLIENT

P5700.05

PROJECT Susitna Hydroelectric Project

BH-1

Watana (North Bank) SITE

SHEET NO 2 OF 10

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF HUN (FT)	(HQD)
-	Quartz Diorite	quartz. Fresh to slightly weathered, generally hard to very hard. Joints very close to wide, fresh to slightly weathered with iron oxide staining on surfaces. Carbonate and sulphides common as coating on joints and fractures.	Run 2 21.0 to 26.0	96 (54)
		18.7-41.1 - Slightly weathered with iron oxide staining along joint surfaces. No penetrative weathering. Joints closely spaced.	Run 3	
30		21.2-22.8 - Fracture zones, very close spaced fractures and joints healed with carbonate and iron oxide. Some open fractures very close to close spaced at 0-10°, 20°, and 70°.	26.0 to 31.0	92 (74)
(28.2)		21.5-21.9 - Core broken by drilling, slickensides on some fragments.		
			Run 4	
			31.0 to 36.0	94 (88)
		36.95-40.0 - Shear/fracture zone, joints and fractures very close to closely spaced. numerous healed fractures throughout.	Pun 5	
		37.1 - Possible shear, with 0.25 inch layer of clay and rock fragments at 40°.	36.0 to	92 (56)
40 (37.6)		37.4-38.3 - Core broken by drilling, fragments 0.25 to 1.0 inch, average less than 0.50 inch. Core loss of 0.6 feet between 37.4 and 40.6.	41.0	
		38.8-39.4 - Shear, 10°, rough, plane with slickensides, chlorite coated, tight. Sulphide mineralization in surrounding rock.  39.5-39.6 - Shear, 40°, very tight, healed.	Run 6 41.0 to 46.0	100
		39.4-40.0 - Some minor hydrothermal alteration with feldspars altering to clay.	Run 7	100
50		41.1-46.5 - Joints close to moderately closely spaced.	to 51.0	(86)
(47.0)		49.4-63.9 - Joints closely spaced.		

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5760.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO. BH-1

SITE

Watana (North Bank)

SHEET NO. 1 OF 10

CONTRACTOR LOGGED BY

Interstate Exploration Inc. DRILLING DATES: August 10 to August 14, 1981

R.R. Henschel

DATE: September 1981

DRILLING METHOD

ROCK

Casing Advancer
Diamond Core - Triple Tube

CASING DIAMETER NW (3.0") I.D.
CORE DIAMETER NO (1.75") 0.D.

LOCATION

LATITUDE N3.227.942

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

DEPARTURE E743,085 AZIMUTH 030°

GROUND SURFACE 2049.7 2032.1 ROCK SURFACE

BOTTOM OF HOLE 1767.9

WATER TABLE NOTES 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	RUN LENGTH	% REC (RQD)
0	Overburden			
10 (9.4)				
18.7		TOP OF ROCK		
(17.6) 20 (18.8)	Quartz Diorite	Medium gray to medium green-gray, medium grained crystalline rock, fibn-foliated with 10-15% mafics (biotite/hornblende), 10-15%	Run 1 18.7- 21.0	100

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

SITE

ALASKA POWER AUTHORITY

Watana (North Bank)

P5700.05 JOB NO

BH-1

PROJECT Susitna Hydroelectric Project

SHEET NO 2 OF 10

DEPTH (FT)	HOCK TYPE	OESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF HUN (FT)	(#30) #(C
	Quartz Diorite	quartz. Fresh to slightly weathered, generally hard to very hard. Joints very close to wide, fresh to slightly weathered with iron oxide staining on surfaces. Carbonate and sulphides common as coating on joints and fractures.	Run 2 21.0 to 26.0	96 (54)
30 - 28.2)		18.7-41.1 - Slightly weathered with iron oxide staining along joint surfaces. No penetrative weathering. Joints closely spaced. 21.2-22.8 - Fracture zones, very close spaced fractures and joints healed with carbonate and iron oxide. Some open fractures very close to close spaced at 0-10°, 20°, and 70°. 21.5-21.9 - Core broken by drilling, slickensides on some fragments.	Run 3 26.0 to 31.0	92 (74)
		36.95-40.0 - Shear/fracture zone, joints and	Run 4 31.0 to 36.0	94 (88)
40 (37.6)		fractures very close to closely spaced. numerous healed fractures throughout.  37.1 - Possible shear, with 0.25 inch layer of clay and rock fragments at 40".  37.4-38.3 - Core broken by drilling, fragments 0.25 to 1.0 inch, average less than 0.50 inch. Core loss of 0.6 feet	Run 5 36.0 to 41.0	92 (56)
		between 37.4 and 40.6.  38.8-39.4 - Shear, 10°, rough, plane with slickensides, chlorite coated, tight. Suchide mineralization in surrounding rock.  39.5-39.6 - Shear, 40°, very tight, healed.	Run 6 41.0 to 46.0	100 (90)
50 (47.0)		39.4-40.0 - Some minor hydrothermal alteration with feldspars altering to clay. 41.1-46.5 - Joints close to moderately closely spaced. 49.4-63.9 - Joints closely spaced.	Run 7 46.0 to 51.0	100 (86)

CLIENT ALASI

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

40' E MO

MOLE NO DIT-

SITE Watana (North Bank)

SHEET NO. 3 OF 10

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(R00)
	Quartz Diorite		Run 8 51.0 to 56.1	100 (76)
60 (56.4)		57.9-59.5 - Felsic dike, light gray, no mafics, very hard.		100 (92)
		62.2-63.8 - Alteration zone, slightly to moderately hydrothermally altered, core slightly pitted, several healed fractures. Sulphide mineralization on fracture surfaces.	Run 10 61.6 to	100 (80)
		62.45 - Fracture, 70°-90°, friable on surfaces, clayey.	66.0	.,,,,,,
		$62.75$ - Possible shear, $40^{\circ}$ - $50^{\circ}$ , less than 0.12 inches wide, clay filling.	Run 11	
		63.9-87.9 - Joints close to moderately closely spaced.	66.0 to	100
70 (65.8)		68.9-87.9 - Joints close to moderately closely spaced.	71.2	
4		68.0-70.0 - Sulphides along most joints.		
		75.9-76.1 - Joints at 50° and 15°, respectively with clay coating, sulphide mineralization.	71.2 to 76.2	100 (94)
80 - (75.2)		63.2-77.4 - Core is more highly broken mostly by drilling, very close to closely spaced throughout.	Run 13 76.2 to 81.1	100 (88)
			Run 14 81.1 to 86.2	100 (94)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALA

ALASKA POWER AUTHORITY

JOB NO

P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Watana (North Bank)

SHEET NO 4 OF 10

		OF RUN (FT)	(900)
Quartz Diorite	86.3-96.5 - Healed breccia, quartz diorite fragments in a fine grained quartz diorite matrix with some minor hydrothermal alteration along joints.		
	86.3-86.9 - Mineralized vain, less than 0.25 inch at 86.65, possible shear.	86.2	100 (88)
	89.1-93.1 - Joints very close to close spaced.	91.2	
	93.1-96.5 - Fracture/alteration zone, light gray, moderately hydrothermal altered, joints very close to close spaced, moderately hard to hard, friable locally.	Run 16 91.2 to 96.2	90 (62)
	91.2-181.0 - Drilling water return generally less than $50\%$ .		
	94.2-96.2 - Core loss 1.2 feet.	Run 17	
	96.5-99.4 - Occasional healed fractures.	96.2	76
	99.4-101.2 - Healed breccia, hard.	to	(68)
	100.15-101.2 - Core loss 1.05 feet. Some clay at 100.15.		
	101.2-117.2 - Healed breccia, irregular fragments of quartz diorite in a medium green-gray, very fine grained quartz diorite	101.2 to	100 (44)
	matrix, hard to very hard. Some quartz healed fractures. Minor hydrothermal alteration locally, numerous quartz stringers and pods.	Run 19 103.9 to 107.0	100 (97)
		Run 20 107.0 to 111.2	98 (86)
	115.0-125.0 - Core medium to dark gray.	Run 21 111.2 to 116.3	100 (100)
		matrix with some minor hydrothermal alteration along joints.  86.3-86.9 - Mineralized vain, less than 0.25 inch at 86.65, possible shear.  89.1-93.1 - Joints very close to close spaced.  93.1-96.5 - Fracture/alteration zone, light gray, moderately hydrothermal altered, joints very close to close spaced, moderately hard to hard, friable locally.  91.2-181.0 - Drilling water return generally less than 50%.  94.2-96.2 - Core loss 1.2 feet.  96.5-99.4 - Occasional healed fractures.  99.4-101.2 - Healed breccia, hard.  100.15-101.2 - Core loss 1.05 feet. Some clay at 100.15.  101.2-117.2 - Healed breccia, irregular fragments of quartz diorite in a medium green-gray, very fine grained quartz diorite matrix, hard to very hard. Some quartz healed fractures. Minor hydrothermal alteration locally, numerous quartz stringers and pods.	fragments in a fine grained quartz diorite matrix with some minor hydrothermal alteration along joints.  86.3-86.9 - Mineralized vain, less than 0.25 inch at 86.65, possible shear.  89.1-93.1 - Joints very close to close spaced.  93.1-96.5 - Fracture/alteration zone, light gray, moderately hydrothermal altered, joints very close to close spaced, moderately hard to hard, friable locally.  91.2-181.0 - Drilling water return generally less than 50%.  94.2-96.2 - Core loss 1.2 feet.  96.5-99.4 - Occasional healed fractures.  99.4-101.2 - Healed breccia, hard.  100.15-101.2 - Core loss 1.05 feet. Some clay at 100.15.  101.2-117.2 - Healed breccia, irregular fragments of quartz diorite in a medium green-gray, very fine grained quartz diorite matrix, hard to very hard. Some quartz healed fractures. Minor hydrothermal alteration locally, numerous quartz stringers and pods.  Run 18 101.2  Run 19 103.9 Run 20 107.0 Run 20 107.0 Run 20 107.0 Run 21 111.2

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-1

SITE Watana (North Bank)

SHEET NO. 5 OF 10

DI PTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DENGTH OF RUN (FT)	HEC (HQD)
120 112.8)	Quartz Diorite	120.4-135.0 - Joints close to moderately close	Run 22 116.3 to 121.2	100 (100)
- 1		123.5-123.75 - Alteration zone, slightly bleached, slightly hydrothermally altered. Two joints at 30° and 50° with some clay/carbonate coating, slightly friable.	Run 23 121.2 to 126.1	100 (96)
		125.0-125.8 - Healed breccia, quartz diorite fragments in fine grained quartz diorite matrix.		
130 122.2)		126.1-127.3 - Alteration zone, slightly bleached, hydrothermally altered and mineralized band, sulphide healed fractures, tight, hard.	Run 24 126.1 to 131.0	100 (100)
		135.8-174.2 - Core becoming more fractured. Joints generally very close to close spaced, some drilling induced. Contains a few	Run 25 131.0 to 136.0	98 (98)
140 131.6)		healed fractures.	Run 26 136.0 to 141.0	100 (80)
		145.5-146.45 - Felsic dike, light gray, fine	Run 27 141.0 to 145.5	100 (100)
		grained, less than 5% mafic minerals, hard.  148.7-148.9 - Joints at 20° and 30°, respectively, clayey material containing some rock fragments. Probably shear plane, no slickensides.	Run 28 145.5 to 149.7	100 (76)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Watana (North Bank)

SHEET NO 6 OF 10

DEPTH	POCK TYPE	DESCRIPTION COLOR TEXTURE FOLIATION, JOINTING FRACTURING, "AULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DENGTH OF HUN (FT)	HEC (#Q(3)
150 1:1.0)	Quartz Diorite	150.7-158.4 - Numerous fractures, joints closely spaced at 10°-20° to core axis, some broken by drilling, planar. Healed with carbonate and chlorite. Core loss 1.2 feet.	Run 29 149.7 to 155.9	81 (53)
160 150.4)	, v.,	159.7-174.2 - Shear/alteration zone, moderately to completely hydrothermally altered with localized shearing.	Run 30 155.9 to 161.0	76 (55)
4		159.7-165.4 - Alteration zone, severely to completely altered, core friable, pitted, feldspars altered to clay. Very soft and plastic in upper 2.0 feet. Slickens des observed on soft clay coated remnant Joint. Core loss 3.3 feet.	Run 31 161.0 to 166.0	58 (0)
170 150.4)		165.4-171.0 - Moderately hard to hard, bleached white, slightly friable along fractures and joints.  171.0-174.2 - Completely hydrothermally altered as above, friable, soft and clayey, plastic.  173.6-174.2 - Quartz vein.	Run 32 166.0 to 171.0	100 (66)
		174.0 - Partially healed shear or breccia zone, 20° to core axis, 0.5 inch wide.  174.2-222.0 - Fresh and hard, joints very close to moderately close spaced.	Run 33 171.0 to 176.0	76 (30)
180			Run 34 176.0 to 181.0	100 (96)

CLIENT ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

BH-1

Watana (North Bank) SITE

SHEET NO 7 OF 10

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	HEC (HQD)
	Quartz Diorite		Run 35 181.0 to 186.0	100 (100)
190 . (178.5)			Run 36 186.0 to 191.0	100 (100)
		195.6-196.6 - Joint at 0°-10°, partially open with thin coating of carbonate and chlorite,	Run 37 191.0 to 196.0	100 (92)
		and sand size rock fragments.  195.0-205.6 - Several closely spaced low angle joints 0°-15°. Most are tight with irregular surfaces, partially to completely	Run 38 196.0 to 199.0	93 (73)
200 (187.9)		coated with chlorite and carbonate.	Run 39 199.0- 201.0	100 (70)
			Run 40 201.0 to 203.9 Run 41	100 (93)
		207.1-207.3 - Shear, 30°, contains 0.13 inch wide brownish green calcareous clay with some small rock fragments, surrounding	Run 42 204.8 to 208.4	100 (100) 100 (64)
210 - (197.3)		core hard.  207.6-208.3 - Shear, 10°, 0.06 inch wide, yellow-brown carbonate filling with small rock fragments. Surrounding core is hard.	Run 43 208.4 to 211.0	92 (92)
		Tock Tragments. Surrounding core is flara.	Run 44 211.0- 216.1	100

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO . NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO.

P5700.05

PROJECT Susitna Hydroelectric Project

SHEET NO. 8 OF 10

SITE Watana (North Bank)

DEPTH (FT)	MOCK TYPE	RESCRIPTION COLOR, TENTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN	1920)
	Quartz Diorite	211.0-270.2 - Drilling water return less than 50%.	Run 44 211.0 to 216.1	100 (76)
220 .			Run 45 216.1 to 221.0	100 (82)
200.7		222.0-224.8 - Alteration zone, moderately to severely hydrothermally altered, feldspars altered to clay. Texture intact. Very friable.	Run 46 221.0 to 226.0	100 (51)
230		223.5-224.8 - Alteration zone, moderately hydrothermally altered, cut throughout by irregular fractures and joints, primarily at 0°-10° and 40°. Carbonate healed but altered by hydrothermal solution. Penetrative up to 0.06 inches around fractures. Weakened but moderately hard.	Run 47 226.0 to 231.0	100 (78)
		224.8-243.0 - Joints close to moderately close spaced.  226.0-226.5 - Quartz vein, 0.12 inches wide at 20° to core axis, 0.75 inches wide alteration zone above it, moderately hydrothermally altered. Moderately hard.	Run 48 231.0 to 236.0	100 (100)
240 - 225.5)		226.3-227.3 - Quartz stringer, 0°-10°, 0.12 inches to 0.25 inches wide.  227.7-228.2 - Mafic dike, aphanitic, 20°, 0.5 inches wide, hard. Probably andesite.  232.8 - Shear, 25°, less than 0.06 inch wide, hard, tight. Healed with carbonate.	Run 49 236.0 to 240.9	100 (94)
			Pun 50 240.9 to 246.0	100 (90)

CLIENT

ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

BH-1

SITE Matana (North Bank) SHEET NO 9 OF 10

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	(800) 86.0
	Quartz Diorite	242.5 - Shear, 30°, less than 0.06 inch wide, possibly broken by drilling. Contains thin	Run 50	
		coating of calcareous clay material.	Run 51	
50		244.5-245.4 - Felsic dike, quartz rich, less than 2% mafics, very hard. Upper and lower contacts at 40°.	246.0 to 251.0	100 (100)
34.9)		243.0-256.0 - Core is generally very hard. Cut by numerous fractures at 5°-20°, most are healed and tight, some broken by drilling. Contains thin coating of carbonate and	Run 52	
		chlorite. Fracture spacing close to moderately close spaced.	251.0 to 256.0	100 (96)
		256.0-299.9 - Core is very hard with close to moderately close spaced joints.	Run 53	
60			256.0 to 260.9	100 (94)
44.57			Run 54	
3		267.4-269.2 - Joint, 5°, healed with carbonate.	260.9 to 265.6	100
			Run 55	
70			265.6 to 270.2	100 (80)
53.7)			Run 56	
			270.2 to 275.4	96 (96
			⊒un 57	

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5'00.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

Watana (North Bank)

SHEET NO 10 OF 10

MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE NOTH OF NUN (FT)	REC (RGD)
Quartz Diorite		Run 57 275.4 to 280.4	100 (100)
	thermally altered, very soft and friable, all feldspars altered to clay, texture partially preserved. 282.5-283.4 - Contains a thin aphanitic	Run 58 280.4 to 285.6	100 (25)
	brecciated but intact.  284.8-287.2 - Aphanitic dike, quartz rich, less than 5% mafics, very hard. Joints close at 10° and 45°, most have carbonate coating. Numerous healed, irregular fractures through-	Run 59 285.5 to 289.0	100 (82)
290 - 272.5)	out. 290.2-292.0 - Fracture, 0°-5°, healed with quartz, very tight, hard.	Run 60 289.0 to 295.0	83 (58)
		Run 61 295.0 to 298.8	100 (82)
		Run 62	100 (100)
	END OF BORING		
		Quartz Diorite  282.5-284.7 - Alteration zone, severely hydrothermally altered, very soft and friable, all feldspars altered to clay, texture partially preserved.  282.5-283.4 - Contains a thin aphanitic dike, 0.38 inches wide, 20°, sheared and brecciated but intact.  284.8-287.2 - Aphanitic dike, quartz rich, less than 5% mafics, very hard. Joints close at 10° and 45°, most have carbonate coating. Numerous healed, irregular fractures throughout.  290.2-292.0 - Fracture, 0°-5°, healed with quartz, very tight, hard.	Quartz Diorite  282.5-284.7 - Alteration zone, severely hydrothermally altered, very soft and friable, all feldspars altered to clay, texture partially preserved.  282.5-283.4 - Contains a thin aphanitic dike, 0.38 inches wide, 20°, sheared and brecciated but intact.  284.8-287.2 - Aphanitic dike, quartz rich, less than 5½ mafics, very hard. Joints close at 10° and 45°, most have carbonate coating. Numerous healed, irregular fractures throughout.  290.2-292.0 - Fracture, 0°-5°, healed with quartz, very tight, hard.  Run 60 289.0  Run 61 295.0  Run 61 298.8  Run 62

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Client Hole No. BH-1 Project Susitna Hydroelectric Project Site Watana (North Sank) Sheet No. 1 of 1 NUMBER OF JOINTS PER JOST FERWEABILITY -DEPTH ELEV HOCK TYPE REMARKS Overburden TOP OF ROCK 18.7' 20 Cuartz Diorite 40 Shear/fracture/ alteration zone. Dike, felsic. 60 Shear. 80 Breccia, healed. fracture zone. 100 1956 altered. 120 140 Dike, felsic. Fracture, healed. 160 Shear, alteration zone. 180 Data 200 Shear. 220 Shear/fracture zone. 240 260 280 Dike, felsic. Fracture zone. 300 END OF BORING 299.91

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO. : BH-2

SITE:

Watana (North Bank)

SHEET NO. 1 OF 13

CONTRACTOR: The Drilling Company

LOGGED BY K.J. White, M. . Bruen

AZIMUTH 043

DRILLING DATES: July 14 TO July 27, 1980 DATE: July 1981

DRILLING METHOD:

SOIL

Casing Advancer

CASING DIAMETER NW (3.0") I.D. Diamond Core - Triple Tube CORE DIAMETER: NO (1.75") 0.D.

LOCATION:

LATITUDE N3.227.725 DEPARTURE E742,040

55°

ELEVATIONS: DATUM

MSL, A.S.P.C., Zone 4 GROUND SURFACE 1838.8

ROCK SURFACE 1830.6 BOTTOM OF HOLE 1510.3

WATER TABLE

1768.8 (7-28-80)

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

(FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	RUN LENGTH	REC (RGD)
0	Overburden	,		
10 (8.2)	Andesite Porphyry	TOP OF ROCK  Greenish gray to medium gray, fine grained groundmass with fine to medium grained white plagioclase phenocrysts. Flow structures. Contains inclusions of a gray-White, medium grained diorite, a green, very fine grained andesite, and possibly sor argillite. Inclusions are generally less than 0.75 inches in diameter. Generally hard, fresh to slightly	Run 1 10.0 to 15.0	100 (46)
		weathered. Join's are iron stained, some carbonate filling. Disseminated sulphides throughout. 10.0-23.4 - Joints closely spaced.	Run 2 15.0 to 18.7	100 (57)
20		15.8-16.9 - Core badly broken by drilling, angular fragments 0.5 to 1.0 inches, carbonate filling and iron oxide staining.	Run 2A	82 (45

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE

Watana (North Bank)

SHEET NO 2 OF 13

DEPTH (FT)	ROCK TYPE	<u>DESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF HUN (FT)	H(C (920)
	Andesite Porphyry	15.8-16.9 - Core badly broken by drilling, angular fragments 0.5 to 1.0 inches, carbonate filling and iron oxide staining.	Run 3 19.8 to	100 (58)
		23.4-26.1 - Joints very close to closely spaced.	25.0	3,777
	-	25.7 - Joint, 30°, trace of clay.	Run 4	100.00
		26.1-30.9 - Joints closely spaced.	Run 5 25.5	100
		29.4 - Fracture, 50°, clay coating.	to 30.5	(58)
30 24.6)		30.9-48.25 - Joints very close to closely spaced.	30.5	
			Run 6	
			30.5 to 35.5	98 (24)
			Run 7 35.5	100
40 32.8)			40.5	(92)
			Run 8 40.5 to 45.7	96 (53)
			Run 9 45.7	100
50		51.0 - Flow structure, 50°.	50.5	
41.0)		51.65-55.9 - Joints very close to moderately close spaced.	Run 10 50.5- 55.7	100 (81)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO 3 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	HEC (400)
	Andesite Porphyry	53.05 - Joint, 30°, less than 0.1 inch wide, rough, irregular, clay coating. 55.7-60.8 - Core loss 0.7 feet.	Run 10 50.5 to 55.7	100 (81)
60 (49.1)		57.65-70.45 - Joints very close to closely spaced.	Run 11 55.7 to 60.8	100 (55)
(49.1)			Run 12 60.8- 63.7	
		64.3 - Joint, 30°, irregular, smooth, slickensides.	Run 13 63.7 to 66.9	88 (28)
		69.7-70.5 - Fracture zone, joints very closely spaced, 30° and 60° orientation. Some	Run 14 66.9- 68.9 Run 15	95 (0)
70 (57.3)		fractures healed, carbonate filling, some iron staining.	68.9- 71.2	100 (65)
		71.2-177.1 - Shear/fracture zone, joints very closely spaced, fracture zones of gouge and breccia. Hole caving, core badly ground in places, grouted. Core loss greater than 20.6 feet.	Run 16 Run 17 72.0 to 75.5	20 (0)
		71.2-79.6 - Fracture zone, joints very closely spaced at 20° to 60°, fresh to slightly weathered. Clay and carbonate filling, rounded to subangular pieces less than 0.2	Run 18 75.5- 77.5	(0)
80 -		feet. Core loss 5.9 feet.  80.8-81.1 - Fracture zone, joints very closely spaced at 40° to 70°, iron oxide staining.	Run 19 77.5 to 81.0	57 (11)
			Run 20 81.0 to 84.5	97 (34)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO 4 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	PEC (PGD)
	Andesite Porphyry	81.9-82.3 Rubble 83.1-85.0 Fracture zone, joints very closely spaced at 30° to 60°, some are healed. Some iron oxide staining and carbonate filling.	Run 22 85.0 to 90.2	77 (51)
90 (73.7)		88.0-109.6 Shear/fracture zone, joints close to very close spaced at 20° to 80°, with iron oxide staining, carbonate coating and clay gouge, slickensides. Core badly broken. Core	Run 23	67
		loss 11.8 feet.	90.2-	(0)
			Run 24 92.0 to 95.0	77
			Run 25	100
			Run 26	92
100			Run 27 97.8 to 100.1	18
(81.9)			Run 28 100.1- 101.8	(0)
			Run 29 101.8 to 108.0	3 (0)
110 -		109.6-118.2 Shear/alteration zone, bleached chalky white breccia and gouge, slightly to severely altered hydrothermally throughout,	Run 30 103.0- 109.6	(0)
(90.1)		soft, friable, slickensides. Thin gray clay layer at 20° to 50°. Core loss 2.2 feet.	Run 31 109.6	75 (0)
		NAME AND DESCRIPTION OF THE PARTY OF THE PAR	to	
		114.8-118.2 Slightly to moderately altered hydrothermally, bleached. Joints at 20° to	115.2	
		40°, healed fractures and joints throughout. Core loss 0.8 feet.	Run 32 115.2- 118.2	73 (0)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO. 5 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, CAT CORE, CEMENTING, ETC.	OF RUN (FT)	(HQD)
118.2 96.8)	Andesite Porphyry		Run 32	73
120 - (98.3)	Andesite and Diorite (Transitional Zone)	Very thin to thin layers of green, medium grained crystalline rock and greenish gray, aphanitic igneous rock. Slightly altered hydrothermally, joints very close to closely spaced, iron oxide stained, penetrative to	Run 33 118.2 to 121.0	79 (29)
125.7 103.0)	0.5 inch, carbonate coated, hard. 122.5-123.7 Fracture zone, broken by drilling. Core loss 0.7 feet.  Diorite Green, medium grained, 20-30% mafics (biotite and hornblende). Generally moderately hard,	Run 34 121.0 to 125.7	87 (51)	
	Diorite	and hornblende). Generally moderately hard, fresh to slightly altered hydrothermally. Joints very close to closely spaced, iron	Run 35 125.7 to 128.4	78 (78)
130 - 106.5)		stained, some carbonate coating and sulfide mineralization. 125.7-128.4 Core loss 0.6 feet.	Run 36 128.4 to 131.0	92 (46)
		closely spaced at 20° and 60°. 134.9-137.7 Healed breccia, 70% diorite	Run 37 131.0 to 134.8	89 (0)
-			Run 38 134.8 to 139.8	94 (70)
140 114.7)		139.6-141.8 Fracture zone, joints very close to closely spaced at 20° to 30°. Core loss 0.7 ft.  143.1-163.5 Shear/fracture zone, joints very closely spaced at 0° to 60°, some slickensides.	Run 39 139.8 to 141.9	81
	-	Breccia and clay gouge, some carbonate, friable locally, pieces less than 0.1 feet. Core badly broken, core loss 10.3 feet.	to	(52)
		The state of the s	Run 41 144.4 to 148.0	Tricone
1			Run 42	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO 6 OF 13

DEPTH	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE HUN (FT)	(#QD)
150 122.9)	Diorite		Run 42 148.0-	22 (0)
			151.0 Run 43 151.0 to	48
	]		Run 44 153.7- 155.7	80 (0)
			Run 45 155.7- 158.2	60 (0)
160 (31.1)			Run 46 158.2 to 160.8	46 (15)
		163.5-170.5 Joints closely spaced, iron oxide stained, carbonate filling.	Run 47 160.8- 162.8	75 (0)
			Run 48 162.8 to 167.9	90 (43)
170 (39.3)		170.5-172.3 Fracture/alteration zone, slightly to moderately altered hydrothermally, joints	Run 49 167.9- 170.5	100 (88)
		very closely spaced at 0°-10°, friable, core badly broken. Feldspars altering to clay. Core loss 0.8 ft.	Run 50 170.5 to 175.8	94 (42)
			Pyg. 51 177.0	67 (0)
180 147.4)			Run 52 177.0 to 181.0	90 (73)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO. 7 OF 13

DEPTH LFT1	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(400)
	Diorite	177.1-197.3 Diorite is generally hard to very hard. Joints are moderately close spaced. 179.65-179.8 Aplitic dike, gray-white, fine	Run 53 181.0- 182.8	100 (100)
		grained, less than 10% mafics. Welded sharp contacts, oriented at 40°.  186.5-187.1, 191.2-191.7 Aplitic dikes, graywhite, fine grained, less than 10% mafics.	Run 54 182.8 to 186.7	100 (100)
		Unfractured, welled contacts at 30° and 75°, sharp.	Run 55 186.7- 189.0	100 (100)
190 (155.6)		191.0-196.4 Core loss 0.7 feet.	Run 56 189.0- 191.0	100 (100)
		195.2-209.3 Shear/alteration zone, slightly altered hydrothermally, gouge material. 195.2-197.4 Breccia, white rock, iron oxide	Run 57 191.0 to 196.4	80 (59)
200 163.8)		staining, feldspars of diorite bordering this zone are altering to clay minerals. Very soft, friable. Core loss 0.4 feet.	Run 58 196.4 to 201.0	91 (37)
		204.6-209.2 Shear zone, joints very closely	Run 59 201.0 to 203.8	100 (32)
		spaced, moderately intense iron oxide on 20° joints, minor chlorite with clay coating. Core badly broken throughout, core loss 0.4 ft. 204.6 Joint at 80°, 0.25 inches wide, gray clay	Run 60 203.8 to 207.1	100 (15)
		205.3-205.7 Breccia/gouge, core badly broken. 207.1-207.4 Core broken, clay on joints. 208.3-208.5 Irregular, dicontinuous vein of	Run 61 207.1- 209.3	91 (0)
(172.0)	carbonate with sulfide mineralization.	Run 62 209.3 to 214.4	100 (49)	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALD, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO 8 OF 13

DEPTH (F7)	MOCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF RUN (FT)	(#Q0)
	Diorite	208.6-209.2 Core badly broken, fragments generally less than 1.0 in., clay on most	Run 62	
		joints, pieces of breccia and gouge. 209.7-237.1 Joints generally very close to close spaced, 15° to 80°, iron oxide stained, some carbonate filling. 213.8-245.8 Generally hard and fresh. Joints are iron stained, some calcite filling. 214.4-218.5 Core loss 0.3 feet.	Run 63 214.4 to 218.5	100
220 - 180.2)			Run 64 218.5 to 223.7	92 (77)
		223.2-223.6 Core loss 0.4 feet.		
			Run 65 223.7 to 228 7	100
230 188.4)			Run 66 228.7 to 232.5	100
		237.1-237.7 Fracture/alteration zone, bleached, slightly altered hydrothermally, increase in sulfides near joints. Joints very close spaced at 60°-70°.	Run 67 232.5 to 237.7	100 (85)
- 240 - (196.6)		241.3-262.0 Shear/alteration zone, moderately to severely altered hydrothermally, highly fractured. Breccia zone, several zones of soft, friable rock, clay gouge, polished	Run 63 237.7 to 241.9	100 (57)
		surfaces with faint slickensides. Joints very close to close spaced at 20° and 50°, iron stained, with clay on most joints. Carbonate veins and coating.	Run 69 241.9 to 247.2	87

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Watana (North Bank)

SHEET NO 9 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	460 (900)
245.8	Diorite Andesite (?)	247.0-248.6 Brecciated and clay gouge, irregular fractures and carbonate filling. Light to medium green aphanitic to fine ground	Run 69	
250 - (204.8)		mass, fine and medium grained white phenocrysts of feldspar, less than 10% mafics, primarily has a porphyritic texture, Contains inclusions of the gray-white diorite and a very fine grained mafic rock. Possible flow structure. Upper contact in brecciated zone assumed to be fairly sharp. Joints very close to closely spaced, most carbonate coated, some iron oxide.	Run 70 247.2 to 252.2	100
		staining. [Note: Resembles both andesite and diorite in places due to variations in grain size.]	Run 71 252.2 to 257.4	100 (49)
260 - 213.0)			Run 72 257.4 to 262.2	100 (28)
			Fun 73 262.2 to 265.0	100 (41)
-			Run 74 265.0 to 269.0	100 (50)
270 - (221.2)			Run 75 269.0- 271.0	100 (100)
		277.7 Lower contact, oriented at 20°, sharp contact of andesite and diorite, single joint with thin clay seam. Rock is fresh and hard on both sides.	Run 76 271.0 to 276.1	100 (84)
-			Run 77	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

TE Watana (North Bank)

SHEET NO. 10 OF 13

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	HEC (HQD)
277.8 (27.6) (280 -	Diorite	Gray-white to gray-green, medium grained rock, 20-30% mafics. Generally very hard and fresh. Joints are closely spaced, some carbonate filling, iron stained, and/or calcite filled.	Run 77 276.1 to 280.6	8 <b>9</b> (58)
-		285.8-287.8 Fracture zone, joints very close	Run 78 280.6 to 285.8	96 (61)
		to closely spaced, oriented at 20° to 60°, carbonate present. Hard and fresh. Core loss 0.1 ft.	Run 79 285.8- 287.8	90 (0)
290 (37.6)		288.2-289.3 Healed shear, 15°-30°, healed with dark green fine grained diorite.  290.7-293.1 Joints very close to closely spaced, oriented at 15° to 70°. Iron staining and carbonate filling.	Run 80 287.8 to 291.1	100 (88)
300 (245.7)			Run 81 291.1 to 296.1	96 (48)
		300.9-301.2 Fracture zone, joints very closely spaced, oriented at 40° to 70°. Clay filling	Run 82 296.1 to 301.1	100
		and chlorite coating. 301.1-306.1 Core loss 0.4 ft. 301.2-328.0 Joints close to moderately close spaced, oriented at 0° to 70° chlorite and	Rur 83 301.1 to 306.1	100 (62)
			Run 84 306.1- 310.2	100 (90)

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

Watana (North Bank) SITE

SHEET NO. 11 OF 13

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	HEC (HQD)
310 - 253.9)	Diorite		Run 84	
253.9)			Run 85 310.2 to 315.4	92 (54)
			Run 86 315.4 to 320.4	100 (86)
320 - (292.1)		321.2-321.4 Shear, breccia and gouge, clay with some carbonate filling, iron oxide staining.	Run 87 320.4	100
-		325.1 Joint, 40°, slickensides.	to 325.3	(52)
		328.0-335.9 Joints, close to very closely spaced	Run 88 325.3- 328.0	100 (63)
330 - (270.3)		generally oriented at 30° to 50°, carbonate filling.	Run 89 328.0 to 332.4	98 (43)
		335.9-372.0 Joints close to moderately close spaced, carbonate and chlorite.	Run 90 332.4 to 337.5	100 (75)
3 <b>4</b> 0 -			Run 91 337.5 to 341.0	97 (81)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK

DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project HOLE NO BH-2

SITE Watana (North Bank) SHEET NO 12 OF 13

DEPTH (#1)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	4EC (499)
	Diorite		Run 92	63 (0)
	-	345.8-348.5 Alteration zone, slightly altered hydrothermally, joints have a thin clay coating/filling. Several healed fractures, moderately hard.	Run 93 341.4 to 346.6	100 (100)
350 (286.7)			Run 94 346.6 to 351.0	98 (77)
			Run 95 351.0 to 356.0	100 (88)
260			Run 96 356.0 to 361.0	94 (95)
- <b>36</b> 0 (294.9) -		361.0-366.0 Core loss 0.8 ft. 362.0 Amount of mafics increase from 20-30% to 30-40%. 362.5-363.5 Felsic Dike, light gray, hard, unfractured, tight contact, oriented at 10°, 0.5 in. wide.	Run 97 361.0 to 366.0	90 (90)
370		370.3-381.0 Carbonate in joints.	Run 98 36€.0 to 370.€	100
(303.1			Run 99	100 (87)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-2

SITE Watana (North Bank)

SHEET NO. 13 OF 13

DEPTH	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	HEC (1900)
	Diorite	374.1-375.0 Iron oxide staining.	Run 99 370.6 to 375.8	100 (87)
380			Run 100 375.8 to 381.0	96 (67)
311.3)		382.0-392.6 Shear/alteration zone, slightly to moderately altered. Joints are very close to close spaced, filled with carbonate and iron oxide staining, clay gouge, and sulfide mineralization.  382.0 Joint, oriented at 70°, 0.1 in. wide black clay layer in a carbonate vein 0.5 in. wide.	Run 101 381.0 to 386.2	96 (51)
390 319.5)		383.5 Shear, oriented at 40°, 0.5 in. wide, breccia, soft and friable. Carbonate filling with iron oxide staining. 386.2-386.8 Shear zone, chalky white clay gouge, iron oxide stained breccia. Soft, friable.	Run 102 386.2 to 391.2	100
		392.6-401.0 Joints very close to close spaced, numerous healed joints throughout, hard.	Run 103 391.2 to 396.3	96 (59
			Run 104 393.3- 398.8	(38
400 327.7) 401.0 328.5)		END OF BORING	Run 105	100

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	BH-2
Site	Watana (North Bank)	Sheet No.	_1 of2

DEPTH (FT.)	ELEV. (FT.)	PERMEABILITY (K) cm/sec	CORE RECOVERY %	#GD % 20 40 60 80	NUMBER OF JOINTS PER IDET	ROCK TYPE	REMARKS
0	1839			20 -0 -0 -0			TOP OF ROCK 10.0'
20						Andesite Porphyry	
40	1798						
60	17 30				HH		
80			H				Fracture zone.
100	1757						Fracture zone.
120				-		Diorite	Shear/alteration zone.
140	1716						1
160	1/16	V v 12 1 1					Shear/fracture zone
180					Ш		Fracture/alteration zone.
200	1675						⊐Shear. ⊐Shear.
220				7			Jicar .
240	1634			<b>+</b>		Andesite(?)	- Shear, slickensides
260	1634					Andesice	Fracture zone.
280						Diorite	
360	1593			E			⇒ Fracture zone.
320 -							
340							Shear/alteration zone.

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client_	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	BH-2
Site	Watana (North Bank)	Sheet No.	2 of 2

DEPTH (FT.)	ELEV (FT)	PERMEABILITY (H) cm/sec	COPE RECOVERY % 20.40.60.80	#QD % 20 40 60 80	NUMBER OF JOINTS PER IOFT 5 IO 15 20	HOCK TYPE	REMARKS
360						Diorite	
			4				
380			4444				h
						1	Fracture/alteratio
400 -	1511					<del> </del>	END OF BORING
						1	401.0'
						1	
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CLIENT

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO. BH-3

SITE

Watana (North Bank)

SHEET NO. 1 OF 31

CONTRACTOR: Interstate Exploration Inc. DRILLING DATES August 15 To September 9, 1981 LOGGEL BY: K.J. White, M.P. Bruen DATE: September 1981

LOGGEL BY

DRILLING METHOD

DIP

Casing Advancer

CASING DIAMETER NW (3.0") I.D. Diamond Core - Triple Tube CORE DIAMETER: NO (1.75") 0.D.

LOCATION LATITUDE N3.228.197 ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

DEPARTURE E744,103 AZIMUTH 338°

55°

GROUND SURFACE 2150.7

ROCK SURFACE

2124.7

BOTTOM OF HOLE 1367.8

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	NOCK TYPE	DESCRIPTION COLOR TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	RUN LENGTH	REC IRGO
0	Overburden	No samples taken.		
1				
1				
1				
10 8.2)				
1				
1				
1				
1				
20 16.4)				

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 2 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEWENTING, ETC.	DE RUN (FT)	WEC (#25)
	Overburden			
30 (24.6)		TOP OF ROCK		
31.7 - (26.0)	Diorite	Medium gray-green, medium grained, less than 5 R quartz. Joints generally close to moderately closely spaced, iron oxide staining near sur- face, most joints carbonate coated. Fresh,	31.7 to 36.7	100 (44)
40 -		to coating of carbonate. 36.7 Felsic dike, light gray, fine to medium grained, 10-20% quartz, less than 5% mafics, 0.5 in. to 1.5 in. wide. Tight contacts, hard, oriented at 90°.	Run 2 36.7 to 40.7	100 (40)
32.01		41.8-42.2 Core broken by drilling, pieces 0.5 in. to 2.0 in., iron oxide stained rock fragments.	Run 3 40.7	100 (37)
		43.4-43.7 Core broken by drilling, from oxide staining on fragments. 44.5 Joint, 30°, 0.25 inch of carbonate	to 45.8	
		filling.	Run 4	(36)
			Run 5	100
50			46.9 to	(97)
41.0)	A THE		50.8 Run 6	100

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Watana (North Bank)

SHEET NO 3 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, DEVENTING, ETC.	OF RUN	(920)
	Diorite	46.0-46.4 Shears, two along joints at 40°, approximately 0.1 foot and 0.05 feet wide, breccia and gouge.  46.4-111.2 Joints close to moderately closely	Run 6 50.8 to 55.8	100 (98)
		spaced, trace to coating of carbonate and	Run 7	100
60 - (49.1)		chlorite 46.8-48.4 Joints 20° to 30°, closely spaced, healed with carbonate. 49.4-50.2 Numerous irregular fractures healed with carbonate, very closely spaced. 52.3 Felsic dike, 30°, unfractured, 0.25	55.8 to 60.7	(92)
		inch wide, tight.	Run 8	100
		52.4-53.1 Fracture zone, irregular, discontinuous, healed with carbonate, very closely spaced joints. 53.3-58.0 Healed diorite breccia, subrounded fragments of diorite to 2 inch, healed with dark green diorite.	60.7 to 65.7	(94)
		57.5-57.9 Fracture zone, fractures less than 0.1 inch wide, very closely spaced, irregular	Run 9	100
		and discontinuous, healed with carbonate.	65.7	(80)
		61.2, 64.3 Inclusion of dark green fine grained diorite, 1.0 inch and 2.0 inches	to	
70 (57.3)		respectively. 65.9-69.9 Fractures, irregular and discontinuous, filled with carbonate, less than	70.7	
(37.3)		0.1 inch to 0.25 inch wide, 10% of rock.	Run 10	98
			70.7	(79)
			to	
		67.7-75.9 Healed breccia, contains fragments of diorite in the dark green, fine grained diorite. Fragments, 70-80% of rock.	75.9	
		1	Run 11	98
			75.9	(68)
			to	
80 -			80.9	
(65.5)			Run 12	98
			80.9	(84)
			to 85.9	

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALC . NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Watana (North Bank)

SHEET NO 4 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF RUN (FT)	REC (PGD)
	Diorite	69.2 Inclusion of dark green, fine grained diorite.	Run 12	
90		69.5-72.8 Occasional patches of red stain, irregular and discontinuous. 79.6-79.8 Core broken by drilling, pieces 1.0 inch to 2.0 inches. 80.8-80.9 Red staining on the core. 81.3-82.3 Joints, 20°-30°, possibly open.	Run 13 85.9 to 90.8	100 (98)
(73.7)	iron oxide staining and carbonate coating. 81.3-87.0 Diorite breccia, healed, hard. 85.7-93.8 Joints/fractures, closely spaced, up to 2.0 inches wide, healed with carbonate.	Run 14 90.8 to 95.8	100 (84)	
100 (81.9)		94.1-95.1 Pods of felsic rock, light gray, fine to medium grained, some have quartz centers, up to 0.5 inches wide. Less than 5% of rock. 96.6-98.5 Joints, very close to closely spaced, healed with carbonate.	Run 15 95.8 to 100.8	100
(81.9)	106.4-106.7 Red stain in core, covering 70% of zone.	Run 16 100.8 to 106.0	100 (100)	
110		111.2-190.7 Joints moderately closely spaced, with zones of closely, spaced joints.	Run 17 106.0 to 110.7	100 (100)
(90.1)		111.6-132.0 Diorite breccia, rounded to sub- angular rock fragments to 1.0 inch, 60-70% of rock, in a dark green diorite matrix. Hard.	Run 18 110.7 tc 115.9	100 (100)
-			Run 19	

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 5 OF 31

DEPTH	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIZION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF HUN (F7)	W(C (440)
120	Diorite	116.7-126.7 Joints, close to moderately closely spaced, healed with carbonate up to 0.25 inch wide, irregular and discontinuous.	Run 19 115.9 to 120.7	100 (100)
(98.3)			Run 20	100
			120.7 to	(100)
			125.7	
		127.0-133.6 Shear/alteration zone, bleached to a light green, slightly altered hydrothemally, hard.	Run 21	100
			125.7	(100)
- 130		127.7 Shear, 15°, slickensides on carbonate, trace amounts of gouge. 128.9-135.7 Fracture zone, healed with car-	to	(100)
		bonate, closely spaced up to 0.5 inch but generally less than 0.1 inch.	130.7	
106.5)			Run 22	100
			130.7	(100)
			to	
			135.7	
		135.7-138.3 Shear/alteration zone, slightly to moderately altered hydrothermally, oriented along healed shear to 10°. Feldspars breaking down to clay, approximately 1.0 inch wide. Moderately hard to soft. Core badly broken by drilling. 137.9-138.3 Silty-sand coating, possible	Run 23 135.7 to 140.7	98 (50)
140 114.7)		gouge.		
., 4			Run 24	
		140.2-143.4 fracture zone, closely spaced. irregular, and discontinuous joints healed with carbonate filling less than 0.1 inch wide.	140.7 to 145.8	100 (100)
		146.0-149.0 Joints healed with carbonate.		
		149.0-152.0 Alteration zone, slightly altered hydrothermally, feldspars altering to clay, hard.	Run 25 145.8 to 150.7	100 (100)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO 15701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 6 OF 31

DEPTH (FT)	ROCK TYPE	CESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	CENSTH OF AUN (FT)	960 (# <b>3</b> 0)
150	Diorite		Run 25	100 (100)
		153.0, 154.0 Felsic dikes, light gray and light red-gray, 10° and 15°, respectively, 0.5 inch wide. Second dike is offset 0.25 inch along a joint at 50°, healed with carbonate, hard.	Run 26 150.7 to 155.7	
160		153.9 Felsic dike, light red-gray, fine grained, at 10°. Truncated by shear at 30°, healed with dark green igneous material and carbonate, with offset greater than 2.0 inches. 156.0 Carbonate vein, possibly a healed shear at 25°, 0.25 inch thick. Carbonate is stained red.  157.0 Alteration zone, moderately altered	Run 27 155.7 to 160.7	100 (100)
131.1)		hydrothermally, approximately 1.0 inch wide at 25°.	Run 28	
		157.3-174.6 Healed breccia, angular fine grained fragments to 0.25 inch in an igneous groundmass, hard. Majority of fragments in breccia are dark gray to green subangular, fine grained, igneous rock.	160.7 to 165.7	(100)
		165.2 Alteration zone, hydrothermally altered, 0.5 inch wide, feldspars breaking down to clay. No definitive contacts.	Run 29 165.7 to 170.7	100 (98)
170 139.3)		Note: Zones of alteration within the healed breccia up to 6.0 inch wide, generally less than 1.0 foot to 2.0 feet apart moderately hard. Up to 25% of feldspars altering to clay.	Run 30 170.7 to 175.7	100 (94)
		177.0, 177.2 Shear, 20°, 0.25 inch wide, healed with green igneous rock and carbonate.	Run 31 175.7 to 180.7	100 (98)
180 147.4)				

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 7 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	#£¢ (#\$0)
	Diorite	178.9 Joint, 20°, possible iron oxide staining. Alteration of feldspars on either side to 0.5 inches. 180.7-190.7 Joints closely spaced, approximately 50% are carbonate healed, with chlorite coating.	Run 32 180.7 to 185.4	100 (87)
190 - 155.6)		184.4-184.7 Core is badly broken, pieces less than 0.5 inches. Friable, possible fracture zone or shear zone. 184.8 Fracture, 0°, carbonate filled, offset approximately 0.5 inches. 186.3 Joints, two, 40° and 90°, with sandy-silt coating. 188.0-190.3 Shear/fracture zone along joint	Run 33 185.4 to 190.7	98 (89)
33.07		at 0° to 10°, joints very closely spaced.	Run 34	100
		Approximately 0.1 to 0.25 inches of gouge, no slickensides. Some are partially healed with carbonate and chlorite.	190.7 to	(100)
Ī		190.3-191.6 Healed breccia, 50-60% rock frag- ments within a dark green diorite matrix,	195.6	
		hard. 190.7-228.6 Joints moderately close to widely spaced, averaging 2-3 feet, most healed with carbonate. 190.7-195.0 Irregular patches of red stain.	Run 35 195.6 to 200.7	100 (94)
200 63.8)		203.0-203.5 Diorite breccia, healed with carbonate.	Run 36 200.7 to 205.7	100
		206.1-206.2 Healed breccia, 70°, hard.	Run 37 205.7	100
210 -			to 210.7	
72.0)			Run 38	100

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 8 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF BUN (FT)	REC (ROD)
	Diorite	214.5-215.1 Numerous fractures, irregular and discontinuous, healed with carbonate up to 0.25 inches wide.	Run 38 210.7 215.7	100 (100)
- 220 (180.2)		218.3-219.4 Healed breccia, approximately 50-60% rock fragments to 2 inches in a fine grained diorite matrix.	Run 39 215.7 to 220.7	100 (100)
		224.1-225.5 Fracture zone, fractures/joints very closely spaced at 0° to 20° and 50° to 70°. Healed with carbonate, tight.	Run 40 220.7 to 225.8	100
230 (188.4)		228.6-228.8 Core broken by drilling (?), angular pieces, 0.25 to 0.5 inches, carbonate coating. 228.6-315.7 Joints moderately closely spaced (average 1.0 to 2.0 feet). Approximately 50% healed with carbonate.	Run 41 225.8 to 230.8	100 (100)
		230.5 Felsic dike, fractured but tight, at 20°, 0.5 inches wide.  233.3 Healed shear, 10°, 1.0 inch wide breccia zone, fragments of breccia are predominately carbonate, matrix is dark green igneous material. Re-shearing along this zone, silt	Run 42 230.8 to 235.9	100 (100)
240 (196.6)		and clay costing.  236.4 Healed shear, 20°, 0.25 inches wide, hard.  239.6 Joint, 20°, trace to 0.25 inches wide, tight.	Run 43 235.9 to 240.9	100 (96)
		241.3 Shear, 10°, 0.5 inches wide, healed with carbonate, tight.	Run 44 240.9 to 245.9	100

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 9 OF 31

SEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	1990)
250 204.8)	Diorite	yellow stain. 243.0-243.6 Carbonate vein, 0.3 inches wide, tight.  245.4-246.4 Numerous fractures, up to 0.25 inches, healed with carbonate. Joint, 10°, 0.5 inches of carbonate filling, 247.5-250.4 Joints closely spaced. 248.0-248.6 Fracture zone, joints very closely spaced, healed with carbonate, some broken by drilling. 248.8-248.9 Core broken by drilling, pieces 0.5 to 1.0 inches. 254.6-255.1 Fracture zone, very closely spaced, joints irregular, discontinuous, healed	Run 44	
			Run 45 245.9	100 (100)
			to 250.9	
			250.9 to 255.9	100 (100)
		with carbonate.	Run 47	100
260 213.0)			255.9 to 260.9	(100)
			Run 48 260.9 to 265.6	98 (92)
			Run 49 265.6 to 270.7	100 (100)
270 21.2)		272.1-272.3 Numerous fractures filled with carbonate, approximately 10-20% of rock is carbonate, some 1s stained red. 274.1 Shear, 20°, coating of clay gouge, slickensides. 275.2 Healed breccia, 30°, approximately 1-5 inches wide, healed with carbonate.	Run 50 270.7 to 275.7	100 (92)
		menes wide, neared with carbonate.	Rún 51	100

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 10 OF 31

(F7.)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	DE HUN (FT)	9(C (HQD)
280	Diorite	280.8-281.2 Inclusion of dark green, fine	Run 51 275.7 to 280.7	100 (94)
229.4)		284.7-302.8 Alternation zone, slightly altered hydrothermally. Within the alteration zone are healed breccia zones up to 2.0 inches wide, healed with dark green igneous rock and carbonate, moderately closely spaced. Feldspars stained yellow-green, moderately hard.	Run 52 280.7 to 285.7	100 (100)
222			Run 53 285.7 to 290.7	100 (100)
290 237.6)			Run 54 290.7 to 295.7	100
300 (245.7)			Run 55 295.7 to 300.7	100 (100)
			Run 56 300.7 to 305.7	100
		306.4-307.0 Healed diorite breccia, hard. 307.0-307.7 Numerous joints, 20°, healed by carbonate, very closely spaced, tight.	Run 57 305.7 to 310.7	100 (100)

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 11 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	HEC (420)
310 253.9)	Diorite	310.6-311.5 Numerous joints healed with carbonate, oriented at 40°, irregular, discontinuous fractures filled with carbonate.	Run 57	100 (100)
		generally less than 0.25 inches.	Run 58	100
			310.7	(100)
-		1	to	
		315.7-348.5 Joints moderately close to widely spaced, many joints healed with carbonate.	315.7	
1		average width 2 to 3 feet.	Run 59 315.7	100 (100)
320		319.9 Healed shear, oriented at 25°, 0.5 inches wide, hard.	to 320.7	
262.1)		321.7-325.4 Healed breccia, 70-80% diorite 329.1-329.7 fragments, hard.	Run 60 320.7 to 325.7	100
330 - 270.3)		331.4 Healed shear, 30°, 0.5 inches wide, healed with dark green igneous material.	Run 61 325.7 to 330.7	100 (100)
.70.3)		carbonate is along contacts.  336.5-340.7 Joints, 10°, closely spaced, slightly to moderately altered hydrothermally, 0.5 inches wide. Healed with carbonate, yellow-orange staining (iron oxide?), moderately hard. Alteration affects 20-30° of	Run 62 330.7 to 335.7	100 (100)
		feldspars.	Run 63 335.7 to 340.7	100 (100)
340 78.5)				

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Watana (North Bank)

SHEET NO 12 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF NUN	HEC (RQ0)
	Diorite	343.2 Carbonate vein, 30°, 0.5 to 1.0 inches	Run 64	100
		wide, minor vugs.	340.7	(100)
	l		to	
	l		345.8	
		346.8-348.2 Joints (3), 10°, closely spaced,		
1	1	slightly to moderately altered hydrothermally affecting 20-30% of feldspars. Healed with	Run 65	100
		carbonate, rusty-orange stained, moderately	345.8	(92)
1	1	hard.	to	7.5.5.
		348.5-392.3 Joints moderately close to close-	350.7	
350 - 286.7)		ly spaced, most healed by carbonate, chlorite coating, average 1 to 2 feet.		
			Run 66	100
1	1	348.5-356.4 Core broken by drilling, pieces 3 to 6 inches.	350.7	(100)
		349.4 Joint, 40° silt/clay coating.	to	
		350.1 Joint, 40°, trace of silt/clay coating 353.0 Joint, 30°, slickensides on chlorite,	355.7	
		carbonate with trace of silt and clay. Healed but broken by drilling.		
		356.1 Joint, 40°, coated with carbonate and	Run 67	100
()		sandy-silt.	355.7	(100)
1		356.6-356.75 Healed breccia 70-80% digrite	to	
		fragments, in a dark green igneous matrix,	360.7	
360		357.4-357.5 Pods of carbonate, up to 0.75		
294.9)		inches long, approximately 10% of rock.	Run 68	100
7		358.2-363.5 Irregular patches of red staining in core, 60-70%.	0.100.00	(100)
		359.7-360.8 Joint, 10°, carbonate healed, tight, slightly to moderately altered hydro- thermally affecting 10-20% of feldspars within	to 365.7	
		<ol> <li>1.0 inch. Carbonate is rusty-orange stained, possible clay coating on surface.</li> </ol>	Run 69	100
			365.7	(100)
			to	
			370.7	
370 303.1)			Run 70	100
003.1)			370.7	100
1			375.7	

CLIENT Alaska Power Authority

JC# NO P5701.05

PROJECT Susitna Hydroelectric Project

Watana (North Bank)

SHEET NO 13 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION: COLOR: TEXTURE, FOLIATION, JOINTING, FRACTUPING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	HEC
	Diorite	365.8-366.6 Fracture zone, joints and fractures healed with carbonate very closely spaced, joints at 20°. Fractures are irregular and discontinuous, tight.	Run 70 370.7 375.7	100 (72)
1		366.8-367.1 Healed breccia, 60-70% diorite	Run 71	100
		fragments, in a dark green igneous matrix, hard. 371.2-371.8 Red staining on core. 372.2 Joint, 10°, 0.1 inch coating of carbonate, chlorite, clay.	375.7 to 380.7	(80)
380 311.3)		374.3-388.7 Joints close to moderately closely spaced, averaging 0.5 to 1.5 feet. 374.6 Joint, 0° to 10°, coated with carbonate chlorite, and silt/clay, approximately 0.1 inches wide. 379.4-388.2 Alteration zone, slightly altered hydrothermally, 30-40% of feldspars show staining and beginning to alter to clay. Close to very closely spaced joints, tight,	Run 72 380.7 to 385.9	100 (69)
1		healed with carbonate, moderately hard.	Run 73	96
390 319.5)		379.5 Joint, 60°, filling of silt/clay, approximately 0.25 inches thick. 379.9 Joint, 80°, coated with silt/clay. 384.5 Joint, 35°, with faint slickensides, chlorite staining.	385.9 to 390.7	(54)
319.57		384.8-385.2 Shear, 70°, predominantly a breccia with layers of gouge to 0.5 inches. Breccia/gouge partially healed with carbonate, soft. 386.2-386.4 Core broken by drilling, average	Run 74 390.7 to 394.3	100 (58)
		1.0 inch, pieces coated with carbonate and chlorite. 386.4 Shear, 50° with 0.1 inch of breccia. 386.5-387.0 Shear, 0° to 10°, 0.1 inch of gouge. Slickensides on chlorite, slightly to moderately altered hydrothermally, friable.	Run 75 394.3 to 399.3	100 (46)
400		392.3-416.7 Joints, very close to closely spaced, numerous zones of core broken by drilling, averaging 0.5 to 1.0 feet.	Run 76 399:3-	100)
		394.7-396.3 Joints, healed with carbonate, some broken by drilling.	Run 77	100
			400.8 to 405.8	(74)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Watana (North Bank)

SHEET NO. 14 OF 31

DEPTH LFT2	ROCK TYPE	DESCRIPTION COLOR: TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	(400)
	Diorite		Run 77	
		1	Run 78	100
		406 2 409 7 Shape and fivestone area delete	405.8	(88)
1		406.3-408.7 Shear and fracture zone, joints very closely spaced.	to	
410 (335.9)		406.3 Joint, 80°, slickensides on chlorite. 407.3-407.7 Core broken by drilling, pieces 0.5 to 1.0 inches, minor slickensides.	410.8	
		409.1-409.5 Alteration zone, core bleached to yellow-gray, slightly to moderately altered	Run 79	100
		hdyrothermally. Feldspars are stained and altering to clay. Trend is parallel to healed	410.8	(90)
1		shear at 40°, crosscuts this zone.	to	17.554.
		414.4-424.4 Shear/alteration zone, core is bleached to light yellow-green, slightly altered hydrothermally, feldspars, stained, hard	415.8	
1		to moderately hard. 415.0 Shear, 20°, slickensides on chlorite	Run 80	100
+		and carbonate filling. Crosscuts 1.0 inch wide zone of very closely spaced joints	415.8	(94)
		healed with carbonate.	to	
420 344.0)		416.6 Possible shear, 30°, healed by carbonate.	420.9	
		416.7-450.5 Joints close to moderately closely spaced, average 1.0 to 2.0 feet. Chlorite	Run 81	100
		coating of carbonate.	420.9	
		419.7 Healed shear, 20°, up to 0.25 inch thick, healed with dark green igneous	to	
		material and carbonate. 424.2 Two joints very closely spaced, 20°.	425.8	
1		slickensides on chlorite and carbonate. Rusty-orange stain on carbonate.	Run 82	100
4		426.7 Joint, healed, 20°, rusty-oran less	425.8 to	(100)
430 352.2)		than 0.1 inches of carbonate. Alteration of feldspars to 0.25 inches on either side. 428.2 Healed joint, 30°, rusty-orange stain, slickensides on carbonate and chlorite.	430.7	
352.27		431.6 Healed joint, 30°, 0.5 inches of	Run 83 430.7- 432.4	100 (100)
		carbonate filling, slickensides, trace of clay.	Run 84	100 (88
			Run 85	100
		437.5 Joint, 10°, trace of silty-sand, slightly altered to 0.5 inches on either side.	432.8 to 438.0	(98)

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 15 OF 31

DEPTH LFT!	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	14601
	Diorite		Run 85	
440 360.4)		439.9 Joint, 15°, healed with carbonate, trace of silty-sand, broken by drilling.	Run 86 438.0 to 440.7	(100)
300.4)			Run 87	
1		443.2 Joint, 20°, slickensides on chlorite.	440.7 to	(100)
	i	1	Run 88	100
450		447.0-447.2 Shears (2), 20° and 40°, approximately 0.3 inches of chlorite breccia, slickensides. 449.0-454.5 Healed diorite breccia, 80 to 90° diorite fragments, in dark green, fine	445.6 to 450.6	(100)
368.6)		grained diorite, hard. 450.5-458.3 Joints and fractures very closely	Run 89	100
		spaced, tight, less than 50% healed by carbonate.	450.6	(100)
		457.2 Joint, 20°, slickensides on carbonate and chlorite. 457.8 Joint, 0°, healed with carbonate, slickensides.	to 455.6	
		450.5-475.9 Joints, very close to closely spaced, average 0.5 to 1.0 feet.	Run 90 455.6	100 (78)
460		459.7-460.7 Core broken by drilling, pieces 0.5 to 1.0 inch. Most surfaces have chlorite and carbonate stain, potential fracture zone.	to 460.7	
376.8)			Run 91	100
		461.5 Joint, 0° to 10°, gray-green coating, similar to clay.	460,7	(100)
-		463.5-464.1 Fracture zone, joints and frac- tures very closely spaced, fragments have gray-green coating, broken by drilling.	463.7 Run 92 463.7 to	100 (76)
		467.4-475.9 Shear/fracture zone, joints very closely spaced. Approximately 25% of the core is badly broken by drilling.	468.3	
			Run 93	

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric

HOLE NO BH-3

Watana (North Bank)

SHEET NO 16 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOTS OR GAIN, CAVING, LOST DORE, CEMENTING, ETC.	OF HUN (FT)	WEC (420)
470 385.0)	Diorite	469.5 Fragment with faint slickensides. 470.3 Joint, 0°, faint slickensides. 471.0 Shear, 10°, approximately 0.5 inches of gouge and breccia. Core is badly broken.	Run 93 468.3 to 473.7	100 (81)
		474.1-530.0 Shear/alteration zone, core is bleached to light yellow-green to light yellow-gray, moderate hydrothermal alteration. Approximately 50% of feldspars have altered to clay. Numerous carbonate healed joints,	Run 94 473.7 to 478.7	96 (8)
480 393.2)		close to very closely spaced. Moderately hard to soft, locally friable.	Run 95 478.7 to	160
		483.7-486.9 Shear zone, partially healed. Breccia healed with carbonate.	483.7 Run 96 483.7 to 488.7	100
490 401.4)			Run 97 488.7 to 491.5	100
		494.6-503.5 Shear zone, partially healed, contact at 20°. Breccia and gouge healed with carbonate.	Run 98 491.5 to 496.5	100
500			Run 99 496.5 to 500.7	86 (0)
500 . 409.6)			Run 10	

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 17 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#EC (#QD)
	Diorite		Run 100 500.7 503.5	71 (0)
			Run 101 503.5 to 507.0	94 (0)
510 - 417.8)		509.7-513.8 Shear zone, partially healed. Breccia and gouge healed with carbonate. Fragments of red-gray igneous material, possibly a dike.	Run 102 507.0 to 510.8	100 (0)
			Run 103 510.8 to 515.8	100
520 -			Run 104 515.8 to 520.8	100
426.0)			Run 105 520.8 to 525.9	100
530		530.0-550.7 Joints close to moderate closely spaced, chlorite coating, trace to coating	Run 106 525.9 to 530.7	100 (14)
434.2)		of carbonate.	Run 107	100

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO. P57C1.05

PROJECT Susitna Hydroelectric Project

HOLE NO BI -3

SITE Watana (North Bank)

SHEET NO. 11 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR. TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	REC (RQD)
	Diorite		Run 107 530.7 to 535.7	100 (100)
		538.3 Joint, 30°, healed with carbonate, slight to moderate alteration to 1.5 inches on either side.	Run 1(8 535.; to 540.;	100 (88)
540 1 442.3)		545.0-551.0 Shear/alteration zone, core is bleached to a medium yellow-green, generally slightly altered hydrothermally. Feldspars are stained, less than 10% are altered to clay. Moderately hard, coincident with a healed breccia zone.	Run 110 541.5 Run 110 541.5 to 546.4	100 (100) 100 (100)
550 - 450.5)		550.7-554.5 Shear/fracture zone joints very closely spaced and badly broken by drilling. Chlorite/carbonate coating on joints, carbonate stained reddish-brown in places.	Run 111 546.4 to 550.7	100 (100)
430.37		FF1 0 Character 100 200	Run 112 550.7 to	96 (24)
		555.1-563.6 Joints are moderately closely spaced.	555.7	
560 -		559.9-622.4 Alteration zone, bleached to a light-medium yellow-green, slightly altered hydrothermally. Feldspars are stained, but generally have not altered to clay. Seems to be a mixture of diorite, an aphanitic/fine	Run 113 555.7 to 560.7	100 (100)
(458.7)		grained dark green igneous rock, and abundant carbonate fillings in approximately 10% of rock. Hard to moderately hard, carbonate stained red in places.  559.9-600.5 Healed shear zone, coincides with altered zone.	Run 114 560.7 to 565.7	100 (78)

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank) SHEET NO 19 OF 31

DEPTH. (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, POLISTION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	960 (900)
	Diorite	560.9-561.0 Two shears, very closely spaced	Run 114	
		30°. Upper shear, 0.5 inches wide breccia zone; lower shear, coating of carbonate. 563.6-565.7 Shear/fracture zone, joints very closely spaced, some joints have a silt/clay coating, gouge(?).	Run 115 565.7 to 570.7	100 (100)
570 466.9)		597.2-600.5 Felsic dike (?), light gray, fine to medium grained. Brittle, slightly altered hydrothermally, highly fractured, numerous drilling breaks. 565.7-600.5 Joints moderately close to wide, chlorite coating, with trace to coating of carbonate.	Run 116 570.7 to 575.1	100
			Run 117	100
			575.1 to	(100)
580	600.4-605.3 Slightly to moderately altered hydrothermally, most joints are carbonate healed. Feldspars are discolored and	580.1		
475.1)		and beginning to alter to clay, moderately	Run 118	100
		hard.	580.1 to	(100)
			585.2	
			Run 119	100
			585.2 to 590.3	(100)
590 483.3)			Run 120 590.3 to 595.4	100 (100)
			Run 121	100 (96)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 20 OF 31

DEPTH- LFT1	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	(400) HEC
600	Diorite	600.5-622.4 Joints close to very closely	Run 121 595.4 to 600.5	100 (96)
(491.5)		spaced, numerous joints are healed with carbonate. Tight and competent, some broken during drilling, carbonate filling averages 0.1 to 0.25 inches. Moderately spaced healed shears, tight.	Run 122 600.5 to 605.7	100 (96)
			Run 123 605.7 to 610.8	100 (98)
610 - 499.7)			Run 124 610.8 to 615.8	100 (100)
			Run 125 615.8 to 620.8	100
507.9)		622.4-633.0 Alteration zones, closely spaced, approximately 0.5 feet wide. Feldspars stained, hard. 622.4-754.0 Joints close to moderately closely spaced, trace of carbonate, chlorite common. Average 0.5 to 1.5 feet.	Run 126 620.8 to 625.9	100 (100)
		626.8 Carbonate vein, offset by joints at 60° offset approximately 0.25 inches.	Run 127 625.9 to 630.7	100 (100)

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 21 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING; LOST CORE, CEMENTING, ETC.	GF RUN (FT)	Ht c (R23)
630 _ (516.1)	Diorite		Run 127	
			Run 128 630.7 to 635.7	100 (100)
			Run 129 635.7 to	100 (86)
640 524.3)			640.7	
			Run 130 640.7 to 645.7	100 (100)
650			Run 131 645.7 to 650.7	100
532.4)			Run 13° 650.7 to 655.6	100
		657.0 Shear, 20°, up to 0.25 inches wide, healed primarily with carbonate, but also some dark green diorite. 657.0-657.8 Joints, 10°-20°, very closely spaced, 20°. Healed with carbonate, tight.	Run 133 655.6 to 660.7	100 (100)
660 - 540.6)		1		

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 22 OF 31

DEPTH (FT)	ROCK TYPE	<u>DESCRIPTION</u> . COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	HEC (400)
	Diorite		Run 134	100
			660.7 to 665.7	(100)
670			Run 135 665.7 to 670.7	100 (98)
48.8)			Run 136 670.7 to 673.8	100 (97)
		677.0-681.1 Joints very close to closely spaced.	Run 137 673.8 to 678.8	100 (92)
680 57.0)			Run 138 678.8 680.8	100 (45)
37.0)		683.1 Irregular shaped inclusion of felsic material.	Run 139 680.8 to 685.7	100 (80)
690 -		688.8-689.4 Fracture zone, core broken by drilling, joints very closely spaced.	Run 140 685.7 to 690.7	100 (80)
665.2)			Run 141	100 (88)

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 23 OF 31

spaced at 60°.  690.7 (695.7 Run 142 1  697.7-698.4 Fractures very closely spaced, discontinuous, healed with carbonate. 699.8 Felsic dike, medium gray, aphanitic, highly fractured but tight, 0.3 inches wide.  700. (573.4)  702.0-707.7 Shear/alteration zone, bleached to a medium yellow-green, generally slightly altered hydrothermally. Hard to very hard. 702.7-703.5 Felsic dike, light green-gray, fine grained, fractured but tight. At 703.0 dike has been offset along a joint at 60°, approximately 1.0 inch. 704.2-705.7 Alteration is slight to moderate, with feldspars altering to clay. Rock is soft to moderately hard, friable along shear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet. 710.3 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide. 711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight. 717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured, Run 146 1	RE, FOLIATION, JOH OR GAIN, CAVING,	HEC (HQD)
697.7-698.4 Fractures very closely spaced, discontinuous, healed with carbonate. 699.8 Felsic dike, medium gray, aphanitic, highly fractured but tight, 0.3 inches wide.  700.7  702.0-707.7 Shear/alteration zone, bleached to a medium yellow-green, generally slightly altered hydrothermally. Hard to very hard. 702.7-703.5 Felsic dike, light green-gray, fine grained, fractured but tight. At 703.0 dike has been offset along a joint at 60°, approximately 1.0 inch. 704.2-705.7 Alteration is slight to moderate, with feldspars altering to clay. Rock is soft to moderately hard, friable along shear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet.  710.3 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide.  711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight.	ture zone,	100 (88)
discontinuous, healed with carbonate. 699.8 Felsic dike, medium gray, aphanitic, highly fractured but tight, 0.3 inches wide. 700.7 702.0-707.7 Shear/alteration zone, bleached to a medium yellow-green, generally slightly altered hydrothermally. Hard to very hard. 702.7-703.5 Felsic dike, light green-gray, fine grained, fractured but tight. At 703.0 dike has been offset along a joint at 60°, approximately 1.0 inch. 704.2-705.7 Alteration is slight to moderate, with feldspars altering to clay. Rock is soft to moderately hard, friable along shear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet. 710.3 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide. 711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight. 717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured,		100
702.0-707.7 Shear/alteration zone, bleached to a medium yellow-green, generally slightly altered hydrothermally. Hard to very hard. 702.7-703.5 Felsic dike, light green-gray, fine grained, fractured but tight. At 703.0 dike has been offset along a joint at 60°, approximately 1.0 inch. 704.2-705.7 Alteration is slight to moderate, with feldspars altering to clay. Rock is soft to moderately hard, friable along shear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet.  710. 3 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide.  711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight.  717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured, Run 146 1	aled with o	(98)
moderate, with feldspars altering to clay. Rock is soft to moderately hard, friable along snear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet. 710.3 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide. 711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight.  717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured, Run 146 1	w-green, ge mally. Har lsic dike, fractured b been offse imately 1.0	100 (78)
along shear. Shear is at 705.0 and 705.5, approximately 0.25 inches of breccia and gouge. Minor sulfide mineralization. 704.5-705.7 Core loss 0.2 feet. 710.7 Felsic dike, 50°, gray-green, fine grained, unfractured, chill margins. Approximately 1.5 inches wide. 711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight. 717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured, Run 146 1	feldspars	100
grained, unfractured, chill margins.  Approximately 1.5 inches wide.  711.0 Felsic dike, 40°, gray-green, fine grained to aphanitic, fractured, chill margins tight.  717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured,  Run 146 1	Shear is at 0.25 inches sulfide min re loss 0.2	(100)
grained to aphanitic, fractured, chill margins tight.  715.6  717.2 Felsic dike, 20°, gray green, fine grained to aphanitic, slightly fractured, Run 146 1	red, chill inches wid	100 (88)
grained to aphanitic, slightly fractured, Kun 146	e, 40°, gra tic, fractu	
718.3 Joint, 10°, trace of sandy-silt. to 719.0 Joint, 10°, slickensides or nlorite, coating of carbonate and chlorite gouge.	tic, slight ) inches wi , trace of , slickensi	100 (100)
720 - Run 147 1		100 (96)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 24 OF 31

DEPTH (FT)	ROCK TYPE	OESCRIPTION : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(#QD)
	Diorite	729.2 Joint, 10°, trace of sandy-silt.	Run 148 724.8 to 730.0	100 (100)
- 730 (598.0)		Run 149 730.0 to 735.0	100 (100)	
740		737.6 Healed breccia, 70-80% diorite fragments in a dark green diorite matrix. Hard, numerous irregular, discontinuous fractures filled with carbonate, up to 0.3 inches, comprise 10% of rock.		100 (100)
740 (606.2)		Run 151 740.2 to 745.2	100 (100)	
		745.7 Joint, 45°, slickensides on chlorite. 749.5 Joint, 80°, slickensides on chlorite.	Run 152 745.2 to 750.3	100 (98)
750 (614.4)		753.6 Shear, 10°, healed. 754.0-773.9 Shear/fracture zone, joints very closely spaced, most are tight, some carbonate	Run 153 750.3 to 755.4	100 (100)
		healed joints. Pieces of intact core approximately 1.0 foot long, brittle.	Run 154	100 (96)

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 25 OF 31

DEPTH	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	9£5 (920)
760	Diorite	757.0 Joint, 30°, slickensides en chlorite. 757.2 Joint, 60°, slickensides on chlorite. 757.7 Joint, 30°, slickensides on chlorite and carbonate. 758.6 Joint, 30°, slickensides on chlorite	Run 154 755.4 to 760.5	100 (96)
622.6)	and carbonate. 759.3 Joint, 30°, slickensides, tr gouge. 764.3-769.3 Most joints becoming h with carbonate, less than 0.1 inch 768.0 Shear, 30°, 1.0 inches of br slickensides on chlorite, talc (?)  770.30.7)  773.9-801.1 Fracture zone, joints ar to very closely spaced, some healed w carbonate, tight, pieces average gene to 1.0 foot, but are brittle.	759.3 Joint, 30°, slickensides, trace of	Run 155 760.5 to 765.5	100 (98)
770			Run 156 765.5 to 770.5	100
-		773.9 Joint, 35°, slickensides on chlorite. 773.9-801.1 Fracture zone, joints are close	Run 157 770.5 to 775.5	98 (70)
780		carbonate, tight, pieces average generally	Run 158 775.5 to 780.6	100
38.9)			Run 159 780.6 to 785.7	100
			Run 160 785.7 to 790.8	100 (100)

# ACRES AMERICAN' INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5710.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO. 26 OF 31

DEPTH (FT)	ROCK TYPE	<u>DESCRIPTION</u> : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	49.0 (400)
790 647.1)	Diorite		Run 160	100 (100)
			Run 161 790.8 to 793.5	100 (100)
1			Run 162	100
			191.5	(76)
- 1			798.5	
800 - 655.3)		800.5-800.7 Alteration zone, slightly altered hydrothermally, slightly bleached. Between a set of joints very closely	Run 163 798.5- 800.7	100
33.37		spaced, at 20°, carbonate healed. Approxi-	Run 164	100
1		mately 10% of feldspars are altered to clay.	800.7	(100)
1		801.1-840.8 Joints are closely spaced, average 0.5 to 1.0 feet. Chlorite filling, trace of carbonate.  801.3 Felsic dike, light gray, fine grained.	to 805.7	
810		0.5 inches wide, offset by a healed shear. 805.7-807.0 Joints, very closely spaced, tight, healed with carbonate. 806.7 Joint, 20°, slickensides on chlorite.	Run 165 805.7 to 810.7	100 (100)
663.5)			Run 166	100
		812.5 Felsic dike or healed breccia, light gray, fine grained to aphanitic ground mass with diorite fragments. Tight contacts, 0.5 inches wide, 10°, hard.	810.7 to 815.7	(100)
+			Run 167	100
-		817.5 Felsic dike, 15°, light gray, fine grained to aphanitic, 1.0 inch wide, margins are fine grained quartz and feldspar, with 0.5 inch zone of quartz.	815.7 to 820.7	(100)
820 - 671.7)				

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Watana (North Bank)

SHEET NO. 27 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	#£C (900)
3	Diorite	821.4 Joint, 50°, coating of sandy-silt/clay, gouge (?).	Run 168 820.7 to 825.5	98 (96)
830		828.9-844.8 Diorite becomes light to medium green, possibly due to changing composition	Run 169 825.5 to 830.5	100 (90)
679.9)		of feldspars, may be an increase in quartz content.  831.3 Felsic dike, 90°, light gray, medium grained, 1.0 inch wide. 831.3-833.6 Gradational change in texture from medium grained to fine grained. Sharp	Run 170 830.5 to 835.2	100 (100)
840		contact with the underlying medium grained diorite, unfractured.	Run 171 835.2 to 840.2	100 (100)
688.1)		840.8-882.3 Joints close to moderately closely spaced (average 1.0 feet), chlorite, trace to occasional filling of carbonate.	Run 172 840.2 to 845.2	100 (100)
		847.8, 848.0 Inclusions of dark green, fine grained diorite, 1.0 inch in diameter.	Run 173 845.2 to 850.2	100 (100)
850 696.3)			Run 174 850.2- 855.0	

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO. P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank) SHEET NO 28 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	1900)
-	Diorite		Run 174	100 (100)
_			Run 175	100
- 860 (704.5)			855.0 to 858.7	(100)
			Run 176 858.7- 860.7	
			Run 177	100
		861.3-862.0 Several inclusions of dark green, fine grained diorite, up to 0.75 inches in diameter.	860.7 to 865.7	(100)
- 1			Run 178	100
			865.7	(100)
870 -			870.8	
12.7)				
-		871.7, 872.0 Inclusions of dark green, fine grained diorite, 1.0 and 2.0 inches,	Run 179 870.8 to	100 (98)
		respectively. 873.1-955.7 Diorite changes to a light gray-green. Increase in quartz, possibly up to 10%.	875.7	
1		to 10s.	Run 180	100
-		878.6 Felsic dike (?), 60°, light gray, fine grained, 2.0 inches wide, irregular contacts, hard.	875.7 to	(100)
880 - 20.9)		879.3-882.5 Healed breccia zone. 880.3 Shear along joint, at 15°, approximately 0.1 inch of clay/silt, carbonate;	880.7	
720.9)		gouge (?). 881.6 Shear along joint, at 20°, 0.5 inches wide breccia gouge zone. Partially healed with carbonate.	Run 181 880.7 to 885.8	100 (94)

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Watana (North Bank)

SHEET NO 29 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	DENGTH OF RUN (FT)	(#20)
	Diorite	882.3-888.1 Core broken by drilling, pieces	Run 181	
		generally less than 3.0 inches. Possible fracture zone (?).	Run 182	100
			885.8	(94)
		888.1-908.0 Joints closely spaced, with	to	
890		local zones of very closely spaced joints. Trace to occasional filling of carbonate.	890.7	
729.0)			Run 183	(100)
		894.5-897.4 Shear/fracture zone (?), joints and fractures close to very closely spaced.	Run 184	100
-		894.5-895.7 Core badly broken by drilling.	892.0	(74)
		pieces 1.0 to 2.0 inches. Two joints at 10° have slickensides, pieces are angular, fresh to slight chlorite staining.	to 896.6	
		Tresh to singht childrite staining.	Run 185	100
-		898.8-899.1 Core broken by drilling, pieces are 1.0 to 2.0 inches, fresh, angular.	896.6	(90)
69893		are 1.0 to 2.0 menes, rresh, ungular.	900.7	
900 737.2)			900.7 Run 186	100
- 1		903.0 Joint, 10°, healed, carbonate filling	900.7	(80)
		to 0.5 inches. 903.8-904.2 Core broken by drilling, pieces	to	*034*
1		0.5 to 1.0 inch.	905.7	
		905.1-906.0 Core broken by drilling or pos-	0 - 107	100
		sible fracture zore. Pieces average 1.0 inch.	905.7	100
- 4		908.0-929.5 Joints are moderately close to	to	(32)
		close, averaging 1.0 to 1.5 feet.	910.7	
910				
745.4)			Run 188	100
1		912.6-913.1 Fracture zone, joints very closely	910.7	(100)
		spaced at 10°.	915.7	
1			915./	
-			Run 189	100

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT Alaska Power Authority

JOB NO P5710.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

ITE Watana (North Bank)

SHEET NO. 30 OF 31

DEPTH (FT)	MOCK TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	PEC (PG0)
	Diorite		Run 189	100
			915.7	(98)
920 (753.6)			to 920.7	
733.07			Run 190	100
		923.5-925.1 Fracture zone, joints very closely spaced. Most are tight but have been broken by drilling.	920.7	(100)
			925.8	
			Run 191	100
930 <sup>-</sup> 761.8)		926.6-928.2 Shear/alteration zone, core bleached to light yellow-green, slightly al- tered hydrothermally, hard to moderately hard. Upper contact is gradational, lower is sharp along a 60° carbonate healed joint. 927.2 Shear on joint at 35°, approximately	925.8 to 930.8	(92)
701.0)		0.5 inches of breccia gouge, slickensides.	Run 192	100
		928.3-928.7 Irregular fractures healed with carbonate, up to 0.3 inches, less than 5% of rock.	930.8 to	(100)
		929.5-955.7 Fracture zone, joints very closely spaced, most are tight, approximately 25% healed with carbonate. Minor sulfide mineral-	935.9	
		ization, unbroken pieces range from 0.5 to 3.0 feet.	Run 193	100
		933.2-946.5 Shear/alteration zone, bleached to light yellow-green, slightly altered hydrothermally. Feldspars are stained,	to	(100)
940		hard to moderately hard. 934.9 Shear, 40°, coating of clay gouge,	940.7	
770.0)		coincident with a healed shear. 943.6 Shear, 30°, up to 0.5 inches of	Run 194	100
	100	breccia gouge.	940.7 to	(100)
		946.1 Shear, 25°, up to 0.5 inches of breccia gouge.	945.8	
			Run 195 945.8 to 950.7	100

CLIENT Alaska Power Authority

JOB NO P5701.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-3

SITE Watana (North Bank)

SHEET NO. 31 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(800)
950 778.2)	Diorite	altered hydrothermally, approximately		100 (100)
		10-25% of feldspars are altering to clay. Hard to moderately hard.	Run 196	100
1		mare to moderately hard.	950.7 to	(100)
-			955.7	
955.7		END OF BORING		
782.9)				
-		1		
-				
1				
-				
-				
1			1	
. 4				
1				
4				
		8		
-			1	
		1		
			1 1	

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 BH-3

 Site
 Watana (North Bank)
 Sheet No.
 1 of 3

	ELEV.	PERMEABILITY (K) cm/sec	** 20 40 60 80	*00 % 20 40 60 80	NUMBER OF JOINTS PER IOFT	HOCK TYPE	REMARKS
0	2151					Overburden	
20							TOP OF ROCK 31.7
40 60	2111					Diorite	Shear.  Fracture zone,
80							Fracture zone.  Breccia, healed.
100	2069						
120					<b>þ</b> :::		Breccia, healed. Shear, alteration zone.
140	2028						Alteration zone.
180							Alteration zone.
200	1987						- Shear.
220					<b>h</b> ::		Shears, healed.
240	1987				<b>5</b>		
280					7		
300-	1905						Alteration zone.
320-					1	-	
340-						1	Alteration zone.

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 BH-3

 Site
 Watana (North Bank)
 Sheet No.
 2 of 3

(FT.)	ELEV (FT.)	PERMEABILITY (X) cm/sec	COME RECOVERY	#00 % 20 40 60 80	NUMBER OF JOINTS PER IOFT	HOCK TYPE	PEMARAS
360							Joint, slickenside
380							] Shear/alteration zone.
400	1823	4 - 1 - 1					zone.
420							Shear/alteration zone.
440	1784						
460	1/84						] Shear/fracture zon
480			-				Shear/alteration
500	1741	No Test Data			5		zone.
520							
540		<b>.</b>		T.	<b>F</b>		
560	1700						Shear/alteration   zone.   Shear/fracture
580		4					zone.
600	1659						
620							
640				-			
660	1619				<b>G</b>		l . oto
680							a lettalyaike
700	1578			. 1			

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Client Project Susitna Hydroelectric Project Hole No. BH-3 Site Watana (North Bank) Sheet No. 3 of 3 NUMBER OF JOINTS PER IOFT PERMEABILITY CORE RECOVERY DEPTH (FT.) HOCK TYPE HEMARKS Shear/alteration zone. 720 740 Zone of joints with slickensides. 1536 760 Shear/fracture zone. 780 800 1496 820 840 1455 860 880 Fracture zone. Shear. 900 1414 920 Shear/fracture/ 940 alteration zone. 960 END OF BORING 955.7 980

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO : BH-4

SITE:

Watana (North Bank)

SHEET NO. 1 OF 31

CONTRACTOR: Interstate Exploration Inc.
LOGGED BY: K.J. White, M.P. Bruen

DATE: September 1981

LOCATION

DRILLING METHOD:

Casing Advancer
Diamond Core - Triple Tube

CASING DIAMETER: NW (3.0") 1.D.
CORE DIAMETER: NW (1.75") 0.D.

LATITUDE N3,228,421 DEPARTURE E743.471

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4 GROUND SURFACE 2187.8

ROCK SURFACE 2177.3

AZIMUTH 060° 58°

BOTTOM OF HOLE 1382.5

WATER TABLE NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

GEPTH (FT)	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	RUN LENGTH	MEC (RQD)
0.0	Overburden	Overburden and cobbles.		
		6.5-12.4 - Very weathered fractured bedrock.		
10 (8.5)		TOP OF ROCK		
12.4 (10.5)	Andesite Porphyry	Medium gray to medium green-gray, aphanitic groundmass with white, fine to medium grained plagioclase henocrysts (20-30%), up to 0.25 inches. Flow structures visible in some sections. Fresh to slightly weathered, hard	Run 1 12.4 to 16.1	100 (92)
20 (17.0)		to very hard. Occasional pods and stringers of carbonate, less than 0.5 inches, joints moderately closely spaced, generally iron stained and carbonate coated.	Run 2 16.1 to 21.0	100 (96)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

RH-4

Watana (North Bank)

SHEET NO 2 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF RUN (FT)	#£0 (920)
-	Andesite Porphyry	12.4-21.0 - Joints closely to moderately closely spaced, trace of iron oxide staining, most joints have a trace of carbonate filling.	Run 3 21.0	100
1		15.8 - Joint, 60°, 0.1 inches of silt/clay, possible shear.	to 25.2	(33)
1		21.0-70.6 - Joints closely to very closely spaced, iron oxide staining.	Run 4 25.2- 27.1	100
1		21.8-22.5 - Shear/fracture zone, joints very closely spaced, slightly weathered.	Run 5	(10)
3C		22.3 - Breccia/gouge, 0.25 inches thick on joint at 50°.	27.1 to 30.8	100
25.4)		24.1-24.3 - Fracture zone, broken core, yellow calcareous silt coating.	Run 6	
]		30.2-34.5 - Color changes to a light gray- green. Contains fragments of argillite to 0.5 inches, comprising approximately 5-10%.	30.8 to 35.7	100
		32.5-41.0 - Fracture zone, joints very closely spaced, pieces are 1.0 to 2.0 inches.	33.7	
1		34.0 - Joint, 80° with a silty-sand coating.	Run 7	100
1		37.4 - Joint, 40° with a silty-clay coating.	Run 8 37.1	89
40 33.9)		38.5-39.6 - "Granitic" rock, medium grained, 20-30% quartz, mafics less than 1.0%. Light yellow-gray rock, slightly to moderately	to 40.7	(0)
-		altered/weathered, badly broken. Joint coated with calcareous clay. Contacts are fractured, not exposed.	Run 9	100
1		39.6-41.0 - Slightly to moderately weathered. 43.4-44.6 - Fracture zone, very closely spaced joints, silty/sand coating.	to 45.8	(33)
1		spaces gomes, and grand coating.	Run 10	
50		48.9-49.6 - Probable fracture zone, pieces average 1.0 inch.  50.1 - Joint, 40°, sulfide mineralization.	45.8 to 50.8	100
(42.4)			Run 11	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 3 OF 31

DEPTH (FT)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#£0 [#00]
	Andesite Porphyry	53.8-57.9 - Fracture zone, very closely spaced joints, heavy iron oxide staining, carbonate.	Run 11 50.8 to 55.6	98 (60)
1			Run 12 55.6- 57.5 Run 13	100
			57.5- 59.2	199)
60 50.9)		62.5-70.6 - Fracture zone, very closely spaced joints, at 10° and 60°, heavy iron oxide staining, some carbonate coating.	Run 14 59.2 to 64.3	100 (40)
			Run 15 64.3 to 69.3	98 (8)
70 59.4)		70.6-84.2 - Joints closely to moderately closely spaced, iron oxide staining, carbonate coating.	Run 16 69.3 to 74.3	100 (72)
		78.1-78.5 - Fracture zone, joints very closely spaced, at 30°. Slightly to moderately weathered, friable in places, silty/sand	Run 17 74.3 to 79.5	100 (60)
80 67.8)		coating on most joint surfaces.  80.5-81.3 - Fracture zone, very closely spaced joints, iron oxide staining, carbonate.  80.9 - Joint, 8°, possible slickensides.  84.2-112.0 - Joints closely spaced, iron oxide	79.5 to 84.5	100 (64)
- 1		staining and carbonate coating.	Run 19	

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 4 OF 31

DEPTH LETT	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	REC (RGO)
	Andesite Porphyry	84.5-112.0 - Rock changes to light green-gray with lithic fragments. Some flow structure at 70°, fragments of argillite, diorite, and andesite up to 1.0 inch but generally less than 0.5 inches.  88.7-90.1 - Shear/fracture zone, joints very	Run 19 84.5 to 89.6	96 (53)
76.3)		closely spaced, at 10° and 60°.	Run 20	
		92.0-102.6 - Joints close to moderately closely spaced, open at 10° to 20°, irregular and rough. Heavy iron oxide staining and organics (?).	89.6 to 94.7	100 (53)
			Run 21	
			94.7 to 99.6	100 (67)
100			Run 22	
		102.9-105.2 - Fracture zone, joints very closely spaced, pieces 1.0 to 2.0 inches, iron oxide stained. Core loss 0.9 feet.	99.6 to 104.5	86 (41)
			Run 23 104.5 to 109.5	100 (58)
		108.2-109.8 - Slightly to moderately weathered, joints very closely spaced.		
. 110 (93.3)		109.8-112.5 - Fracture zone, joints very closely spaced, silt and clay coating.	Run 24	92 (0)
112.0			Run 25	
(95.0)	Diorite	Medium gray-green, medium grained, 20-30% mafics, quartz less than 5%, trace of sulfides. Fresh, hard to very hard, joints closely to very closely spaced.	110.8 to 115.1	95 (23)
.		very crosery spaced.	Run 26	85 (49)

CLIENT ALASKA POWER AUTHORITY

108 NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO. 5 OF 31

DEPTH LETT	.4 IPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(900)
120	Diorite	112.0 - Sharp contact with very thin stringers of andesite penetrating the diorite. Joint at contact, 70°, with a trace of silt coating. Penetrative iron staining for 0.5 feet, slightly weathered.	Run 26 115.1 to 119.8	85 (49)
101.8)		112.0-126.1 - Joints close to very closely spaced, with iron oxide staining.  113.8-115.1 - Fracture zone, joints very	Run 27 119.8 to	84 (0)
		closely spaced at 30° and 50°.	124.8	
		116.0 - Fracture, 10°, tight, healed with calcite, 0.25 inches wide, discontinuous, contains small fragments of diorite.	Run 28	
-		118.2-126.1 - Shear/fracture zone, joints very closely spaced, slightly to moderately weathered. Core loss 1.3 feet.	124.8 to 130.1	96 (51)
130		122.9-124.8 - Shear, gouge and breccia, friable.		
110.2)		126.1-160.1 - Joints close to moderately closely spaced, generally 1.0 to 2.0 feet. Iron oxide staining, carbonate and chlorite present.	Run 29 130.1 to	100 (86)
+		134.0 - Inclusion of dark green, fine grained diorite, 1.0 inch.	135.3	
		137.9 - Joint, 40°, carbonate/calcite.	Run 30 135.3	100
140 118.7)		139.0 - Joint, 10° with calcareous clay coating, some moderate hydrothermal alteration 1.0 inch on either side. Feldspars altering to clay.	to 140.5	(89)
]			Run 31	
-		143.8 - Joint, 30°, moderately altered hydrothermally, 0.25 inches on either side of joint.	140.5 to 145.5	100 (94)
			Run 32 145.5 to 150.6	100 (98)

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Projecr

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 6 OF 31

DEPTH LFT?	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	#EC [490]
150 127.2)	Diorite		Run 32	100 (98)
		153.2-153.6 - Healed shear, 20°, joints very closely spaced, healed with dark green fine grained diorite.  154.7-160.1 - Shear/fracture zone, joints very closely spaced at 20°-60°. Slightly altered	kun 33 150.6 to 155.8	100 (79)
}		hydrothermally, iron oxide staining and carbonate coating.  157.7 - Gouge, 0.1 inches wide.	Run 34 155.8 to 160.1	77 (0)
160 135.7)		160.1-165.2 - No iron oxide staining.	Run 35	
j		163.3 - Joint, 30°, with clay coating.	160.1 to 165.2	100 (92)
-		165.2-205.8 - Joints close to very closely spaced, iron oxide staining, carbonate and chlorite coating.	Run 36	
170		165.2-175.4 - Fracture/alteration zone, slightly to moderately weathered/altered hydrothermally, joints very closely spaced. Hard to moderately hard, iron oxide staining below 171.5.	165.2 to 170.0	88 (21)
144.2)		165.2-165.7 - Clay on most joints. 169.0-169.5 - Shear/alteration zone, severely to completely altered hydro-	Run 37 170.0	100
1		thermally, soft and friable.	to 175.0	(36)
			Run 38 175.0 to 180.0	94 (32)
180			Run 39	

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO. 7 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAU .TING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTINE, ETC	DE RUN (FT)	PEC (900)
	Diorite	181.8-184.2 - Fracture zone, joints are very closely spaced, at 10° and 40°-60°.	Run 39 180.0 to 185.0	100 (22)
190		187.2 - Joint, 70°, with slickensides at 80°.  188.5 - Joint, 50°, with slickensides at 0°.  189.3 - End of iron oxide staining, trace amounts below this depth, carbonate coating on joints.	Run 40 185.0 to 190.1	100 (90)
161.1)		joints.	Run 41 190.1 to 195.0	100 (88)
200		195.5 - Joint, 15°, with clay filling 0.1 inches wide.  199.7-200.1 - Core is broken, sandy clay coating.	Run 42 195.0 to 200.0	100 (48)
169.6)			Run 43 200.0 to 204.0	100 (65)
1		204.4-205.4 - Shear along three joints, at 10°. Slickensides on chlorite and carbonate, 0.1 inches wide.	Run 44 204.0- 205.8	88 (88)
210 178.1)		205.8-375.6 - Joints are moderately close to widely spaced, with a few zones of closely spaced. Trace of carbonate.  209.3-210.7 - Joints closely spaced.  229.8-231.8 - Joints closely spaced.	Run 45 205.8 to 210.7	100 (88)
.,,,,			Run 46	100 (100)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

Watana (North Bank)

SHEET NO 8 OF 31

DEPTH (FT)	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	96C (900)
	Diorite		Run 46 210.7 to 215.7	100 (100)
. 220 (186.6)			Run 47 215.7 to 220.8	100 (100)
			Run 48 220.8 to 225.8	100 (100)
230			Run 49 225.8 to 230.8	100 (94)
		234.8-236.4 - Shear/fracture zone, joints very closely spaced, at 20°. Chlorite and carbonate coating, less than 0.1 inches thick,	Run 50 230.8 to 235.8	100 (100)
240 (203.5)		slickensides.	Run 51 235.8 to 240.8	100 (90)
(203.5)			Run 52 240.8 to 245.8	100 (100)

CLIENT ALASKA POWER AUTHORITY P5700.05

PROJECT Susitna Hydroelectric Project

BH-4

Watana (North Bank) SITE

SHEET NO 9 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(RQD)
	Diorite		Run 52	
250 (212.0)		247.1 - Felsic vein, 90°, light gray, less than 0.25 inches wide, tight, hard.	Run 53 245.8 to 251.0	100 (100)
			Run 54 251.0 to 255.7	100 (100)
260			Run 55 255.7 to 260.8	100 (100)
220.5)			Run 56 260.8 to 265.8	100 (100)
270			Run 57 265.8 to 270.8	100
(229.0)			Run 58 270.8 to 275.8	100
			Run 59	

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

SITE

JOB NO. P5700.05

SHEET NO. 10 9F31

Susitna Hydroelectric Project PROJECT Watana (North Bank)

HOLE NO BH-4

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	PEC (PQD)
280 - (237.4)	Diorite	279.8 - Carbonate vein, 30°-40°, 0.1 inches wide.	Run 59 275.8 to 280.8	100 (100)
			Run 60 280.8 to 285.8	no 100)
290		289.4 - Healed shear, 10°, 0.1 inches wide, healed with carbonate, tight, hard 289.5 - Joint, 10° with slickens come on	Run 61 285.8 to 290.7	100 (100)
-		carbonate and chlorite coating.  291.0 - Healed shear, 10°, less than 0.1 inches thick, carbonate filled, tight, hard.	Run 62 290.7 to 295.8	100 (100)
			Run 63 295.8 to 298.9	100 (84)
300 - (254.4)			Run 64 298.9- 300.8	100 (95)
			Run 65 300.8 to 305.8	100 (100)
		306.0-307.9 { 314.2-314.6 } Red intergranular stain on the diorite.	Run 66 305.8 to 310.8	100 (100)

CLIENT

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE

Watana (North Bank)

SHEET NO. 11 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	PEC (990)
310	Diorite		Run 66	
			Run 67	
			310.8 to 315.8	100 (100)
		316.2 - Healed breccia, 20°, 0.1 feet wide, healed with dark green, fine grained igneous material, hard.	Run 68 315.8 to	100 (96)
320 (271.4)		320.3-320.6 - Core broken by drilling, fresh, angular pieces, 1.0 to 2.0 inches.	320.8	
+		322.0-322.3 - Inclusion of fine grained, dark green diorite.	Run 69	
1		324.4-325.0 - Fractures healed with carbonate, irregular shape, discontinuous, up to 0.5 inches wide.	320.8 to 325.8	(100)
1		326.7-330.4 - Joint, 0°-10°, chlorite and carbonate coated, faint slickensides.	Run 70	
330			325.8 to 330.8	100 (100)
(279.8)		331.2-332.2 - Fracture zone, joints very closely spaced at 0°-30°, some surfaces altered hydrothermally.	Run 71	
			330.8 to 335.8	100 (100)
1			Run 72	
1			335.8 to 340.8	100 (100)
340 (288.3)			0/2/8/3/4/	

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CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank) SHEET NO 12 OF 31

06F7H 1F73	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (FT)	#£C (#20)
	Diorite	343.7-343.8 - Fracture zone, up to 0.1 inches wide, irregular, discontinuous, healed by calcite/carbonate, tight, hard.  344.0 - Healed shear, 30°, healed by dark	Run 73 340.8 to 345.7	100 (100)
350		green, fine grained igneous material, tight, hard.	Run 74 345.7 to 350.7	100 (100)
(296.8)			Run 75 350.7 to 355.6	100 (100)
		355.8 - Fracture, filled with carbonate, discontinuous, 0.25 inches wide. 356.5-357.7 - Fractures, 0°-10°, healed with carbonate less than 0.1 inches thick.	Run 76 355.6 to 360.2	100 (100)
360 (305.3)		361.07 366.0) Healed shears, 15°, less than or equal to 0.25 inches wide. Healed with dark green, fine grained diorite, hard.	Run 77 360 2 to 365.4	100 (100)
		367.7 - Healed fracture, O.l inches wide, regular, discontinuous, healed with carbonate.	Run 78 365.4 to 370.5	100
370 (313.8)		370.0-370.5 - Core broken by drilling.	Run 79 370.5- 375.6	100

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ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE

Watana (North Bank)

SHEET NO. 13 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	#EC (#QD)
	Diorite	373.0-373.2 - Felsic dike, white-yellow to gray, 10-20% quartz, 1.0 to 2.0 inches wide. Contacts are hard, tight, and irregular.	Run 79 370.5 to 375.6	100 (100)
		375.6-423.9 - Joints are moderately closely spaced, average 2.0 feet, generally trace of carbonate and/or chlorite.  378.5 - Joint, 20°, trace of silt/clay.	Run 80 375.6 to 380.6	100 (100)
380 (322.2)			Run 81 380.6 to 385.6	100 (100)
390 330.7)	392.4-393.2 - Healed breccia along several joints at 0° and 15°. Healed with dark green, fine grained diorite, tight, hard.  395.4-395.7 - Carbonate vein, 10°, up to 0.25	Run 82 385.6 to 390.7	100 (100)	
		Run 83 390.7 to 395.5	100 (94)	
400		inches wide.	Run 84 395.5 to 400.6	100 (100)
(339.2)			Run 85 400.6 to 405.5	100 (98)

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ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

Watana (North Bank)

SHEET NO 14 OF 31

DEPTH LFT1	ROCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN	HEC (#99)
410	Diorite	405.2 - Healed breccia along a joint at 10°-20°, approximately 1.0 inches wide. Healed with dark green, fine grained diorite.	Run 86 405.5 to 410.4	100 (100)
347.7)			Run 87 410.4 to 415.7	98 (98)
420 356.2)		416.5-416.8 - Healed breccia, 50°, diorite inclusions up to 2.0 inches in dark green, fine grained diorite.  417.7-418.6 - Healed breccia, diorite fragments up to 2.0 inches and comprise 70-80° of the rock. Healed with a dark green, fine grained diorite, hard, tight.	Run 88 415.7 to 420.7	100 (100)
1		419.3-419.8 - Fracture zone, joints very closely spaced at 60°, carbonate filling, tight healed joints.  420.8 - Felsic vein, 15°, less than 0.25 inches wide, tight.	Run 89 420.7 to 425.7	100 (100)
430 364.6)		423.9-510.4 - Joints close to moderately closely spaced, average 1.0 foot. Trace to coating of carbonate and chlorite.  426.0 - Joint, 10° with faint slickensides on chlorite. Felsic vein, 15°, light gray, fine grained, chilled contact, tight, hard.  429.2 - Joint, 60° with faint slickensides.  429.5 - Joint, 10°, with slickensides on	Run 90 425.7 to 430.9	100 (100)
		chlorite.  429.8 - Joint, 55°, with slickensides on chlorite at 40°.	Run 91 430.9 to 435.8	100 (100)
			Run 92	

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

Watana (North Bank)

SHEET NO. 15 OF 31

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#EC (#QD)
<b>44</b> 0 (373.1)	Diorite	430.7 - Joint, 10°, 0.25 inches thick, healed with carbonate, tight. Crosscutting joint, 10°, coated with talc/chlorite and carbonate, possible slickensides.  430.9-439.2 - Joints/Fractures 0°-10° and 30°-	Run 92 435.8 to 440.8	100 (100)
		50°, very closely spaced, irregular and discontinuous. Healed by carbonate and sulfides, generally moderately hard with some zones of friable rock, tight.	Run 93 440.8	100
		444.5 - Healed shear, 30°, 0.25 to 0.5 inches wide. Healed with dark green, fine grained diorite.	to 445.8	(100)
		445.0-448.0 - Andesite dike, 50°, medium gray-green, aphanitic rock with approximately 10% phenocrysts of carbonate up to 0.1 inches, parallel to flow structures. Fresh, hard, unfractured, contacts tight.	Run 94 445.8 to 450.8	100 (100)
450 _ (381.6)		450.2-455.2 - Felsic dikes, four, 20°-30°, fine grained, composition is probably close to a granodiorite. Moderately closely spaced, 1.0 to 2.0 inches wide, hard, tight contacts.	Run 95 450.8 to 455.8	100 (100)
460		458.2-458.6 - Fracture zone, joints very closely spaced at 30°, healed with carbonate.	Run 96 455.8 to 460.8	100 (100)
390.1)		462.0-463.5 - Alteration zone, slightly altered hydrothermally, diorite bleached to light gray-green, hard.  464.0 - Joint, 20°, faint slickensides on chlorite. Crosscut joint at 30°, faint	Run 97 460.8 to 465.9	100 (100)
	slickensides on chlorite.	Run 98 465.9 to 470.8	100 (98)	

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ALASKA POWER AUTHORITY CLIENT

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

Watana (North Bank) SITE

SHEET NO. 16 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	9EC
470 398.6)	Diorite	465.4 - Shear along joint at 40°, slickensides. 0.1 inches thick gouge.		100 (98)
		465.6 - Felsic dike, light gray, fine grained, possibly granodiorite, approximately 2.0 inches wide at 40°, tight contacts. Part of dike is crosscut by the above shear.	Run 99 470.8 to 475.8	100 (100)
480 407.0)			Run 100 475.8 to 480.8	100 (100)
		$483.3$ - Joint, $10^{\circ}$ , possible faint slickensides on chlorite.	Run 101 480.8 to 485.7	100 (94)
490		489.2 - Healed shear, 30°, 0.75 inches wide, healed with dark green, fine grained diorite.	Run 102 485.7 to 490.6	100 (100)
(415.5)		490.1 - Healed shear as above, 40°, 1.0 inch wide.	Run 103 490.6 to 495.6	100 (100)
		497.3-499.0 - Inclusion or dike of fine grained, dark green diorite, sharp contacts at	Run 104 495.6 to 498.0	100 (100)
500 (424.0)		40°, tight, hard.	Run 105 498.0 to 500.8	93 (93)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 17 OF 31

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	HEC (HQD)
	Diorite	502.6-503.0 - Felsic dike, light gray, fire grained, probably granodiorite. Upper contact fractured, lower contact tight at 70°. Hard, unfractured.	Run 106 500.8 to 505.8	100 (100)
510 (432.5)		510.4-627.8 - Joints moderately close to	Run 107 505.8 to 510.7	100 (100)
(432.5)		widely spaced, trace of chlorite and carbonate coating.	Run 108 510.7 to 515.8	100 (100)
520			Run 109 515.8 to 520.5	100 (100)
441.0)		523.5-525.1 - Zones of joints very closely spaced, at 20°-30°, healed with carbonate.  524.3 - Healed shear, 30°, 1.0 inch wide, healed with dark green, fine grained diorite.	Run 110 520.5 to 525.6	100 (96)
530		526.5-527.6 - Textural and mineralogical changes. Medium to fine grained, less than 15% mafics. Hard, sharp, tight contacts.	Run 111 525.6 to 530.7	100 (100)
(449.4)			Run 112 530.7- 535.8	100 (100)

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CLIENT ALASKA POWER AUTHORITY

JOB NO P57 30.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Watana (North Bank)

SHEET NO 18 OF 31

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF RUN (FT)	REC (RQD)
	Diorite		Run 112 530.7 to 535.8	100 (100)
540 (457.4)		537.1 - Shear along joint, 20°, 0.5 inches of breccia and gouge, slickensides on chlorite. 537.7 - Joint, 30°, slickensides on chlorite. 538.3-538.9 - Numerous healed fractures, irregular, discontinuous. Healed with calcite/carbonate, up to 0.25 inches wide.	Run 113 535.8 to 540.7	100 (100)
		539.1-541.2 - Felsic lenses and dikes, light gray, fine to medium grained. Felsic material comprises 50% of rock, tight contacts, hard. 543.7-548.9 - Alteration zone, bleached yellowish-white, hydrothermally altered. No mafics, feldspars altering to clay, moderately hard to soft. ROD = 0%.	540.7 to 545.9	100 (65)
550 (466.4)			Run 115 545.9 to 550.8	100 (43)
		$553.0\text{-}553.5$ - Felsic dikes, three, $80^{\circ}\text{-}90^{\circ}$ , closely spaced, less than 0.5 inches, hard, tight.	Run 116 550.8 to 555.8	00 (100)
. <b>56</b> 0 (474.9)		559.7 - Healed shear, 30°, 1.5 inches wide. Healed with dark green, fine grained diorite, hard.	Run 117 555.8 to 560.8	100 (100)
		560.5-561.2 - Red staining on core.	Run 118 560.8 to 505.8	1(0

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO. 19 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	#60 (#00)
	Diorite		Run 118	
		567.7 - Felsic dike, 90°, light gray, medium to coarse grained, unfractured, 0.1 feet wide, tight contacts, hard.	Run 119 565.8	100
570 (483.4)		569.3 - Joint, 0°-20°, carbonate healed, slight hydrothermal alteration up to 1.0 inch.	570.9	(100)
(483.4)		571.7-574.9 - Alteration zone, bleached to yellow-white, moderately to severely altered hydrothermally. Feldspars altered to clay, no mafics, moderately hard to soft, locally friable. RQD = 0%.	Run 120 570.9 to 575.9	100 (50)
			Run 121	
580		578.0-578.8 - Healed shears, closely spaced, healed by dark green, fine grained igneous material, hard.	575.9 to 580.8	100
(491.8)		578.5 - Possible offset of felsic dike, 1.0 inch wide. Offset up to 0.5 inches.		
			8un 122 580.8 to 585.8	160 (100)
1			Run 123	0.0000000
		588.5 - Healed shear, 30°, healed with carbonate less than 0.1 inches wide. Healed with dark green diorite, tight.	585.8 to 590.8	100 (100)
590 -		588.8-588.9 - Fracture zone, fractures very closely spaced, healed with carbonate, discontinuous, irregular, hard.	Run 124	
		591.0 - Healed shear, 30°, 0.25 inches wide, healed with dark green diorite and carbonate, tight.	590.8 to 595.8	100 (100)
-			Run 125	

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO. 20 OF 31

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN	MEC (MQD)
600 (508.8)	Diorite	597.0 - Felsic dike, 80°, light orange, 0.5 inches wide. Truncated by healed shear at 40° 597.9 - Inclusion of dark green, fine grained diorite, diameter of 1.0 inch.	Run 125 595.8 to 600.7	100 (100)
		Run 126 600.7 to 605.7	100 (100)	
. 610 (517,3)		610.9-618.3 - Shear/alteration zone, bleached to a light yellow-cray, slightly to moderately	Run 127 605.7 to 610.7	100 (100)
(517.3)	altered hydrothermally with zones of severe alteration. Feldspars altered to clay, moderately hard to soft, biotite crystals close to altered zone.  612.1-618.3 - Shear, 0°, 0.5 inches wide, partially healed with carbonate and chlorite. Alteration is more intense on	Run 128 610.7 to 615.7	100 (15)	
620		one side than the other.	Run 129 615.7 to 620.8	100 (59)
(525.8)		620.1-622.2 - Shear, 10°, partially healed by carbonate, up to 0.5 inches wide.	Run 130	
			620.8 to 625.9	100 (80)
		627.8-710.2 - Joints close to moderately closely spaced, chlorite coated with trace to coating of carbonate.	Run 131 625.9 to 630.9	100 (88)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 21 OF 31

DEPTH (#T)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN	98C (990)
630 534.2)	Diorite	629.3 - Shear, 10°, 0.25 to 0.5 inches wide, partially healed by carbonate.	Run 131	100 (88)
		632.5 - Joint, 10°, partially healed by carbonate. Slickensides on chlorite.  635.9-637.5 - Fracture zone, joints and fractures very closely spaced, up to 0.1 inches wide. Healed with carbonate, discontinuous.	Run 132 630.9 to 635.9	100 (30)
640 542.7)		irregular.	Run 133 635.9 to 640.8	100 (70)
		642.4 - Joint, 10°, slickensides on chlorite. 644.1-644.8 - Fracture zone, joints very closely spaced, at 60°.	Run 134 640.8 to 645.8	100 (45)
650 551.2)		648.0-648.7 - Healed breccia, fragments of diorite comprise 70-80%, healed by dark green diorite. Hard, joint at 20° at upper contact, healed with carbonate, approximately 0.25 inches wide.	Run 135 645.8 to 650.8	100 (70
		649.4-649.8 - Joints, 50°-70°, very closely spaced, tight.	Run 136 650.8 to 655.8	100 (85
			Run 137 655.8 to 660.7	100 (100
660 (559.7)				

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 22 OF 31

DEPTH (ET)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR JAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF RUN (FT)	(#20)
	Diorite		Run 138 660.7 to 665.7	100 (66)
670 568.2)		666.8 - Diorite breccia, 0.5 inches wide, healed with carbonate, irregular, tight.  669.7-670.7 - Joints, 10°, 0.5 inches wide, healed with carbonate. Irregular fractures, discontinuous, healed with carbonate.	Run 139 665.7 to 670.7	100 (96)
		671.4-672.3 - Red stain on core. 672.8 - Joint, 30°, 0.25 inches wide, healed with carbonate. 673.6-678.6 - Shear, 0°-10°, partially healed by carbonate and chlorite. Slickensides, thin coating of gouge less than 0.1 inches.	Run 140 670.7 to 675.7	100 (98)
680 (576.6)			Run 141 675.7 to 680.8	100 (67)
			Run 142 680.8 to 685.7	100 (100)
690			Run 143 685.7 to 690.8	100 (100)
(585.1)		691.7-691.9 - Felsic dike, 30°, light green- gray, medium grained. Up to 10% quartz, 5-10% mafics. Tight, welded contacts, fractured and healed with carbonate, hard.	Run 144 690.8-	100

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 23 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	#£C (900)
	Diorite	692.8-693.3 - Pods of felsic material similar to above dike. Irregular shapes up to 1.0 inch, hard.	Run 144 690.8 to 695.8	100 (100)
700		693.9 - Inclusion of dark green, fine grained diorite, 2.0 inches long.  698.7-700.4 - Shear, 10°, partially healed with carbonate, chlorite. Faint slickensides.	Run 145 695.8 to 700.8	100 (100)
593.6)		701.4-703.1 - Numerous healed fractures, closely to very closely spaced, up to 0.25 inches thick. Healed with carbonate, irregular, discontinuous.	Run 146 700.8 to 705.7	100 (100)
710 .		710.2-710.8 - Fracture zone, joints and fractures very closely spaced, angular pieces	Run 147 705.7 to 710.8	100 (90)
		0.5 to 1.0 inch, most surfaces stained.  710.2-755.9 - Joints closely spaced with zones of very closely spaced. Generally a coating of chlorite and a trace to coating of carbonate.  712.0-713.5 - Fracture zone, joints very closely spaced, at 20° and 60°. Joints at	Run 148 710.8 to 715.8	100 (90)
720		20° are healed with carbonate.	Run 149 715.8 to 720.8	100 (36)
610.6)		closely spaced, at 40°-70°.	Run 150	
		723.3 - Joint, 20°, trace of silty sand.	720.8 to 725.8	98 (56)

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CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO. 24 OF 31

DEPTH (FT)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF HUN (FT)	955 (909)
	Diorite	726.1-730.9 - Shear/fracture zone, joints very	Run 150	98(56)
730		close to closely spaced, oriented at 30° and 10°. Numerous irregular fractures, some carbonate healed. Slickensides.	Run 151 725.8 to 730.8	100 (15)
(619.0)				
1		$732.5$ - Joint, $10^\circ$ , with slickensides on chlorite.	Run 152 730.8	100
		734.6-738.0 - Shear/fracture zone, numerous joints very closely spaced, at 30°. Some healed with carbonate, up to 0.25 inches thick, tight.	to 735.8	(30)
		736.4 - Joint, 20°, slickensides on chlorite.	Run 153 735.8	100
. 740 (627.5)		738.3-739.5 - Joints, 70°, closely spaced.	to 740.8	(30)
		742.3-743.2 - Fracture zone, joints very closely spaced at 70°.	Run 154 740.8 to 745.8	100 (35)
1			Run 155	
750 (636.0)		749.4-755.0 - Fracture zone, joints and fractures very closely spaced, mostly tight, randomly oriented. Joints at 0°-10°, and 60°, less than half are healed with carbonate.	745.8 to 750.8	100 (60)
		752.8-755.0 - Core broken along the 60°	Run 156	
		joint set.	750.8 to 755.9	100 (16)
		755.9-768.8 - Joints are close to moderately closely spaced.		
1		a secretical relative	Run 157	

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 25 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF RUN	#EC  #201
760 - (644.5)	Diorite	758.5-759.8 - Healed shear, 10°, healed with dark green diorite and carbonate, tight.	Run 157 755.9 to 760.9	100 (94)
			Run 158 760.9 to 765.8	100 (80)
. 770 _ (623.0)		768.8-771.2 - Fracture zone, joints very closely spaced, at 0°-10°, some are healed by carbonate.  768.8-786.2 - Joints close to very closely spaced.	Run 159 765.8 to 770.9	100 (65)
		spaced.	Run 160 770.9 to 775.9	100 (16)
780 (661.4)		780.0 - Joint, 15°, slickensides on colorite, trace of yellow sandy silt.	Run 161 775.9 to 780.9	100 (58)
		783.7 - Joint, 15°, trace of silt or clay.	Run 162 780.9 to 785.9	100 (50)
		786.2-850.5 - Joints close to moderately closely spaced, average 0.5 to 1.0 foot. Chlorite coating, trace to coating of cartonate.	Run 163 785.9 to 790.9	100 (90)

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CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

OLE NO BH-4

SITE Watana (North Bank)

SHEET NO 26 OF 31

DEPTH (FT)	MOCH TYPE	OFSCRIPTION COLOR, TEXTURE, POLISTION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	MEC (MGD)
790 (669.9)	Diorite		Run 163	100 (90)
			Run 164 790.9 to 795.8	100 (59)
800 (679.1)		797.1 - Inclusion of fine grained diorite, diameter 1.0 inch. 797.8-798.1 - Fracture zone, joints very closely spaced at 70°. Carbonate, chlorite coating, possibly some talc.	Run 165 795.8 to 800.7	100 (75)
		803.0 - Healed shear, 10°, healed with fine grained felsic material, tight. Offset of 0.5 inches along inclusion of fine grained dirrite.	Run 166 800.7 to 805.6	100 (69)
810 (686.9)		804.1-805.3 - Fracture zone, joints/fractures very closely spaced, at 0°-10°, and 40°, most healed with carbonate, broken by drilling 805.2-806.2 - Healed shear, 10°, 1.0 inch wide fragments of diorite, healed by dark green diorite, tight, hard.  811.9-820.5 - Textural changes in diorite.	805.6	100 (88)
		light gray-green, medium to coarse grained, less than 10% mafics.  812.0-815.8 - Shear/fracture zone, joints very closely spaced at 10° and 60°. Broken by drilling, pieces 0.5 to 2.0 inches, coated with silt or clay. Most joints are tight, minor sulfide mineralization.	Run 168 810.7 to 815.8	100 (41)
		813.5 - Breccia, 1.0 inch wide, partially nealed with carbonate.	Run 169 815.8 to 820.8	100 (32)

ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

PROJECT Susitna Hydroelectric Project HOLE NO. BH-4

CLIENT ALASKA POWER AUTHORITY

Watana (North Bank) SITE

DEPTH

830 (703.8)

840 (712.3

850

(720.8)

SHEET NO 27 OF 31

100 100)

100 100)

100

(100)

100

100)

100

100 (100)

100

(92)

(80)

JOB NO P5700.05

HOLE NO BH-4 SHEET NO 28 OF 31 Watana (North Bank)

ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS

BUFFALO , NEW YORK

DRILLING REPORT

MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF RUN (FT)	#£0 (#20)	DEPTH (#1)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COPE, DEMENTING, ETC.	LENGTH OF RUN (FT)	
Diorite		Run 170 820.8 to	100 (80)		Diorite		Run 176 850.5 to 855.6	0
	825.3-825.9 - Core is broken by drilling, minor sulfide mineralization on broken surfaces.	825.8				858.1-869.9 - Diorite changes to light green-	Run 177 855.6 to	(
	828.8 - Joint, 80°, faint slickensides on chlorite.	Run 171 825.8 to	100 (60)	860 (729.3)		gray, 10-20% mafics. 859.6-866.6 - Fracture zone, joints and fractures very closely spaced, oriented at 30° and 70°. Mostly tight, less than 25%	860.5	
		830.8				healed with carbonate.	Run 178 860.5 to	(
	834.5-835.8 - Fracture zone, joints/fractures	Run 172 830.8 to 835.8	100 (40)				865.5	
	very closely spaced, at 0°-10° and 40°-60°, irregular, healed to partially healed by carbonate. Joint/shear, 0°, offset 0.1 inches 837.8 - Joint, 50°, possible slickensides.						Run 179 865.5 to 870.6	(
	barron - borner, so , possible strekensides.	835.8 to 840.8	100 (94)	870 (737.8)		870.3-871.0 - Fracture zone, joints very closely spaced at 60°.	Run 180	
		Run 174 840.8	100 (100)			873.0-875.2 - Shear/alteration zone, core bleached to a light yellow-green, slightly to moderately altered hydrothermally. Hard to medium hard, joints/fractures very closely spaced, tight, generally healed with carbonate	870.6 to 875.6	
		845.7	(100)			875.0 - Shear, 60°, healed with carbonate, breccia, 0.1 feet. 877.5 - Inclusion of dark green, fine grained	875.6	
		Run 175 845.7 to	100 (85)	- 880 - (746.2)		diorite. 1.5 inches in diameter. 878.8 - Joint, 30°, trace of clay.	880.6	1
	850.5-896.0 - Joints moderately closely spaced, chlorite coating, trace to coating of carbonate.	850.5 Run 176 850.5 to 855.6	100 (100)				Run 182 880.6 to 885.6	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 29 OF 31

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF MUN	#(C (#20)
	Diorite	883.5-884.5 - Numerous healed fractures/joints healed with carbonate, 10% of rock. Joints, 20°-30°, fractures are irregular and discontinuous.	Run 182 Run 183 885.6 to 890.6	100 (100)
890 754.7)		890.6-895.7 - Shear/alteration zone, core is bleached to a light yellow-green, generally slightly altered hydrothermally. Generally hard except for the following zones:	Run 184 890.6	100
-		891.7 - Healed shear, 50°, crosscut by a joint with clay fillings less than 0.1 inches wide.	to 895.6	(45)
1		893.0-895.1 - Moderately altered hydro- thermally, moderately hard to soft, locally friable.	Run 185	
+		893.1 - Shear, 15°, 1.0 to 2.0 inches of breccia, partially healed by carbonate.	895.6 to 900.6	100 (100)
900		893.3-893.4 - Broken fragments of breccia.	900.6	
763.2)		893.8-894.1 - Fragments of altered diorite and breccia, pieces less than 1.0 inch.	Run 186	
1		895.1 - Shear, 30°, 1.0 inch wide, breccia and gouge healed with carbonate.	900.6	100
1		896.0-949.6 - Joints moderately close to wide, chlorite coating, trace to coating of carbonate.	905.6	(98)
1		898.9-899.8 - Joints, 30° and 70°, very closely spaced, healed with carbonate to 0.1 inches.	Run 187 905.6	100
1		902.4 - Inclusion of dark green, fine grained diorite.	910.6	(100)
910 771.7)		903.0-903.2 - Inclusion or dike of dark green diorite, sharp contact at 45°.		
1		904.5 - Joint, 80°, clay and carbonate coating	Run 188	
		909.1 - Felsic dike, 50°, light gray, medium grained, 0.5 inches wide, unfractured, tight contact.	910.6 to 915.6	100
		909.5-910.5 - Healed shear, 0°-10°. healed with dark green, fine grained diorite.	Run 189	100

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

LIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 30 OF 31

DEPTH	POC# TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	(800)
920 (780.2)	Dior'te	913.5-939.0 - Healed shear zone, numerous shears very closely spaced, healed by dark green diorite, hard, competent. Felsic dikes within shear are light gray, fine grained, up to 1.0 inch wide, offset along healed shear	Run 189 915.6 to 920.6	100 (100)
		planes up to 1.0 inch. Approximately 50-75% of zone is healed shears, approximately 5% of the shear zone is felsic dikes.	Run 190 920.6 to 925.7	100 (100)
930			Run 191 925.7 to 930.3	100 (100)
788.6)			Run 192 930.3 to 935.4	100 (100)
940 - (797.1)		939.3-939.4 - Fragments, two, of andesite porphyry, probably fell in hole during bit change.	Run 193 935.4 to 939.3	100 (100)
			Run 194 939.3 to 944.4	100 (98)
			Run 195 944.4 to 949.6	96 (96)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Watana (North Bank)

SHEET NO 31 OF 31

DEPTH	HOGE TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN	960 (400)
949.6	Diorite	END OF BORING	Run 195	
805.3)				
- 1				
- 1			1 1	
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- 1		l .	1 1	
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- 1				
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- 1			1 1	
i			1 1	
4			1 1	
- 1				
- 1				
1				
		1	1	

Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY P5700.05 Project Susitna Hydroelectric Project Hole No. BH-4 Watana (North Bank) Site Sheet No. 1 of 3 PERMEABILITY COME MECOVERY NUMBER OF JOINTS PER -ROCK TYPE TOP OF ROCK 12.4" Overburden Andesite 20 Shear/fracture. Porphyry Fracture zone. 40 2146 Fracture zone. 60 Fracture zone. 80 Shear/fracture. 100 2103 Diorite Fracture zone. 120 1 Shear/fracture zone 140 Shear/fracture zone 2061 160 Fracture/alteration zone. 180 200 2018 220 Shear/fracture. 240 1976 No Test 260 280 Joint, slickensides on chlorite. 300 1934 320 340

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	BH-4
Site	Watana (North Bank)		2 of 3

(FT.)	ELEV (FT)	PERUEABLITY INT EM/MC	**************************************	*00 %	JOINTS PER	ROCK TYPE	HEMARKS
360						Diorite	
380			20000		<b>7</b>		
400	1849						
420			30888		7		Joints, slicken-
440					7		sides. Fracture zone.
460	1806						Dike, mafic.
480					III)		
500	1764		23687				
520							
540			医基管整备 医医管医器	_88	7		Shear.  Alteration zone.
560	1722						A Witch action 2011e.
580			25828				Alteration zone.
600	1679						
620							Shear/alteration zone.
640				72			Shear.
660	1637						
680							
700	1594						

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO .: BH-6

SITE

Watana (North Bank)

SHEET NO. 1 OF 24

CONTRACTOR: The Drilling Company

DRILLING DATES: June 26 TO July 9, 1981

LOGGED BY K.J. White, M.P. Bruen DATE: July 1981

DRILLING METHOD:

ROCK

Casing Advancer

Diamond Core - Triple Tube CORE DIAMETER:

CASING DIAMETER NW (3.0") I.D. NQ (1.75") 0.D.

LOCATION

LATITUDE N3,22€,922 DEPARTURE E744,256

ELEVATIONS: DATUM

MSL, A.S.P.C., Zone 4 1608.8 GROUND SURFACE

AZIMUTH 225° 60°

1601.9 ROCK SURFACE BOTTOM OF HOLE 967.6

WATER TABLE

1461.8 (12-06-80)

NOTES 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR TEXTURE FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	RUN LENGTH	#EC
0.0	Overburden	Sandy gravel with cobbles and boulders.		
8.0	Diorita	TOP OF ROCK	Run 1	
(6.9) Diorite	Diorice	orite Gray-green, fine to medium grained crystalline rock, 30-40% mafics (biotite and hornblende), up to 10% quartz. Slightly weathered, hard, fresh. Joints moderately closely spaced with iron oxide staining.	8.0- to 10.7	74 (52)
-	8.0-10.7 - Cor in core parall	8.0-10.7 - Core loss 0.7 feet. Red staining in core parallel to some joints, penetrative to 0.5 inches.	10.7 to 15.0	88 (60)
17.5			Run 3 15.0 to	100 (35)
15.2)	Quartz Diorite	Green-gray to light gray, fine to medium grained rock. Mafics 20-30% (biotite and hornblende), 10-15% quartz, generally hard to	19.6	
17.3)		very hard, fresh. Gradational contact.	Run 4	83

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO . NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

Watana (North Bank) SITE

SHEET NO 2 OF 24

DEPTH	MOCK TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF AUN	4EC 14001
	Quartz Diorite	Joints are very close to moderately close, with iron oxide staining.  17.1-26.8 - Fracture zone, joints and fractures yery closely spaced, moderately to severely	Run 4 19.6 to 23.8	33
		weathered with penetrative iron oxide staining. Core loss 0.7 feet. 26.0-64.3 - Fresh to slightly weathered, with	Run 5 23.8 to 26.8	37 (1)
		more intense weathering on joints, iron oxide staining. Joints closely to moderately closely spaced.	Run 6 26.8 to	100 (€3)
30		26.8-30.0 - Core loss 0.5 feet.	30.3	
(26.0)		$29.7-30.3$ - Fracture zone, joints and fractures very closely spaced, joints at $0^\circ-10^\circ$ and $30^\circ-40^\circ$ , slightly weathered.	Run 7 30.3 to 32.8	10) (6))
			Run 8	
1			32.8 to 36.8	10( (7£)
			Run 9	
40		40.5-45.0 - Core loss 0.2 feet.	36.8 to 40.5	100
(34.6)			Hun 10 40.5 to 44.7	100
		45.6-46.5 - Core broken by drilling.		
		48.4-48.9 - Fracture zone, joints very closely	Run 11 44.7 to 49.1	91 (57)
1		spaced 0°-10°, 30°, and 50°-60°.	73.1	
50			Run 12	100
43.3)			Run 13	180
			Run 14	-

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-6

Watana (North Bank)

SHEET NO. 3 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	LENGTH OF RUN (FT)	9EC (900)
	Ouartz Diorite		Run 14 51.4- 55.5	100 (82)
			Run 15 55.5 to 59.3	100 (26)
60 (52.0)	į		Run 16 59.3 to 63.2	100 (77)
		$64.3\text{-}105.8$ - Joints are moderately close to closely spaced, at $10^\circ$ to $60^\circ$ , iron stained, some carbonate filled.	Run 17 63.2 to 66.5	97 (33)
		66.5-67.3 - Core loss 0.8 feet. Core broken by drilling.	Run 18	
70 -			Run 19 Run 20 67.7 to 70.4	100 (59)
(60.6)		71.3-73.1 - Shear/fracture zone, joints very closely spaced, at 30°-60°. Slightly to moderately weathered, very thin clay gouge, iron oxide staining.	Run 21 70.4 to 75.3	96 (41)
80 (69.3)			Run 22 75.3 to 80.3	100 (77)
			Run 23 80.3 to 84.2	100 (77)
1			Run 24	100(89

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

Watana (North Bank)

SHEET NO 4 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN	PEC (PGD)
	Quartz Diorite	89.3-94.6 - Core loss 0.3 feet.	Run 24 84.2 to 89.3	100 (89)
. 90 (77.9)			Run 25 89.3 to 94.6	94 (70)
		98.5-98.8 - Core loss 0.3 feet.	Run 26 94.6 to 98.5	97 (79)
100 -			Run 27 98.5- 100.3	83 (78)
(86.6)		101.9-102.3 - Core loss 0.4 feet. 102.7-106.3 - Penetrative iron oxide staining on joints up to 0.5 inches.	Run 29	100(75) 71(54) 100 (0)
2		105.45 - Joint, 45°, clay coating 0.1 inch. 105.8-106.3 - Fracture zone, joints very closely spaced at 10° and 70°, iron oxide staining, clay coating on surfaces for 0.2 feet.	Run 31 103.1 to 108.2	94 (61)
110 (95.3)		106.3-136.8 - Joints moderately closely spaced, generally fresh, minor iron oxide staining.	Run 32 108.2 to 111.7	100 (94)
-		112.7-122.1 - Core loss 0.4 feet.	Run 33 Run 34 112.2 to 116.2	100(90) 100 (94)
15			Run 35	100(84

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 5 OF 24

DEPTH	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEWENTING, ETC	LENGTH OF RUN (FT)	#£0 (#00)
120 (103.9)	Quartz Diorite		Run 35 116.2 to 121.1	100 (84)
-		122.5-123.6 - Penetrative iron oxide staining on joints to 0.5 inches.	Run 36 121.1 to 126.2	100 (82)
			Run 37	100 (89)
130 _ (112.6)		129.6-130.6 - Felsic dike, light gray, fine grained quartz phenocrysts, less than 5% mafics. Fresh, unfractured, tight contacts, at 20°. Iron oxide stained joints, penetrative to 0.5 inches.		100 (91)
3		131.0-131.1 - Felsic dike as above, $20^\circ$ , unfractured, tight. 131.8-132.5 - Joints, $40^\circ$ , with iron oxide staining.	Run 39 131.1 to 136.2	100 (83)
140		136.8-155.1 - Alteration along joints penetrating slightly, average C.06 inches up up to 0.1 feet. Joints are closely spaced, at 20° to 50°, with iron oxide staining and carbonate filling.	Run 40 136.2 to 140.6	100 (66)
(121.2)			Run 41 140.6 to 145.6	76 (100)
		Run 42 145.6 to 150.6	100 (82)	

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENS ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 6 OF 24

DEPTH (FT)	ROCK TYPE	UESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF RUN (FT)	HEC (HOD)
150	Quartz Diorite		Run 42	100 (82)
		154.2-155.1 - Fracture zone, joints very closely spaced, at 20° to 50°, iron and carbonate staining.	Run 43 150.6 to 155.6	100 (46)
160 138.6)		155.1-168.2 - Joints very closely to closely spaced, carbonate coated, iron oxide staining.	Run 44 155.6 to 160.6	106 (72)
		162.4-163.3 - Fracture/alteration zone, altered hydrothermally, numerous healed fractures. Joints and fractures are very closely spaced, 10° to 60°, some iron oxide staining and carbonate filling.	Run 45 160.6 to 165.7	100 (71)
170		165.6-175.2 - Core loss 0.3 feet.  168.2-186.8 - Shear/alteration zone, core bleached to light gray, severely altered hydro- thermally. Soft, friable with numerous re- healed fractures. Joints are close to	Run 46 165.7 to 170.0	100 (47)
(147.2)		moderately close. Contains chalky white diorite with feldspars breaking down into clay minerals, carbonate present.  176.3-177.2 - Shear zone, joints at 20°-60°, soft and friable.  178.2-179.8 - Shear zone, joints at 20°-	Run 47 170.0 to 175.2	94 (19)
		60°, 0.4 feet of clay, soft and friable.	Run 48 175.2 to 179.8	91 (10)
180 (155.9)			Run 49	100(59

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 7 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	99°C (900)
	Quartz Diorite		Run 49 179.8 to 184.9	100 (59)
		186.8-221.1 - Joints closely spaced, most carbonate coated.	Run 50 184.9 to 190.0	100 (82)
190 164.5)			Run 51 190.0 to 195.1	98 (86)
			Run 52 195.1 to 200.2	100 (82)
200 173.2)			Run 53 200.2 to 205.1	100 (45)
	-	Below 208.0, texture fine to medium grained.	Run 54 205.1 to 210.0	98 (95)
210 (181.9)		210.0-215.0 - Core loss 0.3 feet. 210.0-245.0 - Inclusions of fine grained mafic rock, joints very close to widely spaced, up to 2.0 inches.	Run 55	

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 8 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#20)
	Quartz Diorite	215.4-215.7 - Highly fractured and moderately weathered.	Run 55 210.0- 215.0	97 (86)
			Run 56 215.0 to 220.0	96 (72)
220 190.5)		221.1 - Joints moderately close to widely spaced, most carbonate coated, occasional trace of iron oxide staining.	Run 57 220.0 to 225.2	100 (96)
230			Run 58 225.2 to 230.4	100 (85)
199.2)			Run 59 230.4 to 235.4	100 (84)
			Run 60 235.4 to 240.3	100
240 (207.8)			Run 61 240.3 to 245.5	96 (90)

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project HOLE NO BH-6

SITE Watana (North Bank) SHEET NO 9 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	LENGTH OF RUN (FT)	PEC [#25]
	Quartz Diorite		Run 62 245.5 to 249.7	100 (93)
250 (216.5)			Run 63 249.7 to 255.0	100 (79)
		255.2-256.8 - Shear/alteration zone, slightly to moderately altered hydrothermally along joints, small light gray breccia and gouge zone. Numerous rehealed joints, chalky-wnite diorite, feldspars beginning to decompose.  256.0-256.6 - Shear, 30°, joints very closely spaced, clay, carbonate, and	Run 64 255.0 to 260.1	100 (86)
. 260 (225.2)		breccia filling.	Run 65 260.1 to 265.1	100 (100)
		266.5-280.6 - Irregular discontinuous patches of red staining.	Run 66 265.1 to 270.2	100 (82)
270 _ 233.8)		272.6-273.8 - Shear/alteration zone, slightly altered hydrothermally, friable, with a breccia-gouge 0.1 feet thick, closely spaced	Run 67 270.2 to 275.4	100 (56)
		joints.	Run 68	100

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 10 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF BUN (FT)	(#EC (#25)
280	Quartz Diorite	273.4-273.5 - Breccia and clay gouge, 60°, soft and friable, carbonate filling. 273.8-315.0 - Joints moderately closely spaced with minor carbonate coating.	Run 68 275.4 to 280.3	100 (92)
242.5)			Run 69	100
		284.6-290.6 - Core loss 0.2 feet.	Run 70 281.6 to 284.6	100
24			Run 71 284.6- 286.6	100 (100)
			Run 72	
290			286.6 to 290.5	100 (100)
-			Run 73 290.5 to 295.7	100 (92)
300			Run 74 295.7 to 300.7	100 (86)
(259.8)			Run 75 300.7 to 305.0	100
			Run 76 305.0 to 310.2	99 (98)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 11 OF 24

DEPTH (FT)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CF RUN (FT)	#65 (400)
310 _	Ouartz Diorite		Run 76	99 (98)
200.57			Run 77	
			310.2 to 315.4	99 (83)
			Run 78	
			315.4	99
320 277.1)		318.8-319.7 - Shear/alteration zone, bleached light gray, slightly to moderately altered hydrothermally. Friable, feldspars altering to clay, iron oxide staining on joints and fractures.	320.6	(88)
		319.2 - Shear, 30°, 0.13 inch breccia and gouge, carbonate filling.	Run 79 320.6	100
		320.6-325.6 - Core loss 0.2 feet.	325.6	(100)
		321.2-321.9 - Fracture zone, 0°-20°, joints very closely spaced, iron oxide staining and carbonate filling.	323.0	
		322.5-325.6 - Fracture/alteration zone,	Run 80	72 (48)
		slightly to moderately altered hydrothermally, healed joints very close to closely spaced. Carbonate and clay filling in joints from altered feldspars, moderately hard.	325.6 to 330.2	
285.8)		323.8 - Joint, 30°, slickensides, clay and carbonate filling, minor iron oxide staining.	Run 81 330.2	20
		324.4 - Carbonate vein, 40°, 0.5 inches wide, offset 0.5 inches along healed shear at 10°, tight.	332.7	(0)
		328.2-332.7 - Fracture zone, joints very closely spaced, soft and friable. Core loss 3.3 feet.	332.7 to 337.9	96 (65)
			Run 83 337.9	100
340 . 294.4)			to 342.9	(100)

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 12 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	950
	Quartz Diorite	339.0-345.0 - Alteration zone, bleached light gray, slightly altered hydrothermally, feld-spars beginning to alter to clay. Joints very	Run 83	100 (100)
		close to closely spaced at 30°, generally healed and tight with carbonate filling and iron oxide staining, hard to moderately hard.	Run 84 342.9	98
		343.0 - Core loss 0.2 feet.	to 348.8	(92)
		345.0 - Joints close to moderately closely spaced.		
350			Run 85	
(303.1)			348.8	100
			353.8	(100)
			Run 86	
			353.8	100
		357.9-358.6 - Fracture zone, joints very closely spaced at 10°-20°, 30°, and 50°.	358.9	(70)
360		360.1 - Joint, 50°, highly altered hydro-	Run 87	
(311.8)		thermally, carbonate filling.	358.9 to	100
		360.1-361.4 - Fracture/alteration zone, slightly altered hydrothermally, joints very closely spaced (scalloped). Moderately hard	363.1	
		to soft, friable.	Run 88	
			363.1	100
			368.2	(75)
		368.2-373.2 - Core loss 0.2 feet.		
Locality			Run 89	
370 (320.4)			368.2 to 373.2	100

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 13 OF 24

DEPTH (FT)	ROCK TYPE	<u>DESCRIPTION</u> , COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	HEC (HQD)
	Quartz Diorite	374.1-374.7 - Fracture zone, 20-30°, joints very closely spaced, carbonate filling and some iron oxide staining.  377.2 - Joint, 40°, surface severely altered hydrothermally to 0.13 inches.	Run 90 373.2 to 378.4	96 (77)
380 329.1)		380.2-382.2 - Snear/alteration zone, slightly to moderately altered hydrothermally, joints close to very closely spaced. Numerous rehealed fractures, feldspars decomposing to clay, soft and friable.	Run 91 378.4 to 383.7	100 (72)
		381.5-382.2 - Shear zone, 40-50°, joints very closely spaced, clay gouge, breccia. 383.3-388.3 - Core loss 0.1 feet.	Run 92	100
		382.2-477.5 - Joints closely to moderately closely spaced.	383.7 to 388.6	100 (98)
390 337.7)			Run 93 388.6 to 393.3	100
		397.8-398.1 - Fracture zone, joints very closely spaced, at 60° to 80°, minor	Run 94 393.3 to 398.3	100 (86)
400 (346.4)		carbonate coating. 399.5-400.9 - Red staining, irregular and discontinuous.	Run 95 398.3- 400.6	100 (76)
		402.0 - Felsic dike, granodiorite composition, 0.1 feet thick	Run 96 400.6 to 403.4	100 (95)
			Run 97	100 (98)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 14 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(HQ3)
	Quartz Diorite		Run 97	100
. 410 (355.1)			Run 98 406.2 to 410.9	100 (98)
		412.0 - Inclusions of fine grained diorite, 0.2 feet in diameter, sharp contacts, irregular shape.	Run 99 410.9 to 416.0	100 (100)
420			Run 100 416.0 to 420.8	100
(363.7)		421.8 - Inclusion of fine grained diorite, 0.2 feet in diameter.	Run 101 420.8 to 426.0	99 (94)
430			Run 102 426.0 to 430.5	100 (97)
(372.4)			Run 103 430.5 to 435.6	100 (100)
			Run 104	100

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 15 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF HUN (FT)	9EC (993)
440	Ouartz Diorite		Run 104 435.6 to 440.4	100 (98)
381.1)			Run 105 440.4 to 445.6	100 (94)
450	.7)		Run 106 445.6 to 450.6	100 (90)
389.7)		454.6-455.1 - Fracture zone, joints very closely spaced, at 20°-30° and 40°-70°, carbonate coating.	Run 107 450.6 to 455.8	96 (79)
		carbanace coachig.	Run 108 455.8- 458.2	88 (88)
460 398.4)			Run 109 458.2 to 463.2	100 (78)
4			Run 110	43(0
			Run 111 463.9 to 468.4	100 (88)
			Run 112	95(83

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE W

Watana (North Bank)

SHEET NO 16 OF 24

DEPTH 1/73	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF HUN (FT)	REC (RQD)
470 407.0)	Quartz Diorite	472.7-473.3 - Core badly broken by drilling.	Run 112 468.4 to 473.3	95 (83)
		477.5-477.9 - Fracture zone, joints very closely spaced, at 60°-80°, chlorite coating.	Run 113 473.3 to 477.8	100 (92)
480		closely spaced, at 60 -00 , thierite coating.	Run 114 477.8 to 480.3	92 (72)
415.7)		481.9-482.6 - Fracture zone, joints very closely spaced at 40°-60°.  485.3-490.5 - Core barrel mislatched during	Run 115 480.3 to 485.3	94 (65)
490		drilling. Core loss 2.0 feet.	Run 116 485.3 to 490.5	61 (0)
424.4)			Run 117 490.5 to 495.5	99 (95)
			Run 118 495.5 to 500.5	98 (77)
500 433.0)			Run 119	95(91

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 17 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT.)	MEC (RQD)
	Quartz Diorite	505.7 - Healed shear, 40°, 0.5 inches wide, healed with dark green, fine grained diorite,	Run 119 500.5 to 505.6	95 (91)
		tight, hard.	Run 120 505.6 to 510.6	
(441.7)			Run 121 510.6 to 515.6	99 (92)
- 520		516.2-516.8 - Core badly broken by drilling. 517.7 - Carbonate vein, 0.25 inches wide, irregular and discontinuous. 519.3 - Two joints very closely spaced, at 40°, healed with carbonate.	Run 122 515.6 to 520.7	98 (66)
(450.3)			Run 123 520.7 to 525.6	100 (67)
530		529.5-529.9 - Fracture zone, joints very closely spaced at 40°, 0.5 inches spacing, carbonate filling and chlorite staining.	Run 124 525.6 to 530.4	100 (74)
(459.0)			Run 125 Run 126 Run 127	93 100 (0 100 (52

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 18 OF 24

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, POLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (HQD)
	Quartz Diorite	530.5-533.0 - Shear/alteration zone, moderately to severely altered hydrothermally, moderately hard. Feldspars altered to clay.	532.0- 534.5	100 (52)
		530.5-531.8 - Fracture, joints very closel, spaced, carbonate filling. 531.8-532.8 - Anproximately 1.0 foot of light gray clay gouge and breccia. 533.5-547.5 - Core loss 1.2 feet.	Run 128 534.5 to 539.5	100 (90)
540 (67.7)		541.3-541.7 - Fracture zones, joints very closely spaced, at 50° and 40°, carbonate filling and iron oxide staining.	Run 129 539.5 to 544.6	100 (73)
550 476.3)			Run 130 544.6 to 547.5	79 (55)
			Run 131 547.5 to 550.4	100 (76)
			Run 132 550.4 to 555.4	94 (79)
560 -485.0)	$\mbox{\sc u59.6-561.1}$ - Numerous healed joints, $60^{\circ}$ , carbonate filled.	Run 133 555.4 to 560.7	100 (83)	
	560.8-561.5 - Shear, breccia healed with carbonate, chlorite, and quartz.	Run 134 560.7 to 565.7	100 (100)	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 19 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	LENGTH OF AUN (FT)	46C 400)
. 570 -	Quartz Diorite	564.6-576.7 - Shear/alteration zone, light gray, slightly to moderately altered hydrothermally. Joints close to very closely spaced, generally 20°-80°, numerous healed fractures. Feldspars decomposing to clay, carbonate filling and iron oxide staining. Soft, friable in places. Core loss 0.8 feet. 569.0 - Shear, 60°, very thin clay gouge.	Run 134 Run 135 565.7 to 570.7	90 (7)
		571.9-572.7 - Breccia and clay gouge, white to light gray, 20° and 50°, soft, friable.	Run 136 570.7 to 575.9	94 (83)
580 -		579.5-580.7 - Fracture/alteration zone, slightly altered hydrothermally, joints very closely spaced, numerous healed fractures.	Run 137 575.9 to 580.7	98 (£1)
-		581.1-604.3 - Joints closely spaced, some carbonate filling and iron oxide staining. 583.4-583.7 - Core broken by drilling.	Run 138 580.7 to 585.8	100 (54)
590 _ (511.0)		590.8-592.8 - Core barrel mislatched during	Run 139 585.8 to 590.8	100 (51)
311.0)		drilling. Core loss 0.6 feet.	Run 140 590.8- 592.8 Run 141 592.8 to 597.8	70 (0) 99 (82)

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.03

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 20 OF 21

DEPTH	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	HEC
	Quartz Diorite		Run 141	99(82)
. 600 (519.6)		602.1-602.6 - Core broken by drilling.	Run 142 597.8 to 602.6	10ri (4::)
		607.7-€07.9 - Core broken by drilling.	Run 143 602.6 TO 608.3	10) (61)
610 (528.3)		611.3-612.4 - Felsic dike, light gray, fine	Run 144 608.3 to 611.8	10) (81)
		grained, fresh, 6.0 inches thick. Lower and upper contacts at 10°, tight.	Run 145 611.8 to 615.4	7£ (64)
			Run 146 615.4 to 620.3	100 (96
. 620 . (536.9)			Run 147 620.3 to 625.2	100 (94)
		626.1-627.2 - Felsic dike as above, light gray, fine grained, 20-30% quartz, 5-10% mafics, interfingering or containing clasts of the quartz diorite. Unfractured, contacts tight and melted, upper at 70°, lower at 40°.	Run 148 625.2 to 630.2	92 (79)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 21 OF 24

DEPTH (F1:)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF HUN (FT)	46C (HQD)
630 (545.6)	Quartz Diorite	Core loss 0.4 feet.	Run 148 Run 149	92 (79) 88 (72)
			Run 150 631.8 to 636.7	100 (80)
640			Run 151 636.7 to 640.5	100 (100)
(554.3)			Run 152 640.5 to 645.6	98 (85)
649.7 562.7)		648.7-649.7 - High concentration of biotite.	Run 153 645.6 to 650.5	99 (88)
650 - 562.9)	Granodiorite	Light gray-white, generally fine to medium grained crystalline rock, 60-80% feldspars, 10-20% mafics (biotite), 10-20% quartz. Generally hard and fresh, some feldspars stained brown. Upper contact is gradational over 0.1 feet, feldspars slightly altered, tight.	Run 154 650.5 to 655.8	98 (88)
-		656.0-670.0 - Numerous healed joints, calcite filling.	Run 155 655.8 to 660.6	96 (50)
660 - (571.6)			Run 156	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 22 OF 24

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF MUN (FT)	HEE (MQ(0))
	Granodiorite		Run 156 660.6 to 665.7	100 (74)
670 580.2)			Run 157 665.7 to 670.8	97 (90)
300.27		674.4-674.7 - Core broken by drilling.	Run 158 670.8 to 676.0	100 (58)
680			Run 159 676.0 to 680.6	97 (93)
588.9)			Run 160 680.6 to 685.4	98 (90)
			Run 161 685.4- 687.9	76 (72)
690 597.6)			Run 162 687.9 to 692.5	100 (91)
			Run 163	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO 23 OF 24

DEPTH LFT1	POCK TYPE	DESCRIPTION COLOR, TEXTUPE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEWENTING, ETC.	LENGTH OF RUN (FT)	#(c (920)
	Granodiorite		Run 163 692.5 to 697.5	100 (80)
700 (606.2)			Run 164 697.5 to 702.7	100 (83)
		703.5-706.0 - Fracture/alteration zone, slightly altered hydrothermally, joints close to very closely spaced, at 40°-60°, feldspars altering to clay, carbonate filling present.	Run 165 702.7 to 707.2	100 (44)
710 (614.9)			Run 166 707.2 to 712.2	100 (78)
			Run 167 712.2 to 717.1	100 (88)
720 - (€23.5)			Run 168 717.1 to 722.2	100 (92)
		722.0-727.1 - Core loss 0.1 feet.	Run 169 722.2 to 727.3	99 (69)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-6

SITE Watana (North Bank)

SHEET NO. 24 OF 24

DEPTH (FT)	MOCK TYPE	OSSER FROM COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF PUN (FT)	#£0
	Granodiorite	725.7-726.3 - Numerous healed joints very closely spaced, 20°-40°, faint slickensides, calcite filling.	Run 169	99 (69)
730			Run 170 727.3 to 730.5	100 (84)
632.2)			Run 171 730.5 to 735.3	100
640.9)			Run 172 735.3 to 740.4	93 (73)
740.4 641.2)		END OF BORING		
750 . 649.5)				

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY P5700.05 Client Job No. Project Susitna Hydroelectric Project Hole No. BH-6 Watana (North Bank) Site Sheet No. \_1\_ of \_3 COME MECOVERY NUMBER OF JOINTS PER JOST PERMEABILITY DEPTH ELEV HOCK TYPE -TOP OF ROCK 8.0" Cverburden Diorite 20 Fracture zone. Quartz Diorite 40 156€ 60 ⇒ Shear/fracture zone 80 100 1522 Fracture. 120 140 Alteration zone. 1479 160 Shear/alteration 180 zone. 200 1436 220 240 1392 Shear. 260 Shear. 280 300 320 Shear. Fracture zone. 340 Alteration zone.

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Client Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. BH-6 Watana (North Bank) Site Sheet No. 2 of 3 PERMEABUTY REMARKS Quartz 360 Diorite 380 Shear. 400 1263 420 440 460 480 500 1176 Shear, healed. 520 Shear/alteration 540 zone. 1133 560 Shear/alteration zone. 580 600 1089 Dike, felsic. 620 Dike, felsic. 640 Granodiorite 660 €80

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Hole No. BH-6 Susitna Hydroelectric Project Project Sheet No. 3 of 3 Watana (North Bank) Site PERMEABILITY CORE RECOVERS DEFTH ELEV HOCK TYPE -720 740 968 END OF BORING 740.4"

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO. : BH-8

SITE

Watana (South Bank)

SHEET NO. 1 OF 24

CONTRACTOR: The Drilling Company

LOGGED BY: K.J. White, M.P. Bruen

DRILLING DATES: July 29 to August 9, 1980 DATE: July 1980

DRILLING METHOD

SOIL ROCK

Casing Advancer

CASING DIAMETER NW (3.0") I.D. Diamond Core - Triple Tube CORE DIAMETER: NO (1.75") O.D.

LOCATION

LATITUDE N3.225.586

ELEVATIONS: DATUM

MSL, A.S.P.C., Zone 4

DEPARTURE E744,482 AZIMUTH 060°

1979.7 GROUND SURFACE ROCK SURFACE

1972.8 BOTTOM OF HOLE 1328.1

1963.7 WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	RUN LENGTH	REC (RGD)
0.0	Overburden			
8.0 (6.9)	Andesite Porphyry	Light gray to greenish gray, aphanitic ground- mass with white, feldspar phenocrysts to 0.1 inch and 5-10% angular inclusions of argillite to 0.5 inch. Slightly weathered and hard. Flow structures visible.	No Core	
		Joints very close to close spaced with planar to irregular, rough surfaces. Penetrative iron oxide staining up to 0.5 inch, minor carbonate filling. 8.0-13.8 - No core taken.	Run 1	
1		13.8-18.3 - Moderately weathered. Joints very close spaced with traces of sand and silt. Core loss 1.5 feet.	13.8 to 18.0	64
20 (17.3)			Run 2 18.0 to 23.8	90 (26)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

Watana (South Bank)

SHEET NO 2 OF 24

DEPTH (FT)	ROCK TYPE	<u>QESCRIPTION</u> : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF MUN	#EC (PQ0)
	Andesite Porphyry	18.3-34.1 - Slightly to moderately weathered. Joints very close to close spaced. Core loss 1.2 feet.	Run 2 18.0 to 23.8	90 (20)
			Run 3 23.8 to 28.8	92 (58)
30 (26.0)		33.8-38.8 - Core loss 1.1 feet.	Run 4 28.8 to 33.8	100 (35)
		34.1-49.6 Fresh to slightly weathered. Joints very close to close spaced with nonpenetrative iron oxide staining.	Run 5 33.8 to 38.8	79 (56)
40 (34.6)		44.3-49.6 - Fracture zone, joints very close spaced.  46.0-47.1 - Subrounded to subangular inclusions of argillite, quartz, diorite, and volcanics up to 2 inches, andesite matrix.	Run 6 38.8 to 43.9	98 (77)
		47.1-49.6 - Moderately to severely weathered. Silty to sandy clay with 20-30% subangular to subrounded, coarse sand. Core loss 1.1 feet. Drilling water return 50%.	Run 7 43.9- 45.6	100
49.6			Run 8 45.6 to 49.6	73 (26)
43.0) 50 43.3)	Diorite to Quartz Diorite	Light gray to greenish gray, fine to medium grained, nonfoliated crystalline rock. 50-80% felispar, 20-40% mafics (biotite and hornblende), 0-15% quartz and trace carbonate.	Run 9 49.6- 52.5	72 (0)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 3 OF 24

DEPTH (FT)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	HEC (RQD)
	Diorite to Quartz Diorite	Fresh and very hard to hard. Joints close spaced, planar to rough. Carbonate coating on most surfaces. 49.6-53.4 - Fracture/alteration zone, hydro-	Run 10 52.5 to 56.5	91 (11)
-		thermally altered, joints very closely spaced. 50.1-52.9 - Two alteration zones, severely hydrothermally altered. 1 inch wide, 30°, soft and friable.	Run 11 56.5 to 59.5	100
60 52.0)		53.4-61.4 - Joints closely spaced, iron oxide stained. 60.3-61.4 - Healed shear, diorite breccia in dark gray, fine grained diorite matrix. Hard and tight. Carbonate stringers.	Run 12 59.5 to 63.6	85 (67)
		61.4 - Contact resheared, 30°, 0.1 inch clay gouge. 61.4-64.5 - Alteration zone, moderately hydrothermally altered. Joints very close to close spaced.	Run 13 63.6 to 68.0	100 (69)
70 (60.6)	62.2,52.9,64.4 - Severely hydrothermally altered zones, 1.0-2.0 inches wide, at 50-70°. soft and friable. 64.5-75.0 - Joints very close to close, surfaces fresh. 65.0-66.0 - Three healed shears up to 1 inch wide, at 50°. Healed with dark green, fine	Run 14 68.0 to 73.0	100 (87)	
		grained diorite. Hard and tight. 75.0-78.8 - Fracture zone, joints very close to close spaced, open at 10-30°, 90°, and 0°. Some treated with carbonate, minor iron oxide staining and chlorite.	Run 15 73.0 to 77.7	100 (48)
		78.8-91.6 - Joints close spaced. Iron oxide staining, some carbonate filling. Slickensides on some surfaces. 82.0-85.4 - Fracture zone, joints very close spaced at 80-90°, 50-60°, and 20-30°. Minor iron oxide staining, carbonate and chlorite.	77.7 to 80.7 Run 17	100 (25)
		83.5 - Slickensides on carbonate staining.	80.7 to 84.0	97 (55)
1			Run 18	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALD, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 4 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	MEC (ADD)
90 (77.9)	Diorite to Quartz Diorite	88.4-91.6 - Fracture zone, joints very closely spaced at 0-30°. Iron oxide staining, some carbonate filling. 91.6-96.6 - Core loss 0.6 feet.	Run 18 84.0 to 39.3 Run 19 89.3- 91.6	98 (63)
			Run 20 91.6 to 96.6	88 (57)
100 (86.6)		100.0-141.0 - Joints closely spaced, planar, rough. Iron oxide staining and carbonate coating.	Run 21 96.6 to 101.0	100 (91)
		105.2-111.4 - Healed shears, 1-2 feet spacing up to 0.1 feet wide. Healed with dark green, fine grained diorite. Tight, hard.	Run 22 101.0 to 106.2	100 (83)
110 (95.3)		Time grained divirtes. Fight, hard.	Run 23 106.2 to 111.0	100 (94)
			Run 24 111.0 to 116.1	100 (92)
+		116.1-121.1 - Core loss 0.3 feet.	Run 25	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 5 OF 24

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	PEC (AGD)
120 (103.9)	Diorite to Quartz Diorite		Run 25 116.1 to 121.1	95 (80)
			Run 26 121.1 to 126.1	100 (7€)
130 (112.6)			Run 27 126.1 to 131.1	100 (98)
			Run 28 131.1 to 135.6	100 (88)
140 (121.2)		140.8-142.9 - Core loss 0.5 feet. 141.0-190.0 - Joints closely spaced, planar, rough. Carbonate or chlorite filling.	Run 29 135.6 to 140.8 Run 30 140.8- 143.9	100 (82) 79 (26)
		145.0-147.1 - Shear/fracture zone, joints very close, 40-90°. Chlorite filling. 146.0-146.3 - Slickensides on chlorite surface. Joints tight. Fresh and hard.	Run 31 142.9 to 148.0 Run 32	100 (70)

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PROJECT Susitna Hydroelectric Project

OLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 6 OF 24

DEPTH (FT)	MOCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF RUN (FT)	HEC (900)
150 (129.9)	Diorite to Quartz Diorite	148.9-149.3 - Diorite dike, dark green, fine grained. Tight irregular contacts at 30°, hard. 152.6-167.5 - Core loss 0.7 feet.	Run 32 148.0 to 152.6	100 (96)
			Run 33 152.6 to 157.7	100 (89)
160 (138.6)			Run 34 157.7 to 162.7	96 (85)
			Run 35 162.7 to 167.5	90 (79)
170 (147.2)		171.5-173.0 - Shear/alteration zone, hydro- thermally altered, bleached white, medium hard	Run 36 167.5 to 171.9	99 (86)
		to soft and friable, joints very close, some tight and healed with chlorite. Clay gouge less than 3 inches. Angular fragments 0.5-1.0 inches. Resheared healed shear, core loss 0.7 feet.  176.5-182.7 - Septiming intergranular.	Run 37 171.9 to 176.5	85 (39)
18C .		rregular, discontinuous.  180.7-181.0 - Possible fracture zone, core broken into fragments less than 1 inch, some fragments of healed breccia core loss 0.5 feet.	Run 38 176.5 to 181.0	90 (80)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

Watana (South Bank)

SHEET NO. 7 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTIN ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	MEC (MGG)
	Diorite to Quartz Diorite		Run 39	100
		1	to 185.9	(97)
1			Run 40	
-		189.2-189.4 - Possible fracture zone, slightly to moderately hydrothermally altered, fragments	185.9- 189.2	88 (73)
190 (164.5)		less than 1 inch, some healed breccia. Core loss 0.4 feet.	Run 41	
		190.0-230.0 - Joints moderately close spaced, plane, rough, carbonate coated.	189.2 to 194.2	100 (98)
			Run 42	
			194.2 to 199.2	100
200 - (173.2)		199.0-201.8 - Red staining, discontinuous. 200.5 - Healed shear, 40°, 1 inch wide, healed with dark green diorite. Tight, hard, competent.	Run 43 199.2- 201:0	[98]
			Run 44	
		206.8-207.9 - Fracture/alteration zone.	201.0 to 206.4	100
		hydrothermally altered, joints very close at 30°, healed with carbonate, iron oxide staining, patches of rock bleached white, tight, hard.	Run 45	87
210 - (181.9)		210.9 - Healed shear, 0.5 inch wide, carbonate filling at contact, tight, hard, healed with dark green diorite.	to 211.0	(76)
		211.0-215.1 - Core loss 0.6 feet.	Run 46	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

Watana (South Bank) SITE

SHEET NO 8 OF 24

DEPTH (F1)	ROCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	96C (990)
	Diorite to Quartz Diorite		Run 46 211.0- 215.1	100 (68)
			Run 47 215.1 to 219.3	100 (88)
220 - (190.5)		221.2-222.2 - Fracture/alteration zone, hydro- thermally altered, bleached white, joints very	Run 48 219.3- 221.2 Run 49	100 (100)
		close at 30-40°. Iron oxide staining, slightly altered, hard.  224.1-228.1 - Red staining, irregular, discontinuous.	221.2 to 225.4	100 (86)
		225.4-230.6 - Core loss 0.2 feet.	Run 50	
230		230.0-290.0 - Joints moderately close, plane,	225.4 to 230.6	96 (71)
199.2)		rough, carbonate coated. 230.6-231.8 - Joint, tight, red stairing penetrating 0.5 inches on each side.	Run 51	
			230.6 to 235.6	96 (94)
240		238.7, 239.2, 246.2 - Healed shears, 20-70°, less than 1 inch wide, healed with dark green, fine grained diorite, tight, hard.	Run 52 235.6 to 240.9	98 (89)
201.0			Run 53 240.9 to 245.6	100

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HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 9 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, CONTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(400)
	Diorite to Quartz Diorite	246.8-247.2 - Alteration zone, slightly to moderately altered hydrothermally, feldspars altering to clay, mafics completely altered, bleached white. Joints at 50° with iron oxide and carbonate, hard to moderately hard.	Run 54 245.6	98
250 (216.5)		250.0-251.8 - Possible shear/alteration zone, bleached light gray, slightly to moderately hydrothermally altered, hard to moderately hard. Joints wery close at 50°, most tight	251.0	98 (81)
		but some opened by drilling, carbonate filling and iron oxide staining. Some clay on joints from altered feldspars.	Run 55	100
		251.8-324.5 - Joints close to moderately close except where noted.	to 255.2	(57)
		254.8-258.8 - Red staining, irregular, discontinuous.	Run 56	
260			255.2 to 260.1	100 (76)
(225.2)	P 3	261.6-262.2 - Healed shear, 10-20°, healed with dark green diorite, tight.	Run 57	
			260.1 to 265.1	98 (70)
	E Roya		Run 58	
			265.1 to 270.1	100
270 (233.8) 271.5		6 V	Run 59	
(235.1)	Quartz Diorite to Gradodiorite	Light gray, medium grained, non-foliated, crystalline with 15-30% mafics (biotite and hornblende), 10-15% quartz, up to 10% pink feldspar. Gradations to granodiorite. Contains inclusions of fine grained diorite, trace of perite and carbonate. Generally very hard to hard, fresh and competent.	270.1 to 275.3	100 (77

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SITE Watana (South Bank)

SHEET NO 10 OF 24

DEPTH DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING. PEC MOCK TYPE ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC Quartz Diorite Joints moderately close to close, planar, Run 60 to Granodiorite smooth to rough, mostly carbonate coated. 275.3 100 to (100)280 3 280 280.7-281.0 - Dike/possible inclusion of (242.5) granodiorite, fine grained groundmass of orthoclase feldspar and quartz, medium grained Run 61 plagioclase feldspar phenocrysts, tight 280 3 (98)contacts, hard. to 284 4 Run 62 284 4 (85)to 287.8-291.0 - Core barrel mislatch during 287.8 drilling. Core loss 1.0 feet. Run 63 287.3-70 290.0-330.0 - Joints moderately close, planar, 290 291.0 (25) rough, few with carbonate coating. (251.1) Run 54 291.) 100 294.6-295.9 - Core badly broken during (75)to drilling. 296. Run 15 296. (89) to 300.8-302.5 - Healed shear zone, 50-70°, very 3.00.8 300 close shears healed with dark green quartz (259.8) diorite, tight, hard, competent. Run 66 300.8-303.7 (95) Run 67 306.5-308.5 - Core broken during drilling, 303.7 100 (76)fresh angular pieces. to 308.8

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 11 OF 24

	MOCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN	14201
330	rtz Diorite Granodiorite		Run 68 308.8 to 313.2	100 (93)
330			Run 69 313.2 to 318.2	100 (98)
			Run 70 318.3 to 321.5	94 (84)
		324.6-333.1 - Felsic, possible aplite dikes, light pinkish gray, 3 and 2 inches wide at 30° and 20°, respectively. Unfractured, hard.	Run /1 321.5 to 326.9	100 (94)
		330.0-346.3 - Joints close to very close, planar, smooth to rough. Carbonate coated	Run 72 326.9 to 330.8	97 (97)
		with zones of iron oxide staining.	Run 73 330.8 to 335.8	100 (96)
339.3 (293.8)	wite/Diorite	Dark greenish gray, fine grained crystalline	Run 74 335.8 to 340.1	100 (90)

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PROJECT Susitna Hydroelectric Project

SITE Watana (South Bank)

SHEET NO 12 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(#20) #EC
	Diorite/ Diorite Porphyry	phenocrysts, fresh, hard. Joints coated with chlorite and carbonate.	Run 75 340.1- 343.2	97 (76)
347.2- (300.7)	Quartz Diorite	346.3-351.9 - Joints close to moderately close, carbonate coating and filling. Rock description, as above.	Run 76 343.2 to 348.4	100 (100)
350 (303.1)		351.9-437.5 - Joints close to very close, planar, smooth to rough, carbonate coated, zones of iron oxide staining.	Run 77 348.4 to 351.8	10G (68)
		zures of from saide statining.	Run 78 351.8 to 356.8	100 (100)
360 <u>-</u> (311.8)		360.9-361.1 - Diorite porphyry inclusion.	Run 79 356.8 to 360.9	100 (90)
-			Run 30 360.9 to 364.2 Run 81	100 (62)
			Kun 81	(69)
366.3- (317.2)	Diorite Porphyry	Dark greenish gray, fine grained crystalline matrix with medium to coarse grained plagioclase phenocrysts, 40-50% mafics, fresh, hard.  369.5 - Felsic dike, light gray, 1.5 inches	Run 82 365.5 to 370.5	100 (82)
(320.4)		wide, 30°, fractured along trend, tight contacts.	Run 83 370.5 to 375.8	189

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 13 OF 24

DEPTH (FT)	ROCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF RUN	HEC (HQD
	Diorite Porphyry		Run 83 370.5 to 375.8	100
377.0 (326.5) 380 (329.1)	Quartz Diorite	Rock description, as above.  378.3 - Felsic dike, possibly aplite, light gray, unfractured, 0.5 inches wide, 40°, tight.	Run 84 375.8 to 380.7	100 (86)
(329.1)			Run 85 380.7 to 384.3	89 (56
		385.1-387.0 - Shear/alteration zone slightly to moderately altered hydrothermally, soft and friable. Iron oxide staining and carbonate filling on joints. Silty sand gouge. Core loss 0.4 feet.  385.1-400.5 - Iron oxide staining on most joints.	Run 86 384.3 to 389.3	98 (36
390 - (337.7)			Run 87 389.3 to 393.7	98 (67
			Run 88 393.7 to 398.0	100
400 (346.4)		403.5-413.1 - Core loss 0.8 feet.	Run 89 398.0 to 403.5	100 (93
-			Run 90	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 14 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	GF RUN (FT)	REC (RQD)
	Quartz Diorite	405.3-410.9 - Fracture/alteration zone, yellowish gray, slightly hydrothermally altered, generally moderately hard but occasionally soft. Carbonate and iron oxide staining.	Run 90 403.5 to 409.0	91 (26)
410 - 355.1)		407.1 - Moderately to severely altered, possible shear, 2.0 inches wide. Broken rock fragments less than 0.5 inch.	Run 91 409.0 to 413.1	93 (49)
			Run 92 413.1 to 418.3	100 (73)
420 - 363.7)		418.3-418.5 - Healed shear, quartz diorite breccia in fine grained quartz diorite groundmass, tight.  420.0-429.0 - Iron oxide staining on most joints.	Run 93 418.3 to 422.5	100 (79)
			Run 94 422.5 to 427.6	100 (100)
430 - 372.4		433.7-437.5 - Shear/fracture zone, joints very close, 20°-50°, some healed with	Run 95 427.6 to 432.2	100 (57)
		carbonate.  433.7-434.8  436.1-437.5 ) Soft and friable rock,	Run 96 432.2- 434.8	69 (38)
		slickensides, chlorite, clay gouge to 2.0 inches. Core loss 1.1 feet.	Run 97 434.8- 437.5	89 (24)

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HOLE NO. BH-8

SITE Watana (South Bank)

SHEET NO 15 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(RQD)
440 - (381.1)	Quartz Diorite	437.5-453.3 - Joints very close to close spaced, healed with carbonate, iron oxide stained.	Run 98 437.5 to 442.2	98 (6€)
		443.1-446.2 - Shear/alteration zone, rock bleached white, 40-90°, moderately weathered. Joints and fractures close, rough, planar. 0.8 feet clay gouge.	Run 99 442.2 to 447.2	94 (54)
450 (389.7)		448.4-453.4 - Core loss 0.6 feet.	Run 100 447.2 to 452.2	88 (88)
		453.3-610.0 - Joints moderately close to close, planar, smooth to rough, some carbonate coated.	Run 101 452.2 to 457.4	100 (100)
460 (398.4			Run 102 457.4 to 462.2	100 (100)
			Run 103 462.2 to 466.6	100 (100)
			Run 104 466.6- 468.4	100 (89)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 16 OF 24

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	PEC (PQD)
470 (407.0)	Quartz Diorite		Run 105 468.4 471.4	100 (100)
			Run 106 471.4 to 476.6	100
480 - (415.7)		477.8-478.0 - Alteration zone, rock bleached white, moderately hydrothermally altered, soft and friable along joints at 50°.	Run 107, 476.6 to 481.8	100 (75)
			Run 108 481.5- 483.0	(188)
			Run 109 483.0 to 486.8	92 (82
. 490 _ (424.4)			Run 110 486.8 to 491.6	100 (100)
			Run 111	
		494.2-496.8 - Alteration zone, rock bleached white, hydrothermally altered, soft and friable. Core loss 0.5 feet. Feldspars weathering to clay, slightly to moderately	491.6 to 496.6	90 (48
		altered.	Run 112	02.77
. 500 (433.0)		499.4-502.7 - Felsic dike, light gray, fine to medium grained, less than 10% mafics, hard.	496.6 to 501.7	100

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 170F 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	#E0 (#QD)
	Quartz Diorite		Run 113 501.7 to 507.0	96 (87)
510 441.7)	-	508.4-520.7 - Alteration zone, bleached white- gray, slightly to moderately hydrothermally altered, numerous healed joints. Feldspars altering to clay, moderately hard but friable in places, joints close at 30-70°.	Run 114 507.0 to 512.0	88 (28)
	-		Run 115 512.0 to 517.4	<b>94</b> (0)
520 450.3)	-		Run 116 517.4 to 522.4	100 (34)
			Run 117 522.4 to 527.5	100 (98)
530 <b>45</b> 9.0)		531.5-540.9 - Alteration zone, bleached white- gray, slightly to moderately hydrothermally altered, moderately hard to soft. Feldspars altering to clay.	Run 118 527.5 to 532.6	96 (92)

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HOLE NO BH-9

SITE Watana (South Bank)

SHEET NO. 18 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	(RQD)
	Quartz Diorite	535.0-536.3 - Occasional friable zones with clay up to 0.1 feet. Core loss 0.5 feet.	Run 119 532.6 to 537.9	96 (64)
540 - 467.7)			Run 120 537.9 to 542.9	98 (86)
			Run 121 542.9 to 548.1	100 (100)
- 550 (476.3)		553.0-569.9 - Fractured/alteration zone.	Run 122 548.1 to 552.8	100 (100)
		bleached white-gray, slightly to moderately hydrothermally altered, joints very close to	Run 123 552:8-	100
		close at 30-60°, healed with carbonate, iron oxide stained. Moderately hard to soft, friable in places. Feldspars altering to clay. Core loss 0.2 feet.	Run 124 554.2 to 558.0	100
			Run 125 558.0 to 562.8	<b>9</b> 8 (0)
			Run 126 562.8- 567.8	<b>96</b> (0)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8 PROJECT Susitna Hy

SITE Watana (South Bank)

SHEET NO 19 OF 24

DEPTH LFT1	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	M(C (MQD)
	Quartz Diorite		Run 126 562.8 to 567.8	96 (0)
570 . 493.6)		569.0-578.8 - Healed shears, closely spaced, less than 0.1 feet wide, healed with dark green, aphanitic quartz diorite, tight. Core loss 0.6 feet.	Run 127 567.8 to 573.2	94 (39)
		573.0 - Texture of quartz diorite changes. Quartz and white feldspar are fine grained and intergrown, green feldspar (20-30%) is medium grained.	Run 128 573.2 to	92 (87)
		577.6-586.6 - Joints close to moderately close, carbonate coating and iron staining.		
580 - 502.3)		581.6-582.5 - Alteration zone, bleached white, slightly altered hydrothermally, hard.	Fun 129 577.0 to 582.1	100 (98)
			Run 130 582.1 to 587.2	100 (100)
590 - 511.0)		589.0-592.5 - Shear/alteration zone, bleached white-gray, slightly altered hydrothermally, healed and resheared. Numerous, very close shears healed with possible quartz/andesite, randomly oriented from 0-90°, hard.	Run 131 587.2 to 592.3	100 (71)
		589.0-589.3 > 592.1-592.5 \$\forall Zones of reshearing, breccia, and gouge, moderately soft and friable.	Run 132 592.3 to 597.6	98 (81)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 20 OF 24

DEPTH (FT)	ROCK TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	HEC (RQD)
600 519.6)	Quartz Diorite	593.3 - Shear, 30°, 2 inches wide, breccia and gouge, moderately soft, sulphide mineralization and iron oxide staining.	Run 133 597.6 to 602.6	100 (74)
			Run 134 602.6- 605.6	97 (77)
610 528.3)		610.8-635.2 - Joints close to very close, many healed with carbonate.	Run 135 605.6 to 610.6	100 (92)
			Run 136 610.6- 614.0	100 (47)
			Run 137 614.0 to 619.2	96 (50)
620 536.9)			Run 138 619.2 to 622.6	100 (56)
-		626.2-627.7 - Core broken by drilling, rock fragments 1-2 inches, possible fracture zone.	Run 139 622.6 to 627.8	100 (54)
			Run 140	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 21 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(900)
630 545.6)	Quartz Diorite	628.2-629.8 - Core badly broken, rock fragments 1.0-2.0 inches.	Run 140 627.8- 630.4	100
-		635.2-700.0 - Joints moderately close, planar,	Run 141 630.4 to 635.6	100 (69)
640 _ 554.3)		smooth, most carbonate coated.	Run 142 635.6 to 640.9	91 (87)
			Run 143 640.9 to 645.1	100 (95)
1		$646.7\text{-}650.1$ - Shear/alteration zone, rock bleached white-gray, slightly hydrothermally altered, soft and friable. Breccia and clay zone 0.7 feet wide, joints close at $40\text{-}75^\circ$ , carbonate coating.	Run 144 645.1 to 650.4	100 (94)
650 <u>-</u> 562.9)			Run 145 650.4 to 655.4	100 (100)
			Run 146 655.4 to 560.7	98 (91)
660 571.6)				

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO 22 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, POLISTION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DENGTH OF RUN (FT)	#£C (#QD)
	Quartz Diorite		Run 147 660.7 to 665.8	100 (100)
670 - 580. 2)			Run 148 665.8 to 671.1	100 (96)
300.27		671.1-676.4 - Core loss 0.3 feet.	-	
			Run 149 671.1 to 676.4	94 (85)
680 588.9)			Run 150 676.4 to 681.6	100 (100)
-		682.3-690.8 - Red staining, irregular and discontinuous, intergranular.	Run 151 681.6 to 686.9	100 (98)
690 - 597.6)		692.2-695.0 - Core barrel mislatched during	Run 152 686.9 to 692.2	100 (92)
		drilling. Core loss 0.2 feet.	Run 153	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 23 OF 24

DEPTH [FT]	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	(#20)
	Quartz Diorite		Run 153 692.2- 695.0	86 (71)
700 -		700 0 353 A - Ininte classic second selection	Run 154 695.0 to 700.0	100 (74)
606.2)		700.0-752.4 - Joints closely spaced, planar, smooth to rough, carbonate coated	Run 155 700.0 to 705.1	100 (86)
710			Run 156 705.1 to 710.4	98 (83)
614.9)		Run 158 redrilled.	Run 157 710.4 to 715.0	100 (100)
720			Run 158 715.0 to 721.3	83 (60)
623.5)		721.6-724.3 - Joints close, carbonate coating. Core loss 0.2 feet.	Run 159	
			721.3 to 726.6	96 (77)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

LIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-8

SITE Watana (South Bank)

SHEET NO. 24 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COPE, CEMENTING, ETC.	DE RUN (FT)	MEC (MOD)
	Quartz Diorite		Run 159	96 (77)
730 632.2)		731.9-747.1 - Numerous rehealed joints.	Run 160 726.6 to 731.2	100 (87)
			Run 161 731.2 to 736.2	100 (96)
. 740 640.9)			Run 162 736.2 to 741.2	100 (88)
			Run 163 741.2 to 746.2	92 (92)
750 649.5)			Run 164 746.2 to 751.3	100 (73)
752 4			Run 165	100 (100)
752.4 651.6)		END OF BORING		

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No. P5700.05	
Project	Susitna Hydroelectric Project	Hole No. BH-8	
Site	Watana (South Bank)	Sheet No. 1 of	3

DEPTH (FT.)	ELEV (FT.)	PERMEABILITY IN1 cm/sec	CORE RECOVERY % 20 40 60 80	#QD % 20 40 60 80	NUMBER OF JOINTS PER ID FT	ROCK TYPE	REMARKS
0	1980					Overburden	TOP OF ROCK 8.0'
20			HH				
40				7			
60	1937	5				Diorite/ Quartz	Fracture zone.  -Shear.
80				-4		Diorite	□Fracture zone.
100	1893	4):::		7			□Shear zone.
120							
140							Fracture.
160	1850			7			
180							⊐Shear/fracture zone
200	1807				H		Shear, healed.
220				,			- Shear, healed.
240							—Shear, healed.
260	1763			5			
280						Ouartz Diorite/	Dike, granodiorite.
300	1720			<b>—</b>		Granodiorite	- Shear.
320 -			4	7			
340						Diorite/	

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client \_\_ ALASKA POWER AUTHORITY Job No. \_\_\_ P5700.05 Hole No.\_\_\_BH-8 Project Susitna Hydroelectric Project Sheet No. \_2\_ of \_\_3 Watana (South Bank) PERMEABILITY (K) cm/sec CORE RECOVERY NUMBER OF JOINTS PER IOFT ELEV (FT) ROCK TYPE REMARKS Diorite -360 Dike, felsic. 380 Quartz Diorite 400 1634 Fracture zone. 420 Shear. 440 Shear zone. 1590 460 480 500 Dike, felsic. 1547 Alteration zone. 520 Alteration zone. 540 Fracture/alteration 560 zone. 580 1 Shear zone. 600 1460 -620 640 □ Shear/alteration 660 680

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. BH-8 Site Watana (South Bank) Sheet No. \_3\_ of \_ 3\_ COME MECOVERY DEPTH ELEV ROCK TYPE REMARKS Diorite 720 740 760 END OF BORING 752.4'

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO.: DH-12

Watana (South Bank)

SHEET NO. 1 OF 26

CONTRACTOR: Interstate Exploration Inc. DRILLING DATES: July 18 TO August 5, 1981

LOGGED BY .

K.J. White, R.R. Henschel

Diamond Core - Triple Tube

DATE: September 1981

DRILLING

Casing Advancer

CASING DIAMETER: NW (3.0") I.D. CORE DIAMETER: NO (1.75") O.D.

METHOD: LOCATION:

LATITUDE N3,225,624

36°

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

DEPARTURE E744,515 AZIMUTH 220°

GROUND SURFACE 1975.7 1959.8

ROCK SURFACE BOTTOM OF HOLE

1505.9

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).
2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	RUN LENGTH	MEC (RQD)
0	Overburden	Overburden of cobbles, boulders of grano- diorite.	Run 1 0.0- 2.0	(0)
10 5.9)				
20 11.8)				

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

JOB NO.

P5700.05

PROJECT Susitna Hydroelectric Project

BH-12

Watana (South Bank)

SHEET NO 2 OF 26

CEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(600) eEC
	Overburden			
27.0	Andesite	Light bluish-gray to greenish-gray, generally aphanitic to fine grained, contains numerous angular fragments of argillite ranging from 0.13 to 1.0 inch (average 0.25 to 0.38 inches), 2-5% of rock. Generally hard.	Run 2 27.0 to 29.8	100 (55)
17.6)		Joint spacing varies from very close to closely spaced in altered zones, to widely spaced in hard zones. Heavily stained with iron oxides, slightly to moderately weathered and open. Penetrative weathering up to 0.25 inches.	Run 3 29.8 to 34.7	100 (57)
		27.0-31.8 - Moderately weathered along joints, penetrative to 0.5 inches, slightly friable.  37.8 - Heavy iron oxide staining.	Run 4 34.7- 36.6 Run 5 Run 6 37.4-	100 (82) 0 (0) 88
40 23.5)			39.8 Run 7 39.8 to 44.8	98 (93)
-		49.8-51.7 - Fracture zone, very closely spaced fractures, intersecting joints at 50° and	Run 8 44.8 to 49.8	100 (94)
50 29.4)		0-20°. Slightly to moderately weathered with penetrative iron oxide staining to 0.75 inches. 51.7-52.1 - Yellow-brown sandy/clay layer, 0.25 feet thick, small fragments of highly weathered andesite. Sharp contacts at 50°.	Run 9 49.8- 51.9 Run 10	100 (0) 97 (40

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 3 OF 26

MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	4EC (4QD)
Andesite	layer intruded by quartz, friable. 55.4 - Shear, 35°, 0.25 inches wide. Clay layer containing breccia, soft, friable.	Run 10 51.9 to 57.3	97 (46)
	56.1 - Shear, 20°, 0.25 inches of sandy clay breccia.	Run 11 57.3- 59.4	100 (19)
	*	Run 12 59.4 to 62.0	100 (42)
		Run 13 62.0 to 67.2	100 (46)
		Run 14 67.2- 69.5	100
	70.0-73.0 - Shear/fracture zone, joints very close to closely spaced at $40^\circ$ - $60^\circ$ , open, moderately weathered. Friable locally, iron oxide stained, some sandy clay.	Run 15 69.5- 71.4 Run 16 71.4- 73.1 Run 17 73.1- 75.1	84 (66) 100 (35) 100 (78)
	76.5-77.2 - Shear, 15°-20°, thin clayey breccia coating.	Run 18 75.1 to 79.6	97 (63)
	83.6-93.3 - Shear/alteration zone, slightly bleached hydrothermally. Numerous fractures at 30°-40°. Heavy from oxide staining, moderately hard to friable locally.	Run 19 79.6 to 84.6	94 (34)
		Andesite  54.1-54.4 - Shear, 20°, 0.25 inches wide. Clay layer intruded by quartz, friable.  55.4 - Shear, 35°, 0.25 inches wide. Clay layer containing breccia, soft, friable.  56.1 - Shear, 20°, 0.25 inches of sandy clay breccia.  70.0-73.0 - Shear/fracture zone, joints very close to closely spaced at 40°-60°, open, moderately weathered. Friable locally, iron oxide stained, some sandy clay.  76.5-77.2 - Shear, 15°-20°, thin clayey breccia coating.  83.6-93.3 - Shear/alteration zone, slightly bleached hydrothermally. Numerous fractures at 30°-40°. Heavy iron oxide staining.	Andesite  54.1-54.4 - Shear, 20°, 0.25 inches wide. Clay layer intruded by quartz, friable.  55.4 - Shear, 35°, 0.25 inches wide. Clay layer containing breccia, soft, friable.  56.1 - Shear, 20°, 0.25 inches of sandy clay breccia.  Run 11 57.3-59.4  Run 12 59.4  to 62.0  Run 13 62.0  Run 13 62.0  Run 14 67.2-  70.0-73.0 - Shear/fracture zone, joints very close to closely spaced at 40°-60°, open, moderately weathered. Friable locally, iron oxide stained, some sandy clay.  Run 15 69.5-71.4  Run 17 69.5-71.4  Run 18 77.3.1-76.1  76.5-77.2 - Shear, 15°-20°, thin clayey breccia coating.  Run 18 75.1  to 79.6  Run 19 79.6  Run 19 79.6  Run 18 75.1  to 79.6  Run 19 79.6  Run 19 79.6

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

CLIENT

SHEET NO. 4 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(900)
-	Andesite	0.25 inches.  86.6-87.6 - Open fractures, 0-10°, up to 0.5 inches wide, filled with highly weathered rock fragments, locally healed with calcite.	Run 20 84.6 to 89.6	100 (9)
90 (52.9)			Run 21 89.6 to 92.5	97 (59)
- 1		93.3-108.5 - Joints generally close to moderately closely spaced, tight to partially	Run 22	80 (0)
		open. Fresh to moderately weathered with moderate iron oxide staining. Minor clay coating.  97.2-98.1 - Fracture zone, very closely spaced joints, slightly weathered, iron oxide stained, open. Moderately hard.	Run 23 93.5 to 98.5	100 (82)
100 58.8)		99.5-99.8 - Felsic dike, medium gray, very fine grained, very hard.	Run 24 98.5 to 103.5	100 (80)
			Run 25 103.5 to 108.5	100 (36)
108.71		108.5-108.7 - Gradational contact.		
110 (64.7)	Diorite	Light to medium gray, medium grained crystalline rock. Hard to very hard, fresh to slightly weathered along joints with minor iron oxide staining.	Run 26 108.5 to 114.0	96 (84)
			Run 27 114.0 to 119.0	100 (60)

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank) SHEET NO 5 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC	OF HUN (FT)	#1£ (#90)
	Diorite	118.7-124.7 - Felsic dike, medium blue-gray, very fine grained. Porphyritic locally, phenocrysts to 0.13 inches diameter, hard.	Run 27	10( (60))
120 70.6)			Run 28 119.0 to 124.0	100 (74)
		126.1 - Shear, 50°, silty clay gouge less than 1.0 inch. 127.0 - Shear, 15°, 0.1 inch gouge.	Run 29 124.0 to 129.1	100 (43)
130 76.4)		133.8-134.5 - Fracture zone, fractures very closely spaced, 50°, with carbonate coating.	Run 30 129.1 to 134.5	98 (42)
			Run 31 134.5 to 139.5	100 (96)
140 82.3)			Run 32 139.5 to 144.6	96 (88)
			Run 33 144.6 to 149.7	100 (83)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

SITE

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project Watana (South Bank)

HOLE NO. BH-12 SHEET NO 6 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF RUN (FT)	#(C (#20)
150	Diorite		Run 33	100(83)
(88.2)			Run 34	
		152.5 - Dike, 20°-30°, dark gray, very fine	149.7	100
		grained, 0.5 inches wide, hard.	to 154.9	(66)
			Run 35	
- 1			154.9	100
1		159.7-162.4 - Andesite dike, medium green-	to 159.7	(67)
160		gray, very fine grained. Numerous very thin quartz stringers at 45°-60°. Very sharp	Run 36	100
94.1)		contacts.	I.u. 30	(37)
		162.4 - Carbonate filling at contact, less than 0.06 inches thick, hard and brittle.	Run 37	
- 1		than 0.00 menes three, hard and britere.	161.2	94
1			to 166.0	(69)
1			Run 38	
- 1			166.0	97
170			to 169.9	(86)
99.9)			Run 39	
		1	169.9	100
			174.9	(100)
			Run 40	
1	]		174.9	100
			to 179.9	(100)
180		179.2-179.37 180.5-180.63 Felsic dikes, light tan, very		
105.8)		fine grained, hard.	Run 41	100(78)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

NOLE NO BH-12

SITE Watana (South Bank)

SHEET NO. 7 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, PATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	9EC (900)
	Diorite	180.6-183.6 - Alteration zone, bleached, slightly altered hydrothermally.	Run 41 179.9 to 185.0	100 (78)
		Run 42 185.0 to 189.9	100 (85)	
. 190 (111.7)		193.5 - Joint, 30°, slickensides.	Run 43 189.9 to 195.1	100 (71)
200		197.2-197.8 - Shear zone, 50°, slightly friable, clay/breccia layer, 0.38 inches wide, stiff, slightly plastic.  197.7-197.8 - Brecciated zone, 0.25 inches wide, clay seam at 50°.	Run 44 195.1 to 199.9	100 (44)
(117.6)		white, entry seem to so .	Run 45 199.9 to 204.9	100 (48)
-		207.4-208.3 - Felsic dike, light gray, very fine grained.	Run 46 204.9 to 209.8	98 (90)
210 (123.5)			Run 47 209.8 to 214.9	100 (51)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALD, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-12

SITE Watana (South Bank)

SHEET NO 8 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	REC (RQD)
	Diorite	212.6-213.4 - Shear/alteration zone, moderately to completely altered hydrothermally, very closely fractured but still intact. Original	Run 47	100 (51)
		structure and texture of diorite preserved. 214.3-214.4 - Two clay seams 40° and 70°, 0.13 inches wide.	Run 48 214.9 to 219.8	100 (73)
220 129.4)			Run 49 219.8 to 224.9	100 (69)
			Run 50 224.9 to 229.8	98 (84)
230 (135.2)	) -	232.9-234.2 - Shear/fracture zone, fractures very closely spaced. Clay/breccia layer, 0.25 inches wide, friable. 234.2-235.0 - Alteration zone, bleached white, altered hydrothermally, hard.	Run 51 229.8 to 235.0	100 (69)
. 240 (141.1)		altered hydrothermally, hard.	Run 52 235.0 to 240.1	100 (75)
			Run 53 240.1 to 245.3	100 (61)

CLIENT

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank) SITE

SHEET NO 9 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(P20)
250	Diorite		Run 54 245.3 to 250.2	100 (80)
250 (147.0)		251.8 - Joint, $60^\circ$ , clay and rock fragments.	Run 55 250.2 to 255.5	98 (65)
			Run 56 255.5 to 260.2	100 (94)
260 (152.9)			Run 57 260.2 to 265.3	100 (66)
			Run 58 265.3 to 270.2	100 (73)
270 (158.8)		273.7-276.1 - Shear/alteration zone, slightly altered hydrothermally. Fractures very closely spaced, friable, carbonate coating.	Run 59 270.2 to 275.3	100 (65)
			Run 60	100 (0
			Run 61	/

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank) SITE

SHEET NO. 10 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	LENGTH OF RUN (FT)	PEC [PQD]
280	Diorite	273.8 - Shear, 30°-35°, less than 0.13 inches. Soft, plastic, sandy clay. 274.2-276.4 - Core badly broken by	Run 61 276.2 to 279.8	97 (25)
(164.6)		276.2-280.6 - Joints very close to closely spaced.	Run 62 279.8 to 284.5	100 (69)
			Run 63 284.5 to 289.7	100 (70)
290 (170.5)			Run 64 289.7 to 294.2	100 (98)
			Run 65 294.2- 296.5	100 (76)
			Run 66 296.5 to 299.8	82 (77)
300 (176.4)			Run 67 299.8 to 304.5	100 (79)
		308.6-309.4 - Fracture zone, joints very closely spaced at 20°, 50°, and 80°.	Run 68 304.5 to 309.4	100 (80)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 11 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF HUN (FT)	HEC (HQD)
310 (182.3)	Diorite		Run 69 309.4 to 315.6	97 (73)
			Run 70 315.6 to 320.4	100 (83)
320 (188.2)		324.7-325.0 - Fracture zone, joints very closely spaced.	Run 71 320.4 to 325.0	100 (65)
			Run 72 325.0 to 330.0	100 (58)
330 (194.0)		332.7-332.9 - Fracture zone, joints very closely spaced.	Run 73 370.0 to 335.1	100 (45)
		335.6-336.8 - Core broken by drilling.	Run 74 335.1 to 340.0	100 (47)
348.o)			Run 75	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO. 12 OF 26

DEPTH (#71	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	#201
-	Diorite	343.0-343.8 - Fracture zone, joints very closely spaced.	Run 75 340.0 to 343.6	94 (35)
			Run 76 343.6 to 348.3	100 (85)
350 (205.8)			Run 77 348.3 to 353.2	100 (69)
		355.8-362.6 - Alteration zone, bleached white, slightly to severely altered hydrothermally. Joints very close to closely spaced, moderately hard to very friable. Sharp contact at top, gradational at bottom.	Run 78 353.2 to 358.9	93 (39)
1		355.9-356.9 358.0-358.9 Severely altered zones.		
360 (211.7)		362.1-362.6 - Several joints at 40° with minor clay and rock fragments, less than 0.06 inches thick.	Run 79 358.9 to 364.2	98 (47)
1			Run 80	
		366.9-367.6 - Fracture zone, joints very closely spaced.	364.2 to 369.3	100 (65)
370 (217.6)			Run 81 369.3 to 374.6	100 (94)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 13 OF 26

DEPTH. (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	960 (F3D)
	Diorite		Run 81	100 (94)
			Run 82	
			374.6 to 379.6	100 (100)
380 (223.4)			Run 83	100(88
		383.1-383.4 - Fracture zone, fractures very closely spaced.	Run 84 380.4 to 385.0	100 (87)
		387.8-387.9 - Fracture zone, fractures very closely spaced.  389.3-389.8 - Fracture zone, fractures very	Run 85 385.0 to 389.8	100 (88)
390 (229.3)		closely spaced.	Run 86 389.8 to 395.0	98 (96)
		396.1-404.2 - Fracture zone, fractures and joints very closely spaced, partly drilling induced.	Run 87 395.0 to 398.3	100 (42)
400 (235.2)		397.0-397.3 - Quartz vein.	Run 88 398.3 to 401.4	100
			Run 89 401.4 to 404.2	29 (0)
1			Run 90	100(100

# ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank)

SHEET NO 14 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (400)
-	Diorite		Run 90 404.2 to 409.1	100 (100)
410 241.0)			Run 91 409.1 to 414.2	100 (100)
			Run 92 414.2 to 419.2	100 (92)
420 247.0)			Run 93 419.2 to 424.4	100 (100)
			Run 94 424.4 to 429.4	100 (92)
430 <u>1</u> 252.8)			Rur. 95 429.4 to 434.7	100 (58)
			Run 96 434.7 to 439.7	100 (86)

CLIENT

ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE

Watana (South Bank)

SHEET NO. 15 OF 26

DEPTH LFT1	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIR, CAVING, LOST COME, CEMENTING, ETC.	OF RUN (FT)	(#201 #KC
440	Diorite	439.3-439.7 - Fracture zone, joints very closely spaced at 40°.	Run 96 434.7 to 439.7	100 (86)
(258.7)			Run 97 439.7 to 444.8	100 (71)
		444.8-448.2 - Fracture zone, joints and fractures very closely spaced at 20°, 40°, and 50°, partly open to tight, coated with yellow-brown clayey material.		100 (26)
450 (264.6)		449.8-454.8 - Shear/alteration zone, rock bleached, slightly to severely altered hydrothermally.	Run 99	
- 1		449.8-451.8 - Green-gray, granular texture, moderately hard. Possible shear planes present.	449.5 to 454.6	100 (43)
-		451.8-454.8 - Bleached zone, quartz rich, very few mafics, very hard.		
-		457.7-463.2 - Shear/fracture zone, joints very closely spaced, carbonate filling, chlorite/talc coating, slickensides.	Run 100 454.6 to 459.5	96 (31)
460 (220.5)			Run 101 459.5 to 464.5	100 (24)
		463.2-465.2 - Alteration zone, bleached, slightly altered hydrothermally, hard.	464.5	
		464.5-465.2 - Shear zone, very thin shears at 60°-70°, calcareous clay filling, brecciated but intact.	Run 102 464.5 to 469.5	100 (62)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank) SITE

SHEET NO 16 OF 26

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	(#30) #EC
470 (276.4)	Diorite	470.3 - Shear, 85°, 0.5 inches wide, sandy clay filling, chlorite coating, slickensides.	Run 103	
		473.9-474.0 - Shear, 40°, less than 0.1 inches of breccia. Offset by 0.25 inches, healed. Moderately hard.	469.5 to 474.6	100 (63)
		476.7 - Joints, 60°-65°, sandy clay filling, slight chlorite coating.	Run 104 474.6 to	100
+		477.9-482.0 - Shear/alteration zone, slightly to moderately altered hydrothermally. Breccia and gouge material. Soft to moderately hard,	478.8	
480 282.2)		friable.  480.8-480.9 - Possible healed shear, 1.0 inch of dark gray, very fine grained material.	Run 105 478.8 to 484.1	96 (19)
		483.2-483.7 - Joint, 15°-20°, quartz/carbonate coating with slickensides.		
		483.5 - Joint, 60°, sandy clay filling, slickensides.	Run 106	
]		484.6 - Shear/alteration zone, slightly to moderately altered hydrothermally, soft to moderately hard. Shears, 60°-70°, clay/sand breccia.	484.1 to 409.2	100
490		486.1-490.6 - Moderately hard, joints very close to closely spaced.	Run 107	
288.1)		$487.9-488.6$ - Shear zone, $55^{\circ}-70^{\circ}$ , with approximately 0.5 inch spacing. Numerous very thin shears with clay gouge.	489.2 to 494.3	100
		490.6-519.3 - Shear/alteration zone, slightly to moderately altered hydrothermally.		
		Numerous very thin shear planes, brecciated but healed with calcareous sandy clay. Moderately hard to soft, friable. Joints	Run 108 494.3	100
		moderately closely spaced, chlorite coating. 50% of joints healed with carbonate. Irregular patches of red staining.	to 499.5	(52
500			Run 109	100

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank)

SHEET NO. 17 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	HEC (HQD)
	Diorite	498.6-499.1 - Fracture/alteration zone, yellow-green color, very closely spaced joints at 60° healed with carbonate. Feldspars stained but hard.	Run 109 499.5 to 503.7	100 (100)
		500.5 - Alteration zone, 2.0 inches wide, carbonate healed joint at 80°. Hard. 507.2-507.6 - Fracture zone, joints very closely spaced at 40°-70°, silt/clay coating.	Run 110 503.7 to 509.0	100 (91)
_ 510 (299.9)		509.1 - Joint, 30°, silt/clay coating. 511.2-512.8 - Joints, healed with carbonate. 512.8-513.5 - Shear/fracture zone, very closely spaced joints. Shear, 60°-70°, 0.5 inches breccia, partially healed with carbonate.	Run 111 509.0 to 514.1	100 (67)
		511.2-571.6 - Joints, closely spaced with zones of very closely spaced, chlorite coating, carbonate healed, tight, up to 2 feet long.	Run 112 514.1 to 519.1	100 (100)
. 520 (305.8)		520.5-528.6 - Joints, 40°, closely spaced, healed with rusty crange carbonate. Slightly altered hydrothermally to 1.0 inch either side, 10-20% of feldspars altering to clay. Hard, tight.	Run 113 519.1 to 523.2	100 (100)
			Run 114 523.2 to 528.5	94 (72)
530 (311.6)		530.9-538.8 - Fracture/shear zone, very closely spaced joints at 20° and 70°. Most joints healed and tight.  531.1 - Shear, 20°, 0.1 inches breccia/ gouge.  531.6 - Shear, 10°, 0.5 inches breccia, faint slickensides.	Run 115 528.5 to 533.4	100 (48)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank)

SHEET NO. 18 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (AGC)
	Diorite	532.8 - Alteration zone, slightly altered hydrothermally, 1.0 inch wide.	Run 115	
540 317.5)		533.8 - Shear, 60°, 0.5 inches of breccia/ gouge.	Run 116 533.4 to	10) (7?)
		536.7 - Shear, 0°-10°, up to 0.3 inches breccia/gouge.	538.4	
		538.1 - Shear, 25°, less than 0.1 inch of gouge.	Run 117	100
		542.3-545.9 - Felsic dike, light gray, fine grained, 10% mafics, 5-15% quartz, 5% green	to 543.4	(52)
		feldspar phenocrysts. Very closely spaced joints, tight. Upper contact 50°, fractured, sheared, slickensides. Lower contact 30°, propably sheared, trace clay/silt.	Run 118	91 (0)
1		545.9-549.2 - Fracture zone, very closely spaced joints, tight.	Run 119 544.5 to	100
		$548.4$ - Joint, $60^{\circ}$ , clay coating. $549.2$ - Joint, $80^{\circ}$ , clay coating.	549.7	
550 23.4)			Run 120	22.25
1		553.3 - Alteration zone, slightly altered hydrothermally, 10% of feldspars altering to clay, hard.	549.7 to 554.7	98 (54)
560		553.7-556.7 - Felsic dike (?), light gray, fine grained to aphanitic with fine to medium grained phenocrysts, 5-15% mafics, 5-15% feldspar. Tight joints very closely spaced. Upper contact, 40°, gradational 2.0 inches, tight. Lower, 50°, sheared with 0.5 inches of breccia partially healed with carbonate.	Run 121 554.7 to 559.7	100
329.3)		557.0 - Joint, 30°, silt/clay coating, 0.25 inches of alteration, .0% of feldspars altering to clay.	Run 122 559.7	100
		565.7 - Joint, 60°, yellow orange carbonate/ silt coating.	to 564.9	(62)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank)

SHEET NO 19 OF 26

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS ON GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF RUN (FT)	#EC (#00)
1	Diorite	566.0-566.2 - Alteration zone, 10% feldspars altering to clay.	Run 123	
		567.6 - Alteration zone, 1 inch thick, slight hydrothermal alteration, 10% feldspars altering to clay.	564.9 to 570.0	100 (61)
570 (335.2)		571.0-586.1 - Shear/fracture zone, joints very closely spaced, many carbonate healed.	Run 124 Run 125	
575.9		571.4 - Zone of light gray-green, fine grained material 0.5 inches wide, sharp contacts at 70°. Offset by 0.2 inches wide carbonate filled shear at 40°. Either silty clay layer or altered felsic dike.	570.3 to 575.9	71 (45)
(338.6)	Quartz Diorite	Light gray, fine to medium grained crystalline rock. Mafic content, variable averaging 20-30%, 10-15% guartz. Slightly altered overall.	578.0	33 (0)
580		578.0-579.8 - Core loss 0.8 feet. 578.6 - Shear, 25°, 2.0 inches of breccia	Run 127 578.0- 579.8	(22)
(341.0)		partially healed with carbonate and 0.1 inch of gouge.	Run 128	
		582.0 - Shear, 50°, 1.0 inch breccia/gouge. 582.0-586.1 - Alteration zone, bleached to yellow-orange hydrothermally, hard to moder- ately hard. Joints, 10° and 70°-80° with clay	579.8 to 585.0	96 (44)
1		coating.  586.1-605.9 - Joints, closely spaced, healed with carbonate, tight.	Run 129 585.0	100
590		588.0-656.5 - Alteration zone, slightly to moderately altered. Feldspars bleached to yellow-gray. Very close to closely spaced joints. Minor sulphide mineralization. Hard.	to 589.8	(88)
(346.9)		590.2 - Shear, 20°, clay/silt coating, faint slickensides.	Run 130	100
		595.8 - Shear, 20°, 0.1-0.3 inches of gouge.	to 596.0	(75)
1		596.0-596.77 597.8-598.55 Alteration zones, moderately altered hydrothermally, 50% of feldspars		
1		altering to clay.	Run 131	100(92

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CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank) SITE

SHEET NO 20 OF 26

SEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	OF RUN (FT)	HE:
600	Quartz Diorite	596.0-596.7 - Breccia, healed. 598.2 - Joint, 80°, talc coating.	Run 131 596.0 to 599.8	100 (92)
352.8)			Run 132 599.8 to 604.9	100 (100)
			Run 133 604.9 to 609.8	100 (98)
610 358.7)		610.0-613.6 - Moderately altered, 20-30% of feldspars altered to clay.  613.2-613.5 - Shear, 80°, breccia/gouge. 614.3 - Shear, 30°, 0.5 inches breccia/gouge.	Run 134 609.8 to 615.0	100 (38)
		616.2 - Shear, 40-70°, 1.0-to 2.0 ir res breccia/gouge. 619.0 - Shear, 25°, clay/gouge coating.	Run 135 615.0 to 620.1	100 (54)
620 364.6)		621.4 - Shear. 60°, 0.1-1.0 inches gouge.	Run 136 620.1 to 625.0	100 (45)
		626.6 - Shear zone, 1.0 inch breccia/ gouge. 626.8 - Shear, 40°, carbonate, gouge.	Run 137 625.0 to 628.6	100 (87)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 21 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	9£0 (900)
630	Quartz		Run 138	100(73
(370.4)	Diorite	631.3 - Shear, 45°, coating of clay gouge.	Run 139 629.7	100
		633.5 - Shear, 70°, 0.1 inches of gouge.	to 634.7	(80)
1		633.º 639.5 - Moderately altered, feldspars breaking down to clay.		
		634.0 - Shear, 60°, 2.0 inches breccia/ gouge.	Run 140	JONNOON.
1		634.2 - Shear, 15°, clay coating.	634.7 to	100
. 1		635.2 - Shear, 60°, clay coating.	639.8	(13)
		635.7 - Shear, 50°, 0.3 inches of gouge.		
. 640 (376.3)		637.4 - Shear, 40°, 0.5 to 1.0 inches wide, breccia and gouge.	District Colony	
		638.1 - Shear, 50°, clay coating.	639.8 to	100
		639.1 - Shear (?), 30°, clay coating.	645.0	(00)
		643.2 - Shear (?), 60°, clay coating.		
		643.6 - Shear, 30°, 0.5 inches wide, 0.1 inches of gouge along a healed shear of dark gray igneous material and carbonate.	Run 142	V services
		644.0 - Shear, 50°, clay coating, offsets a very thin vein of dark gray igneous material, 0.1 inches wide.	645.0 to 649.8	100 (100)
650 (382.2)		651.6-656.5 - Moderately altered, feldspars	Run 143	
		altering to clay.	649.8 to 655.0	100 (88)
1		654.5-655.7 - Shear, 80°, breccia/gouge.		
			Run 144 655.0	100
656.8 (386.2)	Granodiorite	Light pink-gray, fine to medium grained cry-	to	(92)
	a anouror ree	stalline rock. Mafics 20-30%, primarily horn- blende/biotite, 5-15% quartz, and pink, green,	659.8	
388.1)		and white feldspars. Hard, generally fresh to slightly hydrothermally altered. Alteration	Run 145	
/		nave of the control o		(100)

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-12

SITE Watana (South Bank)

SHEET NO. 22 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	9EC (990)
	Granodiorite	along healed joints.  656.8-681.4 - Joints, close to moderately closely spaced, most healed with carbonate.  660.3-662.0 7 662.9-663.5 Alteration zones, 10-20% of	Run 145 659.8 to 665.0	100 (100)
		feldspars altering to clay, moderately hard.	Run 146 665.0 to 669.8	100 (94)
670 394.0)			Run 147 669.8 to 673.0	100 (100)
•		674.0 - Joint, 35°, penetrative alteration of 0.5 inches. 674.1 - Within 1.0 inch zone, color has changed from pink (fresh rock) to light gray with less than 5° mafics and altered feldspars giving appearance of two rock types in texture		100 (88)
680 400.7)		and composition.  677.4-678.5 681.2-681.4 Alteration zone, moderate hydrothermal alteration of feldspars to clay.	Run 149 678.2 to 683.2	100
581.4 400.7)	Quartz Diorite	Rock description as above.  681.4-695.6 - Joints, close to very closely spaced, many healed with carbonate.		
		683.4-688.3 - Alteration zone, altered hydro- thermally with very thin to thin zones of bleached and altered rock with sulphide alteration.	Run 150 683.2 to 688.2	100 (69)
690 405.7)		684.2 - Joints, 20°, clay coated, possibly sheared. 687.1-688.1 - Shears, 40-70°, very closely spaced, 0.5-1.0 inch breccia/gouge.	Run 151 688.2 to 693.4	100 (77

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

MOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 23 OF 26

DEPTH	ROCK TYPE	DESCRIPTION COLOR TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENSTH OF RUN (FT)	HEC HOD;
	Quartz Diorite	687.1-689.0 - Alteration zone, moderate hydro- thermal alteration of feldspars to clay.	Run 152	
		692.1-692.3 - Shear, 60°, clay coating. 693.5-695.3 - Shear/alteration zone. Very closely spaced shears (3) at 60-90° with 0.5 inches of gouge.	693.4 to 698.4	100 (48)
		695.6-706.5 - Joints close to moderately closely spaced.	Run 153	
700 11.6)		700.5 - Alteration zone, 1.0-2.0 inches pene- trative alteration. 25% feldspars altered to rusty-orange clay.	698.4 to 703.6	96 (96)
		703.4-704.8 - Alteration zone, moderately altered.		
		703.7 - Shear, 40°, 0.1 inches clay and talc (?).  704.1 - Vein, 70°, 0.5 inches wide, light gray, aphanitic, ruggy.  706.5-711.7 - Joints close to very closely	Run 154 703.6 to 708.8	100 (98)
710 - 17.5)		spaced, healed, tight.  711.7-738.3 - Joints close to moderately closely spaced, most are healed with	Run 155 708.8	100
		carbonate, tight.  712.3-712.50 Alteration zones, moderately 713.1-713.40 altered hydrothermally.	713.9	(97)
		714.3 - Shear, 25°, 0.1 inches of clay gouge.	Run 156	
			713.9 to 719.2	100
720 423.4)			Run 157	
			719.2 to 724.4	100

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

SITE Watana (South Bank)

SHEET NO 24 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF AUN	9£0 (900)
-	Quartz Diorite		Run 158 724.4 to 729.6	100 (100)
730 429.2)			Run 159 729.6 to 734.8	100 (100)
1		735.1-751.5 - Alteration zone, moderately altered hydrothermally, numerous shears.	Run 160	
		735.1 - Shear, 60°, 0.5 to 1.0 inch of breccia/gouge, slickensides.	734.8 to	100 (100)
1		736.3-736.6 - Shear, 25°, breccia with minor gouge.	739.8	
740 435.1)		738.3-790.2 - Joints closely to very closely spaced, most joints are tight, carbonate healed, clay coating on many.	Run 161	
		740.3 - Shear, 40°, clay coating.	739.8 to 744.8	100 (64)
1		742.6 - Shear, 80°, 1.0 inch of breccia/gouge.		
1		743.9 - Shear, 30°-40°, 1.5 inches wide breccia/gouge.	Run 162	
1		744.5-744.8 - Core broken by drilling, pieces average 1.0 inch. Clay coating, possible shear.	744.8 to 749.8	100 (80)
750		746.8-747.0 - Shear, 60°, 0.3 inches of gouge, 2.0 inches of breccia, slickensides.		
441.0)		749.3 - Shear, 35°, clay coated.	Run 163	
1		750.2 - Two shears, very closely spaced at 10° breccia/gouge in a 1.0 inch wide zone, slickensides.	749.8 to 754.9	100 (90)
			Run 164	100

ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-12

Watana (South Bank)

SHEET NO 25 OF 26

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#£¢ (#QD)
760	Quartz Diorite		Run 164 754.9 to 759.9	100 (94)
763.6 449.0)	Felsic Dike	Light gray yellow, aphanitic to medium grained,	Run 165 759.9 to 764.9	100 (100)
149.0/2	reisic bike	5-10% dark gray green phenocrysts. 5-10% rusty orange feldspar phenocrysts. Moderately hard. 763.6-764.1 - Healed shear, 30°, resheared with 0.3 inches of gouge.	Run 166 764.9 to	96 (96)
768.5 451.9)	Quartz Diorite	768.0 - Shear, 30°, irregular, breccia/gouge.  Rock description as above.  768.5 - Shear, 80° along lower contact, 2.0	767.5 Run 167 767.5 to 769.8	100
152.8)		inches wide breccia and gouge.  770.4 - Shear, 40°, clay coating with possible talc.	Run 168 769.8 to 775.0	100 (100)
780		775.9 - Shear, 50°, 0.1 inches of gouge, slickensides.	Run 169 775.0 to 780.1	100 (75)
158.6)		781.3-781.6 - Shear, 40°, shear planes very closely spaced, breccia, minor gouge, moderately altered hydrothermally. 786.9-787.5 - Alteration zone, moderately altered.	Run 170 780.1 to 785.1	100 (74)
		787.2 - Shear, 60°, 0.5 inches of breccia/ gouge.  788.3-788.9 - Alteration zone, moderately altered hydrothermally.  788.3-788.4 - Two shears, very closely spaced at 70°, less than 0.1 inches gouge.	Run 171 785.1 to 790.1	98 (72)

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

ALASKA POWER AUTHORITY

SITE

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project Watana (South Bank)

HOLE NO BH-12 SHEET NO. 26 OF 26

DEPTH (F1)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	PEC (POD)
790 464.5)	Diorite 790.2-797.3 - Joints close to moderately closely spaced.		Run 171	98 (72)
•			Run 172 790.1 to 795.1	98 (96)
798.9		797.3-798.9 - Fracture zone, joints very closely spaced. Slight to moderate hydrothermal alteration.	Run 173 795.1 to 798.9	100 (82)
69.8) 800 170.4)		END OF BORING		
-				
-				
1				
-				

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05	
Project	Susitna Hydroelectric Project	Hole No.	BH-12	
Site	Watana (South Bank)	Sheet No.	1 of 3	

DEPTH (FI)	ELEV (FT)	PERMEABILITY (K) cm/sec	CORE RECOVERY %	#00 % 20 40 60 80	NUMBER OF JOINTS PER HOFT 5 G IS 20	ROCK TYPE	REMARKS
0	1976			2200	1111	Overburden	
20							TOP OF ROCK 27.0
40	- 12			<u> </u>		Andesite	
60	1947						Fracture zone.
			1115				
80							Alteration zone.
100	1917						
120				5		Diorite	
140						1	
160	1888				Hin		Dillo matic
		Γ					Dike, mafic.
180				5			Alteration zone.
200	1858	4			HH	1	Shear.
220					219		- Shear.
240				5			- Shear.
	1829	4		2	$\mathbb{H}\mathbb{H}$	1	
260							1 Chara sans
280							- Shear zone.
300	1800			1			
320				- 5			
340		47					

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Site	Watana (South Bank)	Sheet No.	_2_ of3_
Project	Susitna Hydroelectric Project	Hole No	BH-12
Client_	ALASKA POWER AUTHORITY	Job No	P5700.05

(FT)	ELEV (FT.)	PERMEABILITY (K) cm/sec	CORE RECOVERY %	#00 % 20 40 60 90	NUMBER OF JOINTS PER IOFT	ROCK TYPE	REMARKS
360			G	4		Diorite	] Alteration zone.
380							
400	1741						☐ Fracture zone.
420							
440	1711						
460	1711	•					Fracture/alteratio
480							Shear/alteration zone.
500	1682				Ш.		Shear/alteration zone.
520		No Test					Shear.
540	1653	Data		-7			□ Shear/fracture zon
560							
580				[_	Ш	Quartz Diorite	Shear. Shear. Shear/alteration zone.
600	1623					Didi ite	
620				2			
640	1594-						
660	1004					Granodiorite	
680				4		Quartz Diorite	Alteration zone.

### SUMMARY LOG

Client \_\_ ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. BH-12 Watana (South Bank)

Sheet No. 3 of 3

(FT.)	ELEV. (FT.)	PERMEABILITY (K) cm/sec	CORE RECOVERY % 20 40 60 80	#00 % 20 40 60 80	NUMBER OF JOINTS PER IOFT	ADCK TASE	REMARKS
200						Quartz Diorite	- Shear. - Shear.
720							
740	1535						Shear/alteration zone.
760	1333			1		ĺ	Dike, felsic.
780							Shears. Shear.
800	1506						
							END OF BORING 798.9'
						}	
							1
						-	1
							1
							1
							1
						-	
						1	

### SUMMARY LOG

Cirent	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	COE DH-1
Site	Watana	Sheet No.	l_ofl_

0 1459		20 40 60 80	20 40 60 80	NUMBER OF JOINTS PER 10 FT 5 IO 15 20	ROCK TYPE	REMARKS
					Overburden	
20					1	
40						TOP OF ROCK 43.8
60 1409	4				Quartz Diorite	- Shear, breccia.
80					1	
100 1359						Shear, fracture, alteration zone.
120						Dike, andesite.
1319						122.8*

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No. P5700.01

 Project
 Susitna Hydroelectric Project
 Hole No. COE DH-3

 Site
 Watana
 Sheet No. 1 of 1

DEPTH (FT.)	ELEV (FT)	PERMEABILITY (K) cm/sec	CORE RECOVERY	*QD	NUMBER OF JOINTS PER IOFT	ROCK TYPE	REMARKS
0	1458	0.0.02	20 40 60 80	20 40 60 80	5 6 15 20	Overburden	
20							
40							
60 -	1408						
80				1111		Quartz	TOP OF ROCK 77.6
						Diorite	
100	1358						
120				1			
140				4			
160							
						<b>!</b>	
180	1278						END OF BORING 174.5'
				++++	1		
						1	
					<u> </u>		
						1	
	-			++++	1 + + + +	-	

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	COE DH-4
Site	Watana	Sheet No.	_1_ of _1_

REMARKS	ROCK TYPE	NUMBER OF JOINTS PER JOFT	#400 % 20 40 60 90	CORE RECOVERY %	PERMEABILITY (K) cm/sec of p4 p2	ELEV (FT)	DEPTH (FT.)
	Overburden					1461	0
							20
							40
						1411	
TOP OF ROCK 70.0			1111				60
	Ouartz						80
	Diorite						00
Core loss 4.3'.						1361	100
				+			
FUD OF BODING							120
FND OF BORING 122.9'					111111		
							140
					+		
	10-17						
							-

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 COE DH-5

 Site
 Watana
 Sheet No.
 1 of 1

	_						
(FT)	ELEV (FT.)	FERWEABILITY IN1 cm/sec	COME MECOVERY	*00 % 20 40 40 80	NUMBER OF JOINTS PER JOFT	HOCK TYPE	*EMA**S
0	1461					Overburden	
26							
40							
60	411						TOP OF ROCK 59.6'
80				7-		Ouartz Dio: ite/	Andesite porphyry(
			115			Grano- diorite	Alteration zone.
100	1361						4
120							
140							
160	1311			_			
180							THE OF BORING
100							END OF BORING 176.9'
						17. 14. 6	
- 1							
	-		للنب				

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Client\_ Hole No. COE DH-6 Project Susitna Hydroelectric Project Sheet No. \_\_\_ of \_\_\_ Site Watana PERMEABILITY COME MECOVEMY NUMBER OF JOINTS PER TOFT DEPTH ELEV REMARKS HOCK TYPE Reg 11g1ble Flow TOP OF ROCK 3.5' Diorite/ Quartz Diorite Alteration zone. 40 Quartz 60 Diorite 80 100 1616 Fracture zone. 120 Fracture zone. 140 1566 END OF BORING 149.6' 160

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client_	ALASKA POWER AUTHORITY	Job No.	P5700.05	
Project	Susitna Hydroelectric Project	Hole No.	COE DH-7	
Site	Watana	Sheet No.	1 of	1

(FT)	ELEV (FT.)	PERMEABILITY (K) cm/esc (5.6 (c.4 (c.2)	COME MECOVERY % 20 40 60 80	#00 % 20 40 60 80	NUMBER OF JOINTS PER IOFT	ROCK TYPE	REMARKS
0	1716					Overburden	TOP OF ROCK 8.5
20						Diorite/ Quartz Diorite	
40 -	1673					DIOTILE	□Shear/alteration
60 -	1075						zone. □Zone of four
80			医医学电影 医医医系统				closely spaced felsic dikes.
100 -	1630						
120							END OF BORING
140	1596						122.2'
							Land Harris



### SUMMARY LOG

Client ALASKA POWER AUTHORITY

Project Susitna Hydroelectric Project

Job No. P5700.05 Hole No. COE DH-8

Site Watana

Sheet No. 1 of 1

(FT.)	ELEV (FT)	PERMEABILITY	COME MECOVERY	*00 % 20 *0 60 *0	NUMBER OF JOINTS PER JOST	ROCK TYPE	HEMARKS
0	1910	HIII				Overburden	TOP OR ROCK 16.2"
20						Quartz Diorite	Breccia healed
40	1860						andesite matrix.
60 -						Diorite	
80							
100	1810						
120		•					Series of shear
140							zones, (3) 0.5" each.
160	1760						END OF BORING 150.0'
							13010
							7 -7 43

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client ALASKA POWER AUTHORITY

Project Susitna Hydroelectric Project

Watana

Job No. P5700.05 Hole No. COE DH-9

Sheet No. 1 of 1

DEPTH (FT.)	(F1)	PERMEABUTY (K) cm/sec (5 g 4 g 2	CORE RECOVERY AGO	IONTS PER	MOCK TYPE	REMARKS
20	1913				Quartz Diorite	TOP OF ROCK 5.6' Breccia, healed with green igneous
40	1878			4		rock.
6C -	18/8					Fracture zone.
80 -			40000			
100	1843					Shear/fracture zon □Andesite dike.
120						
140					Felsic Dike	
160	1808				Diorite	a asymptotic
180			Ш.			
200	1773					
220						
240 -						
260	1738					Fracture zone.
280		F-14-4		-		
	1701	T1111				END OF BORING 284.2'
300 -	1703-					204.2

Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. COE DH-10 Sheet No. 1 of 1 Site Watana PERMEABILITY CORE RECOVERY ELEV HOCK TYPE REMARKS Overburden TOP OF ROCK 19.6' 20 Andesite Porphyry Diorite breccia in 40 andesite. 1983 Alteration zone. 60 Diorite breccia in 80 andesite. 100 1933 Diorite breccia in andesite. 120 Alteration zone. 140 1883 Negligible 160 □ Fracture zone. 180 200 END OF BORING 203.5 220 1813

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitha Hydroelectric Project Hole No. COE DH-11 Site Watana Sheet No. \_1\_ of \_1 NUMBER OF JOINTS PER JOFT PERMEABILITY CORE RECOVERY DEPTH (FT.) ROCK TYPE REMARKS Overburden TOP OF ROCK 22.7' 20 Diorite 40 1998 Fracture zone. 60 80 100 1963 Fracture zone. Fracture zone. 120 140 1928 Dike, andesite (?). 160 180 Shear/alteration 1893 zone. 200 Shear/alteration zone. 220 240 1858 260 -280 300 1823 END OF BORING 300.0

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 COE DH-12

 Site
 Watana
 Sheet No.
 1 of 1

(FT.)	ELEV (FT.)	PERMEABILITY (K) cm/skc	COME MECOVEMY	*60 %	NUMBER OF JOINTS PER IOFT	HOCK TYPE	*****
0	1951					Overburden	TOP OF ROCK 9.5'
20 -				3		Diorite/ Quartz Diorite	
40	1901	Flow				Quartz Diorite	
60		itble	9				Shear/alteration zone.
80		Negligibl		-			
100	1851	-		2			Fracture zone, minor shears.
120			5 5 5 5 5 5 5 5 5 5				
140				-47			
160	1801						
180							] 177-184.3 Shear/ alteration zone.
200	1751		有意思生物 医电影性的				afteration zone.
220							
240	1701						
260	1701						
280			<b>医医院</b> 医甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基甲基				201 2 205 5 56
300-	1651		68888				291.3-295.5 Shear zone, healed.
320-							END OF BORING 301.1'

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 COE DH-21

 Site
 Watana
 Sheet No.
 1 of 2

(FT)	ELEV (FT.)	PERMEABILITY INT CM/MC	20 42 60 80	*** **	NUMBER OF JOINTS PER JOFT	ADCK TYPE	*****
0	1478					Overburden	
20				1111	++++		
40							
60	1436						
10							TOP OF ROCK 84.5
100	1393					Quartz Diorite	
120							
140							
160	1351						Alteration zone.
180							
200	1309						
220							
240							Alteration zone.
260	1267						Alteration zone.
280							☐ Alteration zone.
300 -	1224						☐ Alteration zone.
32C -				1			Arteración zone.
340							

Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Hole No. COE DH-21 Project Susitna Hydroelectric Project Sheet No. 2 of 2 Site PERMEABILITY (K) on/HC COME MECOVERY -ROCK TYPE Quartz 360 Diorite 380 400 1140 420 440 1098 Alteration zone. 460 480 500 1056 Andesite 520 Ouartz 540 Diorite 1014 560 Alteration and sheared zone. 580 600 972 END OF BORING 603.7 620

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 COE DH-23

 Site
 Watana
 Sheet No.
 1 of 1

SERVICES CORE RECOVERY DOD NUMBER OF

(FT.)	(FT.)	PERHEABILITY (A) cm/sec of o4 o2	20 40 60 80	**** % 20 *0 60 <b>5</b> 0	NUMBER OF JOINTS PER JOFT	HOCK TYPE	HEMARKS
C	1952					Overburden	TOP OF ROCK 7.0"
20						Diorite	
40	1000		2025 2025	5			Terror terror
60	1902	e Flow					Shear/fracture zon Shear/fracture zon Shear/fracture zon
80							Shear/fracture zon
100	1852	Negligibl					
120	1832						END OF BORING 119.2'
			ШШ	ЩЦ	ШШ	<u> </u>	

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. COE DH-24 Watana Site Sheet No. 1 of 1 PERMEABILITY CORE RECOVER (#) cm/sec Overburden Quartz 20 Diorite 40 60 80 100 1961 120 Irregular contact with andesite. 140 1921 END OF BORING 139.91

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Client Susitna Hydroelectric Project Project Hole No. COE DH-28 Site Sheet No. \_\_\_ of \_\_\_\_ PERMEABILITY COME RECOVERY ELEV REMARKS Overburden TOP OF ROCK 9.2' Andesite 20 Porphyry Shear/fracture zone 40 1921 60 Shear/fracture zone 80 Shear/fracture zone. 100 1871 Fracture zone. 120 Andesite END OF BORING 140 1931 125.2'

APPENDIX C
DEVIL CANYON DIAMOND CORE DRILLING LOGS

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO : BH-1

SITE

Devil Canvon (North Bank)

SHEET NO. 1 OF 24

CONTRACTOR: The Drilling Company LOGGED BY: K.J. White, M.P. Bruen

DRILLING DATES: August 23 To August 31, 1980 DATE: July 1981

SOIL

Casing Advancer
Diamond Core - Triple Tube

CASING DIAMETER: NW (3.0") I.D.

CORE DIAMETER: NO (1.75") 0.D.

DRILLING METHOD: LOCATION:

LATITUDE N3,223,408

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4
GROUND SURFACE 1413.7

DEPARTURE E615,930 AZIMUTH 225°

1402.8 ROCK SURFACE 723.1

BOTTOM OF HOLE

1221.7 (11-21-80)

NOTES: 1) Depths measured along hole. True depths in ( ).
2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAM, CAVING, LOST CORE, GEMENTING, ETC.	RUN LENGTH	REC (RGD)
0.0	Overburden	Sandy gravel with layer of silt and scattered cobbles. Not sampled.		
10 (12) 11.8 (10.9)	2)	Medium to dark gray, fine grained, nonfoliated to weakly developed foliation parallel to bedding, 20°. Fresh to slightly weathered, hard, well indurated. Joints generally close	11.8 to	85 (23)
20 (18.4)		spaced with iron oxide staining. Zones of quartz veins and stringers, minor sulfide mineralization.  11.8-30.8 - Numerous quartz veins and stringers, highly folded bedding. Quartz veins (12.7-13.7, 20.8-22.2, 27.1-27.5) are highly fractured but tight, vuggy, crosscutting foliation, contacts are irregular and rough. Quartz stringers are parallel to	15.8 Run 2 15.8 to 20.8	100 (86)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank) SHEET NO 2 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	PEC (P00)
	Argillite	bedding/foliation at 0°-30°, less than 1 inch wide, folded, stretched, less fractured than veins, contacts generally tight. 11.8-80.1 Joint spacing generally close, generally planar and smooth, iron oxide stained, minor quartz and carbonate coating. 11.8-14.9 Core loss of 0.6 ft. Core broken	Run 3 20.8 to 26.2	85 (78)
30		by drilling, clay on some joints. 17.0-20.0 No drilling water return. 17.4-17.9 Core broken by drilling, clay on some joints. 20.8-35.0 Core loss of 1.8 feet.	Run 4 26 2 to 31.3	86 (80)
(27.6)		33.0-33.7 Core broken by drilling zone of quartz stringers 0.5 in. thick.	Run 5 31.3 to 35.0	92 (30)
		36.7 Bedding/foliation is at 20°. Rock does not tend to break along bedding/foliation.	Run 6 35.0 to 40.0	100 (80)
40 (36.8)			Run 7	100
42.5 39.1)	Argillite/ Graywacke	Interbedded argillite and graywacke. Argillite as above, with very thin beds of graywacke, light to medium gray, 20 percent to 30 percent fine to medium sand in argillaceous matrix,	40.0 to 45.0	(52)
		grains elongate parallel to bedding/foliation generally at 20°, foliation is poorly developed. Fresh, hard and well indurated. Joint spacing is generally close, generally planar and rough, iron oxide stained, some carbonate and quartz filling.	Run 8 45.0 to 49.0	100 (90
50 46.0)		carbonate and quartz riving.	Run 9 49.0	100 (45)
		52.8-53.5 Clay on joint surface at 20°.	53.2	

CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

P5700.05

PROJECT Susitna Hydroelectric Project

WOLE WO BH-1

HOLE NO BH-1

Devil Canyon (North Bank)

SHEET NO 3 OF 24

PROJECT Susitna Hydroelectric Project Devil Canyon (North Bank)

ALASKA POWER AUTHORITY

CLIENT

SITE

SHEET NO 4 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	960 (920)
	Argillite/ Graywacke	54.3-61.2 Quartz stringers, spacing is very close to close, less than 0.1 in. wide, healed joints at 60° to 90° are quartz filled.	Run 10 53.2 to 58.3	98 (71)
60 (55.2)			Run 11 58.3 63.5	100 (85)
		62.2 Bedding/foliation is at 20°. 63.5-67.7 Fracture zone, joint and fracture spacing is very close at 15° to 30° and 50° to 70°, planar, smooth to rough. Quartz veins Bedding/foliaton is highly folded and stretched	Run 12	30 (0)
		Core loss of 1.5 feet.  68.8-69.2 Quartz vein at 20° to 90°, highly	Run 13 64.5 to 68.9	82 (34)
70 64.4)		fractured but tight, irregular, vuggy.  70.7-72.0,72.3-72.6 Quartz veins, highly fractured but tight, vuggy, sulphide mineralization. 72.6-77.0 Quartz stringers, parallel to	Run 14 68.9 to 72.3	100 (76)
		bedding/foliation at 0°, less than 0.5 in. wide Contacts are tight.	Run 15 72.3 to 77.2	98 (90)
1		77.2-105.0 No drilling water return.		
80		80.1-108.5 Fracture zone, joint and "hairline"	Run 16 77.2 to 80.7	94 (69)
(73.6)		fracture spacing is very close, 0° to 20° and 60° to 90°, irregular and discontinuous, carbonate and iron oxide staining on most joints, silt on joints from 92.6 to 103.3, slickensides at 93.0 and 105.0 on joints at 0° to 15° and 80°.	Run 17 80.7 to 84.0	82 (48)

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TENTURE, POLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE HUN	(400)
	Argillite/ Graywacke	88.8-101.8 Quartz veins highly fractured but tight, discontinuous, vuggy. Contacts are irregular. Comprise 70 percent of rock.	Run 18 84.0 to 90.0	83 (57)
(82.8)			Run 19 90.0 to 94.4	82 (39)
1			Run 20 94.4 to 97.8	88 (53)
100 (92.1)			Run 21 97.8 to 101.5	54 (8)
		105.0 Bedding/foliation is at 10° to 20°. Argillite is "spotted" with a dark mineral less than 0.05 inch (possibly biotite). 105.7-106.7 Quartz yein, highly fractured,	Run 22 101.5 to 105.0	57 (31)
110 (101.3)		fractures at 40° and 70°, vuggy, sulphide mineralization. Contacts are irregular at 0° to 10°.  108.5-175.0 Joint spacing is close to moderately close, joints are generally planar, smooth to rough iron oxide stained, few with	Run 23 105.0 to 109.1	98 (59)
		carbonate or quartz filling. 110.3-113.9 Quartz stringers, close spacing, stretched, irregular, discontinuous, tight. 112.5-114.7 Core loss of 1.7 ft.	Run 24 109.1 to 112.5	100 (41)
		113.9-114.7 Quartz vein, highly fractured but tight, irregular, fractures at 30°, vuggy, minor iron oxide staining.	Run 25 112.5 to	86 (29)

ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS

BUFFALO , NEW YORK

DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project NOLE NO. BH-1

SITE Devil Canyon (North Bank) SHEET NO. 5 OF 24

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (F1.)	#EC [#20]
	Argillite/ Graywacke	117.6-118.6 Quartz vein, highly fractured but tight,	Run 26 117.6 to 120.9	100 (73)
120.9 (111.3)	Argillite	Medium to dark gray, very fine grained, bedding and poorly developed foliation are at 5° to 15°, very thinly laminated, sulphide mineralization. Fresh, hard, well indurated. Joint spacing is close to moderately close, joints are generally planar, smooth to rough, very few with	120.9 to	100 (53)
		carbonate or quartz filling. 120.9-124.5 Quartz stringers, spacing is very close to close, mostly at 50° to 90°, some at 0°, less than 0.1 in. wide. 120.9-129.0 Clay filling in joints.	Run 28 125.4 to 129.0	100 (22)
130 (119.7)		129.0-134.0 Healed fractures, quartz stringers irregular, discontinuous, tight, less than 0.1 in. wide.	Run 29 129.0 to 134.0	100 (78)
		133.2-134.0 Fracture zone, joint spacing very close, joints at 0° to 20°, iron oxide staining, trace clay and cartonate. slight weathering on joints. Core loss 0.4 feet.	Run 30 134.0 to 139.2	92 (93)
140 - (128.9)		139.5 Bedding/foliation, 20°.  143.0 Sulphide minerals up to 0.5 inches becoming abundant. Progressive replacement with quartz.  144.3-148.0 Core loss 0.2 feet.	Run 31 139.2 to 144.3	98 (92)
		144.3-140.0 Core 1055 0.2 reet.	Run 32 144.3 to	95 (81)
-		148.5 Bedding/foliation, 10°.	148.0	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project NOLE NO. BF-1

SITE Devil Canyon (North Bank) SHEET NO. 6 OF 24

DEPTH LFT?	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF RUN (FT)	HEC (400)
150 (138.1)	Argillite	149.0-157.9 Argillite interbedded with medium gray, fine grained graywacke, beds 2 inches to 2 feet wide, beds are highly folded, possible sheared along bedding planes, healed, tight, hard.		
			Run 31 153.2 to 156.2	100 (73)
		158.5-158.7 Quartz vein, discontinuous, irregular, tight, 0.5 inch wide.	Run 35 156.2 to 161.5	93 (81)
160 - (147.3)			Run 3€ 161.5 to 166.5	100 (100)
170 (156.5)			Run 37 166.5 to 171.5	96 (96)
			Run 38	100
			171.5 176.9	(92)
		175.0-276.1 Joint spacing is generally moderately close, joints are generally planar, rough to slick, very few with iron oxide staining or quartz filling.	Run 39 176.3 to 181.4	100
180 (165.7				

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JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

Devil Canyon (North Bank)

SHEET NO. 7 OF 24

DEPTH (FT)	MOCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	HEC (HQD)
	Argillite	182.2-184.0 Bedding/foliation highly folded. fractures are healed with quartz, tight, hard.	Run 40 181.4 to 186.3	100 (100)
190			Run 41 186.3 to 191.5	100 (100)
191.5 (176.3)	Argillite/ Graywacke	Interbedded argillite and graywacke, Argillite is dark gray, very fine grained, very thin to thinly bedded. Graywacke is reddish gray, fine to medium grained, Bedding and poorly developed foliation are at 0° to 30°. Generally fresh, hard, well indurated, Joint spacing is moderately close.	Run 42 191.5 196.4	100 (100)
200		193.7-199.2 Quartz stringers and pods, closely spaced, folded, parallel to and crosscutting bedding/foliation, tight, less than 0.5 in. wide.	Run 43 196.5 to 201.5	100 (100)
(184.1)			Run 44 201.5 to 204.9	100 (94)
-			Run 45	
		207.3-207.4 Quartz vein, folded, tight.  209.0-209.9 Fracture zone, open, very close spacing, fractures parallel bedding/foliation	to 209.9	(72)
210 (193.3		at approximately 10°, slickensides, iron oxide staining. Core broken during drilling. 209.9-215.8 Fracture, joint spacing is very close to close, average 2 inches at 0° and 70° to 90°, irregular, tight, healed with quartz.	Run 46 209.9- 214.9	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

Devil Canyon (North Bank)

SHEET NO. 8 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(PQD)
	Argillite/ Graywacke			
		216.3-217.7 Lithic graywacke, subangular to subrounded argillite and graywacke fragments, up to 1 inch.	Run 47 214.9 to 220.0	88 (87
220 (202.5)		220.0-221.5 Fracture zone, joint spacing very close, at 0°. Core broken into fragments less than 1 inch, surfaces smooth and coated/filled with grayish green clay. Core loss of 0.6 feet. 222.5-223.1 Quartz pods, parallel to and crosscutting bedding, irregular, discontinuous.	Run 48 220.0 to 225.1	100 (65)
		227.0 Bedding/foliation is at 10°.	Run 49 225.1 to 230.0	100 (100)
230 (211.7)		230.2 Quartz vein at 50°, tight, 0.5 inch wide. 231.5-232.0 Quartz vein at 0°, 1 inch wide. 232.7-235.3 Healed shear/fracture zone, joint spacing is very close, beds offset, brecciated, healed with quartz, tight, hard, fractures irregular at approximately 70° to 90°. 235.0-240.1 Core loss of 0.9 feet.	Run 50 230.0 to 235.0	100 (100)
			Run 51 235.0 to 240.1	82 (82)
240 220.9)		241.6-241.8 Fracture zone, joint spacing is very close, joints at 0° to 10°, clay coating. 241.8-249.0 Quartz stringers, spacing is very close to close, some offset along bedding/foliation, healed, tight.	Run 52 Run 53 241.8 <sup>-</sup> 246.9	(88) 98

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SHEET NO 9 OF 24

Susitna Hydroelectric Project PROJECT

Devil Canyon (North Bank)

HOLE NO BH-1

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PROJECT Susitna Hydroelectric Project Devil Canyon (North Bank)

ALASKA POWER AUTHORITY

JOB NO. P5700.05 HOLE NO BH-1

SHEET NO 10 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION: COLOR, TEXTUPE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	9EC (900)
	Argillite/ Graywacke	246.0 Bedding/foliation is at $0^{\circ}$ to $10^{\circ}$ .		
250			Run 54 246.9 to 251.5	98 (98)
(230.1)		251.0-252.0 Joints at 10° and 30°, slickensides		
		253.5 Bedding /foliation is at 30° 254.1-277.3 Joint spacing is close, chlorite/ talc coating.	Run 55 251.5 to 255.9	100 (84)
256.0	Graywacke	Reddish gray, fine to medium grain sand in argillaceous matrix, bedding/developed foliation is at 0° to 10°. Generally fresh, hard, well indurated. 259.0-262.5 Bedding/foliation intensely folded brecciated and healed with carbonate, tight.	260.5	100 (100)
239.3)		hard. 261.5-262.5 Fracture zone, joint spacing very close, 0° to 40°, irregular to planar,	Run 57 260.6- 262.5	100 (50)
		discontinuous, talc coating.  265.0-276.1 Quartz stringers at 40° to 70°, less than 0.1 inch wide, closely spaced.	Run 58 262.5 to 265.5	94 (70)
		265.8 Bedding/foliation is at 0° to 10°.	Run 59 265.6 to 270.3	98 (94)
270 (248.5)			Run 60	
271.8	Argillite	Dark gray, very fine grained, very thinly laminated, massive. Fresh, hard, well indurated 274.2 Probable fracture zone, joint spacing very close, light green mineral coating. Core	270.3 I. to 274.2	(54)
276.1		broken by drilling, core loss of 1.2 ft. 276.1-2763 Contact zone, brecciated argillite.	Run 61	100 (26)

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF HUN (FT)	PEC (RQD)
Mafic Dike (Diabase?)		Dark yellowish brown to dark green, fine grained feldspar laths, 5% white, radiating zeolites up to 0.2 in., flow structure at 30°. Joint spacing is close, slickensides on most joints. Slightly weathered, hard.	Run 62 276.1 to 280.3	98 (43)
	276.1-277.0 Chilled zone, very fine grained. 276.1-296.0 Drilling water return 50%. 276.1-310.8 Joint spacing is close to very close, joints are generally planar, slick and open, iron oxide staining on most joints, talc coating on few.	Run 63 280.3 to 285.2	100 (67)	
			Run 64	100 (57)
-			Run 65 286.6 to 291.5	94 (71)
290 _ (266.9)	294.8-296.0 Chilled zone, very fine grained.	Run 66 291.5 to 296.0	100 (93)	
296.0				
272.5)	Graywacke	Reddish gray, fine grained, massive. Generally fresh, hard. 296.0-300.4 Shear/fracture zone, joint spacing is very close, joints at 40° to 60°	Run 67 296.0 to 298.9	79 (28)
300 (276.2)		and 20°, slickensides on many surfaces, talc, chlorite coating, random, irregular fractures Core loss of 0.6 feet. 297.0-298.9 Core broken by drilling. 301.0 Bedding is at 50°. 303.7-304.3 Healed fracture zone, fracture	Run 68 298.9 to 303.0	100 (100)
		spacing very close, quartz filling, tight, hard. 305.0-308.5 Numerous healed joints and	Run 69 303.0- 305.0	(85)
		fractures, joints at 0° and 30°, fractures at 65° to 90°, talc/chlorite coating on many surfaces. Core broken by drilling, core loss	Run 70	82 (0) 98
		of 0.6 feet.	306.1- 311.0	(69)

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PROJECT Susitna Hydroelectric Project

HOLE NO. BH-1

SITE Devil Canyon (North Bank)

SHEET NO 11 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTUTE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC	LENGTH OF RUN (FT)	HEC (920)
310 (285.4)	Graywacke	310.8-598.2 Joint spacing generally close to moderately close, generally planar, smooth,		
		carbonate, chlorite and talc coating.	Run 72 311.0 to 315.7	94 (94)
			Run 73 315.7 to 320.0	100 (95)
320 (294.6)			Run 74 320.0 325.0	100 (92)
-		324.0-326.0 Healed breccia, fracture spacing is very close, quartz filling, tight, hard.		
		329.7-334.7 Core loss of 0.4 feet.	Run 75 325.0 to 329.7	100 (68)
330 303.8)		331.2 Sharp contact, tight.	Run 76	92
331.2	Graywacke (Conglomerate)	Reddish, medium to dark gray, fine grained argillaceous matrix with 50 percent to 60 percent angular to subrounded rock fragments of sedimentary. volcanic and plutonic origin, fragments 0.01 ft. to 0.3 ft., no foliation.	329.7 to 334.7	(92)
		massive, very thin interbeds of arqillite. Fresh, hard. Joint spacing moderately close, chlorite/talc and carbonate coating.	Run 77 334.7 to 339.3	98 (96)
340 313.0)				

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO. 12 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(RQD)
	Graywacke (Conglomerate)		Run 78 339.8 to 345.0	98 (92)
		345.0-381.5 Drilling water return less than 50 percent.	Run 79 345.0 to 349.7	100 (100)
350 (322.2)			Run 80 349.7 to 355.0	100 (89)
		356.1-360.7 Graywacke conglomerate inter- calated with reddish gray, aphanitic igneous rock containing subrounded to subangular felsic fragment up to 0.5 inches, hard, contact at 50°, tight.	Run 81 355.0 to \$360.1	100 (100)
360.7	Folois Dibo		Run 82	100
(332.0)	Felsic Dike (Rhyodacite)	Light to medium gray with reddish brown streaks, aphanitic, highly silicic, occasional plagioclase and quartz phenocrysts, inclusions of argillite and graywacke, flow structures at	Run 83 361.3- 363.4	(100) 100 (100)
-		50°. Fresh, very hard, tight contacts. Joint spacing close, are planar, smooth to rough.	Run 84	100
			Run 85 364.4 to 369.3	100 (100)
370.2 340.8)	Graywacke	Rock description, as above.	Run 86 369.3	100 (77)
	(Conglomerate)		to 373.6	

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Susitna Hydroelectric Project

HOLE NO BH-1

Devil Canyon (North Bank) SITE

SHEET NO 13 OF 24

DEPTH (FT)	MOCH TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLKTON, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	HEC (#93)
	Graywacke (Conglomerate)	373.4-373.5 Joint at $70^{\circ}$ to $80^{\circ}$ , clay filling and rock fragments.	Run 87 373.6 to 378.8	100 (100)
380 (349.8)		381.5-401.5 Core broken by drilling, joint spacing is moderately close, joints healed.	Run 88 378.8 to 381.5	96 (67)
		Spacing is moderately close, joints heared.	Run 89 381.5 to 386.6	100 (100)
-		386.5-391.4 Core loss of 0.3 feet.		
390 359.01			Run 90 386.5 t 391.4	94 (86)
333.0)			Run 91 391.4 to 396.5	100 (94)
400			Run 92 396.5 to 401.5	100 (66)
368.2)		401.0-405.7 Healed fractures at 30°, spacing is very close to close, discontinuous, carbonate filling.	Run 93 401.5 to 406.6	100 (100)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE

Devil Canyon (North Bank)

SHEET NO 14 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	DE RUN	REC (490)
410 -	Graywacke (Conglomerate)	408.1-424.1 Core loss of 1.5 feet.	Run 94 406.6 to 411.5	88 (88)
(377.4)		413.4-413.8 Core badly broken, angular fragments up to 0.15 ft. Joint at 15°, slickensides, chlorite coating.	Run 95 411.5 to 415.3	97 (47)
			Pun 96 415.3 to 420.3	96 (62)
420 (386.6)			Run 97 420.3 to 424.1	84 (76)
			Run 98 424.1 to 429.3	98 (98)
430 395.81			Run 99 429.3 to 434.3	100 (100)
			Run 100 434.3- 439.4	98 (88)

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Susitna Hydroelectric Project

HOLE NO BH-1

SITE

Devil Canyon (North Bank)

SHEET NO 15 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE MUN	(#QD)
440 405.0)	Graywacke (Conglomerate)		Run 101 439.4 to 444.4	100 (100)
			Run 102 444.4 to 449.5	100 (100)
450 (414.2)		454.7-514.8 Drilling water return 50 .	Run 10: 449.5 to 454.7	100 (9€)
	_		Run 104 454.7 to 459.8	100 (100)
460 423.4)			Run 10: 459.8 to 463.8	100 (95)
		468.6-497.0 Fracture and joint spacing is very close to close averaging 2 in., fractures and joints at 0° to 90° but mostly 30°, discontinuous, irregular, tight but some broken	to 468.6	5 100 (100)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank) SHEET NO 16 OF 24

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF RUN (FT)	(400)
470 - (432.6)	Graywacke (Conglomerate)	by drilling. Talc/chlorite, quartz, carbonate and white mica coating. Core loss of 1.0 ft.	Run 107 468.6 to 473.1	100 (100)
			Run 108 473.1- 475.3	87 (81)
			Run 109 475.3 to 480.4	100 (100)
480 441.8)			Run 110 480.4 to 485.4	100 (100)
			Run 111 485.4 to 488.7	100 (94)
490 (451.0)			Run 112 488.7 to 491.5	96 (63)
			Run 11: 491.5 to 496.7	(79)
500		497.0-500.0 Fracture and joint spacing generally close with zones of very close, discontinuous, tight. Talc, carbonate and minor quartz and white mica filling.	Run 114 496.7 to 501.4	100 (96)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO. 17 OF 24

DEFTH	SE TYPE	OFSCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (420)
	Graywacke (Conglomerate)		Run 115 501.4 to 506.5	100 (100)
510			Run 116 506.5 to 511.5	100 (100)
(469.5			Run 117 511.5 to 514.8	100 (94)
			Run 118 514.8 to 519.9	100 (100)
520 178.7)			Run 119 519.9 to 525.1	98 (98)
			Run 120 525.1 to 530.4	100 (94)
530 187.9)		530.4-539.0 Core loss of 0.5 feet.	Run 121 530.4- 534.0	86 (87

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO 18 OF 24

DEPTH (F1)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF RUN (FT)	HIC HQL
	Graywacke (Conglomerate)		Run 122 534.0 to 539.0	
540 497.1)	543.5 Joint at 35°, planar, slickensides on talc.	Run 123 539.0 to 544.3		
			Run 124 544.3 to 549.2	98 (96)
550 606.3)			Run 125 549.2 to 554.5	100 (100)
			Run 126 554.5 to 559.7	98 (92)
560 515.5)		563.4 Quartz vein 0.1 feet wide. 564.3 Joint at 55°, planar, slickensides on chlorite/talc.	Run 127 559.7 to 564.8	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1 PROJECT Sus

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Devil Canyon (North Bank)

SHEET NO 19 OF 24

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	(RQ0)
	Graywacke (Conglomerate)		Run 128 564.8 to 569.9	100 (96)
570 524.7)		574.0-582.0 Lithic fragments increase to	Run 129 569.9 to 575.1	100 (96)
		cobble size, up to 6 inches.		
		577.8-578.9 Joints at 40° to 50°, spacing is very close, joints healed, chlorite/talc coating, some slickensides. Core broken by drilling, angular pieces. 579.9-645.2 Drilling water return less than	Run 130 575.1 to 579.9	100 (85)
533.9)		50%.	Run 131 579.9 to 584.9	100 (100)
			Run 132 584.9 to 590.1	100 (100)
590 543.1)			Run 133 590.1 to 595.1	100 (96)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO 20 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	HEC
600	Graywacke (Conglomerate)	598.2-602.2 Healed fracture zone joint spacing very close, joints at 0° to 10° irregular, rough, carbonate healed, joints at 70° to 90° irregular, rough, carbonate healed, talc/	Run 134 595.1 to 599.5	98 (89)
600 552.3)		chlorite filling. Most joints tight but some broken by drilling.  598.2-637.7 Joint spacing is generally close, planar, smooth, tight, coated with talc/chlorite and carbonate.	Run 135 599.5 to 604.2	100 (79)
			Run 136 604.2 to 609.1	100 (100)
610			Run 137	93
561.5)		612.4-613.3 Quartz vein, highly fractured, tight, irregular, inclusions of argillite. 614.9-620.5 Fracture zone, joint spacing is very close, joints at 30°, healed with talc/	Run 138 510.5 to 614.8	100
		chlorite, tight but some broken by drilling. 615.0-630.0 Lithic fragments up to 0.7 feet.	Run 139 614.8 to 619.8	100 (96)
620 570.7)			Run 140 619.8- 621.7	100 (84)
		623.8 Increasing amounts of very thin to thin beds of argillite.	Run 141 621.7 to 626.8	98 (98)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

Devil Canyon (North Bank)

SHEET NO 21 OF 24

DEPTH (FT.)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	CENGTH OF HUN (FT)	HE: (#20)
630 - (579.9)	Graywacke (Conglomerate)	630.0 Joint at 20°, 0.04 inch of calcareous clay.	Run 142 626.8 to 631.7	(100)
		632.0-634.0 Joint spacing is very close, at 30°, discontinuous, tight.	Run 143 631.7 to 636.7	(100)
640 589.1)		637.7-721.3 Joint spacing is close to moderate close, joints generally planar, smooth, coated with carbonate, chlorite and talc.	Run 144 636.7 to 641.4	100 (100)
369.17			Run 14: 641.4 to 645.1	100 (100)
			Run 146 645.1 to 650.0	100 (82)
		649.3-649.8 Core broken by drilling.		-
650 598.3)			Run 147 650.0 to 655.2	100 (100)
		655.2-660.9 No drilling water return.	Run 148 655.2 to 660.4	100 (87)
660 607.5)				

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

Devil Canyon (North Bank) SITE

SHEET NO 22 OF 24

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF HUN (FT)	HEC (HQO)
	Graywacke (Conglomerate)		Run 149 660.4 to 665.6	90 (90)
670			Run 150 665.6 to 670.8	96 (92)
516.7)			Run 151 670.8 to 675.8	100 (100)
680		678.9-683.8 Shear/fracture zone, fracture and joint spacing very close, joints at 70°, planar smooth, fractures irregular, rough. Carbonate and talc/chlorite coating on most surfaces.	Run 152 675.0 to 580.5	89 (62)
525.9)		slickensides on some joints. 678.9-690.0 Core loss of 0.2 feet.	Run 153 580.5 to 683.9	85 (24)
			Run 154 683.9 to 690.0	85 (60)
690 635.1)		689.8 Joint at 0°, planar, slickensides on chlorite. 690.1-693.0 Fracture zone, joint spacing is very close, joints at 30° to 40°, planar, smooth, healed with carbonate and chlorite, some broken by drilling.	Run 150 690.0 - 695.2	

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO 23 OF 24

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	MEC (MQD)
	Graywacke (Conglomerate)		Run 156 695.2 to 700.5	98 (98)
700 _ (644.4)			Run 157 700.5 to 7J5.6	98 (98)
710		707.0-708.3 Shear/fracture zone, joint spacing very close, joints at 30° to 50°, chlorite and sulphide mineralization, slickensides on one joint.	Run 158 705.6 to 710.6	100
653.6)			Run 159 710.6 to 715.7	100 (100)
720			Run 160 715.7 to 721.0	98 (98)
662.8)		721.3-750.2 Joint spacing close to very close, joints generally planar, smooth, tight, coated with carbonate and talc.	Run 161 721.0 to 725. <b>6</b>	100 (91)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE Devil Canyon (North Bank)

SHEET NO 24 OF 24

DEPTH (FT)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CRYING, LOST COME, CEMENTING, ETC.	DE RUN (FT)	( QD)
	Graywacke (Conglomerate)	727.1 Joint 0.1 inch wide with clay filling an rock fragments.	tun 162 725.6- 727.4 Run 163 727.4	00 78) 95 (77)
730 (672.0)		731.4-732.1 Fracture zone, joint spacing very close, joints coated with carbonate and talc. Core loss of 0.6 feet. 733.0 Joint with clay filling.	731.8 Run 164 731.8 to 737.1	94 (77)
740 (681.2)		737.6 Joint at 60°, 0.1 inch wide, carbonate and clay filling.	Run 165 737.1 to 741.5	93 (30)
		745.4-748.0 Fracture zone, joint spacing very close, joints at 50°, planar, smooth, healed	Run 166 741.5 to 745.7	100
		with carbonate, tight, some opened by drilling. 745.7-750.2 Core loss of 0.3 feet.	Run 167 745.7 to 750.2	93 (73)
750.21 (690.6)		END OF BORING		

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	BH-1
Site	Devil Canyon (North Bank)	Sheet No.	1 of 3

DEPTH (FT.)	ELEV. (FT)	PERMEABILITY (R) cm/sec	COME RECOVERY % 70.40.60.80	*00 % 20 40 60 80	NUMBER OF JOINTS PER 10 FT	SOCK TYPE	REMARKS
0	1414					Overburden	TOP OF ROCK 11.8'
20			1112			Argillite	
40							6. 115.25.41
40	1368					Argillite/	
60						Graywacke	Quartz stringers.
80							Fracture zone.
100	1200	<b></b>	1111				Quartz vein.
100	1322						1.0
120					HH		Quartz stringers.
140					1	Argillite	_ quarter ser ringers.
	1284		111113		-		
160					11.		
180							
200	1230				4	Argillite/	Quartz stringers.
200	1230					Graywacke	The second secon
220	- 1				110		Fracture zone, healed with quartz.
240				,			Shear fracture, healed.
	1184			-	1		Quartz stringers.
260						Graywacke	Quartz stringers.
280		4			111.	Argillite Mafic Dike	quartz stringers.
300	1138					Graywacke	Shear/fracture zone
300						Graywacke	Fracture zone,
320 -				1	H		healed. Breccia, healed.
340							breeze, nearear

### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client_	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	BH-1
Site	Devil Canyon (North Bank)	Sheet No.	2 of 3

DEPTH (FT.)	ELEV. (FT.)	PERMEABILITY INT CM/INC	CORE RECOVERY %	*** % 20 40 60 80	NUMBER OF JOINTS PER IOFT	HOCK TYPE	REMARKS
360		İII	HILL			Graywacke	
				_	4	Felsic Dike Graywacke	
38C						Graywacke	
400	1046						Fracture zone,
420					<b>H</b> 1:::		healed.
440							
	1000		医医毒素素		4		
460							
480							
500	954						
520		4					
540							Joint, slickensides
560	903		46555				Joint, slickensides
580							
600	862			1			Fracture zone,
620							Fracture zone,
640						134.13	neu reu.
660	826	4					
680							Shear/fracture zone
700 -	720						Fracture zone, healed.



## Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Job No. P5700.05 Client ALASKA POWER AUTHORITY Project Susitna Hydroelectric Project Hole No. BH-1 Site Devil Canyon (North Bank) Sheet No. 3 of 3 CORE RECOVERY PERMEABILITY ELEV (FT) REMARKS Graywacke 720 740 2 Fracture zone. END OF BORING 760 750.2'

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO.: BH-2

SITE:

Devil Canyon (North Bank)

SHEET NO. 1 OF 21

LOGGED BY

CONTRACTOR: The Drilling Company

DRILLING DATES: Sept. 10 To Sept. 15, 1980 DATE: July 1981

DRILLING

K.J. White, M.P. Bruen Casing Advancer

CASING DIAMETER NW (3.0") I.D.

METHOD:

Diamond Core - Triple Tube CORE DIAMETER: NQ (1.75") O.D.

LOCATION: LATITUDE N3,223,137 DEPARTURE E616, 101

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4 GROUND SURFACE 1213.4

AZIMUTH 0° 60° DIP

ROCK SURFACE 1211.7 BOTTOM OF HOLE 645.7

WATER TABLE 1208.4

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	RUN	MEC (MGD)
0.0	Overburden	Dark brown, organic silt with trace of light gray ash, some angular cobbles. No samples taken.		
(1.7)	Graywacke	Reddish dark gray, fine grained metasediment- ary rock. Bedding coincident with weakly developed foliation at 40°. Very thin to thin beds of dark gray argillite. Generally fresh to slightly weathered, hard, well indurated, sulphide mineralization (5% of rock).	Run 1 2.0 to 6.0	90 (75)
		2.0-30.4 - Joints closely spaced, planar,	Run 2	50 (0)
		rough to smooth, iron exide staining, few with quartz filling.	Run 3	64 (0)
10 (8.7)		6.0-13.0 - Fracture zone, joints and fractures very closely spaced, irregular, discontinuous, healed with quartz, tight. Core loss of 4.4 feet.	Run 4 8.1 to 10.5	63 (0)
(8.7) 11.2 (9.7)	Argillite	Dark gray, very fine grained metasedimentary rock. Very thin to thin bedding coincident with weakly developed foliation at 35° to 65°. Zones of phyllitic sheen, poor cleavage, very thin beds of fine grained graywacke. Generally fresh, hard, well indurated, sulphide mineralization.	Run 5 10.5 to 16.0	64 (48)
20			Run 6 16.0 to 21.0	100 (89)
(17.3)		21.0,- Core loss of 0.1 feet.		

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

Devil Canyon (North Bank)

SHEET NO 2 OF 21

DEPTH (F3)	ROCH TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	#£0 (#00)
-	Argillite		Run 7 21.0 to 26.0	98 (82)
			Run 8 26.0- 28.0 Run 9	100 (57)
30 (26.0)		28.4-32.2 Numerous healed fractures, very closely spaced, healed with quartz, irregular and discontinuous. Core loss of 0.3 feet. 30.3, 30.9 Two healed shears, 30° and 50°, 1 in. wide, quartz healed breccia, tight. 30.4-90.9 Joints close to moderately closely spaced, planar, rough to smooth, iron oxide	28.0 to 33.0	(82)
-		staining, some with quartz filling.	Run 10 33.0 to 38.0	100 (90)
40 34.6)		38.0-67.0 Drilling water return 50 .	Run 11 38.0 to 42.0	95 (88)
			Run 12 42.0 to 46.9	100 (100)
46.0 - (39.8)	Argillite/ Graywacke	Argillite, dark gray, very fine grained meta- sedimentary rock interbedded with thin to thick beds of graywacke, light to reddish gray, fine to medium grained metasedimentary rock with elongated sand grains in an argillaceous matrix Bedding coincident with weakly developed foliation at 40°. Generally fresh, hard, well indurated.	46.9	100 (96)

CLIENT

ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO BH-2

SITE

Devil Canyon (North Bank)

SHEET NO. 3 OF 21

DEPTH (FT)	ROCK TYPE	DESCRIPTION : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OF GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	(400)
	Argillite/ Graywacke	56.0 End of intense iron oxide staining on	Run 14 51.9 to 56.9	100 (100)
60 - (52.0)		joint surfaces.  58.6-61.2 Fracture zone, 0°, very closely spaced fractures, healed with quartz, up to 1 inch wide.	Run 15 56.9 to 62.2	100 (94)
		63.65 Core loss of 0.5 feet. 64.4 Quartz vein, less than 0.1 inch wide, stretched, parallel to bedding/foliation at 40°, crosscut by quartz vein at 90° which is offset along foliation planes.	Run 16 62.2 to 67.0	90 (90)
70 (60.6)		64.4-67.4 Quartz stringers, less than 0.24 inch, closely spaced, parallel to and crosscutting foliation. 68.95-69.05 Core loss of 0.1 foot.	Run 17 67.0 to 71.9	98 (98)
			Run 18 71.9 to 76.8	100 (100)
80 - 69.3)		76.1-78.7 Felsic dike, light gray, aphanitic to fine grained groundmass, 50% quartz and plagioclase phenocrysts, medium grained, less than 5% mafics, granodiorite (?) composition Contacts parallel to bedding/foliation at 60 tight. Chilled zone in dike up to 1 inch wide. Baked zone in surrounding argillite up to 6 inches wide. 78.7 Argillite/graywacke, as above, but com-	Run 19 76.8 to 81.8	100 (84)
		plexly folded and stretched, possibly brecciated, healed, tight.	Run 20 81.8 to 86.9	100 (91)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna

SITE

Susitna Hydroelectric Project Devil Canyon (North Bank)

SHEET NO. 4 OF 21

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(AGD)
	Argillite/ Graywacke		Run 20	
		87.3-87.9 Core loss of 0.2 feet.	Run 21 86.9 to	96 (70)
90 77.9)		89.4-90.9 Felsic dike, as above, subparallel to bedding/foliation, 40°-70°, somewhat irregular, tight.	91.6	
90.9 (78.7)	Graywacke	Reddish, dark gray, fine to medium grained metasedimentary rock with an argillaceous matrix. Bedding coincident with weakly developed foliation at 30° to 40°. Generally fresh, hard, well indurated. 90.9-138.6 Joints generally closely spaced, planar, smooth to rough, carbonate and quartz filling, very few with iron oxide staining.	Run 22 91.6 to 96.9	100 (91)
100 - (86.6)			Run 23 96.9 to 101.7	100 (100)
		104.9 Core loss of 0.1 feet.	Run 24 101.7 to 105.0	97 (76)
		105.7-107.9 Core loss of 0.3 feet.	Run 25 105.0 107.9	90 (66)
			Run 26	100 (56)
110 (95.3)		109.5-112.0 Core loss of 1.5 feet due to core barrel mislatch during drilling. Core badly broken.	Run 27 109.5- 112.0	40 (14)
		114.6-119.4 Core loss of 0.2 feet.	Run 28 112.0 114.6	100 (58)
			Run 29 114.6- 119.4	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO. 5 OF 21

DEPTH 1FT7	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF PUN (FT)	(#20)
	Graywacke		Run 29	
120 (103.9)		119.4-119.8 Quartz veins, folded, stretched, brecciated, healed, tight. 120.5 Bedding/foliation, 50° 121.7-123.2 Core badly broken, angular pieces less than 1 inch, some clay coating on joints at 0°.	Run 30 119.4 to 123.2	92 (53)
-			Run 31 123.2 to 125.9	100 (59
		125.9-132.0 Core loss of 2.5 ft. due to core barrel mislatch during drilling.	Run 32 125.9 to 132.0	59 (0
130 - 112.6)				
		135.0-135.5 Quartz stringers, up to 0.5 inch wide, irregular, discontinuous. Healed sheared contact between argillite and graywacke beds. 136.7-140.3 Core badly broken by drilling. Core loss of 0.5 feet.	Run 33 132.0 to 135.0	100 (73
		137.8 Mafic dike, 30°, 0.5 inch wide, tight contacts. 138.6-141.8 Shear/fracture zone, joints very	Run 34 135.0- 137.0	95 (85
139.5		closely spaced, 10 <sup>0</sup> to 20 <sup>0</sup> . 138.6-139.0 Joints generally close to very closely spaced, planar, smooth to rough open to partially open, many with slickensides.	Run 35 137.0 tc 140.3	88 (30
120.81	Mafic Dike (Diabase)	Dark green, fine to medium grained, feldspar laths form a fibrous texture, 5-10% white, radiating zeolite crystals up to 0.02 inch, quartz replacement of crystals. Upper contact at approximately 50°, irregular, tight, argil-	Run 36 140.3 to 143.4	100 (74
-		lite unaltered. Joints closely spaced, slickensides, chlorite on most.	Run 37 143.4- 145.4	100
		139.5-147.0 Chilled zone in dike: 139.5-139.8 Aphanitic. 139.8-147.0 Very fine grained. 141.3-144.0 Joints at 10° to 20°.	Run 38 145.4- 147.5	100
+		surfaces with chlorite and slickensides.		

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

Devil Canyon (North Bank)

SHEET NO 6 OF 21

DEPTH (FT)	MOCK TYPE	OESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF HUN (FT)	H(C (HQD)
150 - (129.9)	Mafic Dike (Diabase)	147.5-155.0 Core loss of 0.7 feet.	Run 39 147.5 to 152.0	89 (89)
		152.2-155.0 Shear/fracture zone, joints very closely spaced at 10 and 90, friable, breccia and clay gouge, slickensides. Core badly broken.	Run 40 152.0 to 155.0	93
		156.4-172.9 Slickensides on many joint surfaces, some on quartz and chlorite fillings.	Run 41 155.0 to 160.0	100 (82)
160 133.6]		160.0-165.4 Core loss of 0.2 feet.	Run 42 160.0 to 165.4	96 (80)
			Run 43 165.4 to 170.5	100 (100)
170 - 147.2]			Run 44	
		174.6-183.1 Chilled zone: 174.6-178.5 Fine grained, less than 5 zeolites.	to 175.6	(96)
		178.5-183.1 Very fine grained to aphanitic near contact. 179.0-183.8 Fracture zone, joints very closely spaced at 20°, 40° and 60°, chlorite, clay and slickensides on many surfaces. Core broken	Run 45 175.6 to 178.6	100 (87)
180 155.91		into angular pieces below 181.0.	Run 46 178.6- 181.8	100

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE WOBH-2

SITE Devil Canyon (North Bank)

SHEET NO 7 OF 21

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF HUN (FT)	HEC
183.1	Mafic Dike (Diabase)		Run 47 181.8	100 (73)
158.6]	Graywacke	Rock description, as above. 183.1 Contact at approximately 30°, irregular, tight, no shearing, no hornfels in graywacke.	to	(13)
190		186.3-192.2 Quartz stringers, very close to closely spaced at $20^{\circ}$ to $70^{\circ}$ , 0.04 to 0.2 inch wide, crosscutting bedding/foliation ( $50^{\circ}$ ), minor carbonate. 187.7-187.8 Shear, $50^{\circ}$ , breccia and clay incompletely healed with carbonate and quartz, moderately soft and friable.	Run 48 185.9 to 190.8	100 (100)
164.5)		192.2-193.5 Limy sandstone, light gray, fine grained. Fresh, hard, well indurated. Gradational contacts.	Run 49 190.8 to 193.8	100 (100)
		192.5 Bedding and poorly developed foliation at 40°. 193.0-251.1 Joints generally close to moderately closely spaced, planar smooth to rough, tight, quartz and carbonate filling, no staining.	Run 50 193.8 to 198.9	100 (100)
200 - 173.2)			Run 51 198.9 to 203.2	100 (100)
		206.5-212.2 Fracture zone, fractures very closely spaced at 0° to 20°, irregular, healed with quartz and carbonate, tight, hard.	Run 52 203.2 to 208.4	100 (100)
210 181.91			Run 53 208.4 to 211.7	100 (100)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 8 OF 21

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF HUN (FT)	REC (RQD)
	Graywacke	213.4-213.7 Core broken along healed joints.	Run 54 211.7 to 216.9	100 (94)
220 -		218.1-218.3 Fracture zone, healed, as above, but fractures at 90°.	Run 55 216.9 to 220.7	100 (95)
(190.5)			Run 56 220.7 to 226.0	100 (96)
			Run 57 226.0 to	100
230 (199.2)		230.0-231.0 Composition nearly quartzite, less than 20% fines in matrix. 231.2 Joint, 30°, slickensides. 233.0 Bedding/foliation at 40°.	231.2	100 (100)
240		235.0-238.3 Interbedded argillite, very thin to thin beds, dark gray.  236.0-236.6) Shears. 50°, healed quartz veins faulted 237.8-238.3 and folded comprising 40% to 50% of rock, less than 0.5 in. wide, tight, hard, well indurated, tight contacts.	Run 59 236.3 to 241.0	100 (100
(207.8)		241.0-242.0 Fracture zone, joints very close spaced at 50° and 0°, open and tight, slickensides, pyrite, chlorite. 241.0-244.0 Interbedded argillite, very thin to thin beds, dark gray.	Run 60 241.0 to 244.7	100 (89

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO. 9 OF 21

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	#EC (#QD)
	Graywacke	245.8-246.0 Two joints, 60 <sup>6</sup> with slickensides.	Run 61 244.7 to 249.8	100 (90)
250 - (216.5)			Run 62 249.8 to 255.0	100 (100)
258.5 (223.9) 260 -		Interbedded argillite and graywacke, metasedi-	Run 63 255.0 to 260.0	98 (94)
225.2)	Graywacke	mentary rock. Very thin beds (less than 1 inch wide) coincident with foliation at 40° to 50°, zones highly folded and stretched. Tight, hard. Sharp contact.	Run 64 260.0- 262.5	100
-		Joints closely to moderately closely spaced, planar to irregular, slick to rough, tight to open, carbonate, chlorite and clay filling.	Run 65 262.5 to 267.3	94 (83)
-			Run 66 267.3- 269.5	100 (82)
270 - 233.8)			Run 67 269.5 to 274.7	100 (73
273.9° 237.2)	Argillite	As above, bedding/foliation, $40^{\circ}$ to $50^{\circ}$ . 275.2-276.0 Fracture zone, joints very closely spaced at $0^{\circ}$ , $50^{\circ}$ and $70^{\circ}$ , slickensides.	Run 68 274.7- 277.5	96 (50)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 10 OF 21

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	LENGTH OF RUN (FT)	#£C (#QD)
280 (242.5)	Argillite	277.4-279.8 Shear/fracture zone, joints very closely to closely spaced at 0°, 20° and 50°, carbonate, chlorite and talc on most surfaces, clay and slickensides on joints at 0° and 20°. 279.5-281.4 Bedding/foliation folded and stretched. Numerous quartz veins up to 2 in. wide, mostly along foliation and joints, tight.	Run 69 277.5 to 281.5	100 (48)
		hard.  279.5-287.0 Shear/fracture zone, joints very closely spaced at 0° and 10° to 20°, planar, smooth, tight, slickensides, talc coating, pyrite partially to completely replaced by quartz.	Run 70 281.5 to 287.0	100 (95)
287.0 248.5 290 - 251.1	Argillite/ Graywacke	Rock description, as above. Bedding/foliation at 30° to 40°, folded, stretched, offsets in bedding, argillite spotted with dark gray crystals 0.1 inches wide.  291.1, 294.8 Two joints, 70° and 60° respectively, trace clay.	Run 71 287.0 to 292.0	100 (96)
		293.6-294.0 Fracture zone, fractures very closely spaced, irregular and discontinuous, quartz healed, generally crosscutting foliation, tight.	Run 72 292.0 to 297.0	100 (100)
300 259.8		297.0-304.0 Pyrite cubes up to 0.5 inches, partially replaced by quartz. 297.9 Quartz vein at 50°, 0.5 inches wide, slightly folded, parallel to bedding/foliation. 299.7 Joint at 50°, clay filling and sand size argillite fragments.	Run 73 297.0 to 301.7	100 (87)
		300.5-300.7? Shear, healed, folded and breciated 302.0-302.1) fragments in quartz matrix, tight hard.	Run 74 301.7 to 306.7	100 (100)
1		305.5-307.7 Fractures very closely spaced, irregular, discontinuous, quartz filling, slickensides at 306.5.	Run 75 306.7-	100
1		310.4-311.5 Core broken into angular fragments	309.4	(70)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 11 OF 21

DEP1H (#21)	MOC# TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	9EC (920)
310 (268.5) 311.54	Argillite/ Graywacke	up to 1 inch wide. Joint at 30°, slickensides and talc; joint at 40° planar, slickensides, joint at 10°, planar, smooth, with 0.1 inches of silty fine to coarse grained sand.	Run 76 309.4- 311.5	67 (0)
269.8	Argillite	Rock description, as above, few interbeds of graywacke.	Run 77 311.5 to	100 (94)
]		315.0-316.7 Fracture zone, irregular and discontinuous fractures, quartz filled, tight, hard.	316.7	
7		318.6-424.1 Joints generally closely to moderately closely spaced, occasional zones very closely spaced, generally planar, slick to	Run 78 316.7 to 319.7	87 (37)
320 (277.1)		smooth, tight, chlorite and talc filling quartz carbonate and trace clay/silt.	319.7	100 (74)
		322.3-323.0 Breccia, $0^0$ , healed, tight, hard. 325.0-325.5 Bedding, $0^0$ , crosscut by foliation at $50^0$ .	323.5	
		325.5-326.6 Numerous quartz veins and stringers, parallel to bedding/foliation, very closely spaced, contorted, chlorite coating. 328.5 Joint, 45, carbonate, less than 0.1	Run 80 323.5 to 326.9	100 (100)
		inches of silty sand. 328.5 Argillite, reddish gray. 328.5-329.8 Quartz stringers, 60°, closely spaced, up to 0.25 inches wide, tight. 329.5-330.4 Quartz vein, 20°, 0.5 to 2.0	Run 81 326.9 to 330.1	100 (91)
330 285.8		inches wide, irregular, fractured, tight. 330.6-330.9 Quartz vein, 30°, 1.5 inches wide, fractured, tight, chlorite.	Run 32 330.1- 332.6	
334.8		332.6-337.5 Core loss of 1.6 feet. 333.3-333.8 Shear/fracture zone, joints very closely spaced at 20°, slickensides and silty 334.6-334.8 Shear, quartz healed, tight, hard.	Run 83 332.6 to 337.5	67 (53)
289.9	Graywacke	As above, lower contact at 30°.		
1		339.4-342:2 Numerous quartz stringers,	Run 84 337.5- 339.5	100 (70)
339.8	Argillite/ Graywacke	Argillite, reddish, medium to dark gray, very	Run 85	-

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 12 OF 21

DEPTH LFT2	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CF RUN (FT)	(#90)
	Argillite/ Graywacke	fine grained medasedimentary rock thinly inter- bedded with graywacke, reddish, medium to dark gray, fine to medium grained metasedimentary	Run 85 339.5- 343.1	100 (83)
		rock with elongated sand grains. Occasional phyllitic sheen in argillite. Generally fresh, hard well indurated. 340.5-340.6 Quartz vein, folded, tight, hard, inclusions of argillite. 341.5-342.0 Quartz stringers, 0.25 inches	Run 86 343.1 to 347.1	100 (100)
350 (303.1)		342.8-343.3 wide, highly folded and contorted, some offset along foliation fracture cleavage at 40°, tight, hard. 344.0 Graywacke beds becoming fine to coarse grained, some graded beds, beds generally less than 6 inches wide.	Run 87 347.1 to 352.2	100 (100)
			Run 88 352.2 to 357.1	100 (100)
			Run 89 357.1	98 (98)
360 311.8		359.5-362.0 Fracture zone, joints very closely spaced at 30°, tight. 361.4-364.7 Bedding/foliation at 50°.	to 361.9	
-			Run 90	96
			361.9 to	(96)
		364.6 Core loss of 0.2 feet.	366.7	
370		366.5-366.9 Quartz vein, 40 <sup>0</sup> , irregular, parallel to and crosscutting bedding.	Run 91 366.7 to 372.0	96 (96)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO. 13 OF 21

DEPTH (F <sup>-</sup> )	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	#EC (#QD)
	Argillite Graywacke	374.0 Core loss of 0.2 feet. 375.3 Joint, 40 <sup>0</sup> , silty sand filling.	Run 92 372.0 to 376.1	95 (73)
380			Run 93 376.1 to 381.1	100 (100)
329.1)		383.9-389.5 Bedding highly folded and contorted, foliation at 40 to 60 parallel to and crosscutting bedding, offsets along	Run 94 381.1 to 386.2	100 (100)
390 - 337.7]		foliation.	Run 95 386.2 to 391.4	96 (96)
-		391.4-407.1 Core loss of 0.4 feet.	Run 96	98
392.5 339.9	Graywacke	Rock description, as above, few very thin to thin argillite beds. Joints closely to moderately closely spaced, generally planar, slick to smooth, tight, few chlorite and talc filled.	391.4 to 396.6	(88)
400 346.4		394.5 Quartz stringer, 70°, 0.1 inches wide, crosscutting foliation but slightly offset by fracture cleavage. 394.7 Quartz pod, 10°, 0.5 inches wide, 2 inches long, discontinuous. 400.7-406.0 Core loss of 0.1 feet.	Run 97 396.6 to 401.8	98 (98)
		403.0 Bedding/foliation, 60°.	Run 98 401.8 to 407.1	92 (89)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 14 OF 21

DEPTH:	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	Re (:   4001
	Graywacke	406.2 Joint, 20°, clay filling.	Run 98	
410 (355.1)		410.7 Quartz pod with chlorite stringers,	Run 99 407.1 to 411.6	100 (93)
414.0		1 inch wide.	Run 100 411.6 to	100 (100)
(358.5)	Argillite/ Graywacke	Rock description, as above.  Joints generally moderately closely spaced, zones very closely spaced, generally planar	416.9	
420 (363.7)		to irregular, smooth to rough, tight to open, quartz and carbonate filling, some chlorite staining. 415.9-416.6 Felsic dike (aplite), light gray, highly irregular contacts, stringers penetrating graywacke up to 2 inches, tight, hard.	Run 101 416.9 to 421.9	100 (92)
		420.8-421.2 Quartz stringers. 0.25 inches wide, folded, irregular and discontinuous, tight. 422.3-428.0 Quartz veins and stringers less than 1 inch wide, moderately closely to closel spaced, irregular, unfractured, tight, chlorite mineralization.	Run 102 421.9 to 427.2	100 (100)
430 (372.4)		424.1-562.8 Joints generally moderately closely spaced, planar to irregular, smooth to rough, tight to open, some carbonate filling, very few with quartz and clay filling some chlorite staining. 424.4 Less talc and chlorite on joints below. 426.6-431.9 Core loss of 0.4 feet.	Run 103 427.2 to 431.9	100
		431.5 Quartz vein, 2 inches wide, as above.	Run 104 431.9 t 437.2	100 (94)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 15 OF 21

DEPTH LPT1	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(RQD)
	Argillite/		Run 105	96
	Graywacke		437.2	(96)
440 381.1)		439.7-453.6 Quartz veins, 20° to 50°, parallel to subparallel to bedding/foliation, 3 inches to 6 inches wide, closely spaced, very closely fractured, 10% to 20% chlorite mineralization,	442.2	
		tight contacts.	Run 106	100
			442.2 to	(100)
			444.9	
	Mary 1		Run 107	98
	Trans. II		444.9	(98)
			to	
			450.0	
450 389.7)			Run 108	98
			450.0	(98)
			to	
			455.3	
			Run 109	100
			455.3	(100)
			460.1	
460 398.4)			Run 110	100
			460.1	(100
			to	
			465.3	
			Run 111	100
			465.3 to	(100)
			470.3	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 16 OF 21

TERTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	OF HUN	9EC (490)
470	Argillite/ Graywacke		Run 111	
407.0)			Fun 112	100
		472.5-473.0 Core badly broken by drilling.  474.0 Quartz vein, 90°, 1 inch wide, fractured, open joint with chlorite.	470.3 to 475.0	(85)
		tured, open joint with chlcrite. 474.5 Quartz vein, 40°, 1 inch wide, fractured, tight.	Run 13 475.0- 477.3	
			Run 114	100
480 415.7)			477.3 to	(100)
415.7)			481.9	
		434.4-485.4 Core badly broken by drilling.	Run 115 481.9 to 485.4	100 (69)
			Run 116 485.4 to 490.3	100 (96)
490 424.4)		490.3-494.7 Shear/fracture zong, joints very closely to closely spaced at 30 to 60°, very thin breccia, clay gouge and carbonate on	Run 117 490.3- 492.5	
		joint surfaces.	Run 118 492.5 to 495.4	100 (72)
			Run 119 495.4 to	100 (98)
		499.8 Joint, 50°, clay coating.	499.4	
500 433.0)		500.5 Bedding/foliation, 50°.		

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO. 17 OF 21

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXT 18, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN.	#EC (#QD)
	Argillite/ Graywacke	502.2-502.4 Quartz vein, approximately 90°, unfractured, tight, irregular contact. 503.0-503.1 Quartz vein, 60°, broken by drilling, tight contacts. 503.3-503.8 Quartz vein, approximately 0°.	Run 120 499.4 to 504.7	98 (91)
		0.5 inches to 1 inch wide, folded, unfractured tight, irregular. 504.0-505.9 Quartz veins and stringers less than 1 inch wide, folded and offset along foliation, unfractured, tight, hard. 507.2 Quartz pods, 0.5 inches to 1 inch wide,	Run 121 504 7 to 509.1	100 (100)
510 441.7)		as above. 510.2 Quartz vein, 70°, 0.5 inches wide, fractured, tight.	Run 122 509.1 to 514.0	100 (84)
		514.3-514.5 Core broken by drilling.	Run 123 514.0	100 (96)
			to 519.1	
520 450.3)		519.5 Bedding/foliation, 60°.	Run 124 519.1 to 524.3	100 (100)
			Run 125 524.3 to 529.5	100 (92)
530 459.0)		529.5 Joint, 50°, planar, smooth, clay filling 530.3-531.2 Fracture zone, joints at 0°, irregular, rough talc and carbonate coating. Core badly broken. 531.2 Quartz vein, 50°, 0.5 inches to 1.5 inches wide, unfractured, tight.	Run 126 529.5 to 534.7	100 (85)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 18 OF 21

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	#EC (#QD)
	Argillite/ Graywacke	534.7 Core loss of 0.3 feet.	Run 126	
		535.6-543.5 Fractures closely spaced, irregular, tight, quartz healed.	Run 127 534.7 to 538.3	94 (94)
540 67.7)			Run 128 538.3 to 542.0	81 (81)
		543.5-547.2 Shear/fracture zone, joint at 10°, irregular, sandy <ilt 70°,="" at="" badly="" breccia,="" broken.<="" clay="" coating.="" core="" joint="" planar,="" smooth="" talc="" td=""><td>Run 129 542.0 to 547.2</td><td>100 (98)</td></ilt>	Run 129 542.0 to 547.2	100 (98)
550 76.3)		548.7 Joint with clay filling.	Run 130 547.2 to 552.0	100 (100)
			Run 131 552.0 to 557.1	94 (94)
560 - 85.0)		557.1-557.5 Core broken into angular frag- ments, generally less than 0.5 inches.	Run 132 557.1 to 562.0	100 (59)
		562.8-621.0 Fractures and joints very closely to closely spaced, calcite and quartz healed, hard, tight.	Run 133 562.0 to 567.0	100 (88)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 19 OF 21

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIR, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	PEC (PQD)
	Argillite/ Graywacke	562.9-592.0 Bedding highly folded, stretched and brecciated along foliation, tight, hard.	Run 133	
į			Run 134	100
- 570 (493.6)			567.0 to	(94)
			572.1	
			Run 135 572.1-	100
		574.4-598.0 Fracture zone, joints and fractures very closely spaced, most quartz healed generally tight, chlorite coated, joints at 0 to 20 and 50 to 70, fractures, irregular	574.6	(92)
			Run 136	100
		and discontinuous. Some core broken by	574.6 to	(98)
		drilling.	579.9	
580 (502.3)			Run 137 579.9 to 582.9	100 (90)
		i v	Run 138	100 (20)
		584.9-589.6 Core loss of 0.2 feet.	Run 139 584.9 to 589.6	96 (55)
590 (511.0)			Run 140	100
			589.6 to	(68)
			594.6	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

SITE Devil Canyon (North Bank)

SHEET NO 20 OF 21

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	(900)
- 600 - (519.6)	Argillite/ Graywacke		Run 141 594.6 599.6	100 (96)
		601.2-621.0 Fracture zone, joints and frac-	Run 142 599.6- 601.8	100 (82)
		tures very closely spaced, joints at 10° to 20°, planar smooth, some talc and carbonate coating, and at 40° to 70°, planar to irregular, trace talc and carbonate, fract	Run 143 601.8 604.0	100 (91)
		irregular and discontinuous, tight.	Run 144 604.0 to 609.2	100 (88)
610 528.3)			Run 145 609.2 to 614.2	100 (76)
			Run 146 614.2 to 619.5	89 (81)
620 - (536.9)		621.0-656.2 Joints generally widely to very widely spaced, planar, smooth to rough, tight to open, carbonate and quartz filling.	Run 147 619.5 to 624.8	100 (89)
			Run 148 624.8 to	94 (89)
		627.3 Shear, 60°, 1 inch wide, clay and breccia filling, friable. Core loss of 0.2 feet.	630.1	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5709.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-2

Devil Canyon (North Bank)

SHEET NO 21 OF 21

MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	(800)
Argillite/		Run 148	
Graywacke		Run 149 630.1 to	100 (100)
Quartz Diorite/ Granodiorite Dike	Light gray, quartz rich rock, porphyritic texture with medium to coarse grained plagioclase and quartz crystals in a fine grained to aphanitic groundmass of plagioclase and mafics. Overall less than 10 mafics. Generally very hard, fresh, well indurated.	635.3	
		Run 150 635.3	100
	Joints widely to very widely spaced at $30^{\circ}$ and $60^{\circ}$ to $70^{\circ}$ , planar, smooth to rough, tight to open, quartz filling.	640.5	
		Run 151	98
		to 645.8	(32)
	646.0-650.1 Quartz veins, closely spaced 1 inch to 6 inches wide, comprise 50% of rock, highly fractured, tight, minor chlorite, occasional vugs and recrystallization.	Pun 152 645.8 to 650.8	100 (100)
		Run 153 650.8 to 655.5	96 (96)
	END OF BORING		
	Argillite/ Graywacke Quartz Diorite/ Granodiorite	Argillite/ Graywacke  Quartz Diorite/ Granddiorite Dike  Light gray, quartz rich rock, porphyritic texture with medium to coarse grained plagio- clase and quartz crystals in a fine grained to aphanitic groundmass of plagioclase and mafics. Overall less than 10 mafics.  Generally very hard, fresh, well indurated.  Joints widely to very widely spaced at 30 and 60 to 70, planar, smooth to rough, tight to open, quartz filling.  646.0-650.1 Quartz veins, closely spaced 1 inch to 6 inches wide, comprise 50 of rock, highly fractured, tight, minor chlorite, occasional vugs and recrystallization.	Argillite/ Graywacke  Quartz Diorite/ Granodiorite Dike  Light gray, quartz rich rock, porphyritic texture with medium to coarse grained plagioclase and quartz crystals in a fine grained to aphanitic groundmass of plagioclase and mafics. Overall less than 10 mafics.  Generally very hard, fresh, well indurated.  Joints widely to very widely spaced at 300 and 60° to 70°, planar, smooth to rough, tight to open, quartz filling.  646.0-650.1 Quartz veins, closely spaced 1 inch to 6 inches wide, comprise 50° of rock, highly fractured, tight, minor chlorite, occasional vugs and recrystallization.  Run 150 645.8  646.0-650.1 Quartz veins, closely spaced 1 inch to 6 inches wide, comprise 50° of rock, highly fractured, tight, minor chlorite, occasional vugs and recrystallization.  Run 150 645.8  Run 151 645.8  Run 153 650.8

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Job No. P5700.05 Client ALASKA POWER AUTHORITY Project Susitna Hydroelectric Project Hole Nio. BH-2 Site Devil Canyon (North Bank) Sheet No. \_1\_ of \_2\_\_ PERMEABILITY CORE RECOVERY ELEV HOCK TYPE REMARKS Graywacke Argillite 20 Shears, healed. 40 Argillite/ 1170 60 Graywacke 80 Graywacke 100 1126 Fracture zone. 126 140 Joints, slicken-sides. Shear/fracture zone Mafic Dike 1083 (Diabase) 160 Joints, slickensides. 180 Fracture zone. Graywacke Shear. 200 1040 Fracture zone, healed. 220 Joint, slicken-240 Shear zone. 260 Argillite/ Graywacke Argillite -280 Shear/fracture zone 300 953 Shear/fracture zone 320 Shear/fracture zone Argillite/ 340 Graywacke

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Job No. P5700.05 Client \_\_ ALASKA POWER AUTHORITY Project Susitna Hydroelectric Project Hole No.\_ BH-2 Devil Canyon (North Bank) Sheet No. 2 of 2 PERMEABILITY CORE RECOVERS DEPTH (FT) ROCK TYPE REMARKS Argillite/ 360 Graywacke 380 400 863 Graywacke Dike, felsic. Argillite/ 420 Graywacke Quartz veins. 440 numerous. 823 460 480 ☐ Shear/fracture zone 500 780 520 540 Fracture zone. healed. 737 560 580 Fracture zone. 689 600 Fracture zone. 620 640 Quartz diorite dike END OF BORING 655.5' 660

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO.: BH-3

SITE

Devil Canyon (South Bank)

SHEET NO. 1 OF 13

CONTRACTOR: Interstate Exploration Inc. DRILLING DATES: June 28 TO July 13, 1981 DATE: July 1981

CASING DIAMETER NW (3.0") I.D.

DRILLING METHOD:

SOIL

Casing Advancer Diamond Core - Triple Tube CORE DIAMETER:

NQ (1.75") O.D.

LOCATION :

LATITUDE N3,222,146 DEPARTURE E615,883

32°

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

GROUND SURFACE

1398.0

ROCK SURFACE BOTTOM OF HOLE 1394.0 1190.7

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, GEMENTING, ETC.	RUN LENGTH	MEC (MGD)
0.0	Overburden	No samples taken.		
		TOP OF ROCK		
7.5 (4.0) 10 (5.3)	Argillite	Medium to dark gray, very fine to fine grained metasedimentary rock. Very thin beds coincident with weakly to moderately developed primary foliation. Zones of minor secondary foliation. Occasional very thin to medium beds	Run 1 Run 2 8.0 to 10.9	93 (0)
		of light gray, fine grained graywacke. Minor zones of quartz veining.  Joints close spaced, iron oxide stained.  7.5-11.4 - Joint spacing is close to very	Run 3 10.9 to 14.7	100 (50)
		close, iron oxide staining. Bedding and primary foliation at 35° to 40° with weakly developed secondary foliation at 20°.  11.4-21.7 - Joints close to moderately close spaced, iron oxide staining.	Run 4 14.7 to 17.8	100 (100)
20 (10.6)	,		Run 5 17.8 to 22.0	100 (67)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-3

SITE Devil Canyon (South Bank) SHEET NO 2 OF 13

DEPTH (FT)	ROCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	#4C (#QD)
	Argillite	21.7-22.5 - Core broken by drilling, pieces	Run 5	
1		I inch to 2 inches, iron oxide staining.	Run 6	100
- 1		22.5-27.8 - Joints close spaced, iron oxide	22.0-	(53)
4		staining is lessening.	23.9	
- 0			Run 7	
- 1			23.9	100
- 1			to	(38)
		27.8-28.1 - Core broken by drilling, pieces average 1 inch, clay/silt coating.	27.9	
1		28.1-51.7 - Joints close to moderately closely	Run 8	
- 1		spaced, averaging 1 foot, minor iron oxide	27.9	100
30		staining.	to	(56)
15.9)	5.9)		31.9	,,
1			Run 9	
		31.9	100	
-	1 1	į .	to	(96)
			37.0	1,20,
+				
			Run 10	
		1	37.0	100
		1	to	(94)
21.2)			42.0	
+		43.8 - Joint at 50°, open, irregular, rough,	Run 11	
- 1		iron oxide staining, clay/silt coating.	42.0	100
- 1		44.0 - Bedding/foliation, 60°, very faint	to to	(94)
		secondary foliation at 10°.	47.0	(24)
1				
			Run 12	
- 1			47.0	100
			to	(83)
50			51.7	
26.5)		51.7-99.8 - Joints moderately close spaced, iron oxide staining, minor chlorite coating.		

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 3 OF 13

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, POLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOSI CORE, CEMENTING, ETC.	OF RUN	#EC (#90)
	Argillite	55.7 - Joint, 10 <sup>0</sup> , possible slickensides.	Run 13 51.7 to 56.5	100 (98)
60 31.8)			Run 14 56.5 to 61.6	100 (96)
		63.3 - Joint, 90°, open, irregular, heavy iron oxide coating compared to surrounding joints.	Run 15 61.6 to 66.1	100 (96)
70 (37.1)		70.2 - Joint, 25°, possibly open, irregular, rough, heavy iron oxide staining.	Run 16 66.1 to 71.1	100 (100)
		72.6 - Joint, 20°, possibly open, irregular, rough, heavy iron oxide staining.	Run 17 71.1 to 76.3	100 (90)
80 -		80.4 - Joint, 30°, open, planar, smooth, iron oxide staining. Core broken.	Run 18 76.3 to 81.4	100 (96)
			Run 19 81.4 to 86.5	100

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

SHEET NO. 4 OF 13

PROJECT Susitna Hydroelectric Project

Devil Canyon (South Bank)

HOLE NO BH-3

DEPTH (F1)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	DE RUN	(400)
7	Argillite		Run 19	
			Run 20	
90 (47.7)		90.0 - Bedding/foliation highly folded, 55°. Weakly developed secondary foliation at 20°.	86.5 to 91.6	100 (100)
		91.0-91.2 - Quartz pods, up to 1 inch wide, stretched, unfractured.	Run 21	
-		93.1-99.3 - Quartz stringers, close spacing, crosscutting bedding/foliation, generally 0.1 inch wide.	91.6 to 96.8	100 (92)
1		94.3 - Joint, 60°, open, planar, smooth, iron oxide staining.		
4		L	Run 22	
100 -		99.8-101.8 - Quartz vein, highly fractured, broken by drilling along healed fractures, heavy iron oxide staining, possible open joints at 20°. Contains inclusions of argillite up to 0.1 foot wide. Fractured at contacts.	96.8 to 101.8	100 (62)
1		99.8-112.0 - Joints closely spaced.	Run 23	
		104.5-105.5 - Quartz vein, highly fractured, no iron oxide staining. Fractures generally tight. Drilling breaks at both contacts.	101.8 to 107.0	100 (71)
1			Run 24	
110 -		109.3 - Shear, 25°, has approximately 0.5 inch breccia and gouge, slickensides.	107.0 to 112.6	93 (84)
-		112.0-136.5 - Joints moderately close spaced.		
		113.0-128.7 - Sandy argillite and graywacke, bedding/foliation at 60°.	Run 25 112.6 to 117.4	100

LIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 5 OF 13

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN	PEC (HQD)
120 (63.6)	Argillite		Run 26 117.4 to 122.4	100 (96)
		122.4-389.5 - Generally no drilling water return.  123.5-147.0 - Numerous quartz pods and stringers, up to 1 inch wide, folded and stretched, unfractured, spacing moderately close to very close.	Run 27 122.4 to 127.4	100 (100)
130 <u>.</u> (68.9)		129.2 - Joint, 40°, open, irregular, rough, heavy iron oxide staining.	Run 28 127.4 to 132.4	100 (94)
		136.5-144.3 - Joint spacing is close to very closely spaced.	Run 29 132.4 to 137.4	100 (90)
1			Run 30	100 (76)
140 74.2)		141.3 - Quartz vein, 0.1 feet wide, fractured but tight.  142.7 - Quartz vein, 0.05 feet wide, fractured but tight at 15°, subparallel to bedding. Upper contact open, lower tight.	Run 31 139.1 to 144.3	100 (52)
		143.0 - Joint, 60°, possibly open, clay/silt coating.  143.6 - Quartz vein, 60°, subparallel to bedding/foliation, approximately 0.05 feet wide.	Run 32 144.3 to 149.4	100 (90

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

LIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

Devil Canyon (South Bank)

SHEET NO 6 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF RUN (FT)	HEC (HQD)
150 79.5)	Argillite	143.9 - Quartz vein, 50°, approximately 0.05 feet wide, core loss. Argillite has a phyllitic appearance at the contact.	Run 33	98
		144.3-165.6 - Joints close to moderately close spaced.	to 152.6	(81)
		147.0 - Quartz vein, 20°, approximately 0.05 feet wide. Open contacts with iron oxide staining.	Run 34 152.6 to	100 (94)
		148.0 - Bedding/foliation, 40°. 149.6-150.1 - Graywacke, fine grained at top to medium grained at bottom, graded bedding	157.4	
		at 30° and possibly inverted.	Run 35	
. 160 (84.8)		155.5 - Bedding/foliation, 40°, secondary foliation at 0° to 10°. Phyllitic sheen, poorly developed cleavage.	157.4 to 162.4	100 (96)
			Run 36	
		165.6-174.2 - Joints close to very close spaced, tight to partially open, approximately 25% iron oxide staining.	162.4 to 167.4	90 (78)
			Run 37	
170 -			167.4- 170.1	100 (59)
(90.1)			Run 38	
			170.1 to 174.3	95 (55)
•		174.1 - Joint, 30°, clay/silt coating, possibly slickensides.	Run 39	-
		174.2-189.6 - Joints closely spaced, light to	174.3	100
		heavy iron oxide staining.	to 178.7	(95)
	H. H.	180.0-183.0 - Quartz stringers, close to very close spaced, generally parallel to bedding,		
180		less than 0.1 inch but up to 1 inch. Contacts tight except open at 182.0.		
(95.4)				

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 7 OF 13

DEPTH (FT)	-	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	DF RUN (FT)	#EC
	Argillite		Run 40 178.7- 183.5	96 (67)
		184.1 - Bedding/foliation, 30°.	Run 41 183.5 to 187.4	90 (72)
190 (106.7)		189.6-257.0 - Joints close to moderately close spaced, light to heavy iron oxide staining, tight to partially open.	Run 42 187.4 to 192.6	100 (65)
	193.9-195.0 - Quartz stringers and pods, crosscutting bedding, 0.1 inch to 1 inch wide, unfractured. Approximately 10 percent of the zone.	Run 43 192.6 to 197.4	100 (71)	
200 (106.0)			Run 44 197.4 to 202.6	100 (98)
		205.0 - Bedding/foliation, 30°.  206.2 - Joint, 30°, parallel to bedding, silt/clay coating.	Run 45 202.6 to 207.7	100 (84)
210 (111.3)			Run 46 207.7 to 212.6	100 (90)
1				

### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

LIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 8 OF 13

DEPTH (FT)		DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, COMENTING, ETC.	OF RUN (FT)	(M50)
	Argillite		Run 47 212.6 to 215.7	100 (61)
1			Run 48	82 (76)
4			Run 49	
220 (116.6)			217.4 to 222.5	100 (100)
			Run 50	
			222.5 to 227.4	100 (98)
		228.0 - Bedding/foliation, 30°.	Run 51	
230 121.9)			227.4 to 232.2	100 (75)
			Run 52	
1		234.3-253.0 - Quartz stringers, close spaced, parallel to and crosscutting bedding, 0.1 inchwide, unfractured. Contacts tight.	232.2 to 237.4	100 (94)
			Run 53	
240 (127.2)			237.4 to 242.4	100 (94)
			Run 54 242.4- 247.4	96 (78)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

MOLE MO BH-3

SITE Devil Canyon (South Bank)

SHEET NO. 9 OF 13

DEPTH LFT3	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC	CF RUN	HEC
	Argillite			
247.0			Run 54	
250 132.5)	Graywacke	Light to medium gray, mostly fine to medium grained metasedimentary rock with an argillaceous matrix, occasional thin beds of dark gray argillite. Fresh, hard, and well indurated. Joints close to very close spaced, iron oxide staining.	Run 55 247.4 to 252.2	100
1			Run 56	
		254.5 - Bedding/foliation, 25°.	252.2 to 257.4	100 (60)
		257.0-257.4 - Core broken by drilling, pieces 1 inch to 2 inches.		Carlosa:
1		257.0-275.2 - Joints close to very close spaced.	Run 57	
2 <b>6</b> 0 137.8)		258.8-259.2 - Fracture zone, joints very close spaced, 60°, iron oxide staining, light coating of silty clay.	257.4	91 (25)
-		260.3-260.6 - Core broken by drilling, pieces 1 inch to 2 inches.	Run 58	
		263.3-264.7 - Fracture zone, joints very close spaced, $40^{\circ}$ to $60^{\circ}.$	261.8 to 267.0	100 (38)
		268.2-269.5 - Fracture zone, joints very close	Run 59	_
270		spaced at 50° to 70°.	267.0 to 270.3	85 (11)
143.1)			Run 60	100
1		272.9-274.1 - Joint, 10°, open, heavy iron oxide staining.	Run 61	
}		274.4-286.7 - Joints close to moderately close spaced.	271.9 to 276.7	100

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 10 OF 13

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	#£0 (#95)
280 148.4)	Graywacke		Run 62 276.7 to 281.7	100 (88)
		282.9-283.5 - Fracture zone, joint spacing is very close, joints at 10° to 20°.	Run 63 281.7 to 285.7	82 (48)
286.7 151.9)	Argillite	Rock description as above. 286.7-288.4 - Core loss of 1.4 feet. Core	Run 64 Run 65	0 75 (0)
290 153.7)		broken by drilling, pieces less than 0.2 feet. 288.4-303.6 - Probable fracture zone, joint spacing is close to very close, trace iron oxide staining.	Run 68 289.7- 291.8	90 (0) 90 (0)
		289.4-289.7 - Core badly broken, pieces 1/2 inch to 1 inch. 289.7-296.8 - Joints at 30°, 40°, and 60°,	Run 69 291.8- 293.8	80
		fractures at 0° to 10° and 40° to 50°. 294.6-296.6 - Core loss of 1.5 feet. 296.8-299.3 - Core loss of 1.4 feet.	Run 70 293.8 to 296.8	50 (0
			Run 71 296.8- 299.3	64 (36
300 159.0)		301.0-302.0 - Core badly broken by	Run 72	100
		drilling, pieces 1 inch to 2 inches.  303.6-324.5 - Joints close spaced, trace iron oxide staining.	Run 73 Run 74	100 100 (50
1		Trus oxide stammy.	Run 75 303.6 to 306.9	100
		308.2 - Bedding/foliation, 20°.		

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 11 OF 13

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	#(C  920)
310 (164.3)	Argillite	311.1 - Quartz vein, irregular contact at 30°, unfractured, 0.2 feet wide.	Run 76 306.9 to 312.2	98 (84)
		312.2-312.8 - Core badly broken by drilling, pieces less than or equal to 0.1 feet.	Run 77 312.2 to 316.8	61 (26)
320 (169.6)	×		Run 78 316.8 to 321.7	45 (18)
+		Run 79	100(100	
		324.5-334.7 - Joints very close to close spaced, iron oxide staining.	Run 80 322.6 to 326.8	98 (43)
330		237.9-328.7 - Core badly broken by drilling, pieces less than or equal to 0.1 feet.  329.9-331.9 - Core loss of 0.7 feet. Core badly broken. Hole grouted and redrilled.	Run 81 326.8 to 329.9	68 (11)
330 _ (174.9)		331.8-334.7 - Core badly broken, pieces average 1/2 inch to 1 inch.	Run 83 R 84,85 331.9 to	60 (0) N/A 53 (0)
		334.7-352.8 - Joints close spaced, iron oxide staining.	333.8 Run 87 333.8 to 336.6	96 (0)
340			Run 88 336.6 to 341.1	100 (84)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO 12 OF 13

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	RES (490)
344.1	Argillite		Run 89 341.1 to 344.4	91 (12)
(182.3)	Mafic Dike	Dark green, fine grained igneous rock. Fresh and hard. Sheared contacts with breccia and gouge. Joints close spaced, silty sand coating.	Run 90 344.4 to 349.6	100 (58)
350.9		350.5-351.1 - Core loss of 0.3 feet. Core badly broken.	Run 91	100(10
(185.9)	Argillite	Rock description as above.	Run 92	42 10
1		351.1-352.8 - Core loss of 0.7 feet. Core badly broken by drilling.	351.1 to	50 (12)
		352.8-356.6 - Fracture zone, joints very close spaced at 30°, 50°, 60°, and 80°, fractures at 10° to 20°, iron oxide staining, minor carbonate coating.  357.8-362.2 - Joints closely spaced, iron oxide staining.	354.7 Run 94 354.7 to 357.8	100 (19)
_ <b>360</b> (190.8)		361.8-366.6 - Quartz stringers and pods, very close spaced, parallel to bedding, stretched, folded, less than 0.5 inch wide, generally fractured but tight.	Run 95 357.8 to 363.0	100 (75)
		362.2-363.1 - Fracture zone, possibly sheared, heavy iron oxide staining, silty clay coating on joints, possibly gouge, pieces 0.25 to 1 inch.  363.1-389.9 - Joints closely to moderately	Run 96 363.0 to 367.8	100 (57)
370		close spaced, very close in some zones, less than 0.3 feet wide.	Run 97 367.8- 370.5	
(19€.1)		spaced, fractures at 40° to 50°, silt/clay coating on joints, possible slickensides.  371.0 - Quartz vein at 30°, unfractured, 0.75 inch wide.	Run 98 370.3 to 374.4	100 (80)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-3

SITE Devil Canyon (South Bank)

SHEET NO. 13 OF 13

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	OF RUN (FT)	440 (420)
	Argillite		Run 98	
			Run 99 374.4 to 377.8	100 (88)
380 201.4)			Run 100 372.8 to 382.8	100 (88)
			Run 101 382.8 to 387.8	100 (94)
390			Run 102 387.8- 389.9	100 (52)
391.1		END OF BORING	Run 103	(0)
207.3)				

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

Client ALASKA POWER AUTHORITY  Project Susitna Hydroelectric Project		Job No.	P5700.05 BH-3		
		Hole No			
Site	Devil Canyon (North Bank)	Sheet No.	1_ of _ 2_		

(FT.)	ELEV (FT)	PERMEABILITY (4) cm/sec	COME MECCIVENY	*00	NUMBER OF JOINTS PER JOST	ACCK TYPE	PEWARKS
0	1398	040-04	20 40 40 80	20 40 60 80	5 6 5 20	Overburden	TOP OF ROCK 7.5'
20						Argillite	
40							- Joint, open.
60	1371			•			Joint, slickenside
80				•	41		] Joint, open.
100	1345		Ш,		Щ,		- Joint, open.
120						Argillite/	
140			s			Graywacke Argillite	Quartz pods and stringers.
160	1318						
180							□ Quartz stringers.
200	1292				H		
220						1	
240							Quartz stringers.
260	1265	9			1111	Graywacke	= Fracture zone. - Fracture zone.
280		1		منزو			
300 -	1239		TE			Argillite	Fracture zone.
320		4:					
340			#				Dike, mafic, sheared contacts.

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

Client_	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	BH-3
Site	Devil Canyon (North Bank)	Sheet No.	_2_ of2_

*{****	ROCK TYPE	NUMBER OF JOINTS PER IOFT 5 0 5 20	*00 % 20 *0 60 \$0	COME MECOVERY % 20 40 60 80	PERMEABILITY (K) CH/MC	ELEV (FT)	671H
Fracture zone.		46886					60
				医医氏反射			00
				表名言名意			80
							ou.
END OF BORING						1186	00
391.1'						1100	00
1							
1			اعترانات				
							- 1
						1	-
					F 1 (2) (4) (4)	1	-
1							-
						-	-
						-	-
1						- 1	
							-
-							_
				1 1 1 1			- 1
							- 1
							-
							-

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO. : BH-4

Devil Canyon (South Bank)

SHEET NO. 1 OF 16

LOGGED BY

CONTRACTOR: The Drilling Company

K.J. White, M.P. Bruen

DRILLING DATES: August 14 TO August 19, 1980 DATE: July 1981

DRILLING METHOD:

Casing Advancer
Diamond Core - Triple Tube
CORE DIAMETER: NW (3.0") I.D.
CORE DIAMETER: NQ (1.75") 0.D.

LOCATION:

LATITUDE N3,222,004

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

DEPARTURE E615,992 AZIMUTH 195°

GROUND SURFACE 1352.6 1345.5 ROCK SURFACE BOTTOM OF HOLE

919.0 1321.6 WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	RCCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, GEMENTING, ETC.	RUN	MEC (RQD)
0.0	Overburden	No samples taken.		
7.0		TOP OF ROCK		
6.1) 10 8.7)	Argillite/ Graywacke	Argillite, medium to dark gray, fine grained, interbedded with graywacke, medium to dark gray, fine to medium sand grains in an argillaceous matrix, elongate grains parallel to bedding/foliation. Very thin to thin bedding coincident with weakly developed foliation at 20°. Fresh, hard, well indurated.	No Core Taken	
		Joints generally close to very close, planar, smooth to rough, tight to open, quartz and carbonate filling, iron oxide staining.  12.0-15.2 - Core loss of 0.6 feet.	Run 1 12.0 to 15.2	75 (31)
		12.0-15.2 - tore loss of 0.5 feet.  12.0-35.1 - Joints generally close to very close, planar, smooth to rough, tight to open, quartz and carbonate filling, iron oxide staining.	Run 2 15.2 to 18.8	100 (67)
20		20.0, 23.4, 29.8 - Joints, 20-30° with slicken- sides and iron oxide staining, parallel beddimg/foliation.	Run 3	100 (50)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT

ALASKA POWER AUTHORITY

JOB NO

P5700.05

PROJECT Susitna Hydroelectric Project Devil Canyon (South Bank)

HOLE NO. BH-4

SHEET NO 2 OF 16

DEPTH (FT)	ROCK TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	PEC (RQD)
	Argillite/ Graywacke	20.8 - Quartz vein, 50°, crosscutting bedding/foliation, 0.5 inches wide, stretched, tight. 23.0-29.0 - Quartz stringers, 0.1 inches wide, closely spaced, irregular, stretched, tight.	Run 4 20.4 to 25.4	100 (92)
30			Run 5 25.4 to 30.5	100 (96)
33.9			Run 6 30.5 to 34.0	100 (49)
(29.4)	Graywacke	Medium to dark gray metasedimentary rock with medium to coarse grained sand in a fine grained argillaceous matrix, sand grains elongate parallel to bedding/foliation.  Texture massive to weakly developed foliation coincident with bedding at 20-30°.	Run 7 34.0 to 39.0	100 (100)
40 34.6)		35.1-103.1 - Joints generally closely spaced, planar, smooth to rough, tight, carbonate, quartz, chlorite and talc filling, occasional iron oxide staining.	Run 8 39.0 to 44.0	100 (100)
	M	44.0-47.0 - No drilling water return.		
,,		45.2-46.4 - Fracture zone, 2 inches wide, joints very closely spaced at 15-20°, open, sandy silt/clay coating, iron oxide staining. 47.0-58.1 - Drilling water return 50%.	Run 9 44.0 to 48.0	95 (88)
50 ( <b>43</b> .3)		50.3 - No iron oxide staining below.	Kun 10 48.0 to 53.1	98 (98)

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

Devil Canyon (South Bank) SITE

SHEET NO 3 OF 16

(FT)	MOCK TYPE	<u>DESCRIPTION</u> : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (FT)	#(C ,#QD)
	Graywacke		Run 11 53.1 to 58.2	100 (100)
. 60 (52.0)			Run 12 58.2 to 61.5	100 (88)
			Run 13 61.5 to 65.7	100
			Run 14 65.7 to 70.2	100 (100)
. 70 (60.6)			Run 15 70.2 to 75.0	100 (98)
			Run 16 75.0 to 80.2	92 (92)
80 (69.3)		83.2 - Quartz veins, 40°, 0.5 inches wide, tight, sulphide mineralization.	Run 17 Run 18 80.9 to 84.4	100(86 100 (100)

#### ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO , NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

SITE

JOB NO. P5700.05

HOLE NO BH-4

PROJECT Susitna Hydroelectric Project Devil Canyon (South Bank)

SHEET NO. 4 OF 16

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF PUN (FT)	REC (R00)
	Graywacke	86.5 - Quartz vein, 40°, 0.5 inches wide, tight.  88.4-90.3 - Rock fragments 0.5 to 1 inch long, stretched, parallel bedding/foliation at 30°.	Run 19 84.4 to 89.4	100 (100)
90 (77.9)			Run 20 89.4 to 93.8	100 (100)
			Run 21 93.8 to 98.2	100 (100)
100 - (86.6)		102.3-103.1 - Numerous quartz veins and stringers, very closely spaced.	Run 22 98.2 to 103.4	100 (100)
-		102.9 - Quartz vein, 50°, 0.75 inches wide, open contact, trace of sulphur-like mineral. 104.5 - Joint, 25°, planar, rough, slickensides, carbonate coating.	Run 23 103.4 to 108.1	100 (100)
108.4 (93.9) 110 (95.3)	Argillite/ Graywacke	Very thinly bedded graywacke, as above, inter- bedded with argillite, dark gray, very fine to fine grained, bedding coincident with weakly developed foliation at 5-10°, crosscut by microfolds, poor cleavage, phyllitic sheen in places.	Run 24 108.1 to 113.3	100 (100)
14.9 - (99.5)	Argillite	Joints moderately closely spaced at 20-30°, planar, rough to smooth, tight to open, some carbonate and trace silt filling.  Rock description as above.  Joints generally moderately closely to widely	Run 25 113.3 to	100 (100)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Devil Canyon (South Bank)

SHEET NO 5 OF 16

DEPTH (FT)	MOGR TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OF GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	HEC (400)
120	Argillite	spaced with zones very closely spaced, planar, few irregular, rough to smooth, tight to open, few slickensides, carbonate, quartz, talc, and chlorite coating.	Run 26 117.7- 120.0	100 (100)
(103.9)			Run 27 120.0 to 125.0	100 (100)
			Run 28 125.0 to 130.2	100 (100)
130			Run 29 130.2 to 135.5	100 (100)
		135.5-140.5 - Core loss of 0.3 feet.		
140		140.5-240.3 - Drill water return less than	Run 30 135.5 to 140.5	94 (88)
121.2)		140.5-240.3 - Drill water return less than 50%.	Run 31 140.5 to 145.6	100 (100)
			Run 32 145.6 to 150.8	100 (100)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Devil Canyon (South Bank)

SHEET NO 5 OF 16

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATERILOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN (FT)	260 (993)
150 129.9)	Argillite		Run 32	
			Run 33 150.8 to 155.9	100 (100)
160		157.0 - Joint, 20°, with slickensides.	Run 34 155.9 to 160.9	100 (100)
(138.6)		161.7 - Argillite becoming reddish, dark gray, massive to weakly developed foliation. Fresh, hard to very hard, well indurated.	Run 35 160.9 to 165.9	98
170 (147.2)		169.5-170.4 - Quartz veins.	Run 36 165.9 to 170.9	98 (96
(147.2)		171.3-172.3 - Quartz veins and stringers. slickensides, sulphide mineralization, poorly indurated. Core broken and ground by drilling.	Run 37 170,9 to 176,1	100 (90
. 180		178.5 - Joint, 35°, with slickensides. 178.5-181.6 - Joint surfaces talc coated. Core broken by drilling, fragments 0.05 to 0.1 feet.	Run 38 176.1 to 179.6	100 (77

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE WO BH-4

SITE Devil Canyon (South Bank)

SHEET NO 7 OF 16

SEPTH (F7)	MOCH THRE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURINS, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, DEMENTING, ETC.	DE RUN	(#25)
	Argillite	184.2-188.5 - Joints, 15° and 30°, with	Run 39 179.6 to 184.0	100 (100)
		slickensides.	Run 40 184.0 to 189.1	100 (100)
190 (164.5)			Run 41 189.1 to 194.3	100 (94)
		199.8-201.6 - Quartz vein, 10°, 0.5 inches	Run 42 194.3 to 199.6	100 (100)
200 173.2)	wide	wide, fractured, possibly slickensides, talc coating, contact partially open.	Run 43 199.6 to 204.6	100 (100)
		206.8-207.4 - Quartz vein at 0°, 0.5 inches wide, irregular, stretched, tight. 207.6-211.6 - Fractures very closely spaced, irregular, discontinuous, some quartz filled.	Run 44 204.6 to 209.6	100 (100)
210 (181.9)		211.5-213.2 - Quartz vein, 10°, crosscutting foliation, 0.5 inches wide, 40% chlorite in layers and pods, sulphide mineralization.	Run 45 209.6 to 214.9	94 (75)

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

Devil Canyon (South Bank)

MOLE NO BH-4

DEPTH (FT)	MOCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, GEMENTING, ETC.	OF AUN	#EC (#00)
	Argillite	213.5-213.7 - Quartz veins, 0.5 inches wide, irregular, folded, tight.	Run 45	
		214.2 - Quartz vein, 20°, parallel to bedding/ foliation, 0.5 inches wide.	Run 46	
		214.9 - Core loss of 0.3 feet.	214.9	100
220		216.8-220.0 - Quartz veins, closely spaced, less than 0.5 inches wide, tight, crosscutting bedding/foliation at 0-10° but offset along cleavage planes.	to 220.2	(100)
190.5)		221.0-252.0 - Shear/fracture zone, healed,	Run 47	
-		30-40% folded and nonfolded quartz veins. Folded veins contorted and stretched in matrix	220.2	100
		of argillite breccia. Nonfolded veins cross-	to	(96)
1		cutting bedding/foliation, vuggy with chlorite and iron and lead sulphides. Generally tight.	225.3	
- 1		1	Run 48	
		1	225.3	98
4		1	to 230.1	(98)
			230.1	
230		230.1-235.5 - Core loss of 0.2 feet.		
,			Run 49	
1		233.8-328.3 - Joints generally closely spaced,	230.1	96
		planar, some curved and irregular, slick to	235.5	(85)
1		rough, tight, some open, carbonate, quartz, chlorite, and talc coating.	233.3	
+		236.2-240.9 - Fracture zone, very closely to closely spaced joints at 0° to 10°, slick,	Run 50	
		talc and carbonate coating, possible slicken-	235.5	100
+		sides.	to 240.3	(83)
			240.3	
240 <u>-</u> 207.8)		240.3-240.9 - Core loss of 0.1 feet.	D - 53	-
			Run 51	000
1		243.9, 245.8, 249.6 - Faint slickensides.	240.3 to 245.6	98 (98)

CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project MOLE NO BH-4

SITE Devil Canyon (South Bank) SMEET NO 9 OF 16

DEPTH (#T)	MOCA TYPE	DESCRIPTION COLOR TEXTURE FOLIATION JOINTING FRACTURING FAULTING ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	(#20) #£C
	Argillite	246.8-247.0 - Quartz vein, 0.6 feet wide, fractured, vuggy with iron and lead sulphides, carbonate and chlorite at contacts.	Run 52 245.6- 247.8	100
250 (216.5)		248.8-249.1 - Quartz vein, 30°, fractured but tight, open joints at contacts with talc, chlorite and possibly slickensides.	Run 53 247.8- 250.3	96 (52
			Run 54	
252.0 (218.2)	Argillite/ Graywacke	Interbedded argillite and graywacke, as above. Very thin to thin bedding. Joints generally closely spaced, planar, smooth, tight, quartz carbonate, chlorite and talc filling.	250.3 to 255.2	100
		254.0-258.1 - Quartz veins, closely spaced, 0.5 to 1 inch wide, folded, tight.	Run 55	
		257.3 - Core loss of 0.1 feet.	255.2	98
260		257.8 - Quartz vein, 20°, 1 inch wide, fractured but tight, vuggy with sulphide mineralization.	to 260.3	(94
225.2)			Run 56	100
+		262.3 - Quartz vein, 20°, 2 inches wide, vuggy with sulphide mineralization, tight.	260.3- 262.6	(100
-		263.8-264.4 - Quartz vein, fractured, tight to partially open, vuggy with sulphide mineralization, lower contact open.	Run 57 262.6	92
267.0		264.7-308.5 - Argillite "spotted" with biotite (?), microfolds crosscutting foliation at 50%	to 267.6	(72
231.2)	Argillite	Rock description as above.	Run 58	
270 233.8)		266.8-279.5 - Numerous quartz veins and stringers. Veins closely to moderately closely spaced at 30° to 40°, crosscutting bedding/foliation, 0.5 inches to 8 inches wide, fractured but tight. Sulphide, chlorite and	267.6 to 272.3	100
		carbonate mineralization present. Between	Run 59	
1		270.6 to 272.4 broken by drilling. Stringers less than 0.5 inches wide, parallel to bedding/	272.3	100
- 1		foliation, folded, stretched, tight.	to 277.3	(98

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CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project MOLE NO BH-4

SITE Devil Canyon (South Bank)

SHEET NO. 10 OF 16

DEPTH (FT)	MOCH TYPE	<u>QESCRIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF AUN	965 (999)
280 (242.5)	Argillite	278.1-280.8 - Joints, 70° and 0°, with slickensides.	Run 60 277.3 to 281.0	100 (92)
		282.3-287.8 - Quartz vein, fractured but tight, chlorite and sulphide mineralization.  284.6-285.1 - Shear, 10°, 0.5 inches of breccia, chlorite, talc and carbonate coating.	Run 61 281.0 to 286.0	100 (96)
1		286.0 - Core loss of 0.4 feet.	Run 62	
			286.0 to 290.5	91 (87)
290 (251.1)		292.9-295.6 - Shear zone, 10°, parallel to foliation, slick surfaces with talc coating.	Run 63 290.5 to 293.5	100
	breccia and gouge on some surfaces, fragment of breccia/gouge 2 inches wide at 295.5.  Breccia contains angular fragments in a clay matrix. Core loss of 0.7 feet at 293.5.	Run 64 293.5 to 297.9	64 (55)	
300 (259.8)		301.9-307.0 - Core loss of 0.7 feet.	Run 65 297.9 to 301.9	90 (90)
			Run 66 301.9 to 307.0	94 (94
		$307.6-309.6$ , $309.6-311.2$ - Bedding planes, $10^\circ$ , with slickensides. 308.1-311.5 - Joints subparallel to core axis.	Run 67	

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Devil Canyon (South Bank)

SHEET NO 11 OF 16

1691H (61)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF HUN	MEC (MQD)
310 (268.5)	Argillite	310.0-318.0 - Quartz veins and stringers, up to 1 inch wide, folded, parallel to bedding/foliation and crosscutting veins with open fractures and sulphide and talc mineralization.	Run 67 307.0 to 312.2	96 (96)
		312.2 - Core loss of 0.2 feet.	Run 68 312.2 to 317.0	100 (88)
320 277.1)			Run 69 317.0 to 322.0	100 (98)
			Run 70 322.0 to 327.2	98 (98)
330 285.8)		328.3-385.6 - Joints generally closely to moderately closely spaced, planar to irregular, smooth to rough, tight to open, quartz and carbonate filling, chlorite coating.  330.4-331.1 - Joint, 20°, open.	Run 71 327.2 to 332.2	100 (100)
			Run 72 332.2 to 337.3	98 (98)
340 . (294.4)		339.3 - Core loss of 0.2 feet.	Run 73 337.3 to 342.4	96 (96)

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CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-4

SITE Devil Canyon (South Bank)

SHEET NO 12 OF 16

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	(A00)
-	Argillite		Run 73	
		343.9-345.0 - Quartz vein.	Run 74 342.4 to 347.0	96 (91)
350		347.0 - Core loss of 0.2 feet.  349.8 - Joint, 20°, with slickensides.	Run 75 347.0 to 350.0	100 (97)
303.1) 351.2 304.1)	Argillite/ Graywacke	Interbedded argillite and graywacke, as above. Joints generally closely spaced, mostly planar, smooth to rough, tight to partially open,	Run 76 350.0 to 353.5	100 (100)
		quartz and carbonate filling, 2 joints with chlorite coating.  353.5 - Core loss of 0.4 feet.	Run 77 353.5 to 356.5	87 (77)
360 311.8)			Run 78 356.5 to 361.0	93 (93)
362.5			Run 79	
313.9)	Argillite	Rock description as above.  Joints generally closely to moderately closely spaced, planar to irregular, smooth to rough, tight to open, quartz, carbonate and chlorite filling.	361.0 to 366.3	100 (94)
370 (320.4)		362.5-364.5 2 370.7-376.3 2 Quartz vein, very closely spaced fractures, generally tight, some open, vuggy, chlorite, carbonate, and iron and lead sulphide mineralization, contacts at 10° to 20°, parallel to and crosscutting bedding/foliation at 10° and 20°, respectively. 371.0-379.4 - Core loss of 2.0 feet.	Run 80 366.3 to 371.0	100 (100)

CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project HOLE NO BH-4

TE Devil Canyon (South Bank) SHEET NO. 13 OF 16

DEPTH (FT)	POCK TYPE	OESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	DE RUN (FT)	9EC (#05)
	Argillite		Run 81	
		376.3-387.0 - Foliation better developed at	371.0 to 376.5	100 (84)
		10°-20°, phyllitic sheen, poor cleavage.	Run 82 376.5 to	90 (79)
380 329.1)		379.4-386.0 - Core barrel mislatched during drilling, core badly broken. Core loss of 0.2 feet.	379.4 Run 83	
			379.4 to 386.0	97 (97)
		385.6-437.8 - Joints generally closely to very closely spaced, planar, mostly smooth, tight, carbonate, quartz, chlorite and talc filling.		
387.1 335.2)	Graywacke	Medium gray metasedimentary rock with fine to medium grained sand in an argillaceous matrix, with very thin argillite layers.	Run 84 386.0 to 390.8	92 (92)
390 337.7)		Joints closely to moderately closely spaced, planar, slick to rough, tight, chlorite and talc filling.		
-		390.8-396.0 - Core loss of 1.0 feet.	Run 85	88
		393.9 - Bedding/foliation, 20°.	to 396.0	(88)
398.6		396.3-396.8 - Quartz vein, 60°, very closely spaced fractures, generally tight, upper contact open, lower contact tight.	Run 86 396.0	100 (88)
345.2) 400 346.4)	Argillite	Rock description as above.	401.1	(00)
			Run 87	
			401.1 to 406.1	98 (98)

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CLIENT ALASKA POWER AUTHORITY JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

Devil Canyon (South Bank) SHEET NO. 14 OF 16

DEPTH (F1.)	MOCK TYPE	DESCRIPTION COLOR TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC.	DENGTH OF BUN (FT)	19901
	Argillite	406.5-410.4 - Graywacke interbedded with	Run 87	
		argillite, very thin to thin beds.	Run 88	
410 355.1)			406.1 to 411.1	100 (96)
			Run 89 411.1 to	100 (100)
			416.2 Run 90	
420			416.2 to 420.0	100 (100)
363.7)			Run 91	
			420.0 to 425.0	100 (100)
			Run 92 425.0	00
			to 430.3	98 (98)
430 372.4)			Run 93	
		435.2-435.6 - Quartz stringers, generally at	430.3 to 435.1	100 (100)
		0°, less than 0.5 inches wide, parallel to and crosscutting bedding/foliation.		

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

SITE Devil Canyon (South Bank)

SHEET NO 15 OF 16

06976 (#3.)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE HUN (FT)	(#20)
440	Argillite		Run 94 435.1 to 440.1	100 (96)
(381.1) 441.8 (382.6)	Argillite/ Graywacke	Interbedded argillite and graywacke. Rock description as above. Thin bedding coincident with foliation at 15°. Foliation better developed in argillite than in graywacke, phyllitic sheen, poor cleavage.	Run 95 440.1 to 445.1	100 (100)
450		Joints generally closely to very closely spaced, at bedding contacts, joints very closely spaced in graywacke, without penetrating argillite. Joints generally planar, slick to smooth, tight, chlorite, talc and carbonate filling.	Run 96 445.1 to 450.2	100 (94)
(389.7)			Run 97 450.2 to 453.8	100 (100)
		455.0-457.8 - Core broken during drilling along very closely to closely spaced joints	Run 98	100 (44)
		at 20° to 40°, most surfaces coated with talc.	Run 99	100(63
460		chlorite, and carbonate.	Run 100 456.4 to 460.5	100 (80)
(398.4)			Run 101 460.5 to 465.7	100 (94)
465.8 = (403.4)	Argillite	Rock description as above.	Run 102 465.7 to 471.5	100 (100)

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CLIENT ALASKA POWER AUTHURITY

JOB NO. P57 10.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-1

SITE	Devil Canyon (South Bank)	SHEET NO	16 uf	16

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE HUN (FT)	(MOD)
470 46/.0)	Argillite	471.0 - Bedding/foliation, 15°.	Run 102	
			Run 103 471.5 to 475.5	100 (100)
480			Run 104 475.5 to 480.5	100 (94)
415.7)		485.9 - Core loss of 0.2 feet.	Run 105 480.5 to 485.5	98 (98)
490			Run 106 485.5 to 490.5	96 (96)
424.4)			Run 107 490.5 to 495.7	96)
			Run 108 495.7 to 500.7	100 (100)
500.7 433.6)		END OF BORING		

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project Hole No. BH-4 Devil Canyon (South Bank) Site Sheet No. 1 of 2 PERMEABILITY COME RECOVERY ELEV SOCK TYPE ..... TOP OF ROCK 7.0 Overburden Argillite/ 20 Graywacke Joints, slickensides. 40 Gravwacke 1310 60 88 100 1266 120 Argillite. 140 1223 160 180 200 1180 Tracture zone. 220 Fracture zone. 240 1 Quartz veins. 260 Graywacke Quartz veins. Argillite 280 Quartz veins. 300 1093 320 340

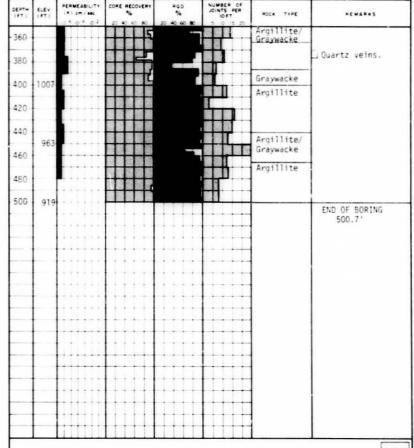
#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 BH-4

 Site
 Devil Canyon (Scuth Bank)
 Sheet No.
 2 of 2





CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

SHEET NO. 1 OF 20

Susitna Hydroelectric Project

HOLE NO : BH-5a

P5700.05

PROJECT:

PROJECT Susitna Hydroelectric Project

ALASKA POWER AUTHORITY

HOLE NO BH-5a

Devil Canyon (North Bank)

SITE Devil Canyon (North Bank)

CLIENT

SHEET NO 2 OF 20

CONTRACTOR: Interstate Exploration Inc. DRILLING DATEs: June 4 TO June 15, 1981 LOGGED BY: R.R. Henschel DATE: July 1981

DRILLING METHOD:

Diamond Core - Triple Tube CASING DIAMETER: NV (3.0") I.D. CORE DIAMETER: NQ (1.75") 0.D.

LOCATION

DEPARTURE E616,646

AZIMUTH 189° 45°

LATITUDE N3, 222, 961

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

GROUND SURFACE 974.5 ROCK SURFACE 974.5

BOTTOM OF HOLE 551.7

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, GEMENTING, ETC.	RUN	MEC (MGD)
0.0	Argillite	Dark gray to black, very fine grained meta- sedimentary rock. Bedding generally coincident with weakly developed foliation at 20° to 25°.	Run 1 0.0- 2.0	60 (25)
		Occasional very thin beds of light to medium R	Run 2	92 (0
1	gray, fine gra sulphide miner locally. Gene	gray, fine grained graywacke. Occasional fresh sulphide mineralization. Slightly phyllitic locally. Generally fresh to slightly weathered, hard, brittle, well indurated.	Run 3 3.2- 5.5	100 (91)
]		Joints generally closely to moderately closely spaced, planar to irregular, rough to smooth, tight to partially open, iron oxide staining.	Run 4 5.5- 8.0	100 (80)
10		0.0-1.5 - Core broken by drilling. Core loss of 0.8 feet.	Run 5	
(7.1)		0.0-42.6 - Joints and fractures very closely to closely spaced, joints at 20-25° and 40°	8.0 to 11.5	94 (39)
1		crosscutting bedding/foliation and at 20-25° parallel to bedding/foliation, planar to irregular, smooth to rough, tight to partially	Run 6	100 (75)
- 4		open, heavy iron oxide staining and filling.	Pun 7	91 (0
		8.2-10.4 - Core broken by drilling. Core loss of 0.2 feet.	Run 8 14.2-	79
	$14.2-15.0$ - Zone of very closely spaced joints at $10^{\circ}$ , $30^{\circ}$ , $60-70^{\circ}$ .	16.6 Run 9	100	
- 1		16.0-16.6 - Core broken by drilling. Core		(100)
20 14.1)	7.	loss of 0.2 feet.	Run 10 18.2 to 22.8	100 (94)

DEPTH (FT)	MOCH TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR SAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	#EC :#301
	Argillite	22.8-30.3 - Fracture zone, joints very closely spaced, fragments hard and well indurated. Core broken by drilling. Some core loss.	Run 10	
			Run 11 22.8 to 28.5	35 (0)
30 (21.2)			Run 12 28.5- 30.7	73 (18)
		31.2-31.7 - Core loss due to mechanical problems. Hole caving badly, 6.0 feet	and the second second second	50 (40)
	1	reamed to 31.7.  33.7-35.7 - Fractures very closely spaced,	Run 14 31.7-	75 (35)
		fragments hard and well indurated. Core broken by drilling.	33.7 Run 15	100
			Run 16 35.2 to 38.2	90 (64)
			Run 17 Run 18	100(100
40 (28.3)		40.8-42.6 - Fractures very closely spaced, fragments hard and well indurated. Core broken by drilling. Some core loss.	Run 19 40.0	(71) 50 (0)
		42.6-114.0 - Joints, close to moderately close spaced, iron stained, generally tight.	42.6 Run 20 42.6- 44.6	100
			-	(90) 100(39)
		46.0 - Bedding becomes less distinct with general trend 0-5°, syndepositional deformation.	Run 22 45.5- 47.8	100 (100)
E0.			Run 23 47.8- 49.8	100 (70)
50 (35.4)			Run 24 49.8 to 53.0	100 (100)

ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS

BUFFALO , NEW YORK

PRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

NOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 3 OF 20

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF NUN	PEC (PQD)
	Argillite		Run 25 53.0 to 57.8	100 (96)
60 (42.4)			Run 26 57.8 to 62.7	92 (92)
		67.9-70.8 - Joints, average 30° and 50°, iron oxide and silt fillings.	Run 27 62.7 to 67.7	100 (94)
70 (49.5)			Run 28 67.7 to 72.5	98 (94)
1		73.9-74.4 - Fracture zone, healed with carbonate, hard.	Run 29 72.5 to 75.7	88 (78)
		76.7-77.2 - Fracture zone, joints at 30° and 40°, closely to very closely spaced, iron oxide staining.		95 (60)
80 (56.6)		80.4-95.0 - Quartz stringers, 20°, crosscut bedding, very thin.	78.3- 80.4	100 (90)
-		82.0-85.3 - Bedding/foliation, 15°.	Run 33 80.4 to 83.8	100 (100)
			Run 34	

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ALASKA POWER AUTHORITY

SITE

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

Devil Canyon (North Bank)

NOLE NO BH-5a
SHEET NO 4 OF 20

DEPTH (F1)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	(#20)
	Argillite	86.1-87.0 - Joints, two, 15-20°, parallel bedding, slickensides, heavy iron oxide	83.8- 86.7	100 (72)
		staining with calcareous clay.	Run 35	
(63.6)		87.3 - Joint, 20°, crosscutting bedding, rough, faint slickensides, iron oxide stained.	86.7 to 90.5	100 (29)
		90.0 - Joint, 30°, faint slickensides, tight.	1 30.0	
		91.1-92.4 - Bedding/foliation, 20°. Joints parallel to and crosscutting bedding, planar, iron oxide and minor carbonate.	Run 36 90.5 to 95.0	93 (82)
		1	Run 37	
1		1	95.0	97
		I	98.0	(87)
1		98.9-101.2 - Fracture zone, very closely spaced joints at 0-20° and 50-80°, rough,	Run 38	
		irregular, iron oxide staining. Core loss 1.1 feet.		
(70.7)			98.0 to	(35)
(/0.//			102.0	(55)
1			Run 39	92
		1	Run 40	(50)
		1	104.5-	100
			106.0	(0)
		107.5 - Joint, 25°, crosscutting bedding,	Run 42	(53)
1		iron oxide staining.	Run 43	100(50)
			108.0-	100
110		1	109.6	(88)
(77.8)			Run 45	
			109.6	92
		113.5 - Joint, 20°, parallels bedding, slickensides, tight, thin iron oxide and clay coating.	to 114.1	(60)
1		cray coacing.	Run 46	
-		116.0 - Bedding/foliation, 10-15°, poorly to well developed. Composition approaching grawwacke.	-	(87)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT S

Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO. 5 OF 20

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN (FT)	AEC (AGD)
- 120 (84.9)	Araillite	116.0-121.0 - Joint spacing close to moderately close, partly open with iron oxide staining and carbonate.  120.6 - Joint, 15°, tight.  121.0-132 Joints, 15° and 25-30°, closely	Run 47 115.9 to 120.8	100 (71)
		to moderately closely spaced, smooth, planar. 122.2-122.5 - Quartz vein, 15-20°.	Run 48 120.8- 123.0	32 6
.		124.8 - Joint, 25°, parallels bedding, open, carbonate coating.	Run 49 Run 50	100 (0)
		128.0-134.0 - Fracture zone, joints, closely spaced at 30-35° and 70°, healed.	123.7 to 128.0	100 (100)
1			Run 51	100(100
- 130 (90.4)		132.0-167.9 - Joint spacing varies from close to wide, average moderately close. 134.0 - Composition becomes progressively	Run 52 129.0 to 134.0	100 (100)
		more argillaceous, with thin interbeds of graywacke.	Pun 53	100 (47)
140		134.4-136.0 - Zone of intense syndepositional deformation.	Run 54 135.9 to 140.9	100 (94)
(33.07			Run 55 140.9 to 145.8	100 (100)
		146.1-146.8 - Vein, 10-15°, sulphide mineralization.	Run 56 145.8 to 149.3	100 (100)

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a
SHEET NO 6 OF 20

SITE Devil Canyon (North Bank)

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	#£C (900)
150 106.1)	Argillite	149.5 - Joint, 35°, well developed slickensides, tight, chloritized.	Run 57	
1			149.3 to 154.2	100 (100)
1		154.8-155.8 - Graywacke, fine grained, medium gray.	Run 58	
-		155.6-155.9 - Fracture zone, very closely spaced joints at 40-50°, open, carbonate/ limonite staining.	154.2 to	97 (82)
		156.5 $\stackrel{?}{>}$ 156.7 $\stackrel{?}{>}$ Joints, 50°, open, carbonate and minor limonite.	158.0 Run 59	
160 (113.1)		159.4 - Joint, $25^{\circ}$ , slickensides, carbonate and iron oxide.	158.0 to 163.0	100 (86)
		166.1 - Joint, 20°, crosscuts bedding, well developed slickensides, zones of clay and breccia.	Run 60 163.0 to	100 (68)
		167.9-170.6 - Fractures, irregular, healed, very closely spaced.	168.0	
1		168.9 - Joint, 25°, well developed slickensides, tight, carbonate.	Run 61	
170 120.2)	Meta-argillite	Rock description as above but with phyllitic sheen.  170.6-205.5 - Joints, closely spaced.	168.0 to 173.0	98 (86)
		170.6-205.5 - Joints, Closely Spaced.	Run 62	100
1		175.0 - Joint, 30°, slickensides, tight,	173.0- 175.4	
177.2 125.5		chloritized.	Run 63 175.4 to	100
125.5	Argillite/ Graywacke	Rock description as above, interbedded with light to medium gray graywacke as stringers.	178.0 Run 64	
180 127.3)		Bedding/foliation generally 0-10°. Localized thin phyllitic bands.	178.0 to 183.3	96 (89)

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JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 7 OF 20

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	(#Q0)
	Arcillite/ Graywacke	183.3-188.0 - Core barrel mislatch. Core loss	Run 64	
		187.1-187.3 - Quartz vein, 20°. 188.0-191.9 - Fracture zone, well healed	Run 65 183.3 to 188.0	66 (23)
190 134.4)		fractures.  190.2 > 190.4 > Joints, 30-50°, irregular, partly open, slickensides.	Run 66 188.0 to 193.3	100 (77)
		193.9 - Fracture, 50°, irregular, slickensides	Run 67 193.3 to 196.3	100 (100)
197 139.3)	Argillite	Rock description as above, with thin incerbeds of graywacke locally. Joints, tight.	Run 68	100 (100)
200 141.4)			Run 69 198.1 to 203.0	100 (88)
		203.0-217.0 - Fractures, numerous, healed. 203.2 - Joint, 20°, crosscuts bedding, faint slickensides. 203.5-204.0 - Fracture and quartz	Run 70 203.0 to 206.0	100 (63)
210		stringers, 15°, tight, irregular, highly chloritized.  205.5-251.7 - Intermittant wavy bands and stringers of graywacke. Joints moderately close to widely spaced at 0-15°.	Run 71 206.0 to 211.3	96 (96)
148.5)			Run 72	

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 8 OF 20

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (490)
	Argillite	215.0 - Joint, 0-10°, possible shear, silt/	Run 72 211.3- 215.3	100 (80)
-		sandy coating.	Run 73 215.3 to 218.3	100 (93)
.220 (155.6)			Run 74 218.3 to 222.8	100 (100)
		222.5-225.0 - Fractures, healed, very closely spaced and irregular, healed, small quartz vein.	Run 75 222.8 to 227.8	100 (100)
230			Run 76 227.8 to 232.6	100 (100)
75.5			Run 77 232.6- 235.1	100
			Run 78 235.1 to 239.5	100 (100)
2 <b>4</b> 0 (169.7)		240.8 - Joint, 30°, tight, chlorite coating.	Run 79	100 (89)
		244.1-247.1 - Fracture zone, very thin joints, 30°, very closely spaced, healed.	Run 80 241.3 to 244.4	100 (100)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 9 OF 20

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (FT)	(#00)
	Argillite	247.1-252.1 - Core loss 0.4 feet.	Run 81 244.4 to 247.4	93 (73)
250 - 176.7)		251.7-252.1 - Silty layer, 80°, with fresh angular rock fragments. Surrounding core fresh. Appears to be river silt.	Run 82 247.4 to 252.4	100 (94)
ł		251.7 - Fracture, 80-90°. 251.7-290.0 - Joints moderately closely spaced with zones of very close spacing.	Run 83 252.4 to	100 (65)
1		252.1-252.4 - Joint, 30°, crosscuts apparent bedding/foliation. Filled by 1/8 inch clay/ breccia.	256.7 Run 84	(65)
260 183.8)		252.4-253.9 - Fractures, irregular, 0-15°, clay/breccia filling.	256.7 to 261.8	100 (75)
1			Run 85	
1		264.5-266.1 - Fracture zone of very closely spaced joints at 5°. Chloritization present. Core loss 0.3 feet.	261.8 to 266.4	93 (80)
1		265.4-267.4 - Fracture zone, very closely spaced joints at 20° and 30-40°.	Run 86	
1		266.5 - Joint, 25°, crosscuts bedding, well developed slickensides at 60°, tight.	266.4 to 271.2	100 (85)
190.9)			Run 87	
		273.5 - Fracture, 25°, open.  274.8-276.0 - Fracture zone, very closely spaced joints at 0-10°, 40° and 60°. Core loss 0.2 feet.	271.2 to 276.4	92 (71)

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

MOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO. 10 OF 20

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	MEC (MGD)
	Argillite		Run 88 276.4 to	96 (96)
280 - 198.0)			281.6 Run 89 281.6 to 284.2	100 (88)
		285.6-288.0 - Quartz stringers, irregular.	Run 90 284.2 to 288.6	98 (93)
		288.0-289.7 - Fracture zone, closely spaced, open to healed joints at 30°, faint slicken-	Run 91	72 (31)
290		sides.	Run 92 289.9- 292.4	72 (48)
		291.0-297.6 - Shear/fracture zone, joint very closely spaced at 0° and 20-30°, slickensides well developed.	Run 93	
-		<pre>291.0-292.9 - Joint surfaces slick, highly chloritized.</pre>	292.4 to 296.4	86 (10)
		296.3-297.9 - Shear, 40°.  296.2-297.6 - Fracture zone, jointed 20-40°, highly chloritized, slickensides.	Run 94	100
297.7 210.5) 300 212.1)	Graywacke	Light to medium gray, fine grained graywacke with thin interbeds of argillite. Bedding/foliation highly deformed by syndepositional processes, generally at 15°.  297.7-367.4 - Joints moderately closely spaced with zones of very closely to closely	Run 95 297.9 to 302.9	100 (92)
		spaced. Numerous weakly healed and rebroken. Generally at 20° and 40-50°. Faint slicken- sides.	Run 96 302.9 to 307.2	98 (86)
			Run 97 307.2 to 312.0	100

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 11 OF 20

DEPTH (FT)	MOCK TYPE	CESCHIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	PEC (920)
310 219.2)	Graywacke		Run 97	
		317.0-317.7 - Fracture zone, very closely	Run 98 312.0 to 317.3	100 (85)
320		spaced joints parallel to bedding/foliation.  320.5 - Joint, 20°, minor shear with 1/16 inch	Run 99 317.3 to 320.3	93 (43)
226.2)		clay/breccia, highly chloritized.  322.0-323.6 - Fracture zone, healed with quartz, joints at 50-60°.	Run 100 320.3 to 323.9	100 (78)
		325.8-326.4 - Joint, 15°, minor shearing healed with carbonate, parallels bedding/foliation.	Run 101 323.9 to 328.3	100 (89)
330 233.3)			Run 102 328.3 to 333.3	100 (92)
		333.2-333.4 - Joint, 25°, crosscuts bedding, healed with clay/breccia and carbonate.  333.3-333.8 - Shear/fracture zone, very	Run 103	93 (29)
		closely spaced joints, slickensides, chloritized.  338.0 - Joint, 15°, slickensides, tight,	Run 104 334.7 to 338.3	100 (89)
340 240.4)		highly chloritized.  340.6 - Joint, 20-30°, curved, minor shearing, highly chloritized.	Run 105 338.3- 343.3	98 (78)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO. 12 OF 20

DEPTH (FT.)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	LENGTH OF RUN (FT)	96C (900)
	Graywacke		Run 105	
		closely to closely spaced fractures, partially weakly healed. Joints at 20°, 25°, 30°, and 60°. Carbonate common. Possibly shearing.  342.0-343.5 - Highly fractured zone, numerous joints at 20-30°, weakly healed.	Run 106 343.3 to 346.4	90 (48)
		Core loss 0.6 feet.	Run 107	100 (62)
350 (247.5)			Run 108 347.7 to 350.5	100 (75)
		354.3 - Fracture, 10-15°, irregular, faint slickensides, chloritized.	Run 109 350.5 to 354.7	100 (79)
		STICKENSIDES, CHIOFILIZEG.	Run 110 354.7 to 358.1	94 (59)
360 (254.5)		361.2-361.5 - Joint, 20°, tight, faint slickensides, planar, chloritized.	Run 111 358.1 to .363.1	100 (96)
		367.4-392.4 - Joint spacing wide to very wide. Thickly bedded at approximately 0-10°.	Run 112 363.1 to 368.1	100 (98)
. 370 (261.6)			Run 113 368.1 to 373.1	100 (98

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 13 OF 20

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF BUN	(400)
	Graywacke		Run 114 373.1 to 378.1	100 (106)
380			Run 115 378.1- 380.5	100 (91)
(268.7)			Run 116 380.5- 382.5 Run 117	100 (100) 70 (50)
		386.2-387.1 - Fractures, very tight, healed.	Run 118 383.5 to 388.2	100 (94)
			Run 119	100 (73)
390 275.7)			Run 120	100 (67)
392.4 <sup>7</sup> 277.4)	Argillite	Dark gray to black, very fine grained meta-	Run 121 391.2- 393.4	100
		sedimentary rock. Sulphide mineralization common. Joint spacing wide to very wide.	Run 122 393.4 to 396.5	100 (94)
400		297.6-399.4 - Sandy argillite, very fine sand grains in fine grained argillaceous matrix.	Run 123 396.5 to 401.3	100
400 - 282.8)			Run 124	100
403.1 - 280.2)	Graywacke	Rock description as above. Joint spacing wide to very wide. Healed fractures at 20° and 40°, faint slickensides on chloritized	Run 125 402.8- 404.6	100

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 14 OF 20

DEPTH	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE HUN (FT)	#EC (#20)
	Graywacke	surfaces.	Run 126 404.6- 407.4	100 (96)
410 289.9)			Run 127 407.4 to 412.3	100 (92)
			Run 128 412.3 to 416.8	100 (89)
420 296.9)			Run 129 416.8 to 421.9	100 (94)
			Run 130	94 (56)
425.7 301.0)	Argillite	Rock description as above. 425.7-456.6 - Joints moderately close to widely spaced, average 30°. Low angle set,	Run 131 423.7 to 428.4	98 (87)
430 304.0)		15°, highly chloritized.	Run 132 428.4 to 433.6	100 (90)
		437.8 - Shears, minor, joints at 40°, highly chloritized with very thin coating of clay/breccia, tight.	Run 133 433.6 to 436.8	94 (88)

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PROJECT Susitna Hydroelectric Project

NOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 15 OF 20

DEPTH (FT)	MOGH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF NUN	#EC (#QD)
-	Argillite		Run 134	(81)
_ 440 (311.1)		440.4-442.5 - Zone of very closely spaced joints at 30-35°, tight, chloritized.  441.5-442.5 - Shears, 20-25°, very closely spaced, highly chloritized, slickensides, carbonate/gouge/breccia coating.	Run 135 438.4 to 442.9	97 (69)
		445.0 - Joint, $20^{\circ}$ , healed, very tight, faint slickensides.	Run 136 442.9 to 446.9	100 (100)
450 318.2)		451.6-456.6 - Core barrel mislatch.	Run 137 446.9 to 452.0	98 (90)
460 (325.2)		456.6-527.4 - Joint spacing generally wide to very wide with zones of very close to closely	Run 138 452.0 to 457.0	72 (0)
		spaced. Occasional irregular, healed fractures and quartz stringers.	Run 139 457.0 to 461.9	100 (96)
			Run 140 461.9 to 466.9	100 (100)
			Run 141	100 (100)

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 16 OF 20

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	1#QD)
470 (322.3)	Argillite		Run 141 466.9 to 471.9	100 (100)
		475.5-475.9 - Quartz vein, 5-10°, 1/2 inch wide. 476.8 - Joint, 50°, open, planar.	Run 142 471.9 to 476.9	100 (100)
480 333.6)		478.6 - Joint, 60°, part open, rough.	Run 143 476.9 to 481.9	100 (94)
			Run 144 481.9 to 486.9	100 (100)
490 346.4)			Run 145 486.9 to 491.9	100 (96)
			Run 146 491.9 to 497.0	100 (82)
500 (353.5)			Run 147 497.0 to 502.0	100 (96)

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PROJECT Susitna Hydroelectric Project

MOLE MO BH-5a

Devil Canyon (North Bank)

SHEET NO. 17 OF 20

DEPTH (FT)	MOCH TYPE	DESCRIPTION - COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OF GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (FT)	REC (RQD)
	Argillite		Run 147 Run 148	100 (93)
		505.2 - Joint, 20°, possible shear healed weakly with carbonate.	Run 149 503.4 to 508.4	100 (100)
510 360.6)		510.4 - Fracture, 60°, open, rough, irregular.  513.0 - Shear, 40°, highly chloritized, 1/16 inch clayey breccia, slickensides.	Run 150 508.4 to 513.7	100
		515.5-516.8 - Fracture, 0-20°, very irregular, highly chloritized.	Run 151 513.7 to 518.4	96 (85
70000			Rún 152	71 (29
- 520 (367.6)		522.7-527.4 - Shear/fracture zone, joints very closely spaced at 10° and 20°, generally irregular, slick, highly chloritized, well	Run 153 519.8 to 523.6	100 (84
		developed slickensides, carbonate. Core loss 2.4 feet.  527.4-538.1 - Fracture zone, closely to moderately closely spaced joints and fractures at 20-30° and 50°, highly chloritized with	Run 154 523.6 to 528.5	57 (12
		carbonate. Many are healed, rebroken by drilling.	Run 155 528.5 to 533.5	100

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ALASKA POWER AUTHORITY CLIENT

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PROJECT Susitna Hydroelectric Project

MOLE NO BH-5a

SITE Devil Canyon (North Bank) SHEET NO 18 OF 10

DEPTH (F1)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	(#CD)
	Argillite	538.1-540.9 - Shear/fracture zone, healed.	Run 156 533.5 to 538.5	!·8 ('+0)
540 381.8)		chloritized.	Run 157 538.5- 540.7	100
	550	540.9-597.7 - Joints, wide to very widely spaced, generally at 20°, healed with carbonat and rebroken by drilling, highly chloritized. Secondary set at 40-45°, moderately closely to widely spaced, tight.	Run 158	1C0 (45)
550 888.9)			Run 159 545.7 to 550.6	94 (8t)
			Run 160 550.6 to 555.7	100
560			Run 161 555.7 to 560.9	100 (100)
395.9)			Run 162 560.9 to 565.9	98 (88)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE Devil Canyon (North Bank)

SHEET NO 19 OF 20

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	DE RUN	(400) 4(C
570	Araillite		Run 163 565.9 to 570.4	100 (100)
403.0)			Run 164 570.4 to 575.4	100 (92)
580			Run 165 575.4 to 580.7	100 (94)
410.1)			Run 166 580.7- to 583.7	100 (87)
			Run 167 583.7 to 588.5	100 (94)
590 (417.1)			Run 168 588.5 to 592.6	100 (100)
			Run 169 592.6 to 597.9	92 (92)

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CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-5a

SITE

Devil Canyon (North Bank)

SHEET NO. 20 OF 20

DEPTH ROCK TYPE		DESCRIPTION COLOR: TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC		DENGTH OF HUN (FT)	
597.9	Argillite	END OF BORING	Run	169	92(92)
422.7)					
600			1		
424.2)			1		
1					
1					
			1		
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#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY P5700.05 Job No. Project Susitna Hydroelectric Project BH-5a Hole No. Devil Canyon (North Bank) Site Sheet No. 1 of 2 PERMEABILITY COME MECOVEM ELEV (FT) -Argillite 20 Fracture zone. 40 940 60 80 100 904 120 140 Joints, slicken-160 sides. Phyllitic sheen. 180 Argillite/ Graywacke 200 834 Argillite Fracture zone. healed. 220 24G-260 280 Shear/fracture zone Shear/fracture zone 300 Graywacke 320 Shear/fracture zone 340 Shear/fracture zone

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.		P5700.05		
Project	Susitna Hydroelectric Project	Hole No.	ВН	-5a		
Site	Devil Canyon (North Bank)	Sheet No.	2	of	2	

(FT.)	ELEV. (F7.)	PERMEABILITY INT on / MC	20.40.60.80	*00 % 20 40 60 80	NUMBER OF JOINTS PER JOFT	HOCK TYPE	PEMARKS
360						Graywacke	
380		g:			<b>D</b>		
400	692			~		Argillite	
420						Graywacke	
140					$\mathbb{H}^{l}$	Argillite	
	657				di ::		- Shear.
160							
180					1,		
500	621	No Test					İ
520							Shear. Shear/fracture zon
540					+++		Shear/fracture zon
- 1	506						
560					11		
580					Ľu 🗆		
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							597.9*
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CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

PROJECT:

Susitna Hydroelectric Project

HOLE NO. : BH-5b

SITE:

Devil Canyon (North Bank)

SHEET NO. 1 OF 7

CONTRACTOR:

Interstate Exploration Inc.

MRLLING DATES: June 19 to June 26, 1981

MATE: July 1981

DRILLING METHOD:

Diamond Core - Triple Tube

CASING DIAMETER: NW (3.0") I.D. CORE DIAMETER: NQ (1.75") 0.D.

LOCATION

LATITUDE N3,222,964

ELEVATIONS: DATUM

MSL, A.S.P.C., Zone 4

DEPARTURE E616,638 AZIMUTH 277° 45°

GROUND SURFACE 976.6 ROCK SURFACE 976.6

BOTTOM OF HOLE 835.0 WATER TABLE

Depths measured along hole. True depths in ( ). All angles measured to the core axis. NOTES: 1)

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, GENERATING, ETC.	MUN LENGTH	MEC (ROD
0.0	Argillite	Medium to dark gray, fine grained meta- sedimentary rock. Very thin beds coincident with weak to moderately developed foliation. Occasional very thin to thin beds of light	Run 1 0.0- 2.5	92 (24
		gray, fine grained graywacke. Fresh, hard, and well indurated. Minor quartz veins and stringers. Sulphide mineralization, predominantly pyrite, crystals up to 0.5 inch, some being replaced by quartz.	Run 2 2.5 to 6.3	87 (55
		Joints close to moderately close spaced with iron oxide staining near surface, and chlorite and carbonate at depth.	Run 3	75 (41
10		0.0-88.3 - Joints close spaced, iron oxide staining.	Run 4 7.9	84
(7.1)		7.9-8.7 - Core broken by drilling, pieces less than or equal to 0.2 feet.	to 12.9	(54
		11.0 - Bedding foliation at 60°.		L.,
-		14.1-14.3 - Core broken by drilling.	Run 5	83 (33
- 1		4	Run 6	
1			14.7 to 17.6	100
		19.5-20.6 - Some core loss. Core badly broken by drilling, pieces up to 2 inches.	Run 7 14.7- 19.4	100
20 14.1)		1	Run 8	83

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CLIENT

ALASKA POWER AUTHORITY

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PROJECT

Susitna Hydroelectric Project

HOLE NO BH-5b

SITE Devil Canyon (North Bank) SHEET NO. 2 OF 7

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	#EC (PQD)
	Argillite		Run 9	(39)
	Argitite		Run 10 21.5	100
			to 26.3	(79)
			Run 11 26.3	93
			to 29.2	(76)
30 _		· ·	Run 12	
	- -		29.2 to 34.0	96 (85)
		27.)	Run 13 34.0- 36.7	100
		37.1 - Joint, 40°, faint slickensides. 37.3-39.3 - Core loss of 1.6 feet. Core broken by drilling, pieces average 1 inch.	Run 14 36.7- 39.3	54 (13)
40		40.3 - Bedding/foliation at 50°.	Run 15	
28.3)		41.7-42.0 - Core broken by drilling, pieces 0.5 inch to 1 inch.	39.3 to 44.2	94 (88)
		45.9 - Joint, 50°, talc/chlorite coating.	Run 16	
			44.2 to 48.1	100 (85)
		48.0-49.7 - Numerous quartz stringers, average 0.5 inch wide. folded and stretched, unfractured. Comprise 30 to 40% of rock.	Run 17	100
50 . (35.4)		51.1-51.3 - Quartz stringers, 0.3 inch to 1 inch side, folded, unfractured.	Run 18 49.3	96 (68)
		52.5-52.8 - Joints very close spaced, heavy iron oxide staining, probably open.	52.1	(00)

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CLIENT ALASKA POWER AUTHORITY

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PROJECT Susitna Hydroelectric Project

HOLE NO BH-5b

Devil Canyon (North Bank)

SHEET NO 3 OF 7

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF HUN (FT)	PEC (900)
	Argillite	57.2-57.7 - Core broken by drilling, pieces	Run 19 52.1 to 57.0	96 (61)
		l inch to 2 inches.  58.2-58.7 - Quartz stringers, 0.5 inch to l inch, folded, fractured but tight.	Run 20 57.0- 59.4	100 (54)
(42.4)		59.2-59.4 - Core broken by drilling, pieces 1 inch to 2 inches.	Run 21 59.4 to 62.9	91 (74)
		66.5 - Joint, 40°, silt coating.	Run 22 62.9 to 66.6	97 (76)
		68.0 - Joint, 50°, trace of silt. 69.6-69.8 - Joints very close spaced. Joint at 40° has slickensides.	Run 23 66.6 to 69.3	100 (89)
70 (49.5)		71.5-72.2 - Core broken by drilling, pieces 1 inch to 2 inches, minor iron oxide staining.	Run 24 69.3- 71.8	100
			Run 25 71.8 to 76.2	98 (71)
			76.2- 77.9	100
1			Run 27	71 (71
80 (56.6)		80.0 - Bedding/foliation at 10° to 20°.	Run 28 79.3	95
-		82.5-83.8 - Core broken by drilling, pieces 0.5 inch to 2 inches. Joints at 20° to 60°,	to 83.0	(76
		some have chlorite coating and slickensides.  83.0-83.3 - Core broken by drilling, pieces average 1 inch.	Run 29 83.0- 84.8	100

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CLIENT ALASKA POWER AUTHORITY JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-5b

SITE Devil Canyon (North Bank) SHEET NO 4 OF 7

MOCK TYPE	DESCRIPTION : COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	OF RUN (FT)	#EC (#99)
Argillite	84.9-86.9 - Core loss of 0.8 feet. Core broken by drilling, pieces 0.5 inch to 2 inches.	Run 30 84.8- 86.9	76 (0)
	88.3-90.7 - Shear/fracture zone, joints very close spaced, joints at 25° to 70°, chlorite	Run 31 86.9- 89.3	100 (67)
		Run 32 89.3 to 92.3	100 (67)
		Run 33	
		92.3 to 96.1	100 (68)
		Run 34	
		96.1 to 99.1	100 (70)
		Run 35 99.1- 101.6	100 (56)
	102.0 - Bedding/foliation at 30° to 40°. 102.0-200.3 - Joints close to moderately close spaced, average I foot, trace of carbonate and chlorite coating.	Run 36 101.6 to 105.1	97 (51)
		Run 37	100(10
		Run 38	100(10
		Run 39	100 (83)
	109.7 - Shear, 30°, 0.1 inch of breccia, slickensides, chlorite coating.	Run 40 108.0 to 112.0	99 (99)
157 [53]		Run 41	1
	115.5 - Bedding/foliation at 50°.	112.0 to 116.0	95 (83)
		Argillite  84.9-86.9 - Core loss of 0.8 feet. Core broken by drilling, pieces 0.5 inch to 2 inches.  88.3-90.7 - Shear/fracture zone, joints very close spaced, joints at 25° to 70°, chlorite and silt coating, some have slickensides.  88.3-102.0 - Joints close to very close spaced, chlorite coating.  102.0 - Bedding/foliation at 30° to 40°.  102.0-200.3 - Joints close to moderately close spaced, average 1 foot, trace of carbonate and chlorite coating.	Argillite  84.9-86.9 - Core loss of 0.8 feet. Core broken by drilling, pieces 0.5 inch to 2 inches.  88.3-90.7 - Shear/fracture zone, joints very close spaced, joints at 25° to 70°, chlorite and silt coating, some have slickensides.  88.3-102.0 - Joints close to very close spaced, chlorite coating.  88.3-102.0 - Joints close to very close spaced, chlorite coating.  89.3

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-56

SITE Devil Canyon (North Bank)

SHEET NO 5 OF 7

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LE GTH	(#QD)
	Argillite		Run 42 116.0- 119.3	94 (88)
120 (84.9)			Run 43	
			119.3 to	100 (90)
		123.7-124.1 - Core broken by drilling, pieces 0.5 inch to 1 inch.	124.2	
			Run 44	
		126.7-127.6 - Numerous quartz stringers, less than 0.5 inch wide, folded, unfractured. Comprise approximately 25% of rock.	124.2 to 129.3	96 (90)
130 -		130.0 - Bedding/foliation at 40° to 50°.	Run 45	
(91.9)			129.3 to 134.3	100 (88)
			Run 46	
			134.3 to 139.3	100 (96)
140			Run 47	
(99.0)			139.3 to 143.7	100 (86)
1			Run 48	90 (83)
			Run 49 145.2 to 149.3	95 (89)

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

Devil Canyon (North Bank)

MOLE NO BH-5b

DESTIN (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR CAIN, CAVING, LOST CORE, CEMENT 40, ETC	OF AUN (FT)	M(C (MQD)
150 106.1)	Argillite		Run 50	
			149.3 to 154.5	99 (96)
		154.5 - Bedding/foliation at $50^{\circ}$ .		
		1	Run 51	
		158.0-159.3 - Shear/fracture zone, joints very	154.5 tc 159.3	100 (90)
160 113.1)		lose spaced. Shears at 30° and 50°, 0.1 inch of breccia, clay, and chlorite, fractures at 40°. Core badly broken, pieces average 1 inch, many have slickensides and clay coating. Core	Run 52	
-		loss of 0.5 feet.	159.3	80
		159.3 - Quartz vein at 40°, 0.5 inch wide, unfractured, upper contact has slickensides, lower contact is tight.	164.3	(77)
		162.9-163.9 - Core loss of 0.8 feet. Core broken by drilling, pieces average 1 inch.	Run 53	
		167.1-168.0 - Core loss of 0.6 feet. Core broken by drilling, pieces 0.5 inch to 1 inch.	164.3 to 169.3	94 (90)
170 120.2			Run 54	
			169.3 to 174.1	100 (86)
+		174.0 - Bedding/foliation at 40°.	Run 55	
		176.6-177.3 - Shear/fracture zone, joint spacing is very close. Joint at 40° has slickensides and chlorite coating. Other joints at 30° and 50°. Core loss of 0.3 feet.	174.1 to 179.3	100 (86)
180		178.8 - Joint, 50°, silt/clay coating. No evidence of shearing. 180.1-181.5 - Core broken by drilling, pieces 0.1 feet to 0.2 feet.	Run 56	001

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-56

SITE Devil Canyon (North Bank)

SHEET NO 7 OF 7

DEPTH (FT)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, POLISTION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN (FT)	HEC (HQD)
-	Argillite		Run 57	
			182.3 to 187.3	100 (94)
		187.0-188.7 - Shear/fracture zone, joints very close spaced. Joints at 20° and 50° have slickensides and chlorite coating.  188.7 - Breccia is less than 0.1 inch wide.		85 (62)
190 (134.4)			189.3 to 192.7	100 (100)
		194.7-195.3 - Shear/fracture zone, joints very close spaced, joints at 20° have slickensides, most have a trace of silt coating. Core loss	Run 58 187.3- 189.3 Run 59 189.3 to 192.7 Run 60 192.7	92 (69)
		of 0.2 feet.	195.3 to	100 (96)
200.3		199.9 - Shear, 50°, slickensides, less than 0.1 inch of gouge.		
(141.6)		END OF BORING		

Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Hole No. BH-5b Project Susitna Hydroelectric Project Devil Canyon (North Bank) Sheet No. \_ of \_ 1 Site PERMEABILITY CORE RECOVERY REMARKS HOCK TYPE Argillite 20 40 60 Shear/fracture. 80 Shear/fracture zone Test 100 906 Cata 120 140 971. Shear/fracture. 160 Shear/fracture. 180 Shear/fracture. END OF BORING 200.3' 200 835

CLIENT:

ALASKA POWER AUTHORITY

JOB NO.: P5700.05

Susitna Hydroelectric Project PROJECT:

HOLE NO.: BH-7

SITE:

Devil Canyon (South Bank)

SHEET NO 1 OF 16

CONTRACTOR: Interstate Exploration Inc. DRILLING DATEs: May 18 TO May 31, 1981 DATE: July 1981

DRILLING METHOD:

SOIL ROCK

Casing Advancer CASING DIAMETER NW (3.0") 1.D. CORE DIAMETER: NQ (1.75") 0.D.

LOCATION

LATITUDE N3.221,701

ELEVATIONS: DATUM MSL, A.S.P.C., Zone 4

DEPARTURE E616,133 AZIMUTH 009°

GROUND SURFACE 1351.0 ROCK SURFACE 1343.2

450

BOTTOM OF HOLE 998.7

WATER TABLE

NOTES: 1) Depths measured along hole. True depths in ( ).

2) All angles measured to the core axis.

DEPTH (FT)	ROCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	RUN LENGTH	REC (RQD
0	Overburden			
0 .1)		TOP OF ROCK		
1.0	Argillite/	Medium to dark gray, very fine grained argillite interbedded with light gray, fine grained graywacke in very thin beds. Foliation parallels argillite bedding at 70° with graywacke bedding/foliation planar to highly deformed. Well indurated, tending to break	Run 1 11.0 to 14.8	81 (0)
		along bedding. Generally fresh to slightly weathered with iron oxide staining and carbonate coating on joint surfaces. Numerous irregular fractures healed with carbonate. Occasional quartz veinlets. Jointing very closely to moderately closely spaced at 0-15°,	Run 2 14.8 to 19.2	80
20 14.1)		55-65°, and 70-80°.	Run 3	100

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CLIENT

ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT

Susitna Hydroelectric Project

HOLE NO BH-7

Devil Canyon (South Bank)

SHEET NO 2 OF 16

SEPTH (F1)	POCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN	MEC (MGD)
	Argillite/ Graywacke	11.0-12.7 - Rubble zone.	19.2- 22.2	
	ar dynac ve	and 0-15°. Iron oxide staining. Core loss	Run 4,5 Run 6 23.8-	62 (0) 91 (70) 94
		1.4 feet.	25.4	(25)
1			Run 8	100
30			to 29.3	(41)
(21.2)			Run 9	
			29.3 to 34.3	100 (83)
		37.5-38.1 - Fracture zone, very closely spaced joints at 0-10° and 70-80°.	Run 10	
			34.3 to 39.3	96 (76)
40 (28.3)			Run 11	
			39.3 to 44.9	96 (73)
			Run 12	
			44.9 to 49.3	95 (90)
50 (35.4)	Arcillite	Rock description as above, with occasional thin beds of graywacke. Hard, fresh. Closely spaced joints. Numerous thin quartz veins.	Run 13 49.3 to 53.1	100 (95)

#### ACRES AMERICAN INCORPORATED - CONSULTI-

DRILLING REPORT

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ALASKA POWER AUTHORITY

JOB NO P5700.05

ERS

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

sme Devil Canyon (South Bank)

SHEET NO 3 OF 16

DEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIR, CAVING, LOST COME, CEMENTING, ETC.	DENGTH OF HUN (FT)	HEC (HQD)
	Argillite		Run 14	60 (0)
			Run 15 54.1 to 59.0	100 (94)
59.0 (41.7) - 60 - (42.4)	Quartz Diorite	Light gray, fine to medium grained dike material, very hard, sharp contacts. Joints moderately close to widely spaced at generally 10-20° and 70-80°.	Run 16 59.0 to 63.0	100 (70)
			Run 17 63.0 to 67.7	100 (97)
. 70			Run 18 Run 19	100(73 100 (83)
73.3			Run 20 69.6 to 74.9	100 (80)
51.8)	Argillite/ Graywacke	Rock description as above.		
			74.9 to 78.9	100 (45)
. 80 (56.6)			Run 22 78.9 to	85 (61)
		83.5-86.4 - Core broken by drilling. Fragment 0.25 to 2 inches with chlorite coating. possible fracture zone.	83.5 Run 23	100001

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CLIENT ALASKA POWER AUTHORITY

JOS NO. P5700.05

PROJECT Susitna Hydroelectric Project

MOLE NO BH-7

Devi Canyon (South Bank)

SHEET NO 4 OF 16

DEPTH (FT)	MOGK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF RUN	REC (400)
	Argillite/ Graywacke	87.0-104.8 - Shear/fracture zone at very closely to closely spaced joints, highly chloritized breccia and gouge, faint slickensides.	Run 24 84.1 to 89.1	94 (0)
90 (63.6)		87.0-91.0 - Core loss 1.3 feet. 94.4-104.8 - Joints, 70-80° paralleling bedding and 0-10°. Core loss 3.3 feet.	Run 25 89.1 to 94.3	81 (42)
			Run 26 94.3 to 99.3	64 (0)
-100 - (70.7)			Run 27 99.3 to 104.1	54 (0)
		108.3-122.4 - Shear/fracture zone, very closely spaced joints. Extensive chloriti-	Run 28 104.1 to 108.7	93 (9)
110 (77.8)		zation on rock fragments and joints.  109.0-110.0 - Breccia/gouge.	Run 29	(0)
		110.0-113.0 - Joint, 40° and 20°, very closely spaced. 112.0-115.0 - Breccia/gouge.	Run 30 110.0 to 115.0	56 (0)
			Run 31	24

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO 5 OF 16

DEPTH (FE)	MGC# TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN (FT)	MEC (MQD)
	Argillite/ Graywacke		Run 31 115.0 119.1	24 (0)
(84.8)			Run 32 Run 33 120.2- 122.4	6 (0) 69 (0)
		125.9-130.7 - Shear/fracture zone, very closely to closely spaced joints at 0-10°.	Run 34 122.4 to 126.1	100 (27)
		50°, 80-90°, healed with carbonate, chloritized gouge. 125.9-126.1 - Breccia/gouge on joints at	Run 31 115.0 119.1 Run 32 Run 33 120.2-1 122.4 Run 34 122.4 to 126.1 Run 35 126.1- 128.2 Run 36 Run 37 130.1 to 133.7 Run 38 133.7 to 138.6 to 142.1	86 (0)
_130 (91.9)		80-90°, possible slickensides.  126.9-127.3 - Gouge on fracture at 30°, 1/4 inch thick. Core loss 0.6 feet.		90 (0)
		130.1 - Foliation well developed, 30-35°. Phyllitic texture locally. 133.0-133.4 - Fracture zone, very closely spaced joints at 30-50° and 0-10°.	130. i	89 (58)
		135.4 - Joint, 60-70°, slickensides.	133.7 to	100 (99)
140			Run 39	
(99.0)			to	100 (83)
			Run 40	100 (89)
1			Pun 41	75 (0)
-			Run 43	300 (47)
			Run 44 146.8- 149.6	100 (100)

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CLIENT ALASKA POWER AUTHORITY

JOB NO P5700 05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO 6 OF 16

DEPTH- (FT)	MOCK THPE	DESCRIPTION COLOR: TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF HUN (FT)	1.420)
150	Graywacke	Light gray, fine grained metase imentary rock, thickly bedded, disseminated sulphide minerals.	Run 45 149.6 to 154.5	(90)
157.2	Argillite/ Graywacke	Rock description as above. Foliation poorly to well developed, generally parallel to	Run 46 154.5 to 159.6	100
160		bedding. Fresh, hard.  Joints closely to moderately closely spaced at 60-70°, 80°, and 0-10°. Carbonate filling common.	Run 47 159.6 to 164.4	00 (95)
			Run 48 164.4 to 169.4	130 (31)
170 120.2)			Run 49 169.4 to 174.4	110 (110)
			Run 50 174.4 to 179.5	100
180			Run 51	

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO. 7 OF 16

(67)	MOCH TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	HEC HEC
	Argillite/ Graywacke		Run 51 179.5 to 184.9	97 (93)
		188.2-188.9 - Broken zone, low angle healed fractures rebroken by drilling.	Run 52 184.9 to 188.8	100 (89)
190 134.3)			Run 53 188.8 to 193.7	100 (86)
			Run 54 193.7 to 198.9	96 (96)
200			Run 55	83 (67)
141.4)			Run 56 200.1 to 203.7	100 (74)
į			Run 57 203.7 to 208.7	100 (88)
210 148.5)		208.2 - Shear, 0-10°, less than 1 inch of breccia/gouge.	Run 58 208.7 to 213.7	100 (93)

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CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

SITE Devil Canyon (South Bank)

HOLE NO BH-7

SHEET NO. 8 OF 16

DEPTH (FT)	ROCK TYPE	DESCRIPTION: COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	OF HUN	(400)
	Argillite/ Graywacke		Run 59 213.7 to 218.9	100 (90)
220 155.54			Run 60 218.9 to 224.9	100 (90)
		226.6-227.2 - Quartz vein, 60-70°, part open contacts.	Run 61 224.9 to 229.5	98 (92)
230 (162.6)		231.0-231.5 - Quartz vein, 10-15°.  233.7-237.8   245.0-248.0   Bedding/foliation highly 248.8-251.2 distorted and irregular.	Run 62 229.5 to 234.6	100 (86)
		Numerous quartz stringers. Hard, fresh.	Run 63 234.6 to 239.6	98 (98)
240 (169.7)			Run 64 239.6 to 244.5	100 (100)
- 1				

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO. 9 OF 16

(FT)	HOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	(HQD)
	Argillite/ Graywacke		Run 65 244.5 to 249.3	100 (92)
250 176.8)		254.1-254.3 - Fracture zone, very closely	Run 66 249.3 to 254 3	98 (84)
		spaced joints at 0-10°, 45-50°, and 80-90°. Numerous thin contorted quartz stringers and veinlets, hard, tight.	Run 67 254.3 to 259.2	98 (86)
260 183.8)		260.0 - Foliation well developed, 40-50°, bedding 70-80°.	Run 68 259.2 to 264.1	100 (94)
			Run 69 264.1 to 267.9	95 (95)
			Run 70	100
270 190.9)			Run 71 269.5 to 274.6	100 (82)
			Run 72	100

# ACRES AMER.CAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO. 10 OF 1

DEPTH (FT.)	MOCK TYPE	<u>OESCHIPTION</u> COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CF RUN (FT)	1600) 660
	Argillite/ Graywacke		Run 72 274.6- 279.6	
280 198.0)			Run 73 279.6 to 284.6	100 (98)
290			Run 74 284.6 to 289.6	100 (96)
205.0)		292.1-314.4 - Quartz stringers, closely to moderately closely spaced, up to 3/8 inches thick.	Run 75 289.6 to 294.6	100 (98)
		297.1 - Joint, 80°, chlorite, slickensides. 299.6 - Joint, 75°, faint slickensides.	Run 76 294.6 to 299.6	100 (100)
212.1)		301.0-332.6 - Predominantly graywacke composition, thick beds, joints closely spaced generally at 70-80° and 5-15°.	Run 77 299.6 to 304.6	98 (62)
			Run 78 304.6 to 309.6	100 (89)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO 11 OF 16

DEPTH (FT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	LENGTH OF RUN (FT)	HEC (HOD)
310 219.2)	Argillite/ Graywacke		Run 79 309.6 to 314.6	100 (78)
			Run 80 314.6 to 319.6	100 (96)
320 226.2)			Run 81 319.6 to 324.7	100 (92)
1		326.7-326.9 - Fracture zone, very closely spaced joints at 0-10°, 50-60°, and 80-90°, chloritized. 327.5-327.8 - Shear zone, 70-80°, several chloritized planes.	Run 82 324.7 to 329.6	100 (80)
330 233.3)		330.6-332.6 - Shear/fracture zone, very closely spaced joints at 0-10° and 70-80°, highly chloritized, quartz and carbonate coating. Core loss 0.4 feet.	Run 83 329.6 to 332.6	87 (20)
			Run 84 332.6 to 337.7	100 (84)
340 (240.4)			Run 85 337.7 to 342.1	100 (91)

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALD, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-7

SITE Devil Canyon (South Bank)

SHEET NO. 12 OF 16

DEPTH (F7.)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST COME, CEMENTING, ETC	DENGTH OF RUN (FT)	(900)
1	Argillite/ Graywacke		Run 85	
	343.0-344.9 - Shear/fracture zone, 80°, very closely spaced fractures with some very thin breccia clay gouge coating, highly chloritized.	Run 86 342.1 to 347.8	91 (88)	
350 247.5)			Run 87 347.8 to 352.9	100 (100)
			Run 88	100 (100)
		358.4-363.0 - Joint, 0-5°, slick, planar, highly chloritized, tight, offset by 3/16 inches.	Run 89 354.9 to 359.9	100 (83)
360 254.5)		358.2-372.8 - Predominantly graywacke, fine to medium grained.	Run 90 359.9 to 364.6	100 (59)
1			Run 91 364.6 to 369.6	100 (86)
370 261.6)			Run 92 369.6 to 374.6	100 (100)

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO. 13 OF 16

DEPTH (#7)	HOGE TYPE	DESCRIPTION LOLDR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	DE RUN	HEC (HOD)
374.6	Argillite/ Graywacke			
264.8)	Graywacke	Light to medium brownish gray metasedimentary rock with subrounded to elongate quartz grains. Bonded locally with dark gray argillaceous beds. Hard to very hard. Foliation poorly developed except in argillaceous layers, generally at 50°. Bedding, 70-85°, average 80°. Minor thin irregular quartz stringers.	Run 93 374.6 to 379.6	100 (98)
380 268.7)		Joints moderately closely to widely spaced 0-10° and 70-80°.	Run 94 379.6 to 384.6	100 (100)
			Run 95	100 (62)
390			Run 96 385.9 to 390.5	100 (82)
275.7)			Run 97 390.5 to 393.8	100 (76)
			Run 98 393.8 to 398.8	100 (94)
400 282.8)			Run 99 398.8 to 403.8	94 (86)
- 1		404.0-4U7.7 - Foliation weakly developed at 50-60°.	Run 100	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

SITE Devil Canyon (South Bank)

HOLE NO BH-7
SHEET NO 14 OF 16

DEPTH LFT)	ROCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	CENGTH OF RUN (FT)	HEC (HOD)
	Graywacke		Run 100 403.8 to 409.2	98 (98)
410 289.9)			Run 101 409.2 to 414.5	98 (91)
		$414.0\text{-}414.5$ - Fracture zone, very closely spaced joints and fractures at $10^\circ$ and $20^\circ$ .		
		418.2-420.8 - Argillaceous zone with weakly developed foliation at $50^{\circ}$ .	Run 102 414.5 to 419.6	100 (92)
420 296.9)			Run 13 419.6 to 424.7	100 (88)
		427.0 - Shear, 1.8 inch wide, tight, chloritized, sulphides. 427.5-427.6 Quartz veins. 429.6-432.8 - Argillaceous zone with bedding	Run 104 424.7 to 429.6	100 (76)
430 304.0)		at 60-65°, phyllitic locally, closely spaced joints.  433.4-446.6 - Quartz intrusions 70% of core. Highly irregular contorted quartz stringers, pods and veinlets destroying original structur of rock. Zones range from 1 inch to 8 inches thick.	Run 105 429.6 to 434.6	100 (98)
			Run 106 434.6- 437.7	100 (57)

CLIENT ALASKA POWER AUTHORITY

JOB NO P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO. BH-7

SITE Devil Canyon (South Bank)

SHEET NO 15 OF 16

SEPTH (FT)	MOCK TYPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, MATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC.	GF RUN (FT)	HEC (HQD)
-	Graywacke		-	
440 311.1)			Run 107	
			437.7 to 444.7	100 (88)
			Run 108 444.7 to 449.7	100 (90)
450 (318.2)		450.6-456.7 - Argillaceous zone, hard, brittle, weakly developed foliation at 40-45°. Joints generally 50° and 70-80°.	Run 109 449.7 to 454.8	100 (98)
-			Run 110	
-		457.9-460.7 - Quartz vein, massive, hard, sulphide mineralization.	454.8 to 459.7	100 (73)
460 325.2)		461.7-462.7 - Core loss 0.4 feet.	Run 111 459.7- 461.7 Run 112	80 (45)
		463.0 - Shear zone, 65°, 1/4 inch wide breccia/gouge, healed with carbonate, chloritized, intact but friable, slickensides.		(0)
		chioritized, intact but irrable, stickensides.	462.7 to 467.6	100 (98)
+			Run 114	

## ACRES AMERICAN INCORPORATED - CONSULTING ENGINEERS BUFFALO, NEW YORK DRILLING REPORT

CLIENT ALASKA POWER AUTHORITY

JOB NO. P5700.05

PROJECT Susitna Hydroelectric Project

HOLE NO BH-7

SITE Devil Canyon (South Bank)

SHEET NO 16 OF 16

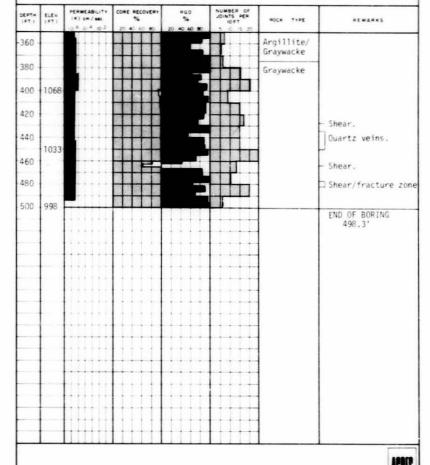
DEPTH (FT)	HOCK THPE	DESCRIPTION COLOR, TEXTURE, FOLIATION, JOINTING, FRACTURING, FAULTING, ALTERATION, WATER LOSS OR GAIN, CAVING, LOST CORE, CEMENTING, ETC	OF RUN (FT)	PEC (900)
470 (332.3)	Graywacke		Run 114 467.6 to 472.6	100 (84)
			Run 115 472.6 to 477.8	100 (100)
480 (339.4)		479.5-480.9 - Shear/fracture zone, 15-20°, very closely spaced joints and fractures, some breccia/gouge, chloritized, some carbonate.	Run 116 477.8 to 480.3	100 (64)
			Run 117 480.3 to 485.6	100
490		488.7-490.5 - Foliation highly contorted and folded quartz stringers.	Run 118 485.6 to 489.7	100 (71)
(346.4)			Run 119 489.7 to 494.7	100
498.3			Run 120 494.7 to 498.3	100
(352.3) 500 (353.5)		END OF BORING		

#### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG Client ALASKA POWER AUTHORITY Job No. P5700.05 Project Susitna Hydroelectric Project BH-7 Hole No.\_\_ Devil Canyon (South Bank) Sheet No. 1 of 2 Site PERMEABILITY CORE RECOVERY NUMBER OF JOINTS PER JOST PEMARKS ROCK TYPE TOP OF ROCK 11.0' Overburden 20 Fracture zone. Graywacke 40 Argillite 60 Quartz Diorite Argillite/ 80 Graywacke Shear/fracture zone 100 1280 Shear/fracture zone 120 ] Shear/fracture zone 140 160 180 200 Shear. 220 ] Quartz stringers. 240 260 280 Quartz stringers. 300 320 Shear/fracture zone 340 Shear/fracture zone

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	BH-7
Site	Devil Canyon (South Bank)	Sheet No.	2 of 2



### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	USBR DH-1
Site	Devil Canyon (South Bank)	Sheet No.	1 of 1

DEPTH (FT)	ELEV (FT.)	PERMEABILITY (K) cm/sec	CORE RECOVERY % 20 40 60 80	90 40 60 80	NUMBER OF JOINTS PER HOFT	ROCK TYPE	REMARKS
0	1420					Argillite	Zone permeated by quartz stringers.
20							Fracture zone.
41)						-	
60	1385		山山市			1	□ Fracture zone.
	-					ł	⇒ Fractures, open. Quartz vein.
80						1	Chief Carl 15
100	1349		++++	, E			Fracture zone.
120			H				01.000-10110-01 (4000-001)
120						]	END OF BORING 118.2'
	1					}	118.2
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	-						1
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						}	1
		4 4 4 4 4 4 4					
-							

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-5

 Site
 Devil Canyon (South Bank)
 Sheet No.
 1
 of
 1

DEPTH (FT.)	ELEV (FT)	PERMEABILITY (K) cm/sec.	CORE RECOVERY % 20.40.40.80	#00 % 20 40 60 80	NUMBER OF JOINTS PER IOFT 5 0 15 20	ROCK TYPE	PEMARKS
0	1374			20 40 60 60	5 0 15 20	Overburden	
20							
40							
-	1324						TOP OF ROCK 55.5
60			Ħī.	=_		Graywacke	Fracture zone.
80							
100	1074						END OF BORING 86.2'
100	1274						
	-					-	
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### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	USBR DH-6
Site	Devil Canyon (South Bank)	Sheet No.	1 of 1

DEPTH (FT.)	ELEV (FT)	PERMEABILITY	CORE RECOVERY % ZO 40 60 80	#00 % 20 40 60 80	NUMBER OF JOINTS PER HOFT	SOCK TYPE	PEMARKS
0	1370			20 40 40 40	1111	Overburden	
20						1	
40						1	
60	1320						
00							
80		111111					TOP OF ROCK 87.5'
100	1270	No Test Data				Graywacke	Faint slickensides
							END OF BORING
120	1250					1	107.3'
		111111		1111			
				1			
			$\cdots$				
				1111	1111		

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	USBR DH-7
Site	Devil Canyon	Sheet No.	1 of 1

DEPTH (FT.)	ELEV.	PERMEABILITY (K) cm/sec	CORE RECOVERY	#QD % 20 40 60 80	NUMBER OF JOINTS PER HOFT	HOCK TYPE	REMARKS
0	1376					Overburden	
20-					1		
							TOP OF ROCK 33.9
40	1326		Missing	Core		Argillite	
60-	1320						
					1		END OF BORING 59.5'
					1		
-					1		
					1	1	
			1		+		
					1		
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### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No.	USBR DH-8
Site	Devil Canvon (South Bank)	Sheet No.	1 of 1

(FT.)	ELEV (FT.)	PERMEABILITY (K1 cm/sec	CORE RECOVERY % 20 40 40 80 80	#0.0 % 20 40 60 80	NUMBER OF JOINTS PER IDFT 5 0 15 20	ROCK TYPE	REMARKS
20	1448					Graywacke	
20						Argillite	- Breccia zone,
40	1423						healed.
60	1423					-	
80							Fracture zone.
100	1398					Graywacke	Numerous quartz
120							stringers and blebs
140							- Fracture zone.
160	1373						END OF BORING
100						1	150.5
- 1							
-						-	
						1	
.							
-			++++			-	
						1	
1							
							4000

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	USBR DH-9
Site	Devil Canyon (South Bank)	Sheet No.	_1_ of _1_

OEPTH (FT)	ELEV (FT.)	PERMEABILITY (K) cm/sec	CORE RECOVERY %	#QD % 20 40 60 80	NUMBER OF JOINTS PER ID FT 5 6 5 20	ROCK TYPE	PEMARKS
0	1424					Graywacke	
20			5				
						1	= Fracture zone.
40						1	
	1389					1	= Fracture zone.
60						1	
	1			_		1	- Fracture zone.
80				-			
100	1318					1	END OF BORING 87.0'
100	1310					1	87.0
						1	
						-	
						1	
	-		1			1	
			1 + + + + +			1	
						1	
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		1-11111				1	
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	-					1	1
						1	
	-					1	
						1	
	-		1			1	
						1	
		111111	11111	11111	1111	1	



#### SUMMARY LOG

Client ALASKA POWER AUTHORITY
Project Susitna Hydroelectric Project

Job No. P5700.05 Hole No. USBR DH-10

Site Devil Canyon (South Bank) Sheet No. 1 of 1

REMARKS	ROCK TYPE	NUMBER OF JOINTS PER JOFT	#0.0 % 20 40 60 80	CORE RECOVERY %	PERMEABILITY (K) cm/sec	ELEV (FT.)	(FT)
1	Graywacke			11113		1425	0
							20
			7				40
			_==4		Data	1386	-
							60
					Test		80
					No	1346	100
Fracture zone.							
END OF BORING						1315	120
122.7'							140
- 7.49 -							
19-9-33							
	J-15/11/5						
( P. 77 L )					1		
							-
							-
	100						

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-11

 Site
 Devil Canyon (South Bank)
 Sheet No.
 1 of 1

(FT.)	(FT)	FERMEABILITY (K) cm/sec 0 6 0 4 0.2	CORE RECOVERY	***	NUMBER OF JOINTS PER JOFT	ROCK TYPE	REMARKS
0	894		20 40 60 80	20 40 60 80	3 6 5 20		
					1111	Argillite	
20			1113			1	
-	-		1115				
40	867						END OF BORING 31.2
-							31.2'
-							
							Note: Boreno e
	1						daylighted.
						1	
			11111				
	-	1 101 1 1				1	
-						1	
						1	
						1	
		111111				1	
			7 1 1 1 1 1			1	
		555531				1	
-							
-							
- 1							
						1	
						1	
					1111		
					11111	1	
-	-					1	
-					1 1 1 1	1	

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-11A

 Site
 Devil Canyon (South Bank)
 Sheet No.
 1
 of
 1

DEPTH (FT)	ELEV (FT)	PERMEABILITY (X) cm/sec	COME RECOVERY	*00 %	NUMBER OF JOINTS PER JOIT	ROCK TYPE	
0	894		THE	20 40 60 80		Argillite	
279						1	
20						1	
16	866						END OF BORIN
•	000					1	29.81
						]	
						1	
			1				
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#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-11B

 Site
 Devil Canyon (South Bank)
 Sheet No.
 1
 of
 1

(FT.)	ELEV (FT)	PERMEABILITY (K) cm/sec 0.6 0.4 0.2	COME RECOVERY % 20 40 60 80	900 % 20 40 60 80	NUMBER OF JOINTS PER HOFT 5 C 5 20	HOCK TYPE	PEMARKS
20	894					Argillite	Fracture zone.
40	863						END OF BORING 33.9'

### Acres American Incorporated - Consulting Engineers Buffalo, New York SUMMARY LOG ALASKA POWER AUTHORITY Job No. P5700.05 Client Susitra Hydroelectric Project Project Hole No. USBR DH-11C Devil Canyon (South Bank) Site Sheet No. \_\_\_ of \_1 PERMEABILITY CORE RECOVERY ROCK TYPE PEWARKS Argillite 20 40 Core Missino 851 Sandy interbeds. 60 8.0 100 809 Fracture zone. 120 Graywacke 140 Fracture zone. END OF BORING 160

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

DEPTH (FT)	ELEV.	PERMEABUTY (*) cm/sec	CORE RECOVERY	**	NUMBER OF JOINTS MER JOFT	ROCK TYPE	MEMARKS
0	896	210102		20 40 60 80	5 0 5 20	Argillite	+
20			4			argillice	□ Graywacke
20		Data					D Dr dywacke
40		A COLUMN TO A CANADA	115				
	861	cient					
60		T	Core M	ssing	1111	1	
03		asuf.	1112			1	
				_		Graywacke	1
100	825		1				
120						1	
120							END OF BODING
140	797					-	END OF BORING 127.5'
		111111				-	
						1	
	-						
-		11111	1 + + + + +			1	
						1	
						1	
						-	
		111111	11111			1	
						1	
						1	

#### SUMMARY LOG

DEPTH (FT.)	ELEV (FT.)	FERWEABUTY (K) cm/sec.	COME MECOVEMY	*03 % 20 40 60 90	NUMBER OF JOINTS PER JOST	ADCK TYPE	REMARKS
20	896		HHE			Argillite	Numerous thin
40			$\Pi \Pi$				quartz veins.
	861	5					
60		8				Graywacke	
80							1
100	825					Argillite	
120							
140			Core Mi	ssing			
160	783						END OF BORING 149.7'
						1	
						1	
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#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-13

 Site
 Devil Canyon (North Bank)
 Sheet No.
 1
 of
 1

(FT.)	(FT.)	PERMEABILITY (K) cm/sec 0 6 0 4 0 2	CORE RECOVERY % 20 40 40 80	% % 20 40 60 90	NUMBER OF JOINTS PER 10 FT	HOCK TYPE	PEWARKS
0	912	THE P				Graywacke	
20			115	5	1	Argillite	
40						Graywacke	-
60	877		Core Mi	issing		1	
80		Negligible Flow	Try		1111	1	D Breccia, healed.
100	841	No	1			1	] Breccia, healed.
120		Test Data		<b>7</b> *∷		1	
140	813						END OF BORING 137.0'

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-13A

 Site
 Devil Canyon (North Bank)
 Sheet No.
 1 of 1

DEPTH (#7.)	ELEV.	PERMEABUTY (K) EM/MC	COME RECOVERY	***	NUMBER OF JOINTS PER JOST	-	******
0	912		TILL	2000	1 0 1 20	Graywacke	
20		No	뒫			Argillite	1
40		Test Data	1		1	Graywacke	
60	882		111111111111111111111111111111111111111			1	
			TIE	-		1	Dike, felsic, mino shearing at contac
80	864						END OF BORING
						1	
						1	
						-	
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#### Acres American Incorporated - Consulting Engineers Buffalo, New York

#### SUMMARY LOG

 Client
 ALASKA POWER AUTHORITY
 Job No.
 P5700.05

 Project
 Susitna Hydroelectric Project
 Hole No.
 USBR DH-14

 Site
 Devil Canyon (North Bank)
 Sheet No.
 1 of 1

(FT)	ELEV. (FT)	PERMEABILITY (H) cm/sec	20 40 60 80	*00 % 20 40 60 80	NUMBER OF JOINTS PER JOFT		*****
0	903	THE T	2.00	20 40 60 60	3 5 3 5	Argillite	- Fracture zone.
20						night hite	rracture zone.
20						1	
40		No Flow				]	
	868						
60							END OF BORING 50.0'
-							50.0
-			11111				OU VEN
-							Note: Borehole daylighted in the
						1	river.
						1	
					1 1 1 1 1	1	
					11111	1	
						1	
						1	
						1	
						]	
						1	
						1	
-						1	
-						-	
-						-	
-	-					-	
						1	
-			11111			1	
-						1	
		111111				1	
						1	İ
						1	
						1	
						1	
						1	

### SUMMARY LOG

Client	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	USBR DH-14A
Site	Devil Canyon (North Bank)	Sheet No.	1 of 1

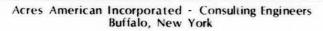
DEPTH (FT.)	ELEV (FT.)	PERMEABILITY (#) tm/sec 05.04.02	COME MECOVERY	#25 % 20 ~2 60 <b>8</b> 0	NUMBER OF JOINTS PER JOFT 5 G S 20	HOCK TYPE	PEWARKS
0	903	700				Argillite	- Fracture zone.
26				7			
40							
	863		Core Mi	issing		1	
60			11114			1	- Fracture zone.
			11111			1	quartz healed.
80			111.			1	
100							Interbeds of
100	823		114				graywacke.
120			Core M	issing		1	
120			00.0	1 1 1 1			
140	921						END OF BORING
						1	130.41
						1	
						1	
					1111	1	
		111111				1	
		111111				1	
						1	
						]	
-							
-			1			1	
						1	
						1	
					1111	1	
					1111	1	
						1	
						1	

#### Acres American Incorporated - Consulting Engineers Buffalo, New York

### SUMMARY LOG

Client_	ALASKA POWER AUTHORITY	Job No.	P5700.05
Project	Susitna Hydroelectric Project	Hole No	USBR DH-145
Site	Devil Canyon (North Bank)	Sheet No.	_1_ of _ 1_

DEPTH (FT)	ELEV (FT)	PERMEABILITY (K) cm/sec	CORE RECOVERY	*00	NUMBER OF JOINTS PER JOST	ROCK TYPE	REMARKS
0	902	3,0,01	1114	20 40 60 80	5 0 5 20	Argillite	
20						highline	
20							- Fracture zone.
40							
-	859						
60							- Joint, silt coating
80							
80				7			
100	815		$\coprod \coprod \mathcal{U}$				- Joint, slickensides
			1			C	Fracture zone.
120			HI.			Graywacke	Diriacipre zone.
			1				
140							END OF BORING
160	772						146.21
						1	
			1		1111	-	
			1		1	1	
			1	1111	1	1	
						1	



### SUMMARY LOG

Client ALASKA POWER AUTHORITY

Job No. P5700.05

Project Susitna Hydroelectric Project

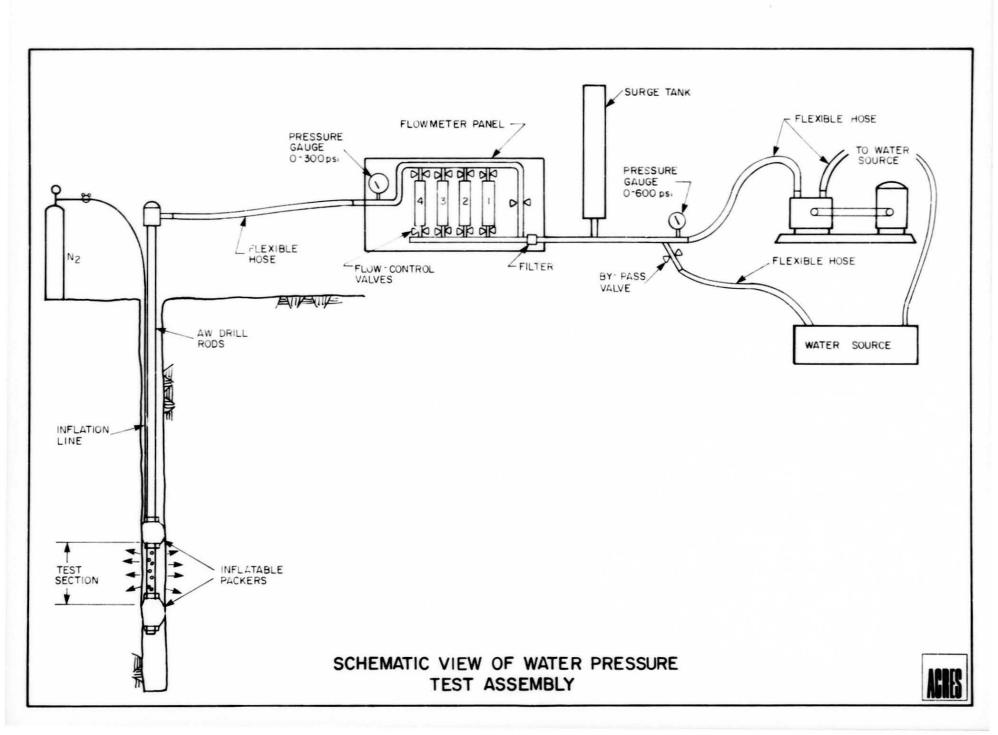
Hole No. USBR DH-140

Site Devil Canyon (North Bank)

Sheet No. \_\_\_\_ of \_\_\_\_

DEPTH (FT)	ELEV (FT)	PERMEABILITY (#) cm/sec	COME RECOVERY	#0D %	NUMBER OF JOINTS PER JOFT	HOCK TYPE	HEMARKS
0	903	040402	20 40 65 60	20 40 60 80	5 0 5 20	Graywacke	+
20		<b>—</b>				G-aywacke	
40							- Fracture zone.
60	862						
08			11,74				END OF BOOTNO
100	821						FND OF BORING 82.2'
						}	
						1	
						1	
						1	

APPENDIX D WATANA WATER PRESSURE TESTING DETAILS



Borehole Number	BH-1
Location Watana	
Ground Surface Elev	ation2049.7 ft.
Static Water Level	1993.3 ft
Dip of Hole 700	
Stickup 7.1 ft.	

Depth T From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
22.6	32.6	13	5	0.22	$1.65 \times 10^{-5}$
30.0	40.0	18-20	6	0.10	$5.65 \times 10^{-6}$
40.0	50.0	30-31	8	0.12	$4.75 \times 10^{-6}$
50.0	60.0	28	3	0.0	0.0
60.0	70.0	35-36	9	0.45	$1.36 \times 10^{-5}$
70.0	80.0	39	2	1.05	$3.01 \times 10^{-5}$
80.0	91.1	45-46	8	5.4	$1.41 \times 10^{-4}$
90.0	101.1	48-50	6	9.03	$2.25 \times 10^{-4}$
100.0	111.1	53	6 .	>10	>2.36 x 10 <sup>-4</sup>
110.0	121.1	60-63	8	0.48	$1.02 \times 10^{-5}$
120.0	131.1	62-64	6	0.43	$9.06 \times 10^{-6}$
130.0	141.1	69-73	8	0.90	$1.74 \times 10^{-5}$
140.0	151.1	72	8	1.5	$2.87 \times 10^{-5}$
150.0	161.1	76	6	>10	>1.84 x 10 <sup>-4</sup>
160.0	171.1	81	6	>10	$^{>}1.75 \times 10^{-4}$
171.1	200.0	No Test			
* 200.0	211.0	98-99	4	6.0	$9.08 \times 10^{-5}$
210.0	221.0	105	10	7.1	$1.02 \times 10^{-4}$
220.0	231.0	109-114	5	3.80	$5.21 \times 10^{-5}$
230.0	241.0	112-115	6	1.41	$1.90 \times 10^{-5}$
235.0	246.0	118-119	6	1.30	$1.69 \times 10^{-5}$
250.0	261.0	120-122	6	1.35	$1.73 \times 10^{-5}$
260.0	271.0	No Test			
270.0	281.0	133-138	10	2.0	$2.34 \times 10^{-5}$
* Packer	rs did not	t completely seal	1.		

BH-1 (continued)

Depth T From (feet)	To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
279.0	290.0	140-142	6	1.25	$1.42 \times 10^{-5}$
180.0	300.0	90	8	3.0	$6.84 \times 10^{-6}$
200.0	300.0	100	8	2.3	$5.64 \times 10^{-6}$
220.0	300.0	110	8	2.15	$5.91 \times 10^{-6}$
240.0	300.0	120	8	2.3	$7.63 \times 10^{-6}$
260.0	300.0	130	8	2.2	$9.43 \times 10^{-6}$
280.0	300.0	138	8	2.3	$1.65 \times 10^{-5}$

NOTE: Section 180 ft to 300 ft depth, tests performed using single packer only.

Borehole No	umberBH	-2
Location_	Watana	
Ground Sur	face Elevation	1838.8 feet
Static Wate	er Level	1768.8 feet
Dip of Hole	e5	5 <sup>0</sup>
Stickup	0 fe	et

Depth Tested		Gauge Duration		Flow	Coefficient of	
From (feet)	To (feet)	Pressure (psi)	of Test (minutes)	Rate (gpm)	Permeability (cm/sec)	
23.9	40	20	20	.32	1.44 x 10 <sup>-5</sup>	
38.9	55	26	10		5.96 x 10 <sup>-6</sup>	
53.9	70	30	20	.42 to 2.5	$1.14 \times 10^{-5}$ to $6.8 \times 10^{-5}$	

Depth From	Tested To	Gauge Pressure	Duration of Test	Flow Rate	Coefficient of Permeability
(feet)	(feet)	(psi)	(min)	(gpm)	(cm/sec)
34	45	19-20	8	0.07	6.21 x 10 <sup>-6</sup>
40	51	23	5	0.17	$1.30 \times 10^{-5}$
50	61	27	4	0.20	$1.32 \times 10^{-5}$
60	71	31	4	0.02	1.16 x 10-6
70	81	35	5	3.10	$1.60 \times 10^{-4}$
* 80	91	39	2	2.90	$1.35 \times 10^{-4}$
90	101	43	5	0.06	$2.54 \times 10^{-6}$
100	111	47-49	5	0.08	$3.05 \times 10^{-6}$
<b>*110</b>	121	No Test			
120	131	54	10	0.32	1.09 x 10 <sup>-5</sup>
130	141	58	9	0.29	9.23 x 10-6
140	151	64	9	0.03	$9.53 \times 10^{-7}$
150	161	67	11	0.05	$1.38 \times 10^{-6}$
160	171	72	11	0.03	$8.00 \times 10^{-7}$
170	181	76	10	0.08	1.92 x 10-6
180	191	80	16	0.07	$1.63 \times 10^{-6}$
190	201	84	12	0.04	8.87 x 10-7
200	211	88	12	0.04	$8.65 \times 10^{-7}$
210	221	92	10	0.06	1.21 x 10 <sup>-6</sup>
220	231	96	8	0.06	1.16 x 10 <sup>-6</sup>
230	241	100	8	0.20	$3.74 \times 10^{-6}$
240	251	104	10	0.48	8.63 10.6
250	261	108	10	0.17	$2.95 \times 10^{-6}$

<sup>\*</sup>Packers did not completely seal.

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
260	271	112	8	0.16	$2.66 \times 10^{-6}$
270	281	117	12	0.25	$4.01 \times 10^{-6}$
280	291	121	8	0.15	$2.33 \times 10^{-6}$
290	301	125	8	0.17	$2.54 \times 10^{-6}$
300	311	129	8	0.12	1.75 x 10 <sup>-6</sup>
310	321	133	6	0.16	2.26 x 10-€
320	331	137	6	0.22	$3.02 \times 10^{-6}$
330	341	141	6	0.22	$2.93 \times 10^{-6}$
340	351	145	6	0.36	$4.67 \times 10^{-6}$
350	361	149	6	0.46	$5.81 \times 10^{-6}$
360	371	153	6	0.70	$8.61 \times 10^{-6}$
370	381	158	8	0.82	$9.78 \times 10^{-6}$
380	391	162	5	0.40	$4.65 \times 10^{-6}$
390	401	166	5	0.47	$5.34 \times 10^{-6}$
400	411	170	5	0.98	$1.09 \times 10^{-5}$
410	421	150	4	1.02	$1.28 \times 10^{-5}$
420	431	178	5	2.8	$2.97 \times 10^{-5}$
430	441	162	5	1.0	1.16 x 10 <sup>-5</sup>
440	451	187	12	2.2	$2.22 \times 10^{-5}$
450	461	193	12	1.8	$1.76 \times 10^{-5}$
460	471	195	6	2.2	$2.13 \times 10^{-5}$
471	520	No Test			
520	531	215	8	0.59	$5.19 \times 10^{-6}$
*530	541	190-200	6	3.22	$3.12 \times 10^{-5}$
*540	551	100	8	0.95	$1.78 \times 10^{-5}$
*550	561	180	10	0.59	$6.18 \times 10^{-6}$
560	571	235	8	0.41	$3.29 \times 10^{-6}$
570	581	240	8	0.22	$1.73 \times 10^{-6}$
580	591	200-210	10	6.07	5.59 x 10 <sup>-5</sup>
*590	601	200	10	6.87	6.49 x 10 <sup>-5</sup>
600	611	224	10	0.09	$7.60 \times 10^{-5}$
610	620	200	10	0.41	$3.87 \times 10^{-6}$

<sup>\*</sup>Packers did not completely seal.

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
620	631	220	10	0.15	1.29 x 10 <sup>-6</sup>
<b>*</b> 630	641	210	6	1.53	1.38 x 10 <sup>-5</sup>
640	651	240-250	8	5.05	$3.90 \times 10^{-5}$
*650	661	220-235	8	3.63	$3.02 \times 10^{-5}$
660	671	200-245	10	0.47	$3.90 \times 10^{-6}$
670	681	200	10	0.61	$5.76 \times 10^{-6}$
680	691	200	12	0.94	$8.88 \times 10^{-6}$
690	701	220	10	0.23	$1.98 \times 10^{-6}$
700	711	225	8	0.24	$2.02 \times 10^{-6}$
710	721	225	8	0.24	$2.02 \times 10^{-6}$
720	731	230	8	0.23	$1.89 \times 10^{-6}$
730	741	235	8	0.24	$1.93 \times 10^{-6}$
740	751	240	6	0.25	1.97 x 10 <sup>-6</sup>
750	761	240	8	0.25	1.97 x 10 <sup>-6</sup>
760	771	245	6	0.24	$1.85 \times 10^{-6}$
770	781	250	8	2.35	$1.78 \times 10^{-5}$
780	781	250	6	2.50	1.89 x 10 <sup>-5</sup>
790	801	250	8	2.23	1.69 x 10 <sup>-5</sup>
800	811	250	6	1.42	1.07 x 10 <sup>-5</sup>
810	821	250	8	1.60	1.21 x 10 <sup>-5</sup>
820	831	240	6	4.17	3.29 x 10 <sup>-5</sup>
830	841	245	8	1.29	9.96 x 10 <sup>-6</sup>
840	851	250	8	0.61	$4.62 \times 10^{-6}$
850	861	160-165	8	0.57	6.63 x 10 <sup>-6</sup>
860	871	160	8	0.89	1.05 x 10 <sup>-5</sup>
870	881	210	10	0.98	8.82 x 10 <sup>-6</sup>
880	891	235-245	8	2.80	2.21 x 10 <sup>-5</sup>
890	955	235-240	8	2.45	4.61 x 10 <sup>-6</sup>
900	955	240-245	8	2.45	5.31 x 10 <sup>-6</sup>
911	955	240-250	8	2.00	5.05 x 10 <sup>-6</sup>
922	955	240-250	8	2.03	6.51 x 10 <sup>-6</sup>
933	955	240-250	10	2.11	9.41 x 10 <sup>-6</sup>
944	955	235-250	8	2.30	1.85 x 10 <sup>-5</sup>

<sup>\*</sup>Packers did not completely seal

Borehole Number\_\_\_BH-4
Location\_\_Watana
Ground Surface Elevation\_\_2187.8 ft.
Static Water Level 1687.8'
Dip of Hole\_\_\_58°
Stick-up\_\_\_0.0 ft.

Dep From (feet	To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
40	51	22	8	0.06	2.96 x 10 <sup>-6</sup>
50	61	26	6	0.9	$3.60 \times 10^{-5}$
60	71	30-40	10	0.02	$6.73 \times 10^{-7}$
70	81	35	6	0.09	$3.03 \times 10^{-6}$
80	91	40	6	0.11	$3.40 \times 10^{-6}$
90	101	43	5	0.06	$1.77 \times 10^{-6}$
100	111	47	5	0.10	$2.78 \times 10^{-6}$
110	121	52	6	0.10	$2.59 \times 10^{-6}$
120	131	56	6	0.05	$1.23 \times 10^{-6}$
130	141	60	5	0.23	$5.37 \times 10^{-6}$
140	151	64	5	0.10	$2.23 \times 10^{-6}$
150	161	69	5	0.05	$1.05 \times 10^{-6}$
160	171	73	5	0.05	1.01 x 10 <sup>-6</sup>
170	181	77	5	0.06	$1.16 \times 10^{-6}$
180	191	81	5	0.15	$2.79 \times 10^{-6}$
190	201	86	5	0.16	$2.83 \times 10^{-6}$
200	211	90	5	0.55	$9.40 \times 10^{-6}$
210	221	94	5	0.65	1.07 x 10 <sup>-5</sup>
220	231	98	7	0.86	1.37 x 10 <sup>-5</sup>
230	241	102	5	4.5	$6.94 \times 10^{-5}$
*240	to 260	No Test			
260	271	115	7	1.3	1.81 x 10 <sup>-5</sup>
270	281	119	5	1.7	$2.31 \times 10^{-5}$
280	291	124	8	0.97	1.27 x 10 <sup>-5</sup>

<sup>\*</sup>Packers did not completely seal

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
290	301	128	6	1.6	2.04 x 10 <sup>-5</sup>
300	311	132	6	1.8	$2.23 \times 10^{-5}$
310	321	136	6	1.2	1.45 x 10 <sup>-5</sup>
320	331	140	8	0.21	$2.48 \times 10^{-6}$
330	341	145	6	0.80	9.16 $\times$ 10 <sup>-6</sup>
340	351	150	6	0.92	$1.02 \times 10^{-5}$
350	361	153	6	0.14	$1.53 \times 10^{-6}$
360	371	158	6	0.08	$8.49 \times 10^{-7}$
370	381	162	6	0.83	8.62 x 10 <sup>-6</sup>
380	391	165	6	0.68	$6.95 \times 10^{-6}$
390	401	170	6	0.77	7.66 x 10 <sup>-6</sup>
400	411	175	6	0.32	$3.10 \times 10^{-6}$
410	421	179	6	0.24	2.28 x 10 <sup>-6</sup>
420	431	183	7	0.18	1.68 x 10 <sup>-6</sup>
430	441	188	9	0.19	$1.73 \times 10^{-6}$
440	451	192	6	0.18	1.61 x 10 <sup>-6</sup>
450	461	196	6	0.17	1.49 x 10 <sup>-6</sup>
460	471	200	6	0.21	1.81 x 10 <sup>-6</sup>
470	481	204	6	0.48	4.06 x 10 <sup>-6</sup>
480	491	209	6	1.1	9.10 x 10 <sup>-6</sup>
490	501	213	6	0.81	6.58 x 10 <sup>-6</sup>
500	511	217	4	0.70	5.59 x 10 <sup>-6</sup>
510	521	220	7	0.90	7.10 x 10 <sup>-6</sup>
520	531	225	6	1.0	7.73 x 10 <sup>-6</sup>
530	541	230	6	0.52	3.94 x 10 <sup>-6</sup>
540	551	234	6	0.83	6.19 x 10 <sup>-6</sup>
550	561	240	6	2.1	1.53 x 10 <sup>-5</sup>
560	571	245	6	0.80	5.72 x 10 <sup>-6</sup>
570	581	250	6	0.92	6.47 x 10 <sup>-6</sup>
580	591	250	6	0.55	3.87 x 10 <sup>-6</sup>
590	601	250	6	0.70	4.92 x 10 <sup>-6</sup>
600	611	250	6	0.75	5.27 x 10 <sup>-6</sup>

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
610	621	250	6	0.90	6.32 x 10 <sup>-6</sup>
620	631	250	6	0.73	$5.13 \times 10^{-6}$
630	641	250	6	0.97	$6.82 \times 10^{-6}$
640	651	250	6	1.1	$7.73 \times 10^{-6}$
650	661	250	5	0.84	$5.90 \times 10^{-6}$
660	671	250	5	1.4	9.86 x 10 <sup>-6</sup>
670	681	250	6	2.9	$2.04 \times 10^{-5}$
680	691	250	6	1.4	9.84 x 10 <sup>-6</sup>
690	701	250	6	0.97	$6.82 \times 10^{-6}$
700	711	250	6	0.83	$5.83 \times 10^{-6}$
710	720	250	6	1.0	$7.03 \times 10^{-6}$
720	731	250	6	0.95	$6.68 \times 10^{-6}$
730	741	250	6	0.73	$5.13 \times 10^{-6}$
740	751	250	5	0.80	$6.62 \times 10^{-6}$
750	761	250	5	1.5	1.05 x 10 <sup>-5</sup>
760	771	250	5	0.90	$6.32 \times 10^{-6}$
770	781	250	5	0.92	$6.47 \times 10^{-6}$
780	791	250	5	0.92	$6.47 \times 10^{-6}$
790	801	9 250	5	1.1	$7.73 \times 10^{-6}$
800	811	250	5	0.82	$5.76 \times 10^{-6}$
810	821	250	5	0.84	$5.90 \times 10^{-6}$
820	831	250	5	0.70	$4.92 \times 10^{-6}$
*830	841	250	5	3.8	$2.67 \times 10^{-5}$
*840	851	250	5	2.6	$1.83 \times 10^{-5}$
850	861	250	6	1.1	$7.73 \times 10^{-6}$
860	871	250	5	1.1	$7.73 \times 10^{-6}$
870	881	250	5	1.5	1.05 x 10 <sup>-5</sup>
880	891	250	5	1.5	$1.05 \times 10^{-5}$
890	901	250	5	1.0	$7.03 \times 10^{-6}$
900	911	250	5	1.0	$7.03 \times 10^{-6}$
910	921	250	5	1.0	$7.03 \times 10^{-6}$
920	931	250	5	0.92	$6.47 \times 10^{-6}$
*930	941	250	5	2.4	1.69 x 10 <sup>-5</sup>
940	951	250	6	1.0	$7.03 \times 10^{-6}$

<sup>\*</sup>Packers did not completely seal

SUMMARY OF WATER PRESSURE

TEST RESULTS

Borehole Number BH-6

Location Watana

Ground Surface Elevation 1608.8 ft

Static Water Level 1461.8 ft.

Dip of Hole 60°

Stickup 2.5 - 5.5 ft.

Depth From (feet)	Tested To (feet)	Stick-up (feet)	Gauge Pressure (psi)	Duration of Test (min)	Average Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
33.9	50	2.5	16 to 18	10	11	4.59 x 10 <sup>-4</sup>
48.9	65	5.5	22 to 24	10	10.8	$3.27 \times 10^{-4}$
63.9	80	2.5	28 to 30	10	6.4 to 8.0	$1.5 \times 10^{-4}$ to $1.98 \times 10^{-4}$
78.9	95	5.5	35 to 36	10	2.4	4.81 x 10 <sup>-5</sup>
43.9	110	2.5	41 to 44	10	2.2	$3.80 \times 10^{-5}$
108.9	125	5.5	48 to 50	10	2.9	$4.30 \times 10^{-5}$
123.9	140	2.5	54 to 58	10	4.4	5.84 x 10 <sup>-5</sup>
138.9	155	5.5	61 to 62	10	3.7	$4.40 \times 10^{-5}$
153.9	170	2.5	66 to 68	10	4.3	4.72 x 10 <sup>-5</sup>
168.9	185	5.5	76 to 78	10	4.0	3.95 x 10 <sup>-5</sup>
183.9	200	2.5	82 to 88	10	1.3	1.23 x 10 <sup>-5</sup>
198.9	215	5.5	92 to 98	15	1.7	1.49 x 10 <sup>-5</sup>
213.9	230	2.5	98 to 104	10	1.4	1.19 x 10 <sup>-5</sup>
228.9	245	5.5	108	15	1.75	1.42 x 10 <sup>-5</sup>
243.9	260	2.5	114	25	1.0	7.91 x 10 <sup>-6</sup>
258.9	275	5.5	125	25	1.2	8.88 x 10 <sup>-6</sup>
273.9	290	2.5	125	45	1.2	8.94 x 10 <sup>-6</sup>
288.9	305	5.5	130	145	.51	$3.90 \times 10^{-6}$
303.9	320	2.5	140	25	4.9	3.38 x 10 <sup>-5</sup>
318.9	335	5.5	140	10	6.2	4.25 x 10 <sup>-5</sup>

BH - 6 (continued)

Depth	Tested		Gauge	Duration	Average	Coefficient of
From (feet)	To (feet)	Stick-up (feet)	Pressure (psi)	of Test (min)	Flow Rate (gpm)	Permeability (cm/sec)
333.9	350	2.5	200	10	10 to 30	5.34x10 <sup>-5</sup> to 1.60x10 <sup>-</sup>
348.9	365	5.5	200	50	.31 to 14.7	1.65x10 <sup>-6</sup> to 7.81x10 <sup>-5</sup>
363.9	380	2.5	204	10	15 to 30	7.89x10 <sup>-5</sup> to 1.58x10 <sup>-</sup>
378.9	395	5.5	202	10	15 to 30	7.91x10 <sup>-5</sup> to 1.58x10 <sup>-4</sup>
393.9	410	2.5	204	10	6.6	3.47×10 <sup>-5</sup>
408.9	425	5.5	202	10	3.75	1.98x10 <sup>-5</sup>
423.9	440	2.5	202	10	5.7	3.02x10 <sup>-5</sup>
438.9	455	5.5	200	15	11 to 30	5.85x10 <sup>-5</sup> to 1.59x10 <sup>-7</sup>
453.9	470	2.5	200	10	11 to 30	5.88x10 <sup>-5</sup> to 1.60x10 <sup>-4</sup>
468.9	485	5.5	202	15	11 to 30	5.80×10 <sup>-5</sup> to 1.58×10 <sup>-1</sup>
483.9	500	2.5	200	10	11 to 30	5.89×10 <sup>-5</sup> to 1.60×10 <sup>-4</sup>
498.9	515	5.5	202	15	7.8	4.12 x 10 <sup>-5</sup>
513.9	530	2.5	204	15	7.5	3.95 x 10 <sup>-5</sup>
528.9	545	5.5	195	15	5.2	2.82 x 10 <sup>-5</sup>
243.9	560	2.5	205	10	3.8	1.99 x 10 <sup>-5</sup>
558.9	575	5.5	200	15	1.45	7.71 x 10 <sup>-6</sup>
573.9	590	2.5	195	10	5.2	2.83 x 10 <sup>-5</sup>
588.9	605	5.5	200	15	8.6	$4.57 \times 10^{-5}$
603.9	520	2.5	205	10	2.95	1.55 x 10 <sup>-5</sup>
618.9	635	5.5	203	10	3.35	1.76x10 <sup>-5</sup>
633.9	650	2.5	198	20	.55	2.96x10 <sup>-6</sup>

Borehole Numb	er BH-8	
Location	Watana	
Ground Surfac	e Elevation_	1979.7 ft.
Static Water	Level1	804.7
Dip of Hole_	60°	
Stickup	1.2 to 6.2	ft.

Depth From (feet)	Tested To (feet)	Stick-up (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
31.9	48	1.2	20	13	4.55	1.81x10 <sup>-4</sup>
46.9	63	6.2	25	20	2.1	6.15×10 <sup>-5</sup>
61.9	78	1.2	31	5	.34	8.33x10 <sup>-6</sup>
76.9	93	6.2	38	10	4.0	7.80x10 <sup>-5</sup>
91.9	108	1.2	45	15	6.2	1.06x10 <sup>-4</sup>
106.9	123	6.2	51	20	3.2	4.67x10 <sup>-5</sup>
121.9	138	1.2	57	10	8.0	1.06x10 <sup>-5</sup>
136.9	153	6.2	64	5	3.2	3.74×10 <sup>-5</sup>
151.9	168	1.2	70	9	6.6	7.15×10 <sup>-5</sup>
166.9	183	6.2	77	10	3.0	2.92x10 <sup>-5</sup>
181.9	198	1.2	84	10	0.38	3.45×10 <sup>-6</sup>
196.9	213	6.2	90	10	1.2	1.01x10 <sup>-5</sup>
211.9	228	1.2	97	8	2.15	1.75x10 <sup>-5</sup>
226.9	243	6.2	104	8	3.7	2.87x10 <sup>-5</sup>
241.9	258	1.2	110	6	10.3	7.82x10 <sup>-5</sup>
256.9	273	6.2	116	5	7.5	5.45x10 <sup>-5</sup>
271.9	288	1.2	50	6	7.0	7.84×10 <sup>-5</sup>
286.9	305	6.2	50	7	3.85	4.24x10 <sup>-5</sup>
301.9	318	1.2	50	6	2.95	3.30x10 <sup>-5</sup>
316.9	333	6.2	142	5	7.8	5.00x10 <sup>-5</sup>
331.9	348	1.2	149	5	7.3	4.58x10 <sup>-5</sup>

Depth From (feet)	Tested To (feet)	Stick-up (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
346.1	363	6.2	155	6	2.45	1.48×10 <sup>-5</sup>
361.9	378	1.2	162	5	2.75	1.63x10 <sup>-5</sup>
376.9	393	6.2	150	35	12.7	7.86x10 <sup>-5</sup>
391.9	428	1.2	110	40	10.9	8.27x10 <sup>-5</sup>
406.9	423	6.2	50	5	1.7	1.87x10 <sup>-5</sup>
421.9	438	1.2	188	6	.4	2.14x10 <sup>-6</sup>
436.9	453	6.2	195	5	2.4	1.24x10 <sup>-6</sup>
451.9	468	1.2	200	8	.36	1.84x10 <sup>-6</sup>
466.9	483	6.2	200	6	.54	2.74×10 <sup>-6</sup>
481.9	498	1.2	200	7	.54	2.76x10 <sup>-6</sup>
496.9	513	6.2	200	7	.60	$3.05 \times 10^{-6}$
511.9	528	1.2	200	5	.55	2.81x10 <sup>-6</sup>
526.9	543	6.2	200	5	.96	4.87x10 <sup>-6</sup>
541.9	558	1.2	200	6	.85	4.35×10 <sup>-6</sup>
556.9	573	6.2	200	6	2.76	$3.86 \times 10^{-6}$
571.9	588	1.2	200	7	2.05	1.05x10 <sup>-5</sup>
586.9	603	6.2	200	6	.85	4.32x10 <sup>-6</sup>
601.9	618	1.2	200	7	2.8	1.43x10 <sup>-5</sup>
616.9	633	6.2	200	6	.75	3.81x10 <sup>-6</sup>
631.9	648	1.2	200	6	.82	4.20x10 <sup>-6</sup>
646.9	663	6.2	225	8	1.60	$7.46 \times 10^{-6}$
661.9	708	1.2	200	6	.80	$4.09 \times 10^{-6}$
676.9	723	6.2	200	7	1.1	5.59x10 <sup>-6</sup>
691.9	738	1.2	200	6	1.08	5.53x10 <sup>-6</sup>
706.9		6.2	200	6	1.2	$6.09 \times 10^{-6}$
721.9		1.2	200	12	1.0	5.12x10 <sup>-6</sup>

Borehole Number BH-12

Location Watana

Ground Surface Elevation 1975.7 ft.

Static Water Level 1975.7 ft.

Dip of Hole 360

Stickup 7.1 ft.

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
30.0	41.0	10	10	3.10	4.52 x 10 <sup>-4</sup>
30.0	41.0	8-10	10	3.00	$4.73 \times 10^{-4}$
40.0	51.0	14	10	6.35	$7.08 \times 10^{-4}$
50.0	61.0	15	6	2.91	$3.07 \times 10^{-4}$
60.0	71.0	20	8	0.07	$5.78 \times 10^{-6}$
70.0	81.0	22	10	0.036	$2.73 \times 10^{-6}$
80.0	91.0	27	10	0.18	$1.14 \times 10^{-5}$
90.0	101.0	30	8	0.45	$2.59 \times 10^{-5}$
* 100.0	111.0	30	3	0.82	$4.72 \times 10^{-5}$
* 105.0	116.0	30	4	0.99	$5.70 \times 10^{-5}$
110.0	121.0	35	10	0.30	$1.50 \times 10^{-5}$
120.0	131.0	38-40	10	0.32	1.42 x 10 <sup>-t</sup>
130.0	141.0	42	10	0.53	$2.24 \times 10^{-5}$
140.0	151.0	44	12	0.19	$7.70 \times 10^{-6}$
150.0	161.0	48-49	12	0.60	$2.22 \times 10^{-5}$
160.0	171.0	51	6	0.17	$6.00 \times 10^{-6}$
170.0	181.0	54	6	0.05	$1.67 \times 10^{-6}$
180.0	191.0	58	6	0.02	$6.29 \times 10^{-7}$
190.0	201.0	60	6	0.10	$3.02 \times 10^{-6}$
200.0	211.0	65-66	6	0.39	1.08 x 10 <sup>-5</sup>
210.0	221.0	70-71	10	1.67	$4.30 \times 10^{-5}$
220.0	231.0	71	6	0.30	$7.72 \times 10^{-6}$

\* 230.0 241.0 No Test

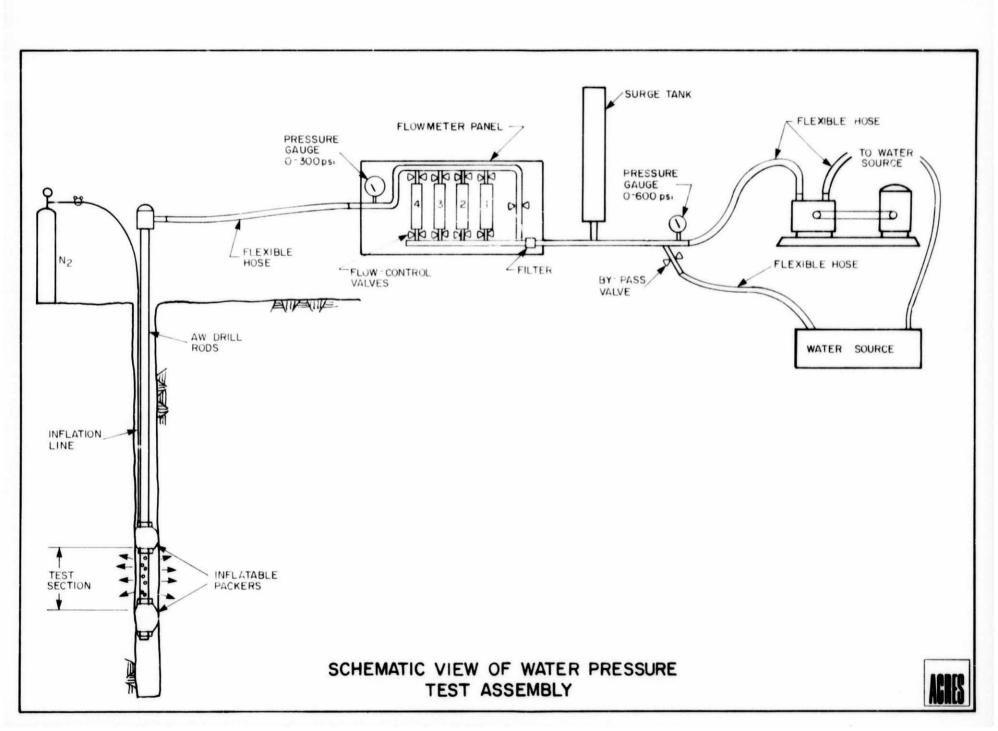
<sup>\*</sup> Packers did not completely seal

	Depth Te From (feet)	To (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
	235.0	246.0	73-74	6	0.21	5.27 x 10 <sup>-6</sup>
	240.0	251.0	77	6	0.18	$4.29 \times 10^{-6}$
	250.0	261.0	80-82	6	2.54	5.76 x 10 <sup>-5</sup>
*	260.0	271.0	84-85	11	0.70	1.52 x 10 <sup>-5</sup>
	270.0	281.0	88-92	8	2.45	5.02 x 10 <sup>-5</sup>
	275.0	286.0	86-90	11	2.12	$4.40 \times 10^{-5}$
*	286.0	289.0	No Test			
	289.0	300.0	91-92	11	2.02	$4.07 \times 10^{-5}$
	299.0	310.0	92-98	10	1.00	1.94 x 10 <sup>-5</sup>
	309.0	320.0	98-103	12	0.90	1.64 x 10 <sup>-5</sup>
*	310.0	321.0	98-99			
	310.0	321.0	98-99	10	0.89	$1.67 \times 10^{-5}$
*	321.0	324.0	No Test			_
	324.0	335.0	104-108	10	4.75	$8.62 \times 10^{-5}$
	329.0	350.0	No Test			
	349.0	360.0	110	6	0.56	$9.45 \times 10^{-6}$
	359.0	370.0	114-116	8	1.05	1.70 x 10 <sup>-5</sup>
	369.0	380.0	117-119	10	0.76	$1.20 \times 10^{-5}$
	380.0	391.0	120-122	10	0.79	$1.21 \times 10^{-5}$
	390.0	401.0	126-128	8	1.48	2.17 x 10 <sup>-5</sup>
	400.0	411.0	128-132	10	1.77	$2.54 \times 10^{-5}$
	410.0	421.0	132-134	10	0.66	9.25 x 10 <sup>-6</sup>
	420.0	431.0	134-136	8	0.84	1.16 × 10 <sup>-5</sup>
	430.0	441.0	136-140	10	0.74	1.00 x 10 <sup>-5</sup>
	440.0	451.0	140	10	0.89	1.19 x 10 <sup>-5</sup>
	450.0	461.0	144	8	0.91	1.18 x 10 <sup>-5</sup>
	460.0	700.0	Hole Caving	, Redrilled and	Tested From B	
	700.0	711.0	222-226	10	0.75	$6.30 \times 10^{-6}$
	710.0	721.0	226-228	6	0.75	6.22 x 10 <sup>-6</sup>
	720.0	731.0	232-236	8	0.81	$6.52 \times 10^{-6}$
	730.0	741.0	230-234	6	0.80	$6.49 \times 10^{-6}$
	740.0	751.0	234	8	0.77	6.20 x 10 <sup>-6</sup>
	750.0	761.0	238-244	8	1.59	1.24 x 10 <sup>-5</sup>

<sup>\*</sup>Packers did not completely seal.

Depth Tested		Gauge	Duration		Coefficient of
From (feet)	To (feet)	Pressure (psi)	of Test (min)	Flow Rate (gpm)	Permeability (cm/sec)
760.0	771.0	240-246	10	1.27	$9.84 \times 10^{-6}$
770.0	781.0	242-250	14	2.25	$1.72 \times 10^{-5}$
780.0	791.0	250-256	10	2.10	$1.56 \times 10^{-5}$

APPENDIX E DEVIL CANYON WATER PRESSURE TESTING DETAILS



TEST RESULTS

Borehole Number BH-1

Location Devil Canyon

Ground Surface Elevation 1413.7 ft.

Static Water Level 1221.7 ft.

Dip of Hole 670

Stickup 3 to 8 ft.

From (feet)	To (feet)	Stickup (feet)	Gauge Pressure (psi)	of Test (min)	Flow Rate (gpm)	Permeability (cm/sec)
38.9	55	8	20	11	.72	2.34 X 10 <sup>-5</sup>
53.9	70	3	30	10	4.06	1.03 X 10 <sup>-4</sup>
68.9	85	8	40	10	6.18	1.18 X 10 <sup>-4</sup>
83.9	100	3	45	10	.78	1.33 X 10 <sup>-5</sup>
98.9	115	8	55	10	5.17	7.23 X 10 <sup>-5</sup>
113.9	130	3	60	46	.90 to 5.40	1.16 X 10 <sup>-5</sup> to 6.95 X 1
128.9	145	8	70	21	.77	8.50 X 10 <sup>-6</sup>
143.9	160	3	75	14	.83	8.57 X 10 <sup>-6</sup>
158.9	175	8	85	11	1.05	9.58 X 10 <sup>-6</sup>
173.9	190	3	90	10	.06	5.18 X 10 <sup>-7</sup>
188.9	205	8	100	10	2.16	1.68 X 10 <sup>-5</sup>
203.9	220	3	105	10	2.19	1.63 X 10 <sup>-5</sup>
218.9	285	8	115	10	0.84	5.89 X 10 <sup>-6</sup>
233.9	250	3	120	10	2.70	1.87 X 10 <sup>-5</sup>
248.9	265	8	130	10	5.37	3.50 X 10 <sup>-5</sup>
263.9	280	3	135	10	.25	1.61 X 10 <sup>-6</sup>
278.9	295	8	145	10	3.63	2.22 X 10 <sup>-5</sup>
292.9	310	3	150	10	2.05	1.24 X 10 <sup>-5</sup>
308.9	325	8	160	10	1.24	7.11 × 10 <sup>-6</sup>
323.9	390	3	165	10	.42	2.38 X 10 <sup>-6</sup>
338.9	355	8	170	10	1.48	8.15 X 10 <sup>-6</sup>
252.9	370	3	180	10	1.61	8.61 X 10 <sup>-6</sup>
368.9	385	8	190	10	2.15	1.10 x 10 <sup>-5</sup>
383.9	400	3	195	10	.26	1.32 × 10 <sup>-6</sup>

BH-1 (Continued)

Depth T From (feet)	To (feet)	Stickup (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
398.9	415	8	200	10	.40	1.97 X 10 <sup>-6</sup>
413.9	430	3	200	10	1.98	$9.84 \times 10^{-6}$
428.9	445	8	200	10	.29	1.43 x 10 <sup>-6</sup>
443.9	460	3	200	10	1.15	$5.72 \times 10^{-6}$
458.9	475	8	200	10	5.08	$2.50 \times 10^{-5}$
473.9	490	3	200	10	7.21	3.58 X 10 <sup>-5</sup>
488.9	505	8	200	10	2.34	1.15 X 10 <sup>-5</sup>
503.9	420	3	200	10	1.48	7.35 X 10 <sup>-6</sup>
518.9	535	8	200	10	4.2	$2.07 \times 10^{-5}$
533.9	550	3	200	10	.39	1.94 x 10 <sup>-6</sup>
548.9	565	8	200	10	4.51	$2.22 \times 10^{-5}$
563.9	580	3	200	10	3.72	1.85 X 10 <sup>-5</sup>
578.9	595	8	200	10	3.9	$1.92 \times 10^{-5}$
593.9	610	3	200	10	9.7	$4.82 \times 10^{-5}$
608.9	625	8	150	13	2.58	1.54 X 10 <sup>-5</sup>
622.9	639	3	130	18	1.20	7.91 x 10 <sup>-6</sup>
638.9	655	. 8	130	11	1.63	$4.11 \times 10^{-6}$
653.9	670	3	200	10	7.4	$3.68 \times 10^{-5}$
668.9	685	8	130	11	1.03	6.72 X 10 <sup>-6</sup>
683.9	700	3	150	25	.45	2.71 x 10 <sup>-6</sup>
698.9	715	8	150	19	.69	$4.12 \times 10^{-6}$
713.9	730	3	150	13	.23	$1.39 \times 10^{-6}$
728.9	745	8	150	14	.78	4.66 X 10 <sup>-6</sup>

TEST RESULTS

Borehole Number BH-2

Location Devil Canyon

Ground Surface Elevation 1213.4 ft.

Static Water Level 1208.4 ft.

Dip of Hole 60°

Stickup 2 to 7 ft.

Depth T From (feet)	ested To (feet)	Stickup (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
13.9	30	7	12	10	.72	5.92 x 10 <sup>-5</sup>
28.9	45	2	18	10	1.1	$7.39 \times 10^{-5}$
43.9	60	7	22	10	4.0	2.08 x 10 <sup>-4</sup>
58.9	75	2	25	10	1.16	5.85 x 10 <sup>-5</sup>
73.9	90	7	35	10	.15	5.27 x 10 <sup>-6</sup>
88.9	105	2	42	12	.67	$2.10 \times 10^{-5}$
103.9	120	7	50	10	. 31	$7.94 \times 10^{-6}$
118.9	135	2	65	10	.25	$6.09 \times 10^{-6}$
133.9	150	7	70	10	2.92	5.88 x 10 <sup>-5</sup>
148.9	165	2	82	10	1.27	2.46 x 10 <sup>-5</sup>
163.9	180	7	85	10	.35	$5.67 \times 10^{-6}$
178.9	195	2	100	10	.15	$2.41 \times 10^{-6}$
193.9	210	7	105	10	.49	$6.58 \times 10^{-6}$
208.9	225	2	110	10	.46	6.02 x 10 <sup>-6</sup>
223.9	240	7	115	10	.37	4.54 x 10 <sup>-6</sup>
238.9	255	2	125	10	.08	9.58 x 10 <sup>-7</sup>
253.9	270	7	130	10	.21	2.28 x 10 <sup>-6</sup>
268.9	285	2	100	32	.68 to 3.1	7.22x10 <sup>-6</sup> to3.29x10 <sup>-5</sup>
283.9	300	7	145	10	.99	1.33 x 10 <sup>-5</sup>
298.9	315	2	155	10	.21	2.01 x 10 <sup>-6</sup>
313.9	330	7	160	10	.25	2.21 x 10 <sup>-6</sup>
328.9	345	2	170	10	.36	3.12 x 10 <sup>-6</sup>
343.9	360	7	175	10	.26	2.10 x 10 <sup>-6</sup>
358.9	375	2	185	10	.71	5.64 x 10 <sup>-6</sup>
373.9	390	7	190	10	.60	4.46 x 10 <sup>-6</sup>

# BH-2 (Continued)

Depth Tested			Gauge	Duration	Flow	Coefficient of
From (feet)	To (feet)	Stickup (feet)	Pressure (psi)	of Test (min)	Rate (gpm)	Permeability (cm/sec)
388.9	405	2	190	10 .	.38	$2.78 \times 10^{-6}$
403.9	420	7	200	10	.62	$4.27 \times 10^{-6}$
418.9	435	2	200	10	.36	$2.51 \times 10^{-6}$
433.9	450	7	200	10	.61	$4.20 \times 10^{-6}$

TEST RESULTS

Borehole Number BH-3

Location Devil Canyon

Ground Surface Elevation 1398.0 ft.

Static Water Level dry hole

Dip of Hole 32°

Stickup 7.1 ft.

Depth To From (Feet)	To (Feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
20.0	31.0	18	10	1.35	9.5 x 10 <sup>-5</sup>
30.0	41.0	22	8	0.71	$4.1 \times 10^{-5}$
40.0	51.0	12	8	0.36	$2.7 \times 10^{-5}$
50.0	61.0	16-22	8	4.4	$2.6 \times 10^{-4}$
60.0	71.0	22	8	0.72	$3.4 \times 10^{-5}$
70.0	81.0	20-22	12	0.71	$3.3 \times 10^{-5}$
80.0	91.0	25	10	0.98	$3.9 \times 10^{-5}$
90.0	101.0	28-29	8	0.32	1.1 x 10 <sup>-5</sup>
100.0	111.0	30	12	0.28	$9.3 \times 10^{-6}$
110.0	121.0	30	2	11.0	$3.5 \times 10^{-4}$
120.0	131.0	35	8	2.4	$6.8 \times 10^{-5}$
130.0	141.0	38	8	1.1	2.9 x 10 <sup>-5</sup>
140.0	151.0	41-46	6	11.0	$2.6 \times 10^{-4}$
150.0	161.0	45-46	6	3.4	$7.7 \times 10^{-5}$
160.0	171.0	46	2	11.0	$2.4 \times 10^{-4}$
170.0	181.0	48	6	2.45	5.1 x 10 <sup>-5</sup>
180.0	191.0	52	10	5.6	$1.1 \times 10^{-4}$
190.0	201.0	54	12	4.6	$8.6 \times 10^{-5}$
200.0	211.0	60	20	2.2	$3.8 \times 10^{-5}$
210.0	221.0	60	4	11.0	$1.9 \times 10^{-4}$
220.0	231.0	64	10	0.80	$1.3 \times 10^{-5}$
230.0	241.0	65	20	2.3	$3.6 \times 10^{-5}$
240.0	251.0	68-77	14	0.58	$8.4 \times 10^{-6}$
250.0	261.1	72-74	4	11.0	$1.6 \times 10^{-4}$

Depth Te From (Feet)	To (Feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
260.0	271.0	72-75	8	5.6	7.8 x 10 <sup>-5</sup>
270.0	281.1	77	6	11.0	$1.5 \times 10^{-4}$
280.0	291.1	79-80	6	5.3	$6.8 \times 10^{-5}$
290.0	301.1	83	8	8.9	1.1 x 10 <sup>-4</sup>
300.0	311.1	86	8	5.7	$6.8 \times 10^{-5}$
310.0	321.1	88-90	7	1.1	1.3 x 10 <sup>-5</sup>
320.0	331.1	80-91	8	8.7	1.0 x 10 <sup>-4</sup>
330.0*	341.1	92-94	7	11.0	$1.2 \times 10^{-4}$
340.0*	351.1	96-97	6	11.0	1.2 x 10 <sup>-4</sup>
350.0*	361.1	100	6	11.0	1.1 x 10 <sup>-4</sup>
360.0	371.1	100-102	8	8.2	$8.3 \times 10^{-5}$
370.0*	381.1	105	8	11.0	$1.1 \times 10^{-4}$
380.0*	390.7	108	9	11.0	$1.1 \times 10^{-4}$

TEST RESULTS

Borehole Number BH-4

Location Devil Canyon

Ground Surface Elevation 1352.6 ft

Static Water Level 1321.6 ft

Dip of Hole 60°

Stickup 1 to 6 ft

Depth Te From (feet)	To (feet)	Stickup (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
13.9	30	1	10	10	.046	3.48 X 10 <sup>-6</sup>
28.9	45	6	15	10	.252	1.15 X 10 <sup>-6</sup>
43.9	60	1	20	10	.247	$1.03 \times 10^{-5}$
58.9	75	6	24	10	.039	1.38 X 10 <sup>-6</sup>
78.9	90	1	34	12	3.21	9.48 X 10 <sup>-5</sup>
88.9	105		UNA	BLE TO SEAT	PACKERS	
108.9	125	14	50	10	.26	5.29 X 10 <sup>-6</sup>
118.9	135	6	55	10	3.75	$7.46 \times 10^{-5}$
123.9	140	1	56	10	4.24	8.58 X 10 <sup>-5</sup>
138.9	155		UNA	BLE TO SEAT	PACKERS	
148.9	165	6	70	10	.052	$8.54 \times 10^{-7}$
153.9	170	1	50	10	1.042	2.31 X 10 <sup>-5</sup>
163.9	180	1	80	10	.622	9.37 X 10 <sup>-6</sup>
178.9	195	6	85	10	.041	5.74 X 10 <sup>-7</sup>
193.9	210	1	95	10	.034	4.41 X 10 <sup>-7</sup>
208.9	225	6	100	10	.02	$2.44 \times 10^{-7}$
223.9	240	1	105	10	.029	3.45 X 10 <sup>-7</sup>
238.9	255	6	115	10	.048	5.18 X 10 <sup>-7</sup>
253.9	270	1	125	10	.034	3.46 X 10 <sup>-7</sup>
208.9	205	6	130	10	.036	$3.48 \times 10^{-7}$
283.9	300	1	140	10	.028	2.57 X 10 <sup>-7</sup>
298.9	315	6	145	10	. 105	9.22 X 10 <sup>-7</sup>
313.9	330	1	150	10	.033	2.85 X 10 <sup>-7</sup>
328.9	345	6	160	12	.423	$3.40 \times 10^{-6}$

BH-4 (Continued)

Depth Tested			Gauge	Duration		Coefficient of
From (feet)	To (feet)	Stickup (feet)	Pressure (psi)	of Test (min)	<pre>Flow Rate (gpm)</pre>	Permeability (cm/sec)
343.9	360	1	170	10	.208	1.60 X 10 <sup>-6</sup>
358.9	375	6	175	10	.113	8.36 X 10 <sup>-7</sup>
373.9	390	1	185	10	.92	$6.54 \times 10^{-6}$
388.9	405	6	190	9	.09	6.17 X 10 <sup>-7</sup>
403.9	420	1	200	10	.151	9.98 X 10 <sup>-/</sup>
418.9	435	6	200	10	.121	$7.92 \times 10^{-7}$
433.9	450	1	200	10	.119	7.87 $\times$ 10 <sup>-7</sup>
448.9	465	6	200	10	.099	$6.48 \times 10^{-7}$
458.9	475	1	200	10	.103	$6.81 \times 10^{-7}$

TEST RESULTS

From To (feet)		To	Gauge Pressure (psi)	Duration of Test (minutes)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)	
	63.0	74.0	30	6	0.89	$3.5 \times 10^{-5}$	
	73.0	84.0	30	6	0.93	$3.6 \times 10^{-5}$	
	83.0	94.0	33	6	0.71	$2.6 \times 10^{-5}$	
	93.0	104.0	36 ·	6	1.0	$3.5 \times 10^{-5}$	
	103.0	114	40	8	2.5	$8.2 \times 10^{-5}$	
	114.0	115.9	No Test				
	115.9	126.9	40	16	3.4	$1.1 \times 10^{-4}$	
	126.9	135.6	No Test				
	135.6	146.6	55	8	0.76	$2.0 \times 10^{-5}$	
	143.0*	154.0	55	4	9.4	$2.4 \times 10^{-4}$	
	153.0	164.0	60	2	0.01	$2.4 \times 10^{-7}$	
	163.0*	174.0	60	6	9.2	$2.2 \times 10^{-4}$	
	173.0	184.0	65	10	5.1	$1.2 \times 10^{-4}$	
	183.0	194.0	70	<b>L</b>	0.06	$1.3 \times 10^{-6}$	
	193.0	204.0	70	4	0.09	1.9 x 10 <sup>-6</sup>	
	203.0	214.0	75	6	0.04	$8.2 \times 10^{-7}$	
	213.0	224.0	80	4	0.10	1.9 x 10 <sup>-6</sup>	
	223.0	234.0	85	8	0.14	$2.6 \times 10^{-6}$	
	233.0	244.0	85	8	0.16	$2.9 \times 10^{-6}$	
	243.0	254.0	90	6	0.10	$1.8 \times 10^{-6}$	

<sup>\*</sup>Packers did not completely seal

Depth From (feet)	Tested To (feet)	Gauge Pressure (psi)	Duration of Test (minutes)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
253.0	264.0	95	6	0.14	$2.4 \times 10^{-6}$
263.0	274.0	95	6	0.13	$2.2 \times 10^{-6}$
273.0	284.0	100	6	0.58	9.3 x 10 <sup>-6</sup>
283.0	294.0	105	12	1.0	$1.5 \times 10^{-5}$
293.0	304.0	110	12	1.1	$1.6 \times 10^{-5}$
303.0	314.0	110	18	1.7	$2.5 \times 10^{-5}$
313.0	324.0	115	8	1.4	$2.0 \times 10^{-5}$
323.0	334.0	118-120	8	0.13	$1.8 \times 10^{-6}$
333.0	344.0	124	8	0.07	$9.4 \times 10^{-7}$
343.0	354.0	124	8	0.58	$7.8 \times 10^{-6}$
353.0	364.0	132	8	0.21	$2.7 \times 10^{-6}$
363.0	374.0	132	8	0.87	1.1 x 10 <sup>-5</sup>
373.0	384.0	134	8	0.40	$5.0 \times 10^{-6}$
383.0	394.0	139	8	0.22	$2.7 \times 10^{-6}$
393.0	404.0	144	8	0.45	5.3 x 10 <sup>-6</sup>
403.0	414.0	145	8	0.33	$3.8 \times 10^{-6}$
413.0	424.0	148	8	0.30	$3.4 \times 10^{-6}$
423.0	434.0	150	8	0.35	$4.0 \times 10^{-6}$
433.0	444.0	155	8	1.7	1.9 x 10 <sup>-5</sup>
443.0	454.0	162	8	2.1	2.2 x 10 <sup>-5</sup>
453.0	464.0	164	7	0.29	$3.0 \times 10^{-6}$
463.0	474.0	171	8	2.6	$2.6 \times 10^{-5}$
473.0	484.0	170	6	5.9	6.0 x 10 <sup>-5</sup>
484.0	503.0	No Test			,
503.0	514.0	180	10	0.82	$7.9 \times 10^{-6}$
513.0	524.0	185	6	0.93	8.7 x 10 <sup>-6</sup>
523.0	534.0	190	8	3.7	$3.4 \times 10^{-5}$
533.0	544.0	190	6	3.3	$3.0 \times 10^{-5}$
543.0	554.0	195	6	5.4	$4.8 \times 10^{-5}$
553.0	564.0	200	4	0.38	$3.3 \times 10^{-6}$
5€3.0	574.0	200	6	0.66	$5.8 \times 10^{-6}$
573.0	584.0	205	8	0.47	$4.0 \times 10^{-6}$
581.7	592.7	210	6	0.43	$3.6 \times 10^{-6}$

# SUMMARY OF WATER PRESSURE TEST RESULTS

Borehole Numb	er BH-5b	
Location De	evil Canyon	
		976.6 ft
Static Water	Level	946.2 ft
Dip of Hole_	45°	
Stickup 2	.2 - 4.0 feet	<u>:</u>

Depth From (feet)	Tested To (feet)	Stickup (feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
23.0	34.0	4.4	21	7	0.51	3.1 x 10 <sup>-5</sup>
33.0	44.0	4.0	25	6	1.4	6.9 x 10 <sup>-5</sup>
43.0	54.0	4.0	28	6	11.0	$4.9 \times 10^{-4}$
54.0	63.0		No Test			_
63.0	74.0	4.0	32	6	0.06	$2.4 \times 10^{-6}$
68.3	79.3	2.2	30	8	0.33	1.4 x 10 <sup>-5</sup>
79.3	116.0		No Test			_
116.0	127.0	2.2	46	6	0.68	2.2 x 10 <sup>-5</sup>
126.0	137.0	2.2	52	6	0.10	$2.9 \times 10^{-5}$
136.0	147.0	2.2	55	8	0.47	1.3 x 10 <sup>-5</sup>
146.0	157.0	2.2	58	6	0.71	1.9 x 10 <sup>-5</sup>
156.0	167.0	2.2	60	6	0.67	1.7 x 10 <sup>-5</sup>
166.0	177.0	2.2	65	8	1.7	4.1 x 10 <sup>-5</sup>
176.0	187.0	2.2	70	6	0.64	1.5 x 10 <sup>-5</sup>
186.0	197.0	2.2	70-72	8	0.18	$4.0 \times 10^{-6}$

# SUMMARY OF WATER PRESSURE TEST RESULTS

Borehole Number_	BH-7		
Location Devi	1 Canyon		
Ground Surface El	evation	1351.0 ft	
Static Water Leve	el133	88.3 ft.	
Dip of Hole	45°		
Stickup As No	ted		

Depth T From (Feet)	To (Feet)	Stickup (Feet)	Gauge Pressure (psi)	Duration of Test (min)	Flow Rate (gpm)	Coefficient of Permeability (cm/sec)
30.0	47.0	6.1	20	8	5.2	$2.6 \times 10^{-4}$
35.9	52.0	1.1	20	6	0.19	$1.0 \times 10^{-5}$
50.9	67.0	6.1	20	6	0.38	1.9 x 10 <sup>-5</sup>
65.9	82.0	1.1	25	6	3.2	$1.4 \times 10^{-4}$
80.9	97.0	6.1	30	14	3.6	$1.3 \times 10^{-4}$
95.9	112.0	1.1	35	11	3.0	$1.0 \times 10^{-4}$
110.9	127.0	61.	40	8	1.9	$5.6 \times 10^{-5}$
125.9	142.0	1.1	45	22	0.89	$2.5 \times 10^{-5}$
138.9	155.0	7.0	48	20	0.04	1.1 x 10 <sup>-6</sup>
148.9	165.0	3.1	50	10	0.02	$5.0 \times 10^{-7}$
163.9	180.0	3.1	55	10	0.03	6.9 x 10 <sup>-7</sup>
178.9	195.0	8.1	60	10	0.03	$6.1 \times 10^{-7}$
188.9	205.0	8.1	60	12	0.22	$4.5 \times 10^{-6}$
205.0	233.0		No Test			
233.9	253.1	3.1	80	9	0.38	6.2 x 10 <sup>-6</sup>
248.1	265.0	8.1	80	10	0.26	$4.1 \times 10^{-6}$
263.9	280.0	3.1	85	6	0.22	$3.4 \times 10^{-6}$
278.9	295.0	8.1	90	7	0.11	1.6 x 10 <sup>-6</sup>
293.9	310.0	3.1	95	10	0.07	$9.7 \times 10^{-6}$
308.9	325.0	8.1	102	10	1.1	$1.4 \times 10^{-6}$
323.9	340.0	3.1	105	10	0.43	$5.4 \times 10^{-6}$
338.9	355.0	8.1	110	8	0.44	$5.2 \times 10^{-6}$
353.9	370.0	3.1	115	10	0.61	$7.1 \times 10^{-6}$

# BH-7 (Continued)

Depth T From	ested To	Stickup	Gauge Pressure	Duration of Test	Flow Rate	Coefficient of Permeability
(feet)	(feet)	(feet)	(psi)	(min)	(gpm)	(cm/sec)
368.9	385.0	8.1	120	10	0.78	$8.5 \times 10^{-6}$
383.9	400.0	3.1	124	9	0.90	9.7 x 10 <sup>-6</sup>
398.9	415.0	8.1	128	10	0.58	$6.0 \times 10^{-6}$
413.9	430.0	3.1	135	10	0.65	$6.5 \times 10^{-6}$
428.9	445.0	8.1	140	10	0.56	$5.3 \times 10^{-6}$
443.9	460.0	3.1	145	10	0.67	$6.2 \times 10^{-6}$
458.9	475.0	8.1	150	10	0.63	$5.6 \times 10^{-6}$
473.9	490.0	3.1	155	10	0.62	$5.4 \times 10^{-6}$
478.2	494.3	8.1	158	12	0.70	$5.9 \times 10^{-6}$

APPENDIX F WATANA BORROW AREA INVESTIGATION

#### EXPLANATION OF SELECTED SYMBOLS

#### STANDARD SYMBOLS

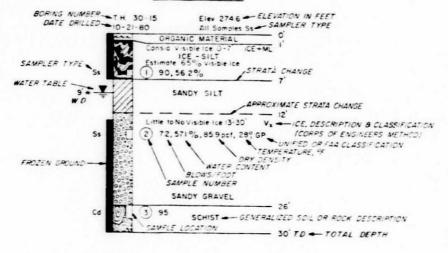
	ORGANIC MATERIAL	3	COBBLES & BOULDERS	1 × 1	GNEOUS ROCK		SANDY SILT
	CLAY	0=0=0 0=0=0	CONGLOMERATE	<b>3</b>	METAMORPHIC ROCK		SILT GRADING TO SANDY SILT
$\mathbb{Z}$	SILT		SANDSTONE		ICE, MASSIVE		SANDY GRAVEL, SCATTERED COBBLES (ROCK FRAGMENTS)
	SAND		MUDSTONE	變	ICE - SILT	2523%	INTERLAYERED SAND 8 SANDY GRAVEL
0000	GRAVEL	田	LIMESTONE		ORGANIC SILT	<b>2</b>	SILTY CLAY W/TR SAND

#### SAMPLER TYPE SYMBOLS

\$1 1.4" SPLIT !	SPOON WITH 47 # HAMMER	Ts SHELBY TUBE
Ss 14" SPLIT S	SPOON WITH 140 # HAMMER	Tm MODIFIED SHELBY TUBE
SI 25" SPLIT 5	SPOON WITH 140# HAMMER	Pb PITCHER BARREL
	SPOON WITH 340# HAMMER	Cs CORE BARREL WITH SINGLE TURE
	SPOON WITH 140# HAMMER	Cd CORE BARREL WITH DOUBLE TUBE
	SPOON WITH 340# HAMMER	Bs BULK SAMPLE
Sp 25" SPLIT S		A AUGER SAMPLE
	SPOON DRIVEN WITH AIR HAMMER	G GRAB SAMPLE
HI 2.5" SPLIT S	SPOON DRIVEN WITH AIR HAMMER	

NOTE: SAMPLER TYPES ARE EITHER NOTED ABOVE THE BORING LOG OR ADJACENT TO IT AT THE RESPECTIVE SAMPLE DEPTH.

#### TYPICAL BORING LOG



#### DRILLING SYMBOLS

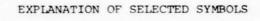
WD: While Drilling AB: After Boring WL: Water Level TD: Total Depth WS: While Sampling

Note: Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious unfrozen soils, the indicated elevations are considered to represent actual ground water conditions. In impervious and frozen soils, accurate determinations of ground water elevations cannot be obtained within a limited period of observation and other evidence on ground water elevations and conditions are required.

PREPARED BY:

PREPARED FOR





ACRES

# SOILS CLASSIFICATION AND CONSISTENCY

CLASSIFICATION: Identification and classification of the soil is accomplished in accordance with the Unified Soil Classification System. Normally, the grain size distirbution determines classification of the soil. The soil is defined according to major and minor constituents with the minor elements serving as modifiers of the major elements. Minor soil constitutents may be added to the classification breakdown in accordance with the particle size proportions listed below; (i.e., sandy silt with some gravel, trace clay).

no call - 0-3% trace - 3-12% some - 13-30% sandy, silty, gravelly - >30%

Identification and classification of soil strata which have a significant cobble and boulder content is based on the unified classification of the minus 3 inch fraction augmented by a description (i.e., cobbles and boulders) of the plus 3 inch fraction. Where a gradation curve, which includes the plus 3 inch fraction, exists (samples from test trenches and pits) a modifier is used to describe independently the percentage of each of the two plus 3 inch components. If there is no gradation curve incorporating the plus 3-inch fraction (as in auger holes), the plus 3-inch material is described as a single component (i.e., cobbles and boulders), and a modifier is used to indicate the relative percentage of the plus 3-inch fraction based on the field logs. The modifiers in each case are used as follows:

Scattered - 0-40%

Numerous - >40%

SOIL CONSISTENCY - CRITERIA: Soil consistency as defined below and determined by normal field and laboratory methods applies only to non-frozen material. For these materials, the influence of such factors as soil structure, i.e. fissure systems, shrinkage cracks, slickensides, etc., must be taken into consideration in making any correlation with the consistency values listed below. In permafrost zones, the consistency and strength of frozen soils may vary significantly and unexplainably with ice content, thermal regime and soil type.

	Cohesionless	Soils	Cohesive Soils						
	N* (blows/ft)	Relative Density		N* (blows/ft)	qu - (tsf)				
Very Loose Loose Medium Dense Dense Very Dense	0 - 4 4 - 10 10 - 30 30 - 50 >50	20% 20 to 40% 40 to 60% 60 to 80% >80%	Very Soft Soft Medium Stiff Very Stiff Hard	0 - 2 2 - 4 4 - 8 8 - 15 15 - 30 >30	0 - 0.25 0.25 - 0.5 0.5 - 1.0 1.0 - 2.0 2.0 - 4.0 >4.0				

\* Standard Penetration "N": Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch OD split-spoon except where noted.

Often the split-spoon samplers do not reach the total intended sample depth. Where this occurs the graphic log notes a refusal (Ref.) and give an indication of the cause of the refusal. Tight soils are indicated by a blow count value followed by a penetration length in inches. The presense of large rock fragments is indicated by a cobble and boulder callout following the refusal callout. In certain instances a blow count of 100+ may be listed to indicate tight soils where total sampler penetration is possible with more than 100 blows per foot.

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#### EXPLANATION OF ICE SYMBOLS

Percentage of visible ice has been grouped for the purpose of designating the amount of soil ice content. These groups have arbitrarily been set out as follows:

0%	No Visible Ice
1% - 10%	Little Visible Ice
11% - 20%	Occasional Visible Ice
21% - 35%	Some Visible Ice
>35%	Considerable Visible Ice

The ice description system is based on that presented by K. A. Linell, and C. W. Kaplar (1966). In this system, which is an extension of the Unified Soil Classification System, the amount and physical characteristics of the soil ice are accounted for. The following table is a brief summary of the salient points of their classification system as modified to meet the needs of this study.

### ICE DESCRIPTIONS

GROUP	ICE VISIBILITY & CONTENT	SUBGRO	UP			
SYMBOL	ICE VISIBILITY & CONTENT	DESCRIPTION	SYMBOL			
		Poorly bonded or friable	N,			
N	ice not visible	Well Ice bonded Excess	Nb Nbn			
		Individual ice crystals or inclusions	V <sub>x</sub>			
		ice coatings on particles	v <sub>c</sub>			
V	ice visible, <50%	Random or irregularly oriented ice formations	٧,			
		Stratified or distinctly oriented ice formations				
ICE	ice visible, >50%	ice with soil	ICE + soil type			
ICE	Individual layer >6" thick *	ice without	ICE			

. In some cases where the soil is ice poor a thin ice layer may be called out by special notation on the log, i.e. 2" ice lens at 7"

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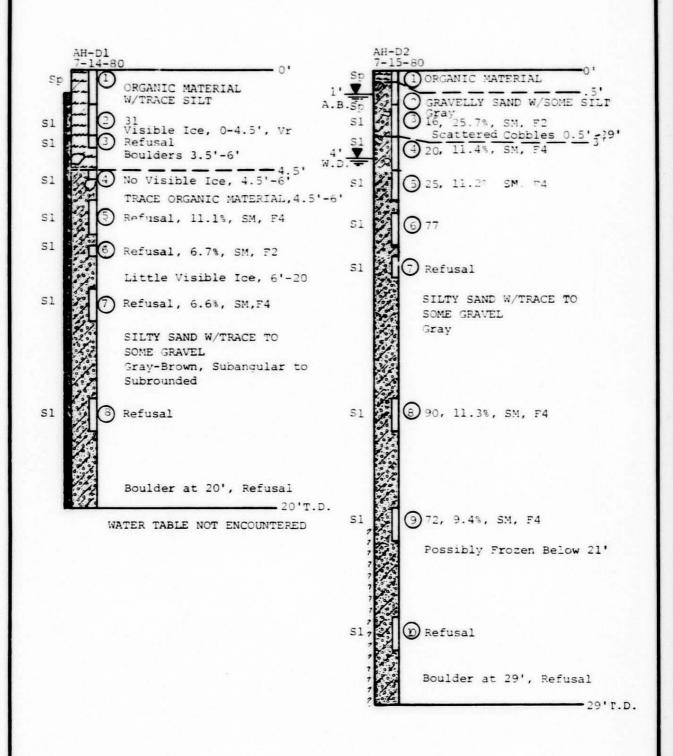
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F.1 BORROW SITE D

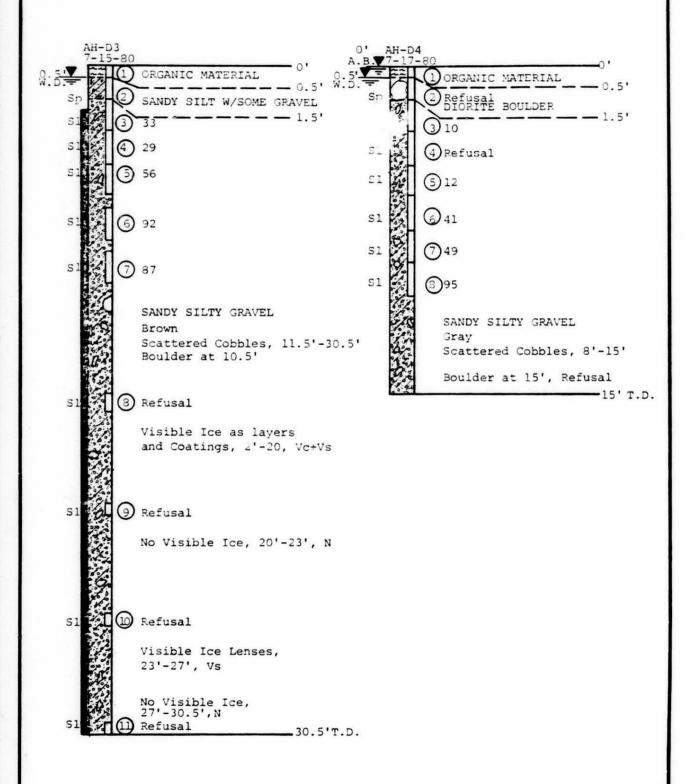
AUGER HOLE LOGS



ODDOU ADEA D

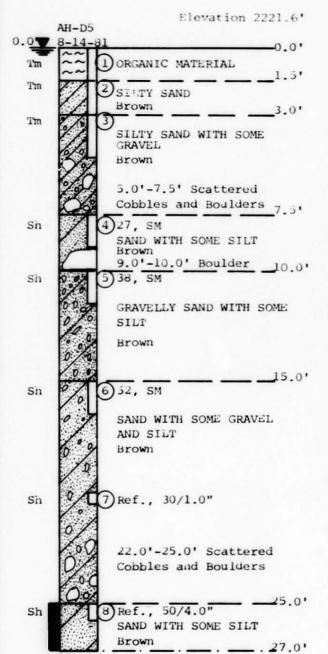
ACRES

PREPAREC FOR



BORROW AREA D AUGER HOLES AF-D3 AND AH-D4 ACRES

PREPARED FOR



\_----27.0 (9)94, 13%, SM Sh SAND WITH SOME SILT Brown 25.0'-48.3' No Visible Ice. 35.0' 10 72, 16%, SM-SC Sn SILTY SAND WITH SOME TO TRACE CLAY Gray 35.0'-40.0' Scattered Cobbles 40.0 11) 78, 12%, CL Sh SANDY SILT WITH SOME TO TRACE CLAY AND TRACE GRAVEL Gray \_\_45.0' 70, 9%, SM-SC SAND WITH SOME GRAVEL AND SILT, TRACE CLAY AND SCATTERED COBBLES 50/3.0" 48.3'T.D. Thermal Probe Installed to 50.0' Stand Pipe Piezometer Installed to

PREPARED BY

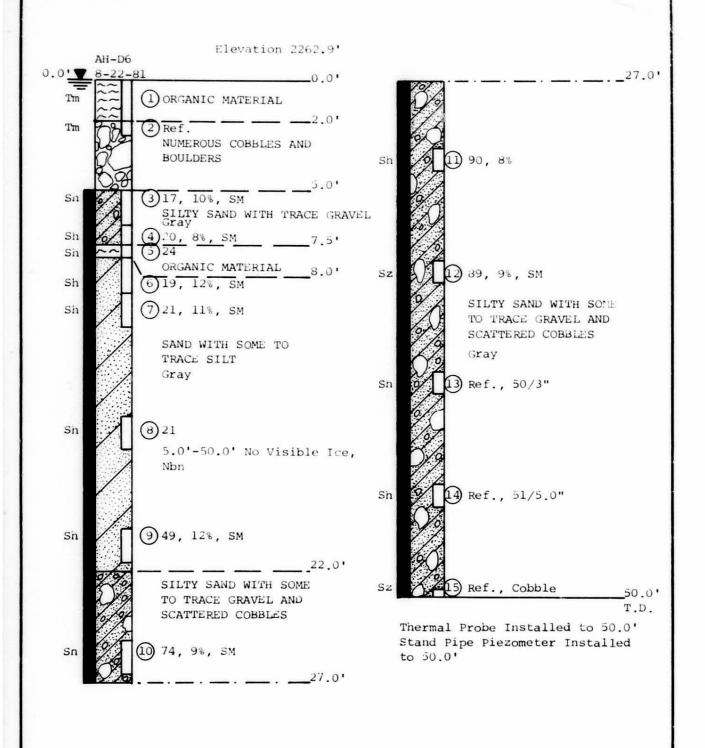
RAM CONSULTANTS, INC.

BORROW AREA D AUGER HOLE AH-D5

30.0'

PREPARED FOR

Scale: 1"=4'

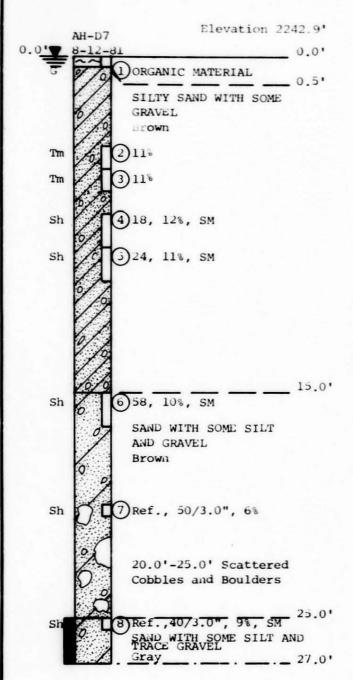


RAM CONSULTANTS, INC.

BORROW AREA D AUGER HOLE AH-D6



PREPARED FOR:



..\_\_\_ 27.0 30.0'-31.5' Boulder SAND WITH SOME SILT AND TRACE GRAVEL Gray (9) Ref.,50/2.0", 9% Sh 25.0'-48.3' No Visible Ice, Nbn \_\_ 40.0' (10) Ref.,50/3.0",9%,SM Sh SAND WITH SOME SILT Gray 44.0'-48.0' Boulders Ref.,50/3.0" 48.3'

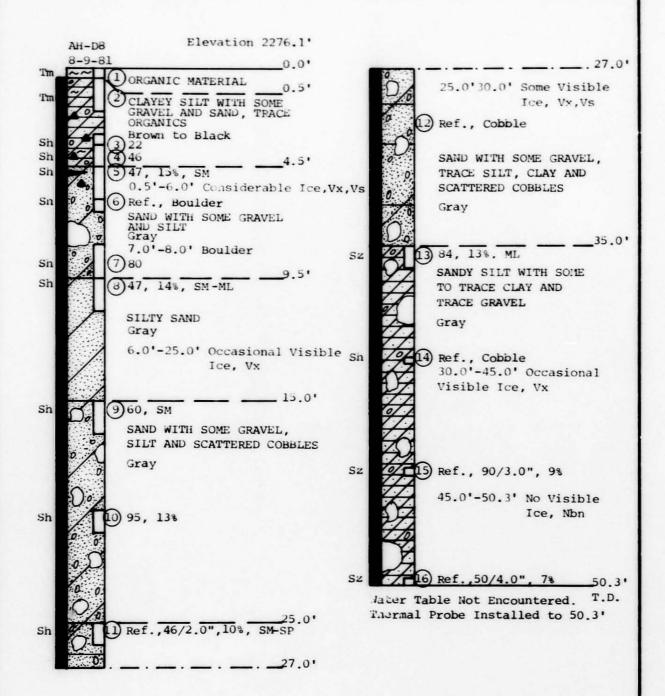
Thermal Probe Installed to 48.0' Stand Pipe Piezometer Installed to 27.0'.

PREPARED BY

PREPARED FOR:



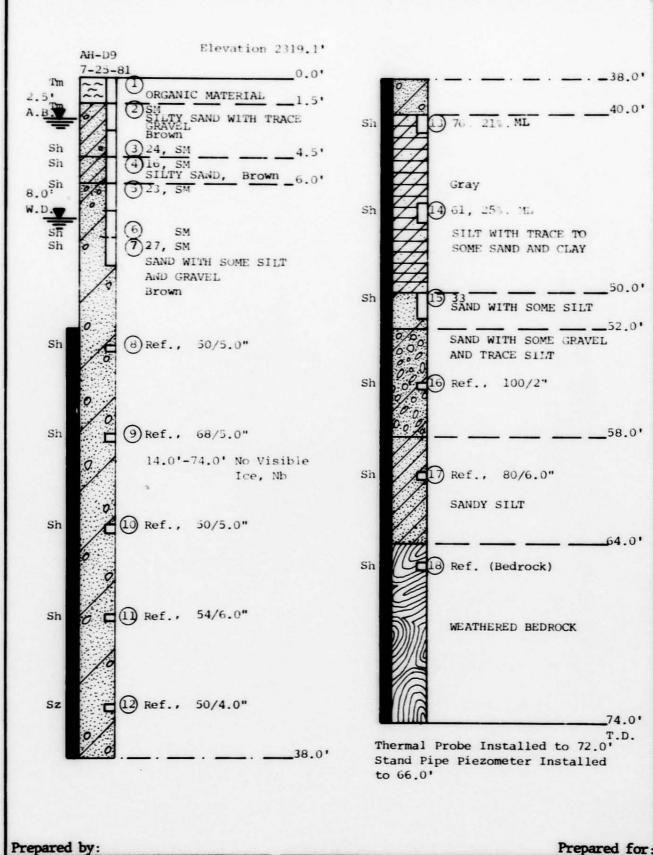




PREPARED FOR:

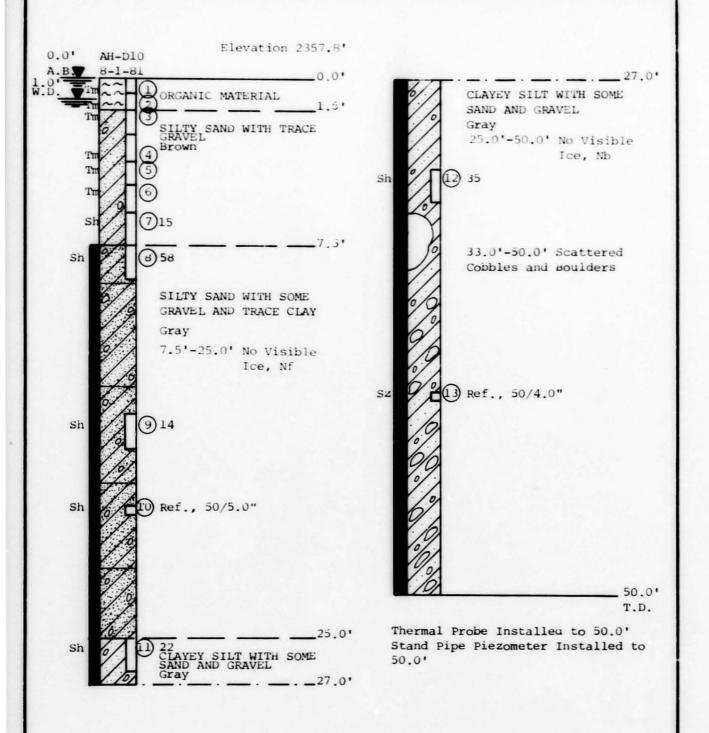






Prepared by:

BORROW AREA D AUGER HOLE AH-D9 ACRES

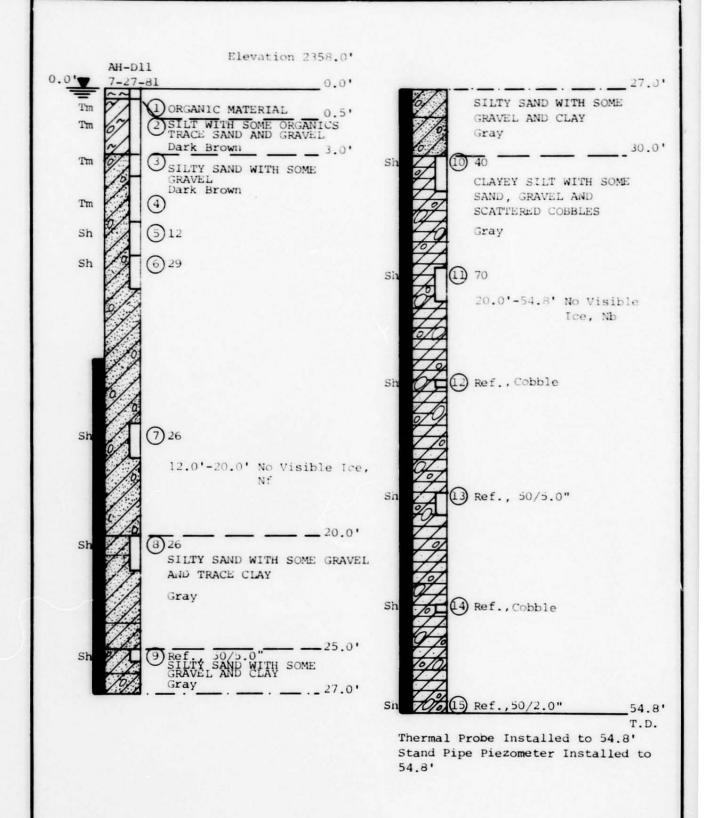


RAM CONSULTANTS, INC.

BORROW AREA D AUGER HOLE AH-D10



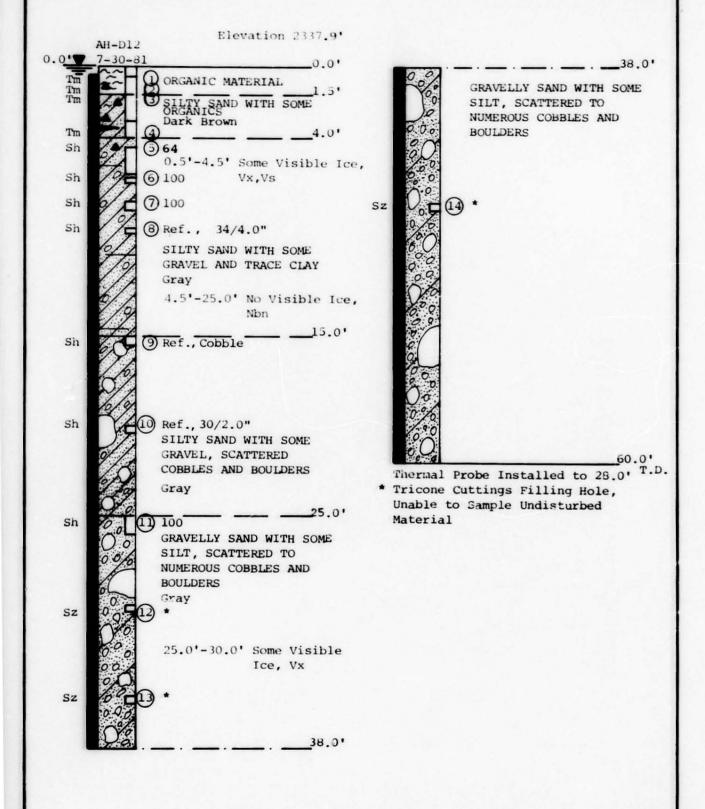
PREPARED FOR:



PREPARED FOR:





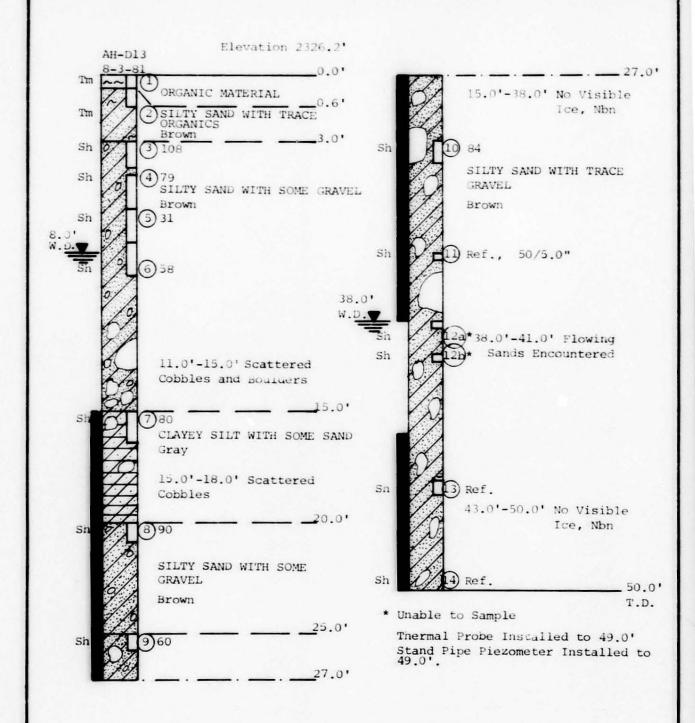


Prepared by:

Prepared for:



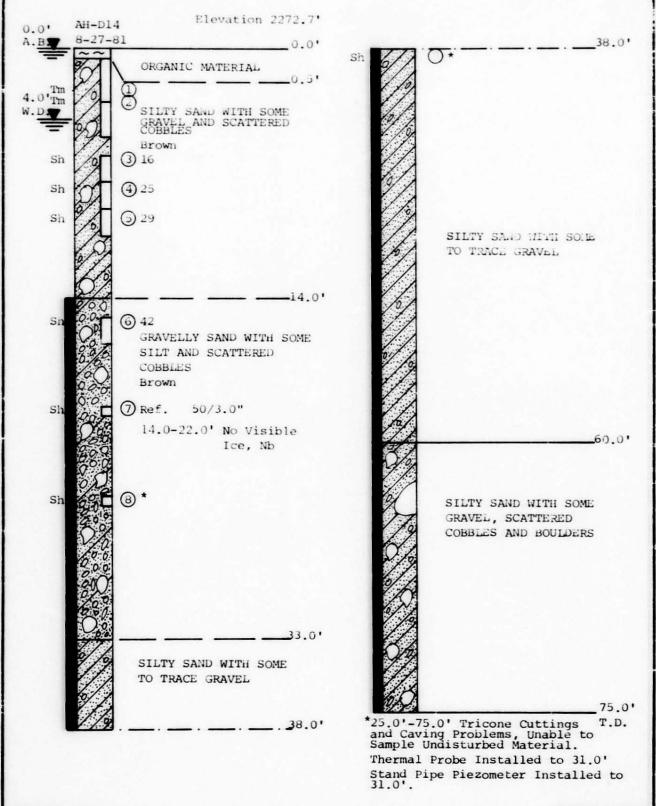




PREPARED FOR







PREPARED FOR





LABORATORY TEST DATA

PROJECT	NO	052504	
		war and the second	The second secon

CLIENT: Acres American, Inc.

PROJECT NAME Susitna Hydroelectric

(Watana Dam Site)

R	ŧ	M_	С	0	N	s	U	L	T	<b>A</b>	N	T	s	INC.	

SUMMARY OF LABORATORY TEST DATA

DATE _	October	17,	1980	
DARTY			2405 40	

NO. BORING	SAMPLE	DEPTH	4"	3"	2"	132"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200	.02	.005	.002	% Moist.	LL	PI	Unified Class.
AH-Dl	5						100	99	95	94	90	84	69	42.3	49.0	6.1	2.6	11.1	NV	NP	SM
AH-Dl	6	8.0'- 8.5'				100	87	87	83	80	76	69	54	28.3	14.4	6.1	3.3	6.7			SM*
AH-D1	7	10.0'-10.3'						100	91	91	87	76	62	35.7	18.2	8.2	4.9	6.6			SM*
AH-D2	3	1.5'- 3.0'		100	80	80	80	77	73	72	67	61	47	28.5	12.0	3.2	2.9	25.7	NV	NP	SM
AH-D2	4	3.0'- 4.5'				100	94	92	90	89	86	79	62	35.0	21.2	4.1	2.4	11.4	13.9	NP	SM
AH-D2	5	4.5'- 6.0'					100	98	96	92	87	80	59	30.7	13.8	3.9	1.6	11.2	NV	NP	SM
AH-D2	8	15.0'-16.5'						100	99	97	93	87	70	44.0	22.5	8.9	4.0	11.3	15.5	2.2	SM
AH-D2	9	20.0'-21.5'				100	96	94	93	91	85	78	61	38.6	21.3	10.3	4.2	9.4	17.5	4.2	SM
	-																				

REMARKS:	*	Estimated	Value
	(alvert	the second second second	

\*\* NV=Non Viscous NP=Non Plastic

NOTE: SIEVE ANALYSIS . PERCENT PASSING

\*\*\*\*\*\*\*

PROJECT	NO	052504	
OF T	· ronderorus		-

CLIENT: Acres American, Inc.

PROJECT NAME Susitna Hydroelectric

(Watana Dam Site)

REML	CONSULTANTS, INC.	
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SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_\_ PAGE NO. \_\_\_\_

NO. SE ON	SAMPLE	DEPTH	4"	3"	2"	112"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200	.02	.005	.002	% Moist.	LL	PI	Unified Class.
AH-Dl	5	6.0'- 7.5'					100	99	95	94	90	84	69	42.3	19.0	6.1	2.6	11.1	NV	NP	SM
AH-D1	6	8.0'- 8.5'				100	87	87	83	80	76	69	54	28.3	14.4	6.1	3.3	6.7			SM*
AH-D1	7	10.0'-10.3'					-	100	91	91	87	76	62	35.7	18.2	8.2	4.9	6.6		-	SM*
AH-D2	3	1.5'- 3.0'		100	80	80	80	77	73	72	67	61	47	28.5	12.0	3.2	2.9	25.7	NV	NP	SM
AH-D2	4	3.0'- 4.5'				100	94	92	90	89	86	79	62	35.0	21.2	4.1	2.4	11.4	13.9	NP	SM
AH-D2	5	4.5'- 6.0'					100	98	96	92	87	80	59	30.7	13.8	3.9	1.6	11.2	NV	NP	SM
AH-D2	8	15.0'-16.5'						100	99	97	93	87	70	44.0	22.5	8.9	4.0	11.3	15.5	2.2	SM
AH-D2	9	20.0'-21.5'				100	96	94	93	91	85	78	61	38.6	21.3	10.3	4.2	9.4	17.5	4.2	SM

REMARKS:	*	Estimated	Val

\*\* NV=Non Viscous NP=Non Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

FREEDUCE

PROJECT	NO	052504
S. Charles Street, Sect.		

CLIENT: Acres American, Inc.

PROJECT NAME Susitna Hydroelectric (Watana Dam Site)

R	ŧ	M	c	0	N	5	UL	TA	N	T	s,	INC.	
			_		_				_				

DATE _	October	1/,	1980	

SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_ PAGE NO. \_\_\_\_

DESC	RIPTION	4"	3"	2"	112"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200	.02	.005	.002	Moist.	LL	PI	Unifie Class
DEADMAN	W-80-282 (Grab Sample)			-		_						100	99.5	81.3	69.6	50.8	42.1	55.9	33.2	CL-CH
DEADMAN	W-80-300			100	95	93	89	87	86	80	76	58	26.9	9.2	3.0	1.3	6.6	NV**	NP**	SM
	(Grab Sample)					_						_								-
+++																				
++																				
++																				

REMARKS:	* Estimated Value	
	** NV=Non Viscous,	NP=Non Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO 052506
Client: Acres American

PROJECT NAME Susitna Hydroelectric

Rέ	M	CONSULTANTS,	INC.	
-				

SUMMARY OF LABORATORY TEST DATA

DATE _	September	1981	
PARTY	NO	PAGE	NO1

BORING	SAMPLE	DEPTH	I :/2"	-"	3/4"	1/2"	3/8"	4	10	40	200	.02	.005	.002	FINE SPG	L.L.	P. I.	WET DENSITY	DRY DENSITY	MOISTURE CONTENT	CLASS
D5	4	7.5'- 9.0'						100	87	53	22.8										SM
D5	5	10.0'-11.5'	100	70	69	67	67	67	52	35	15.9										SM
D5	6	15.0'-16.5'			100	76	76	76	69	51	23.2										SM
D5	9	30.0'-31.5'						100	84	60	26.4					14	NP			13	SM
D5	10	35.0'-36.0'						100	85	63	44.6					17	6			16	SM-SC
D5	11	40.0'-41.5'			100	98	96	92	87	73	55.2					23	14			12	CL
D5	12	45.0'-46.0'		100	88	88	88	88	74	48	25.3					39	14			9	SM-SC
D6	3,4	5.0'- 7.5'	*				100	91	84	67	40.5					15	NP			10, 8	SM
D6	6,7	8.0'-11.0'	*					100	80	55	23.2					13	NP			12,11	SM
D6	9	اد.21.5						100	80	40	11.7					17	2			12	SW-SM
D6	10	25.0'-26.5'	**	83	30	77	75	71	67	51	32.5					15	NP			9	SM
D6	11	30.0'-31.0'																		8	
D6	12	35.0'-36.0'			100	98	94	89	83	65	40.5					17	NP			9	SM
D6	13	40.0'-40.5'																		12	
	D5 D5 D5 D5 D5 D5 D6 D6 D6 D6 D6 D6	D5 5 D5 6 D5 9 D5 10 D5 11 D5 12 D6 3,4 D6 6,7 D6 9 D6 10 D6 11 D6 12	D5 4 7.5'- 9.0' D5 5 10.0'-11.5' D5 6 15.0'-16.5' D5 9 30.0'-31.5' D5 10 35.0'-36.0' D5 11 40.0'-41.5' D5 12 45.0'-46.0'  D6 3,4 5.0'- 7.5' D6 6,7 8.0'-11.0' D6 9 20.0'-21.5' D6 10 25.0'-26.5' D6 11 30.0'-31.0' D6 12 35.0'-36.0'	D5 4 7.5'- 9.0' D5 5 10.0'-11.5' 100 D5 6 15.0'-16.5' D5 9 30.0'-31.5' D5 10 35.0'-36.0' D5 11 40.0'-41.5' D6 12 45.0'-46.0'  D6 3,4 5.0'- 7.5' D6 6,7 8.0'-11.0' D6 9 20.0'-21.5' D6 10 25.0'-26.5' **83 D6 11 30.0'-31.0' D6 12 35.0'-36.0'	D5 4 7.5'- 9.0' D5 5 10.0'-11.5' 100 70 D5 6 15.0'-16.5' D5 9 30.0'-31.5' D5 10 35.0'-36.0' D5 11 40.0'-41.5' D5 12 45.0'-46.0' 100  D6 3,4 5.0'- 7.5' D6 6,7 8.0'-11.0' D6 9 20.0'-21.3' D6 10 25.0'-26.5' **83 83 D6 11 30.0'-31.0' D6 12 35.0'-36.0'	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0' D5 5 10.0'-11.5' 100 70 69 67 D5 6 15.0'-16.5' 100 76 D5 9 30.0'-31.5' D5 10 35.0'-36.0' D5 11 40.0'-41.5' 100 98 D5 12 45.0'-46.0' 100 88 88  D6 3,4 5.0'- 7.5' 7 D6 6,7 8.0'-11.0' 7 D6 10 25.0'-26.5' 83 83 80 77 D6 11 30.0'-31.0' D6 12 35.0'-36.0' 100 98	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5       4       7.5'-9.0'       0	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5 4 7.5'- 9.0'	D5       4       7.5'-9.0'       0       0       0       0       0       0       87       53       22.8       0	D5       4       7.5'-9.0'       0       0       0       0       0       0       87       53       22.8       0	D5 4 7.5'-9.0'	D5 4 7.5'-9.0'	D5       4       7.5'-9.0'       0       0       0       100       87       53       22.8       0

REMARKS :_	*	Sample Combined for Sieve Analysis and Atterberg Limits
	**	100% Passing 2"
	NP=	Non-Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT	NO
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052506

Client:

Acres American

PROJECT NAME Susitna Hydroelectric

CONSULTANTS, INC.

September 1981

PARTY NO \_\_\_\_\_ PAGE NO \_\_\_\_\_

## SUMMARY OF LABORATORY TEST DATA

NO.	BORING	SAMPLE	DEPTH	1 :/2"	1"	3/4"	1/2"	3/8"	4	10	40	200	.02	.005	002	FINE SPG	L.L.	P. I.	W E T DENSITY	DRY DENSITY	MOISTURE CONTENT	CLASS
	D7	2	4.0'- 5.0'																		11	
	D7	3	5.0'- 6.0'																		11	
	D7	4,5	7.0'-10.0'	100	97	91	88	85	79	71	51	31.2									12,11	SM
	D7	6	15.0'-16.5'	100	90	88	86	84	80	72	52	26.6									10	SM
	D7	7	20.0'-20.2'																	-	6	
	D7	8	25.0'-25.7'		100	94	94	94	94	77	51	23.3				2.62					9	SM
	D7	9	35.0'-35.2'																		9	
	D7	10	40.0'-40.7'	-					100	79	50	19.8				2.73					9	SM
	D8	5	4.5'- 6.0'				100	82	82	57	39	17.5					14	NP			15	SM
	D8	8	9.5'-11.0'						100	84	67	41.8					14	NP			14	SM-ML
	D8	9	15.0'-16.5'					100	88	73	47	17.7										SM
	D8	10	20.0'-21.0'																		13	
	D8	11	25.0'-25.7'	100	77	77	72	72	72	55	33	11.2					18	5			10	SM-SP
	D8	13	35.0'-36.0'			100	97	95	91	86	72	52.6									13	ML
	D8	15	45.0'-45.2'																		9	
	D8	16	50.0'-50.2'	-				-			-										7	

REMARKS: \* Sample Combined for Sieve Analysis NP= Non-Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO \_\_\_ 052506

Client:

Acres American

PROJECT NAME Susitna Hydroelectric

## REM CONSULTANTS, INC.

DATE	September	1981	 

SUMMARY OF LABORATORY TEST DATA

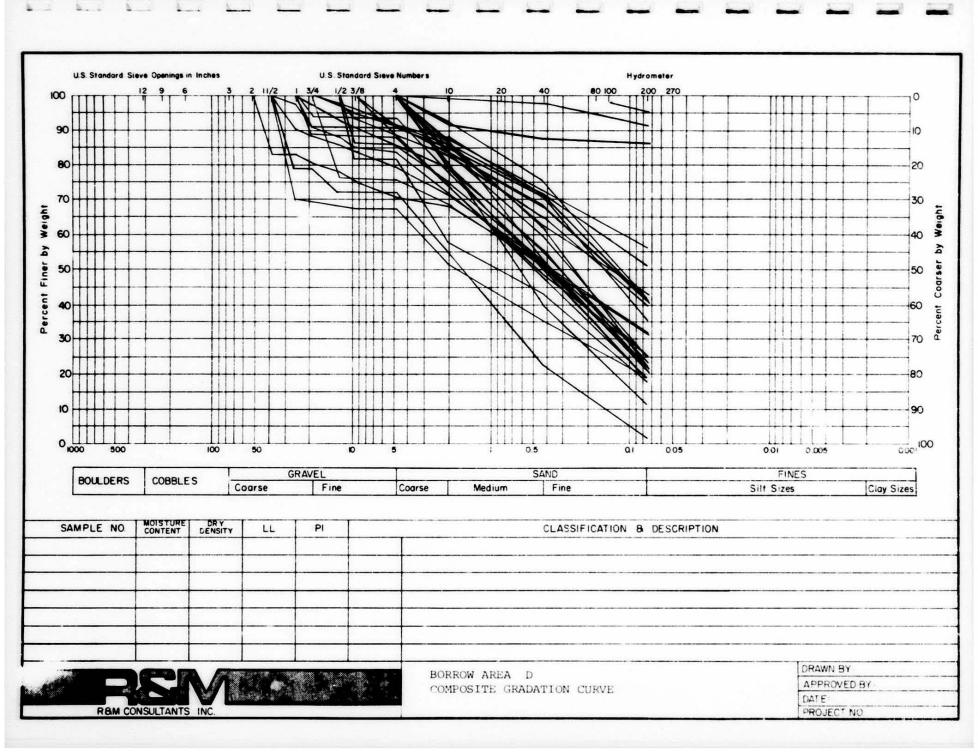
PARTY NO \_\_\_\_\_ PAGE NO \_\_\_3

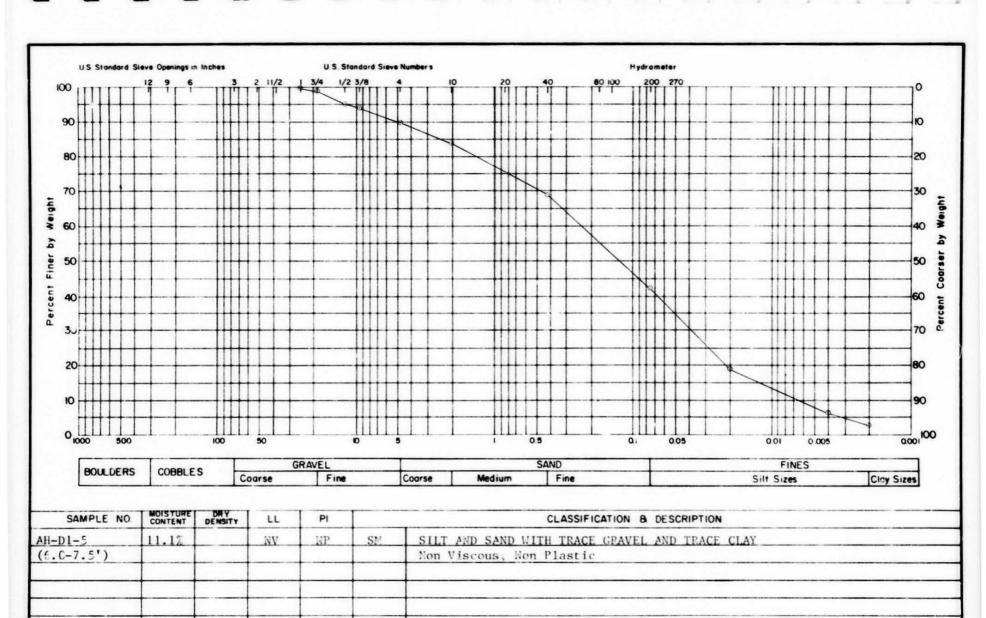
NO.	BORING	SAMPLE	DEPTH	1 1/2"	ı"	3/4"	1/2"	3/8"	4	10	40	200	.02	.005	.002	FINE	L.L.	P.1.	W ET DENSITY	DRY	MOISTURE CONTENT	CLASS
	D9	2	1.5'- 3.0'		100	91	91	91	91	85	71	35.4										SM
	D9	3	3.0'- 4.5'					100	91	87	71	41.4										SM
	D9	4	4.5'- 6.0'						100	93	75	41.6										SM
	D9	5	6.0'- 7.5'		100	97	93	91	86	79		20.9										SM
	D9	6	7.5'- 9.0'						100	86	61	23.0										SM
	D9	7	9.0'-10.5'				100	86	86	75	53	21.7										SM
	D9	13	40.0'-41.0'						100	99	98	91.7					21	NP			21	ML
	D9		45.0'-46.5'						100	92	87	82.7					35	7			25	ML
	BORR	ow	D							<b>*</b> 80	100	200										
	BULK	SA	MPLE							100	98	95.1					59	23				МН

REMARKS: NP= Non-Plastic

\*Sieve Size

NOTE: SIEVE ANALYSIS : PERCENT PASSING





PSIV.
RBM CONSULTANTS INC.

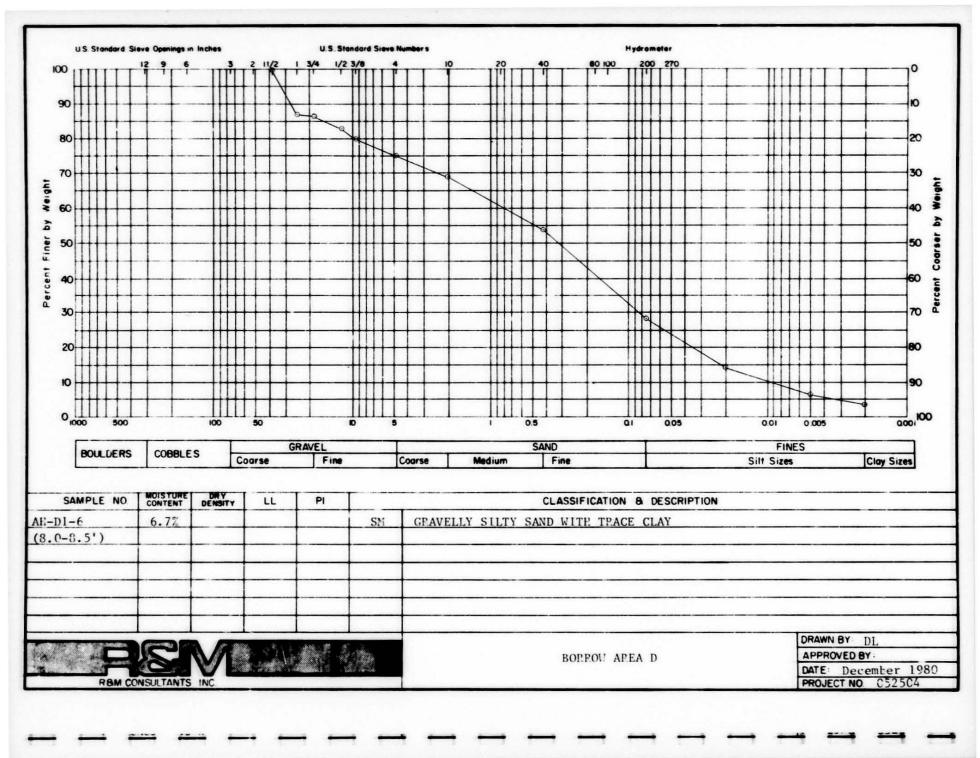
BORROW AREA D

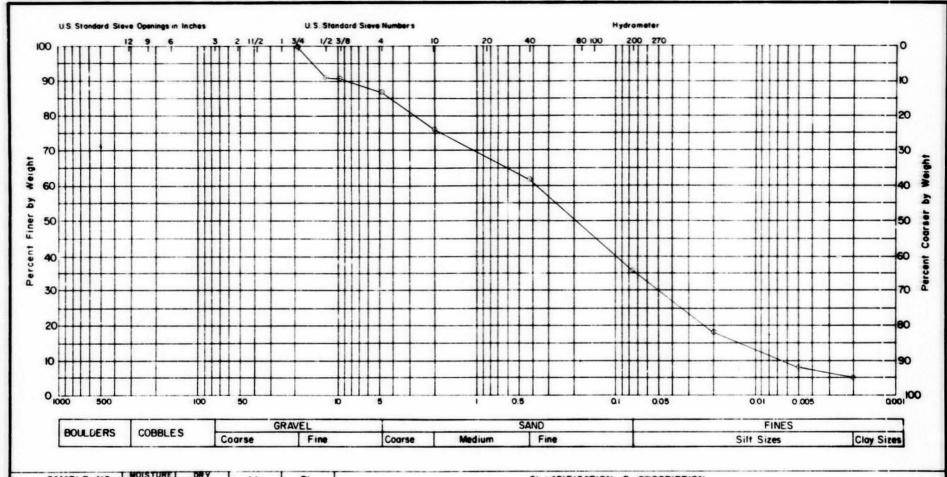
DRAWN BY DL

APPROVED BY:

DATE: December 1980

PROJECT NO 052504

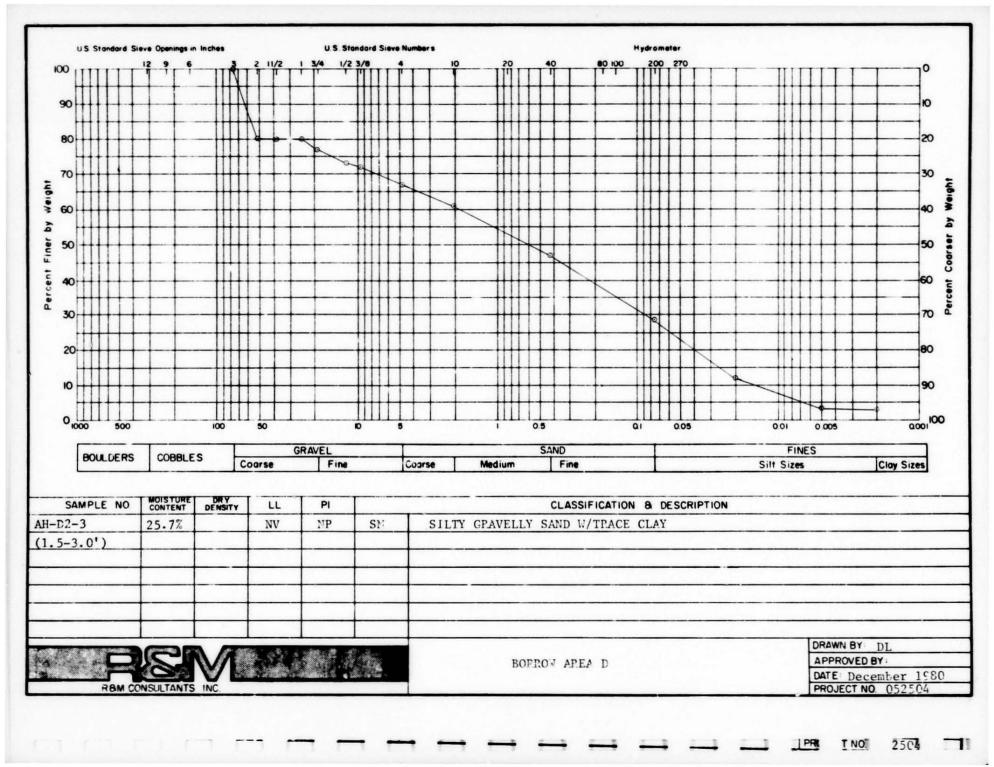


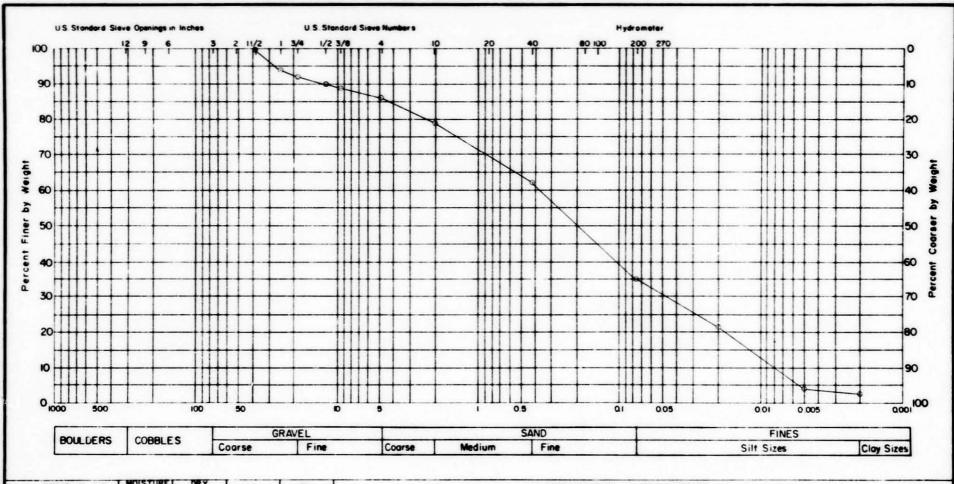


SAMPLE NO	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION	
AH-D1-7	6.6%				SM	SILTY SAND WITH SOME GRAVEL, TRACE CLAY	
(10.0-10.3')							
	-			-			
	-			-			
	1						
						DRA	WN BY DL

BORROW AREA D

APPROVED BY:
DATE: December 1980
PROJECT NO. 052504





SAMPLE NO	CONTENT	DRY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-D2-4	11.4%		13.9	NP	Sli	SILTY SAND WITH SOME CRAVEL, TRACE CLAY
(3.0-4.5')						Non Plastic
	•				*	

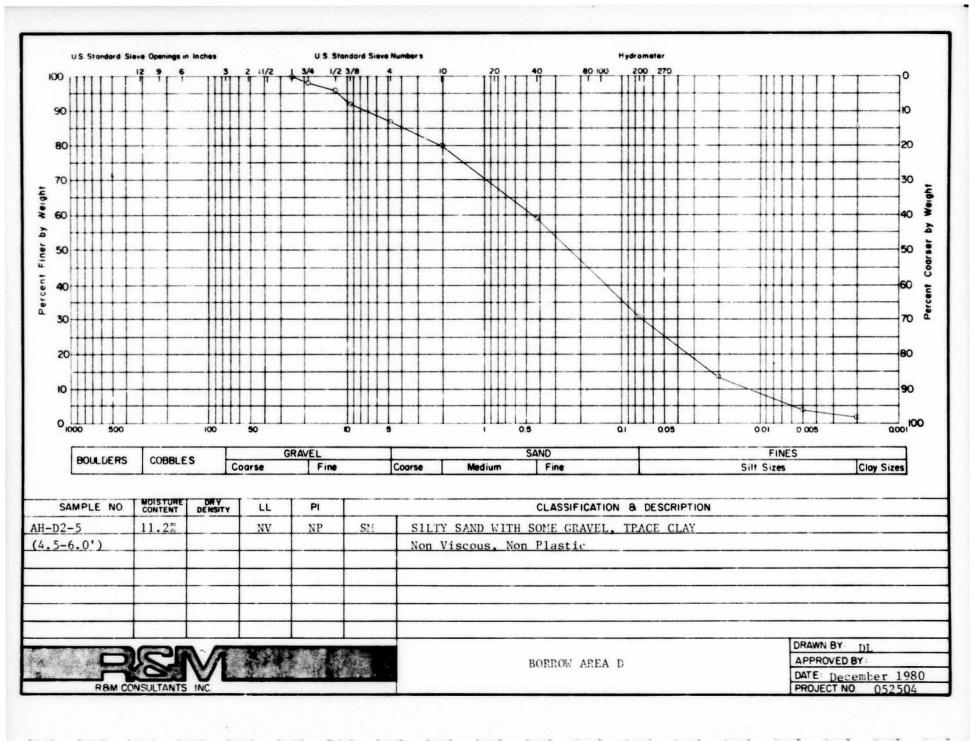
BOPROW AREA D

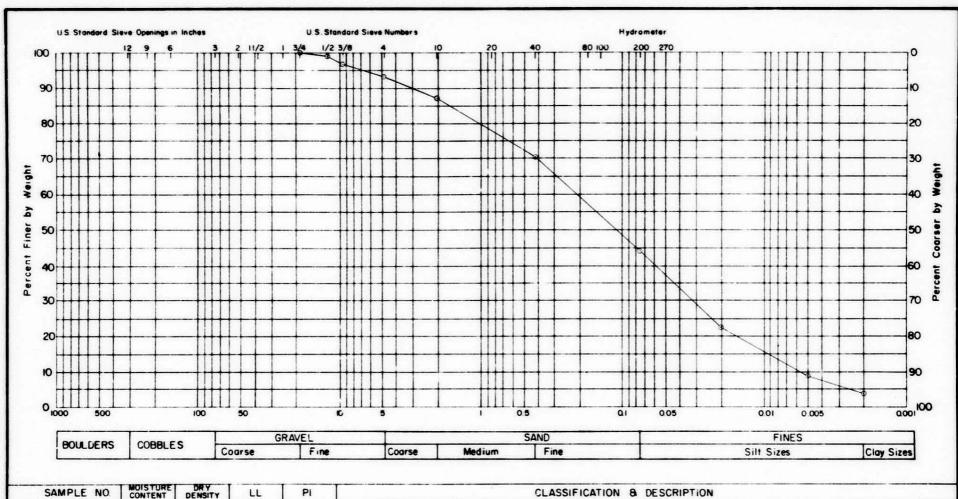
DRAWN BY: DL

APPROVED BY:

DATE: December 1080

PROJECT NO 052504

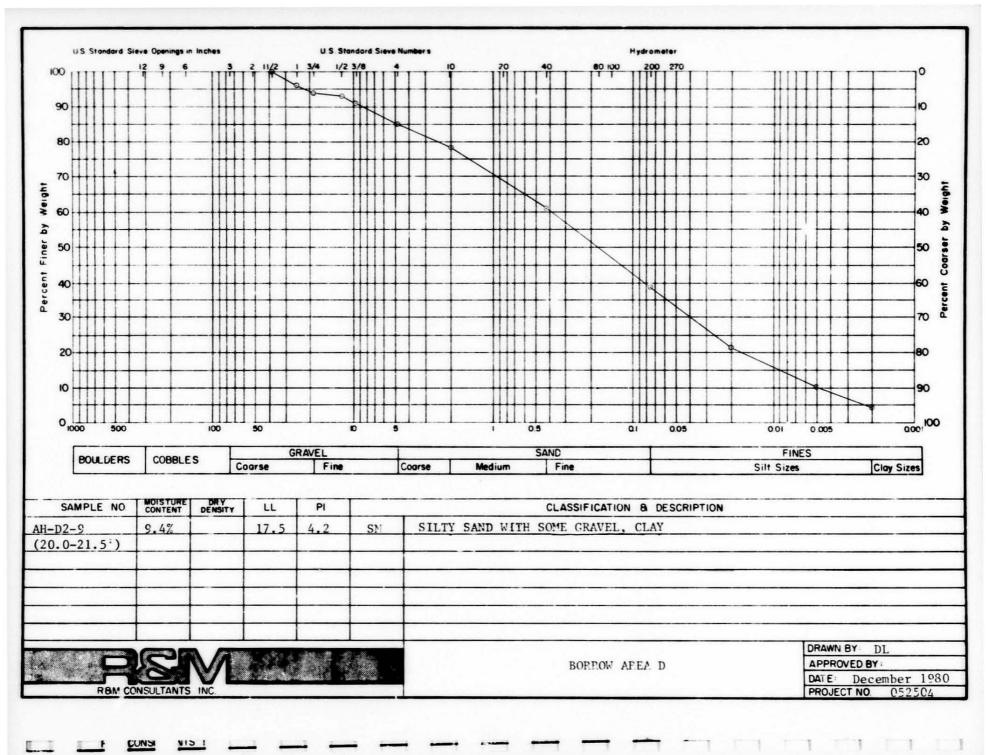


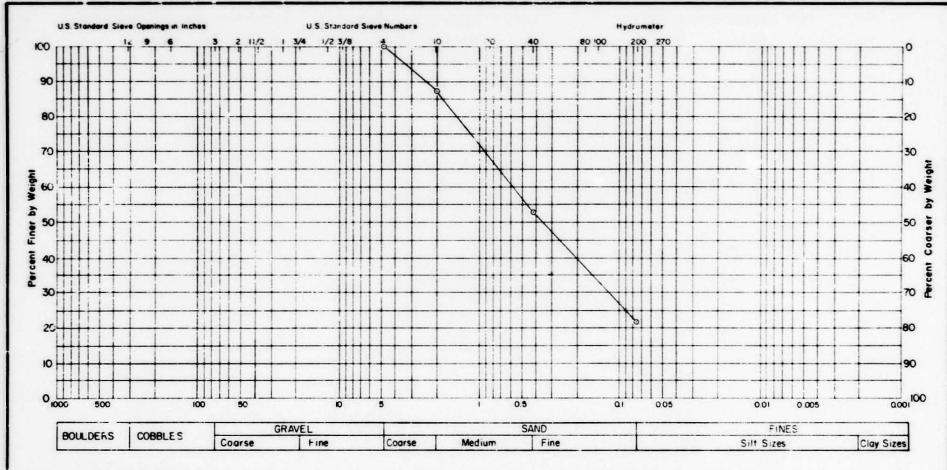


SAMPLE NO.	MOISTURE	DRY	LL	PI		CLASSIFICATION & DESCRIPTION	
AE-D2-S	11.3%		15.5	2.2	SM	SILTY SAND WITH TRACE GRAVEL, TRACE CLAY	
(15.0-16.5')							
							DRAWN BY: DL
		1//	X			BORROW AREA D	APPROVED BY

BORROW AREA D

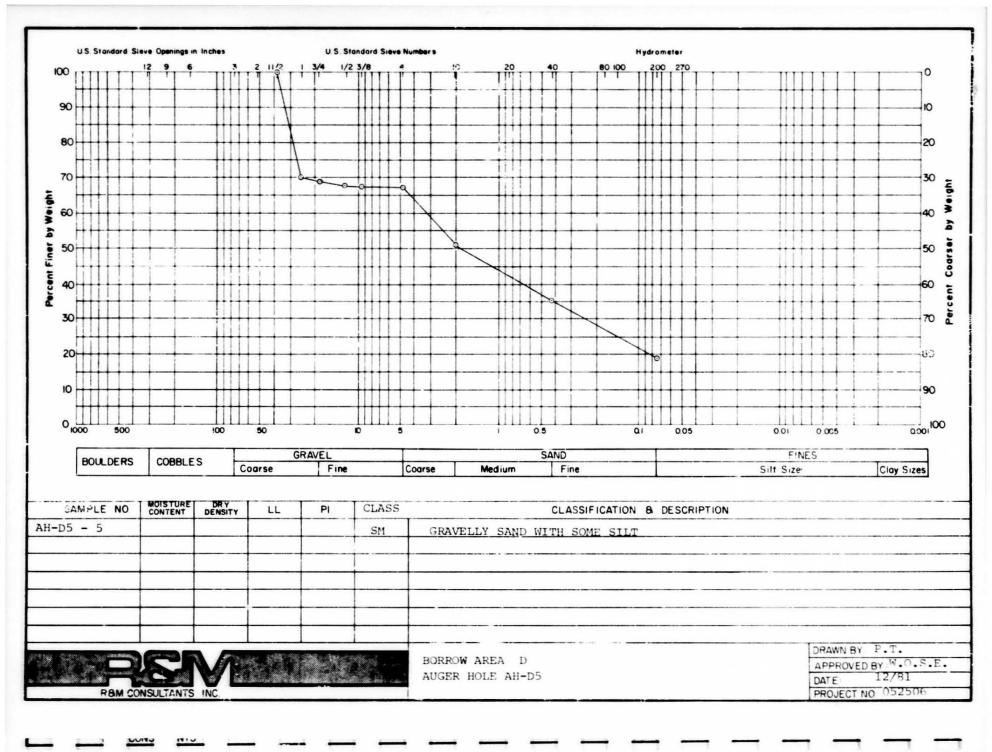
DATE: December 1980 PROJECT NO. 052504

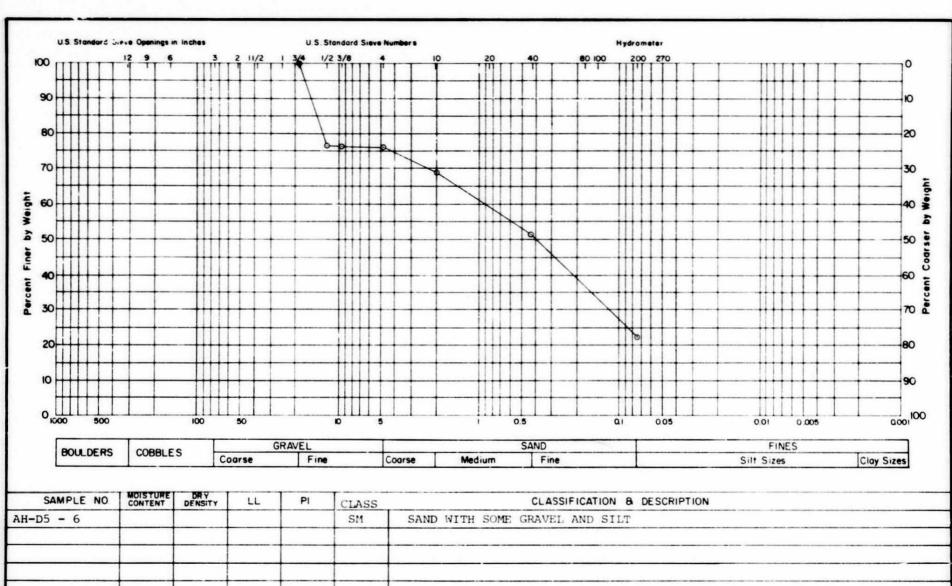




SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRI	PTION
H-D5 - 4					SM	SAND WITH SOME SILT	
-							
							DRAWN BY P.T.
					. +4	BORROW AREA D	APPROVED BY: W.O.S.E

PROJECT NO. 052506





SAMPLE NO.	CONTENT	DRY	LL	PI	CLASS	CLASSIFICATION & DESCR	RIPTION
AH-D5 - 6					SM	SAND WITH SOME GRAVEL AND SILT	
					1		DRAWN BY P.T.
		1/4	4	4		BORROW AREA D	APPROVED BY W.O.S.E.

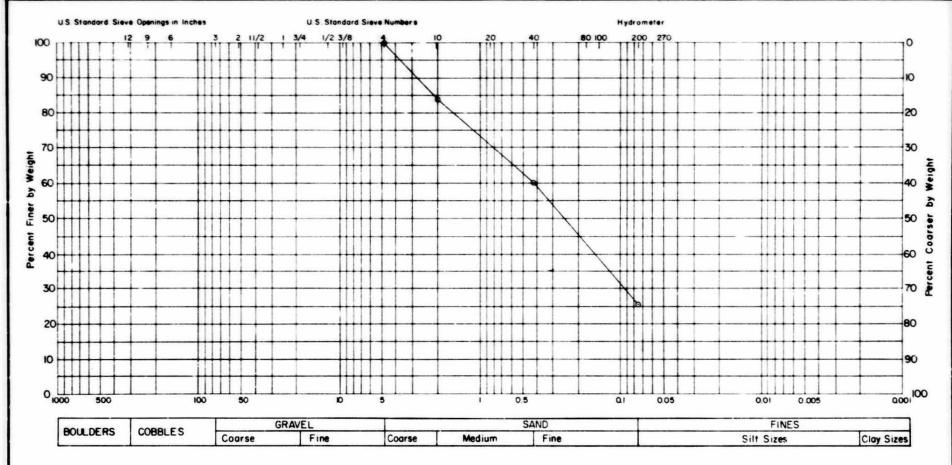
AUGER HOLE AH-D5

RAM CONSULTANTS INC.

12/81

PROJECT NO 052506

DATE:

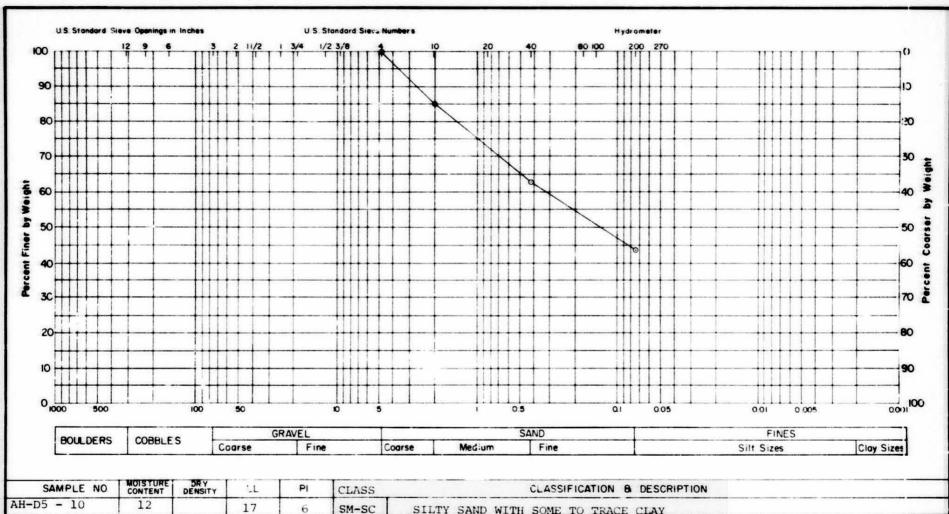


SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION	
AH-D5 - 9	13		14	NP	SM	SAND WITH SOME SILT	
	-			-			
	-			-			
				-	+-+		
	-				+		
	1			-	+ +		
						DRAWN BY P	T

BORROW AREA D AUGER HOLE AH-D5 APPROVED BY: W.O.S.E.

DATE: 12/81

PROJECT NO 052506



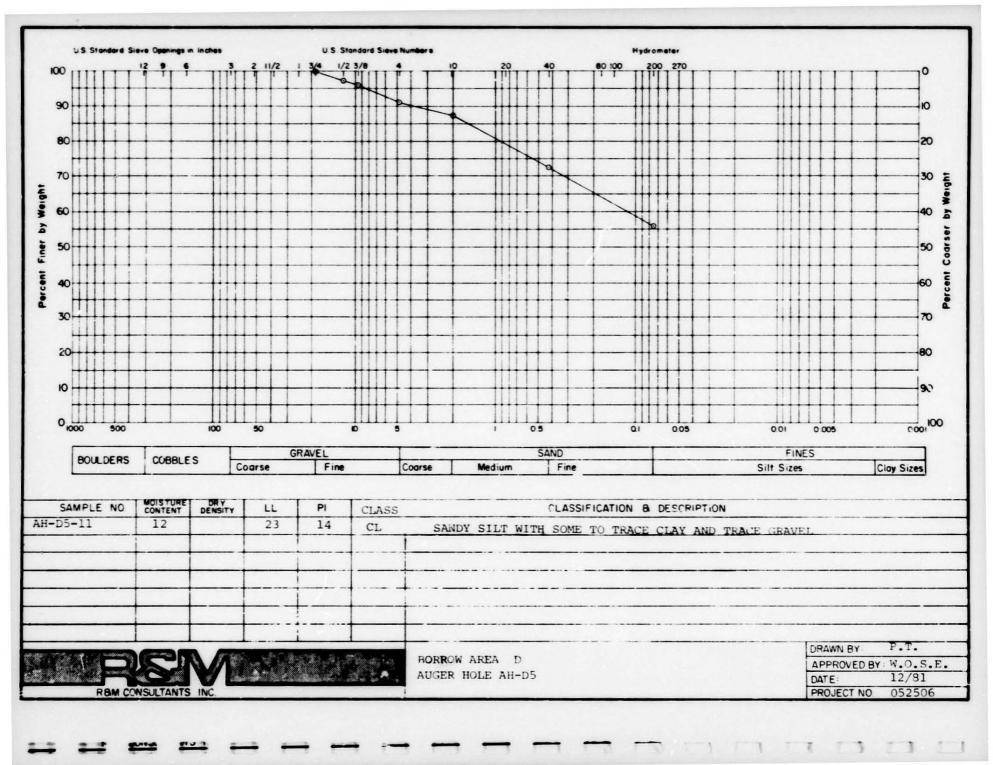
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D5 - 10	12		17	6	SM-SC	SILTY SAND WITH SOME TO TRACE CLAY
				<b></b>	+-+	
					++	
	+				++	<del></del>
					-	

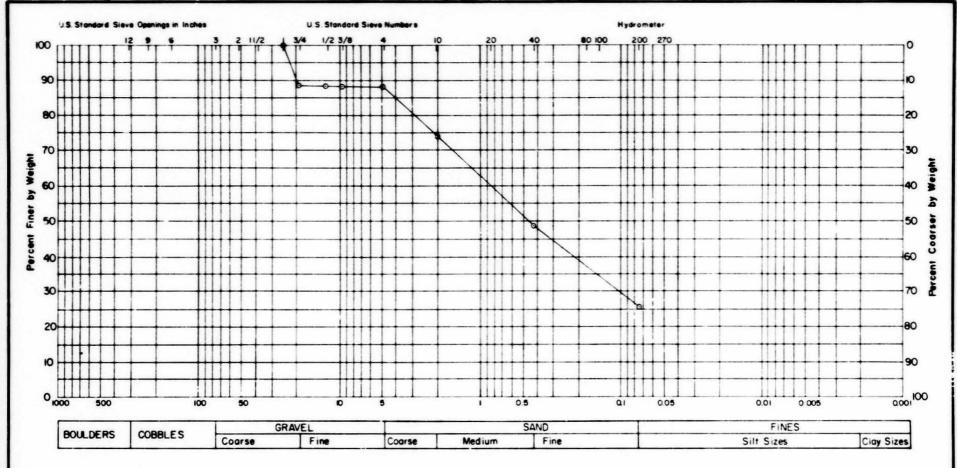
BORROW AREA D AUGER HOLE AH-D5 DRAWN BY P.T.

APPROVED BY: W.O.S.E.

DATE: 12/81

PROJECT NO 052506





SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION	
AH-D5 - 12	9		39	14	SM-SC	SAND WITH SOME GRAVEL AND SILT AND TRACE CLAY	
				İ			
				<u> </u>	1		
Mary 112 - September 1		A Constant	or and	Zancii den 3	and the		DRAWN BY P.T.
				100		BORROW AREA D	APPROVED BY: W.O.S.E

AUGER HOLE AH-D5

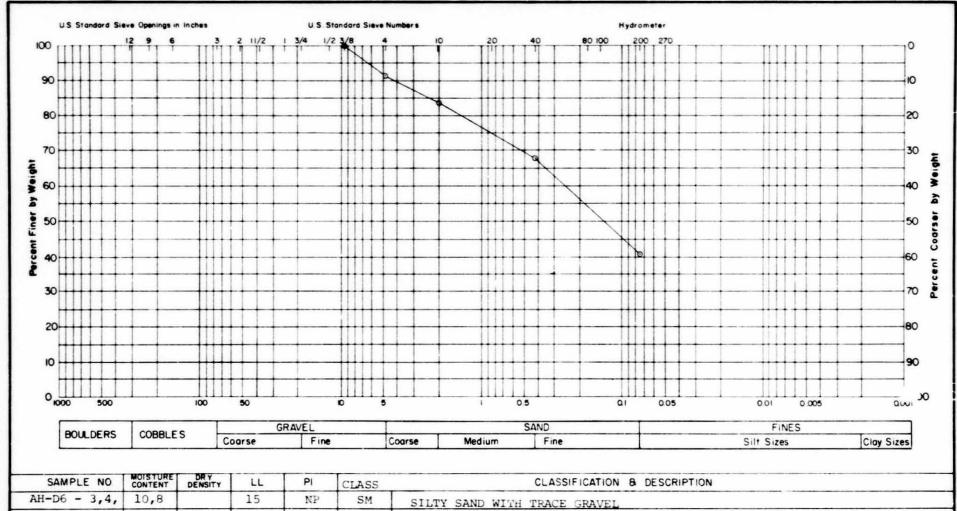
RBM CONSULTANTS INC.

12/81

052506

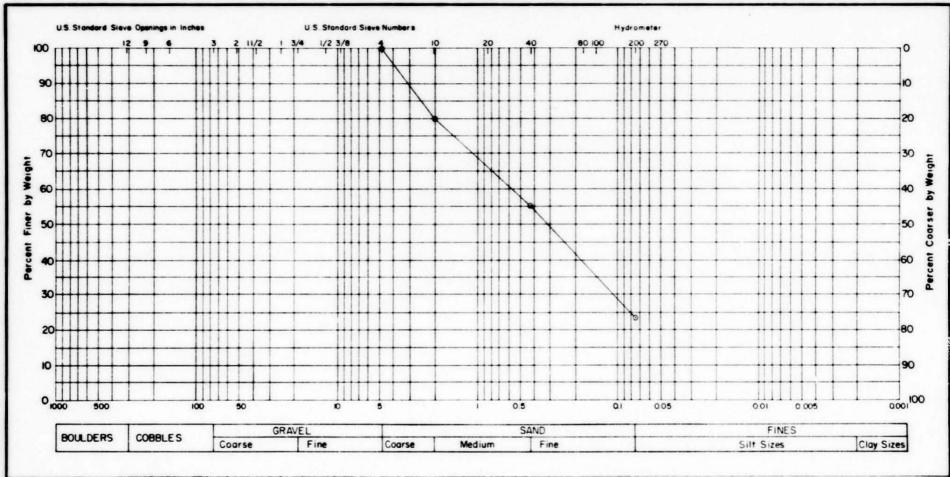
DATE:

PROJECT NO.



SAMPLE NO	CONTENT	DRY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION	
AH-D6 - 3,4,	10,8		15	NP	SM	SILTY SAND WITH TRACE GRAVEL	
	-						
							DRAWN BY P.T.
To an all a	RI	M				BORROW AREA D AUGER HOLE AH-D6	APPROVED BY: W.O.S.I

PROJECT NO. 052506



SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPT	TION
AH-D6 - 6,7	12,11		13	NP	SM	SAND WITH SOME SILT	
			-		ļi		
	-			-	-		
	1						
C. Mariner of desirable		A Property	Asset No.	Maio M.	Settle 1		DRAWN BY P.T.
						BORROW AREA D	APPROVED BY: N.O.S.

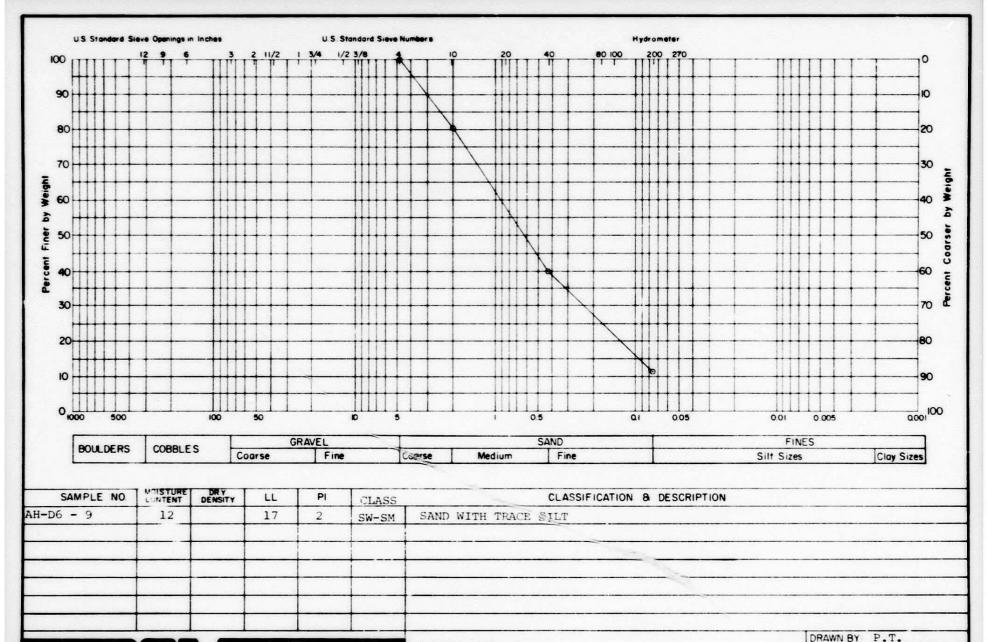
AUGER HOLE AH-D6

RBM CONSULTANTS INC.

12/81

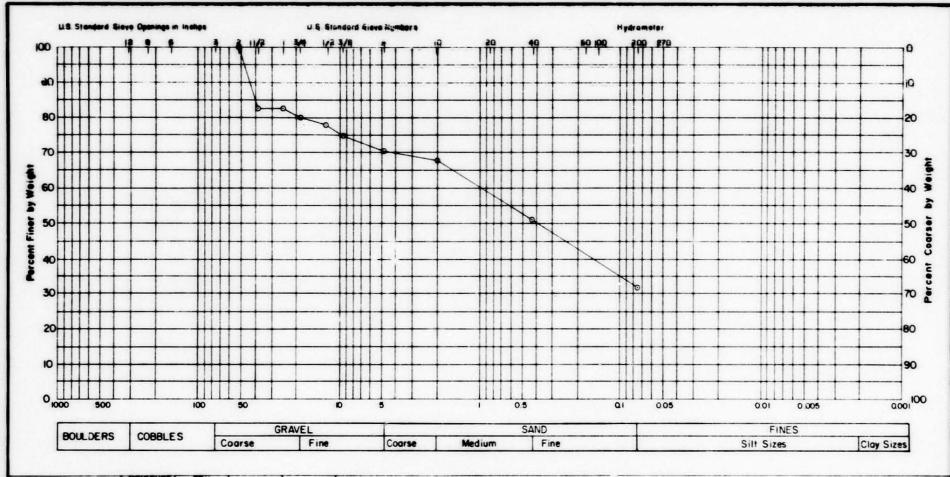
PROJECT NO 052506

DATE



BORROW AREA D AUGER HOLF AH-D6 APPROVED BY: W.O.S.E.
DATE: 12/81

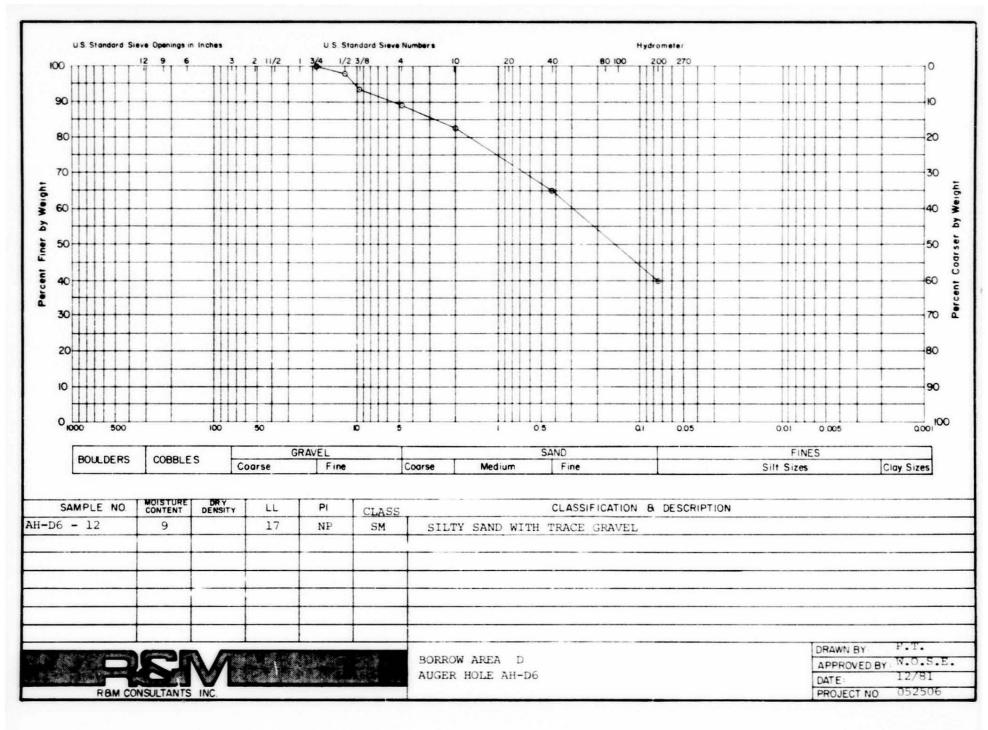
PROJECT NO. 052506

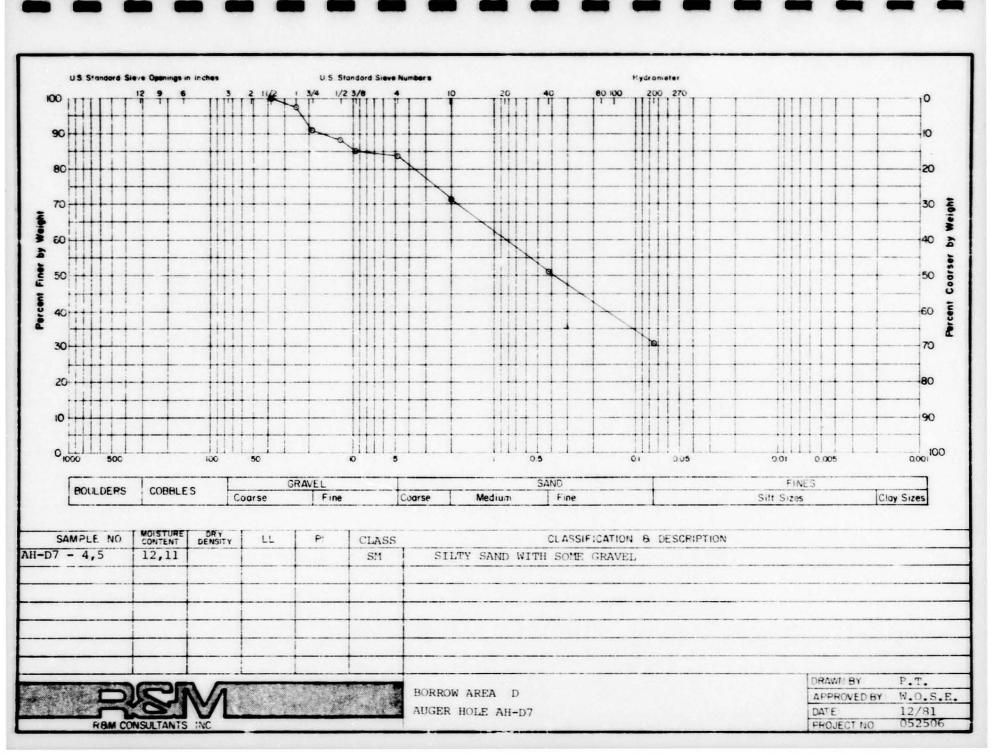


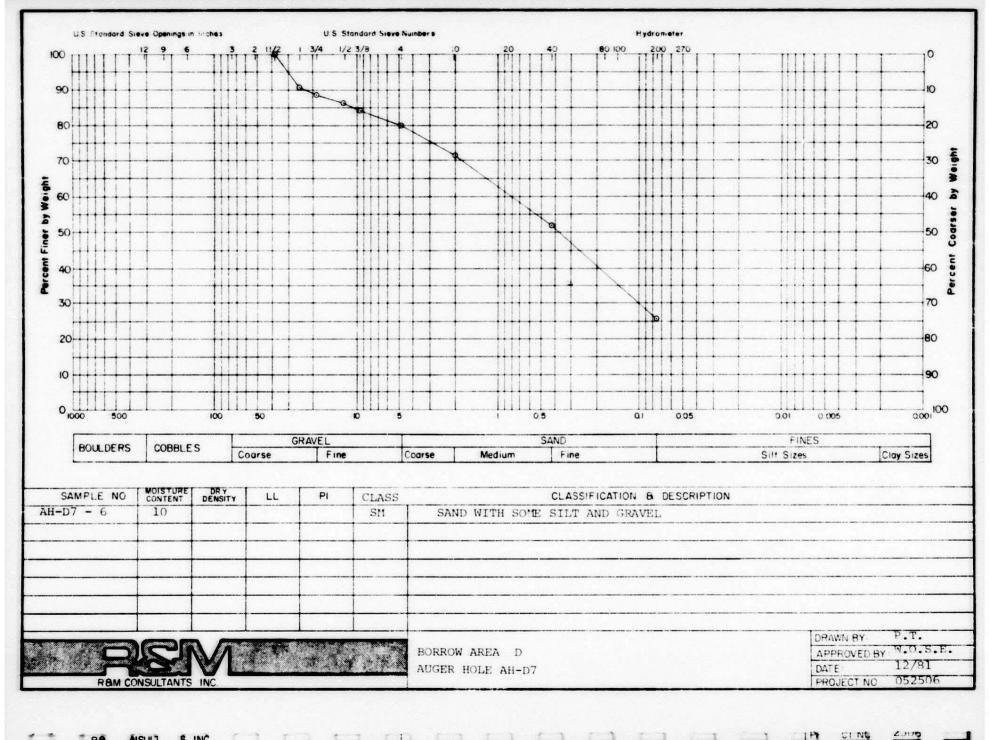
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D6 - 10	9		15	NP	SM	SILTY SAND WITH SOME GRAVEL
					+ +	
		-		-	+ - +	

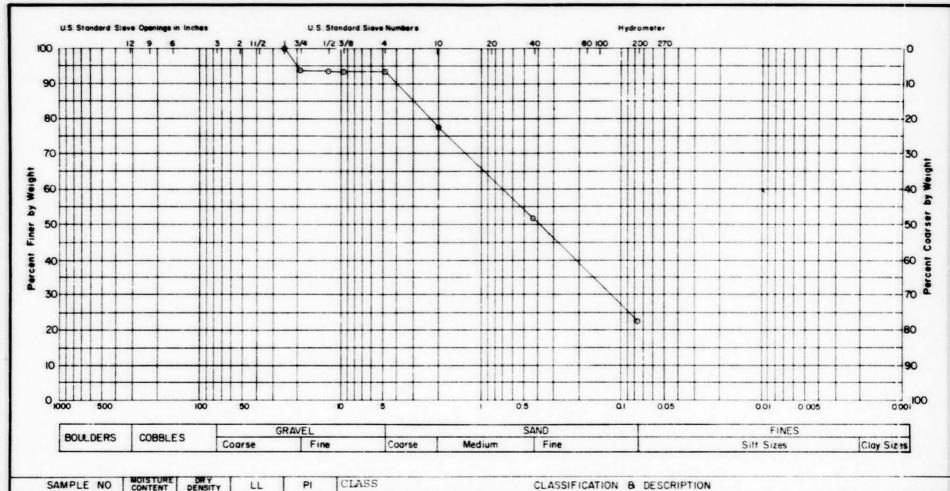
BORROW AREA D AUGER HOLE AH-D6

DRAWN BY	P.T.
APPROVED BY	W.O.S.E.
DATE:	12/81
PROJECT NO.	052506









SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESC	RIPTION
AH-D7 - 8	9				SM	SAND WITH SOME SILT, TRACE GRAVEL	
	-				+		
					+		
							DRAWN BY P.T.
						BORROW AREA D	APPROVED BY W.O.S.E

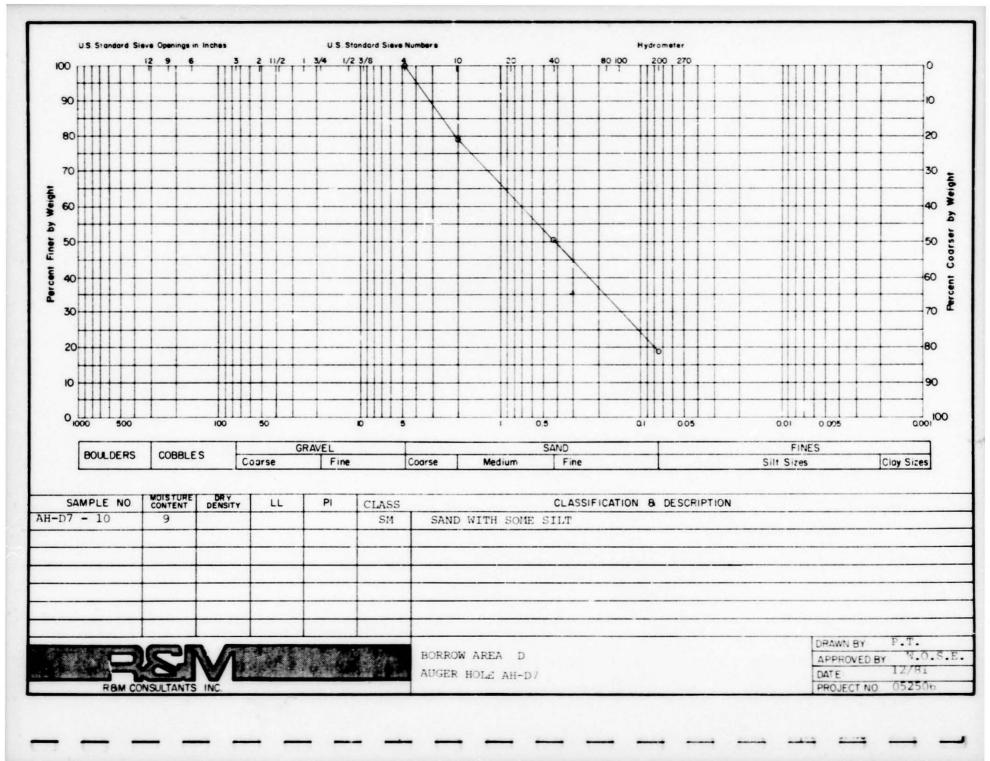
AUGER HOLE AH-D7

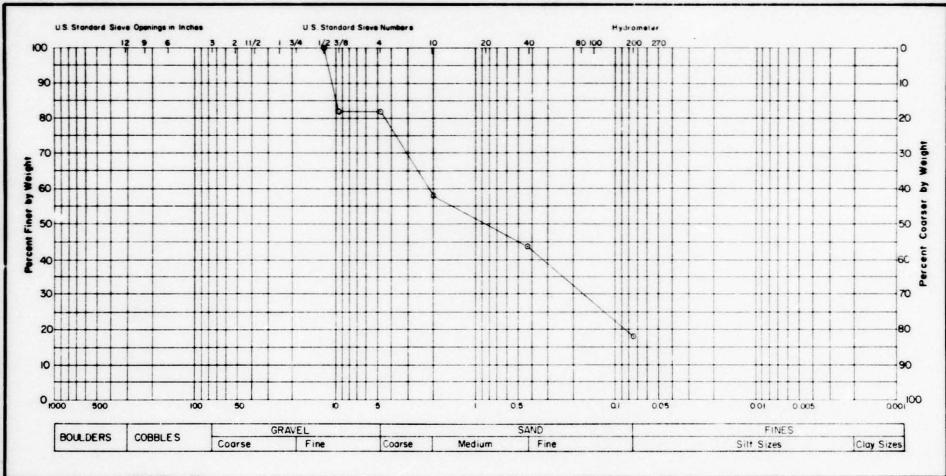
ROM CONSULTANTS INC.

12/81

PROJECT NO 052506

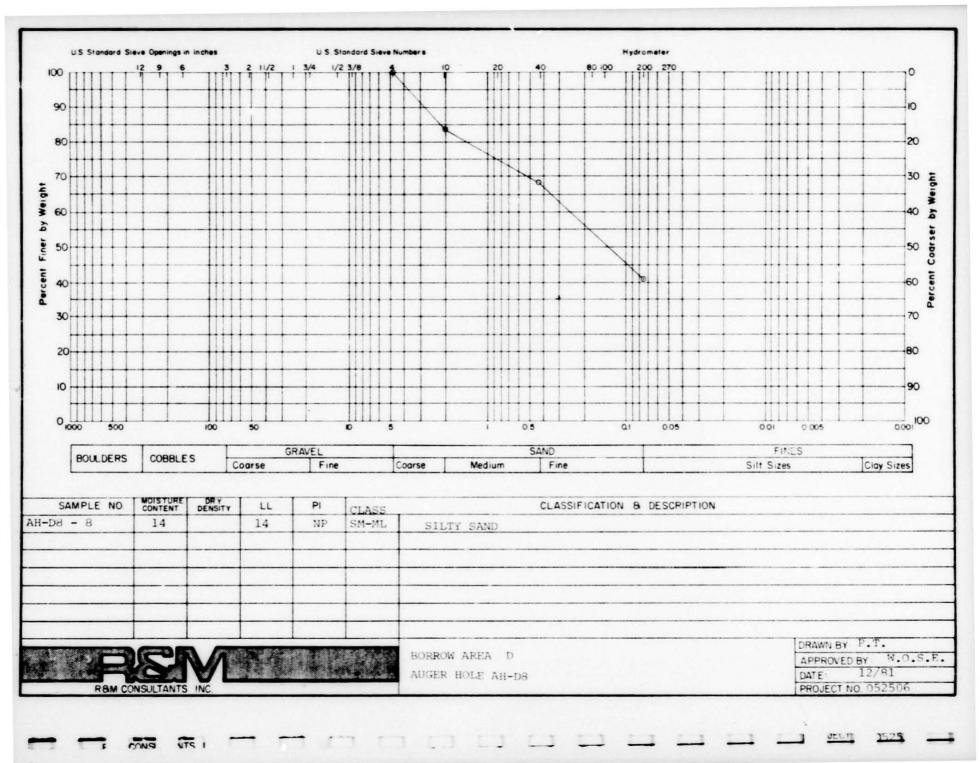
DATE:

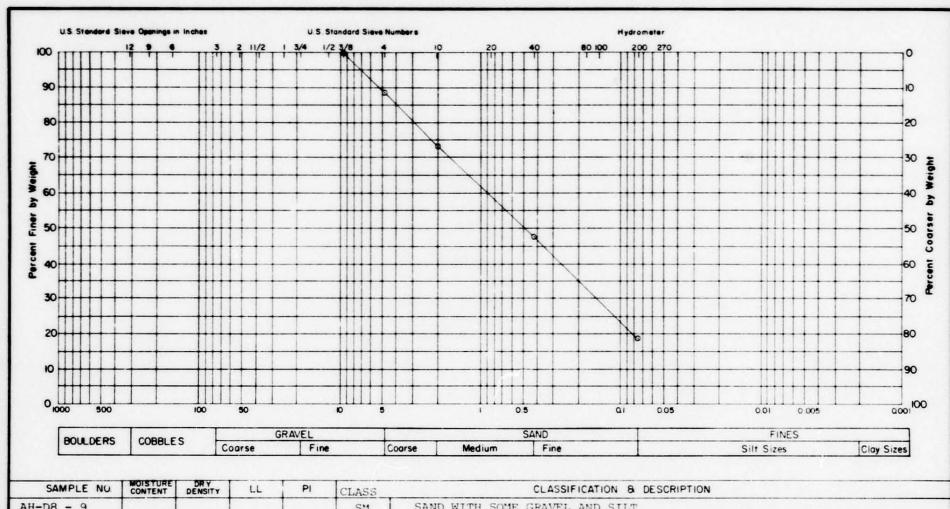




SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D8 - 5	15		14	NP	SM	SAND WITH SOME GRAVEL AND SILT

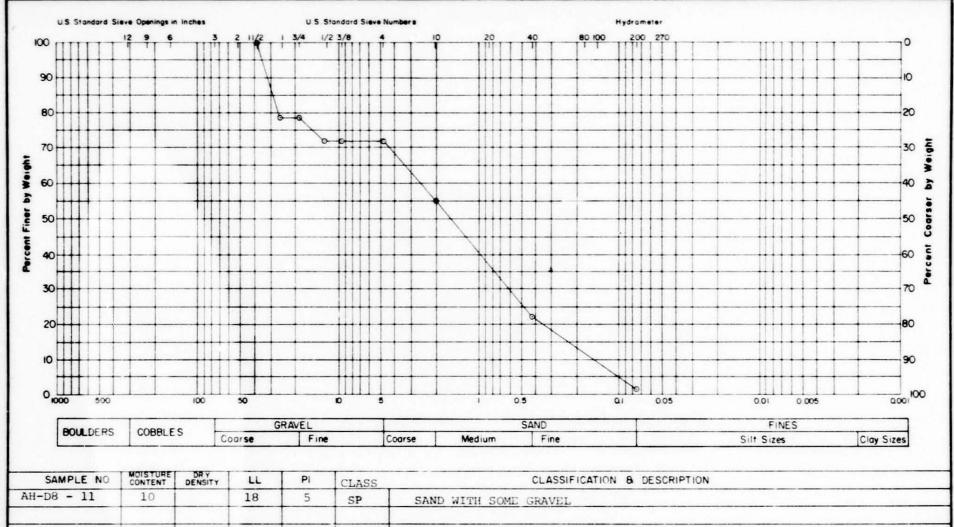
BORROW AREA D AUGER HOLE AH-D8 DRAWN BY P.T.
APPROVED BY W.O.S.E.
DATE 12/81
PROJECT NO 052505





SAMPLE NO.	CONTENT	DENSITY	L.L	PI	CLASS	CLASSIFICATION & DESCRIPTION	
AH-D8 - 9					SM	SAND WITH SOME GRAVEL AND SILT	
	-				-		
					+		
	-				+		
	1				<u> </u>	DRAWN BY P.T.	

BORROW AREA D AUGER HOLE AH-D8 APPROVED BY V.O.S.E.
DATE 12/81
PROJECT NO 052506



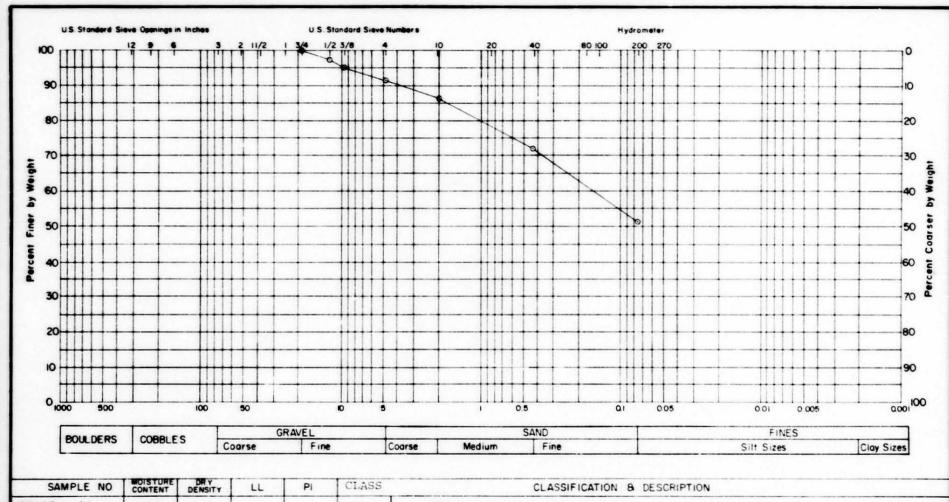
SAMPLE NO	CONTENT	DENSITY	LL	Pi	CLASS	CLASSIFICATION & DESCRIP	TION
AH-D8 - 11	10		18	5	SP	SAND WITH SOME GRAVEL	
	-	-			-		
CONTRACTOR STATE			1 300				DRAWN BY P.T.
		A DEE	1 1	2.4	4	BORROW AREA D	APPROVED BY N.O.S.

BORROW AREA D AUGER HOLE AH-D8 DRAWN BY P.T.

APPROVED BY N.O.S.E.

DATE 12/81

PROJECT NO 052506



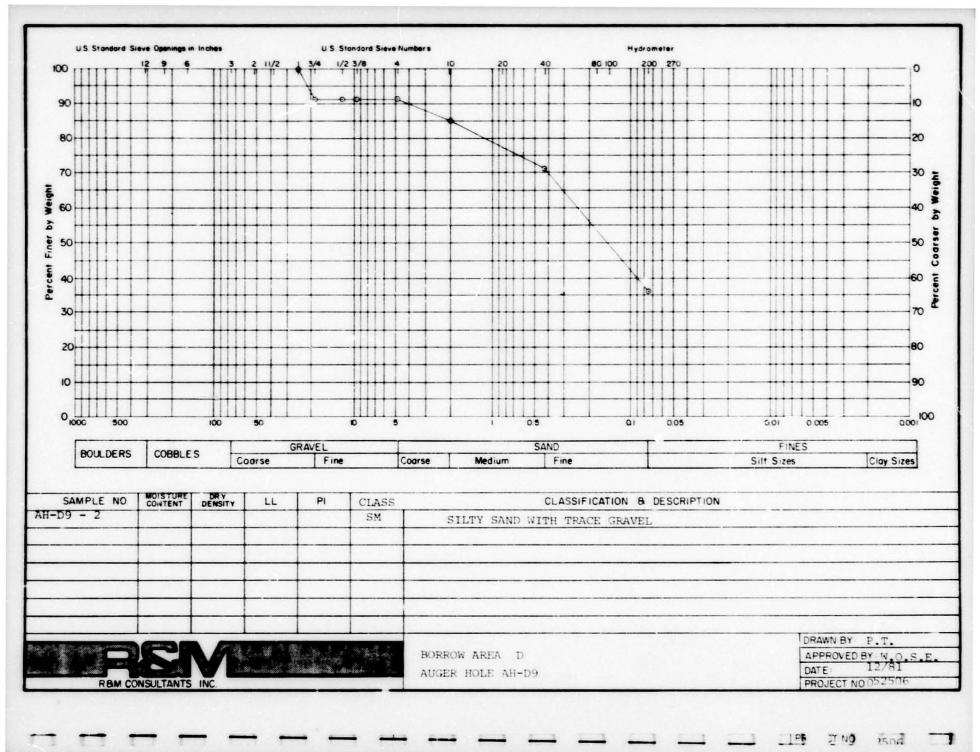
SAMPLE NO	CONTENT	DENSITY	LL	Pi	CLASS	CLASSIFICATION & DESCRIPTION
AH-D8 - 13	13				ML	SANDY SILT WITH SOME TO TRACE CLAY AND TRACE GRAVEL
	-				+	
	-					
						DRAWN BY P.T.

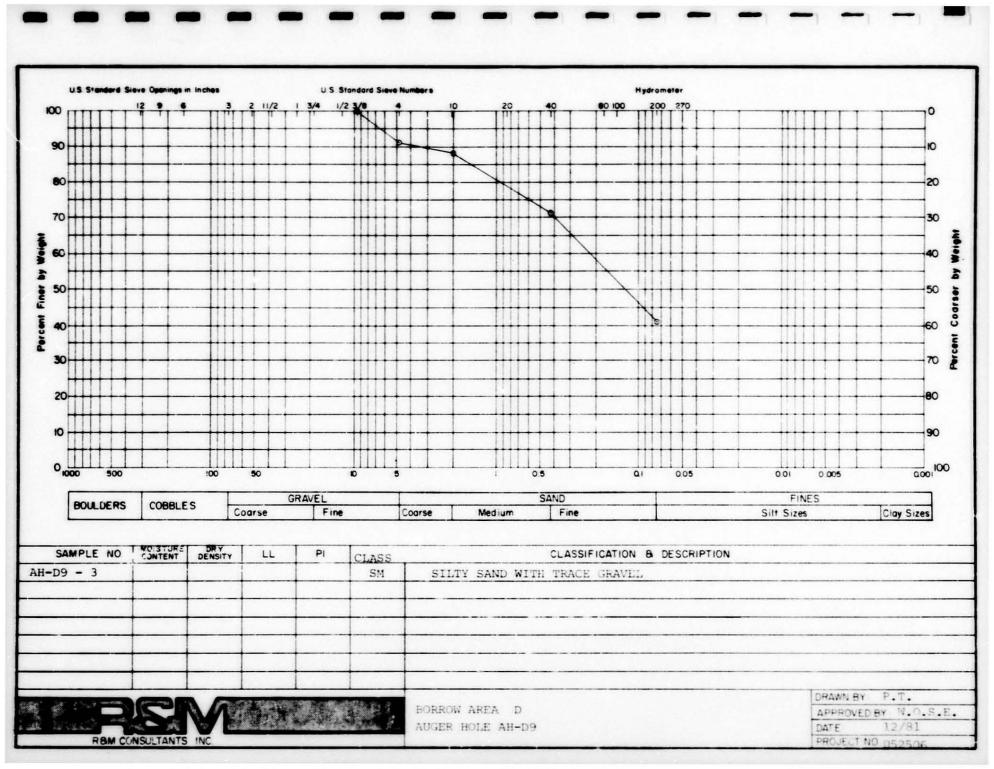
BORROW AREA D AUGER HOLE AH-D8 DRAWN BY P.T.

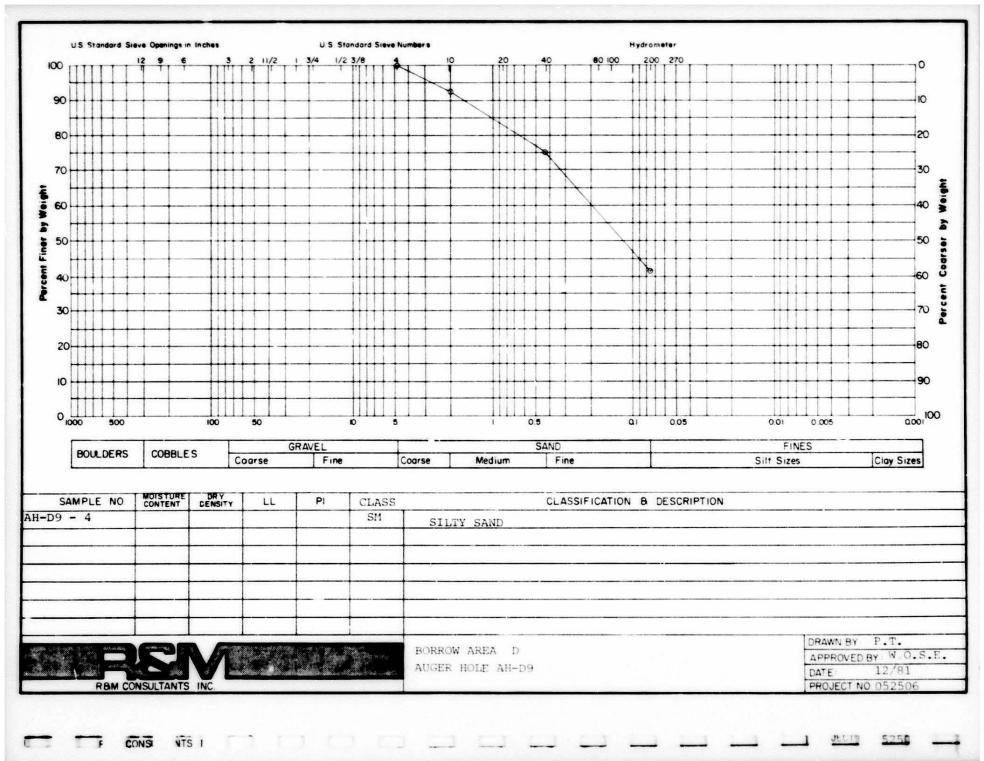
APPROVED BY W.O.S.E.

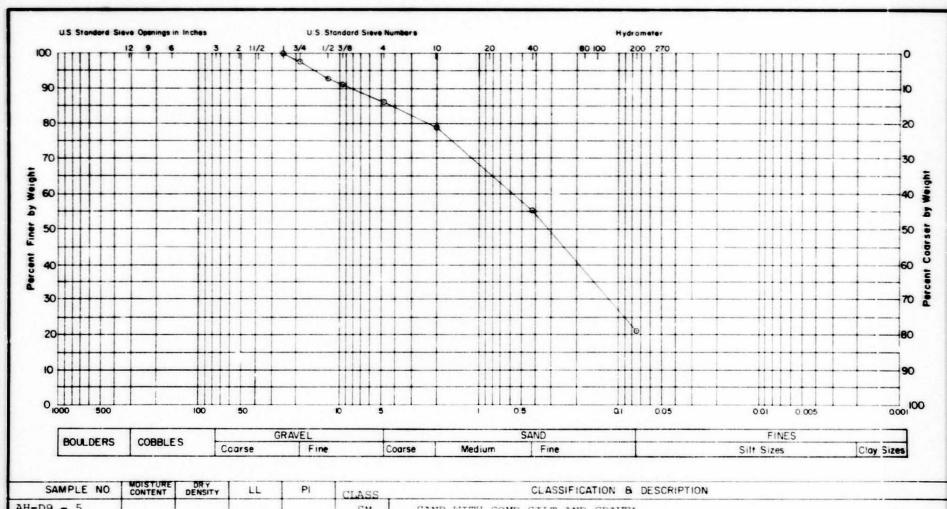
DATE 12/81

PROJECT NO 052506









SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D9 - 5					SM	SAND WITH SOME SILT AND GRAVEL
						DRAWN BY P.T.

BORROW AREA D

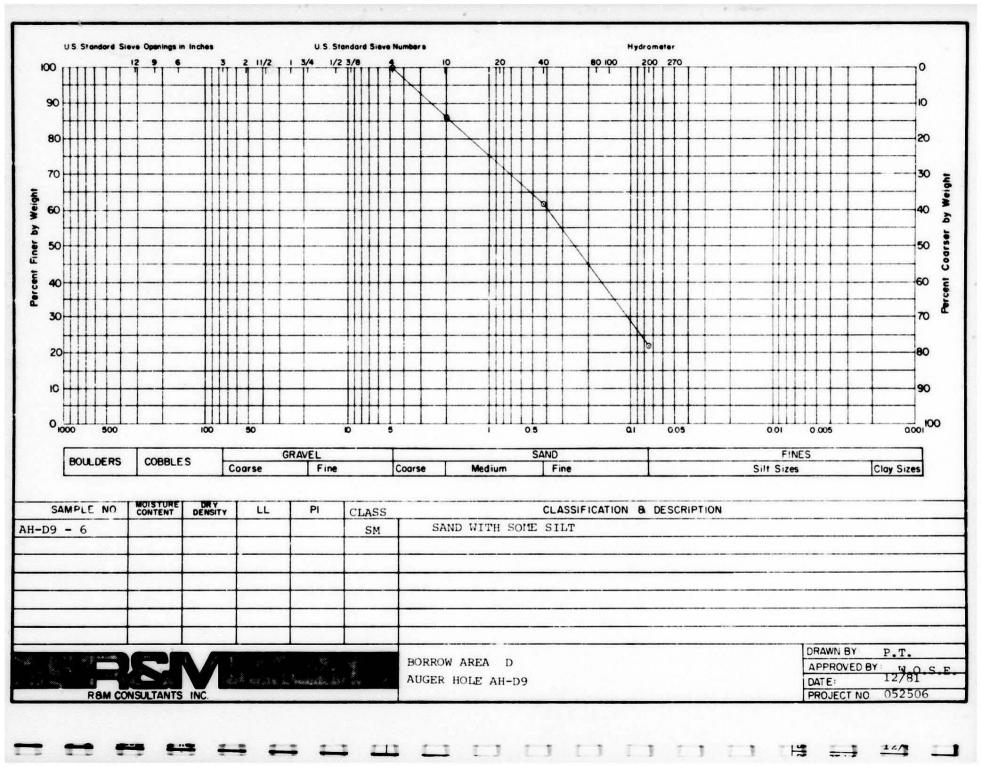
AUGER HOLE AH-D9

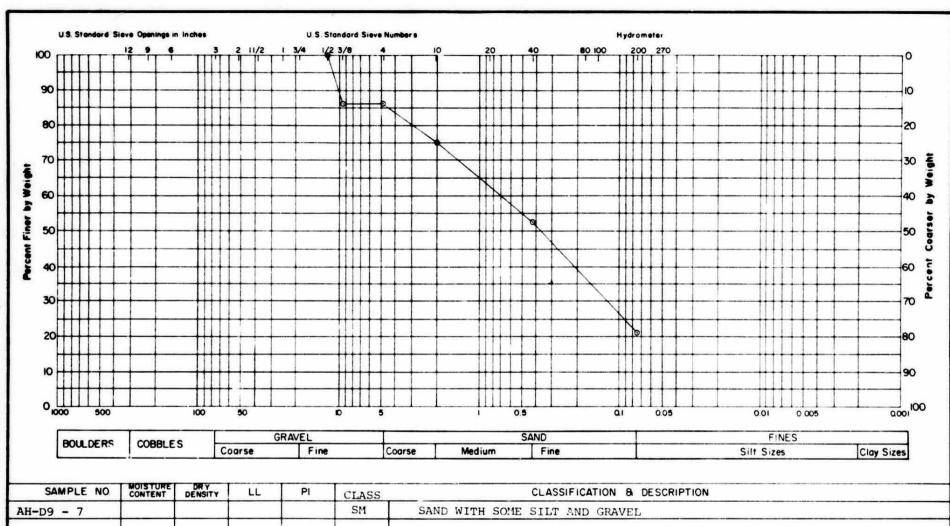
DRAWN BY P.T.

APPROVED BY W.O.S.E.

DATE 12/81

PROJECT NO 052506





SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D9 - 7					SM	SAND WITH SOME SILT AND GRAVEL
				ļ		
	-				+	
					+	
	L					

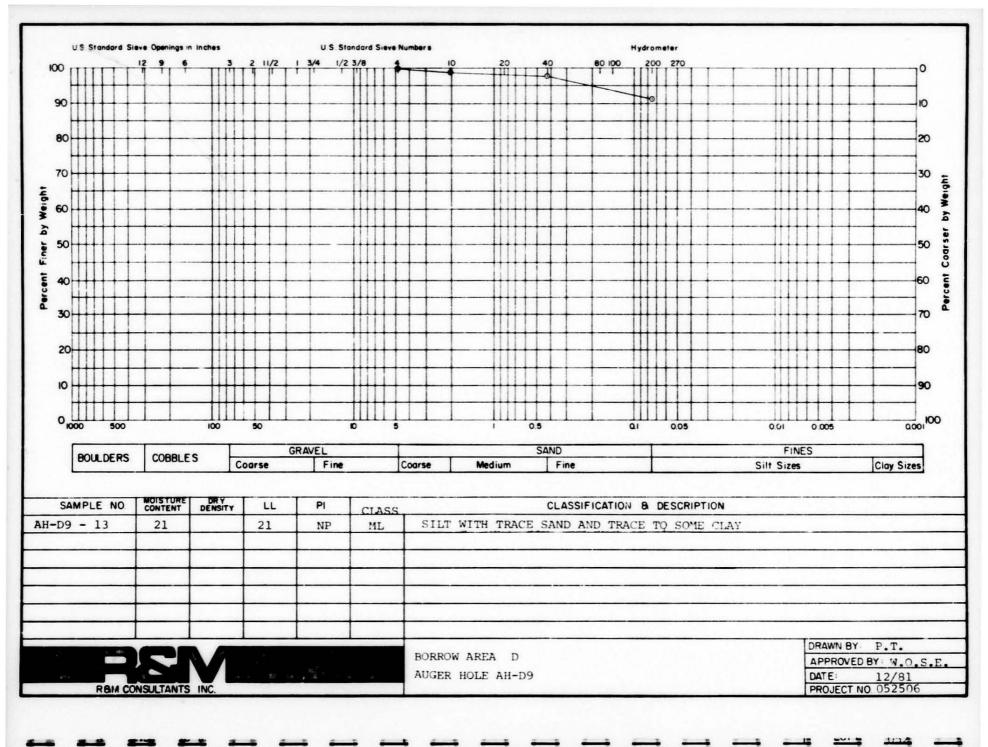
R8M CONSULTANTS INC.

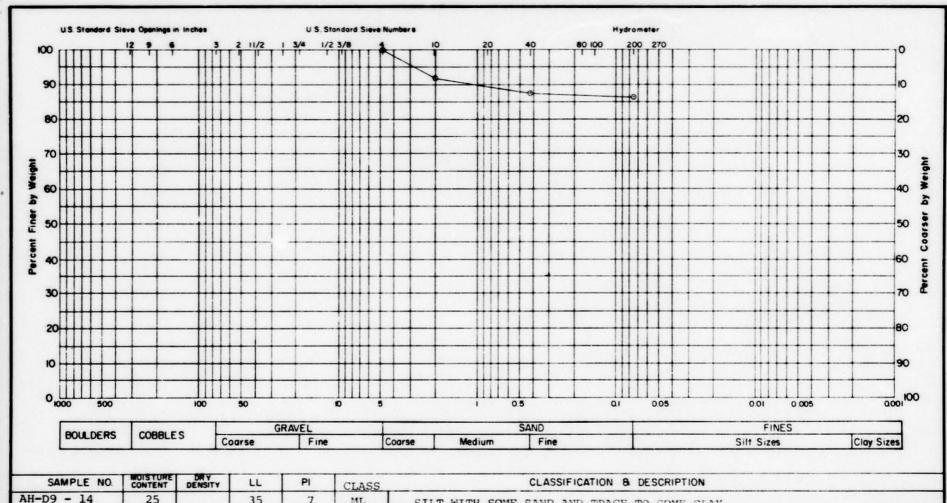
BORROW AREA D AUGER HOLE AH-D9 DRAWN BY: P.T.

APPROVED BY: W.O.S.E.

DATE: 12/81

PROJECT NO 052506





SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
AH-D9 - 14	25		35	7	ML	SILT WITH SOME SAND AND TRACE TO SOME CLAY
					1	
					-	
					++	
	-				+	
			-		++	
					1	DRAWN BY P.T.

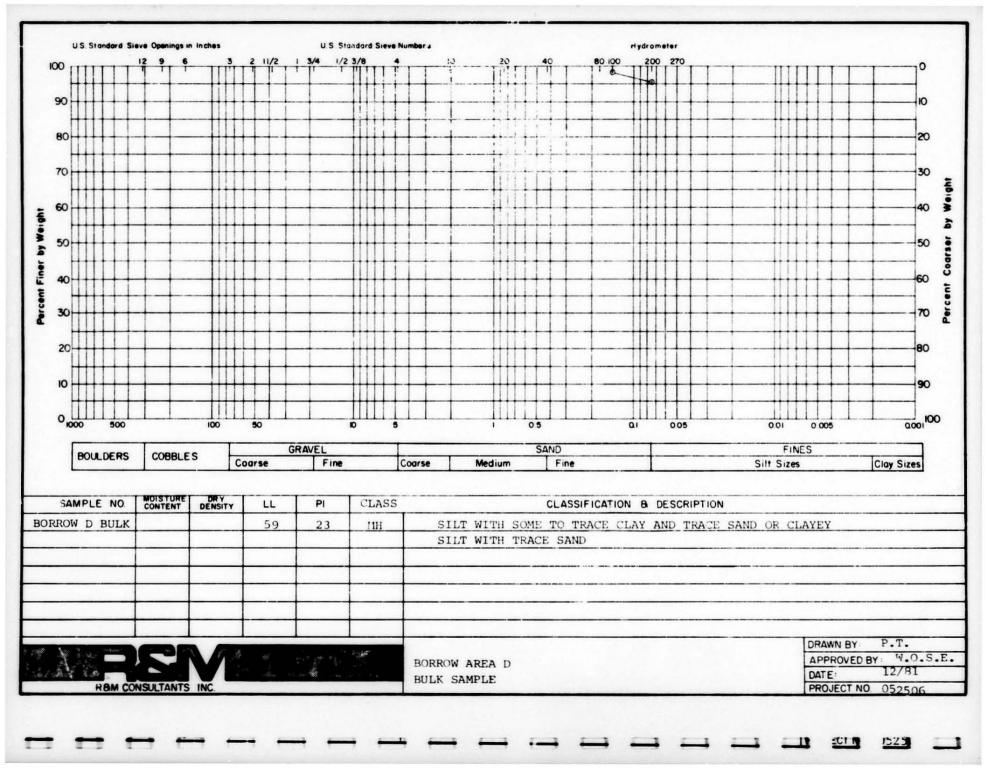
RBM CONSULTANTS INC.

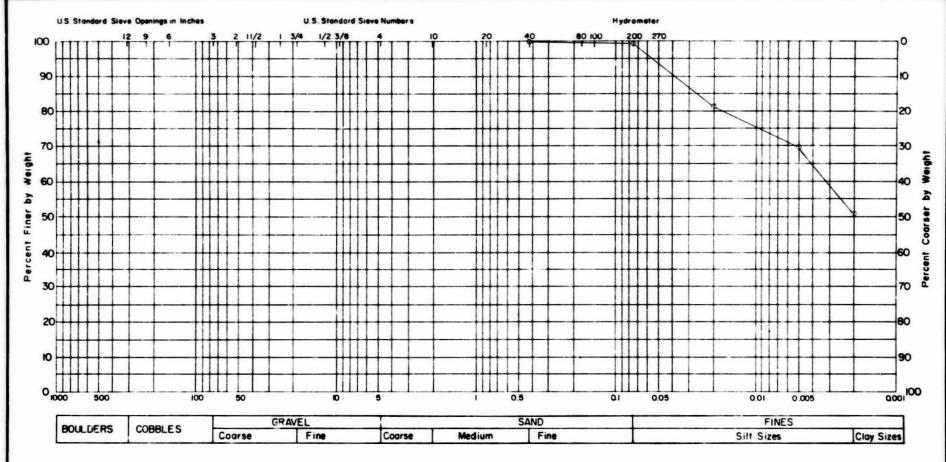
BORROW AREA D AUGER HOLE AH-D9 DRAWN BY: P.T.

APPROVED BY: 7.0.S.E.

DATE: 12/81

PROJECT NO 052506



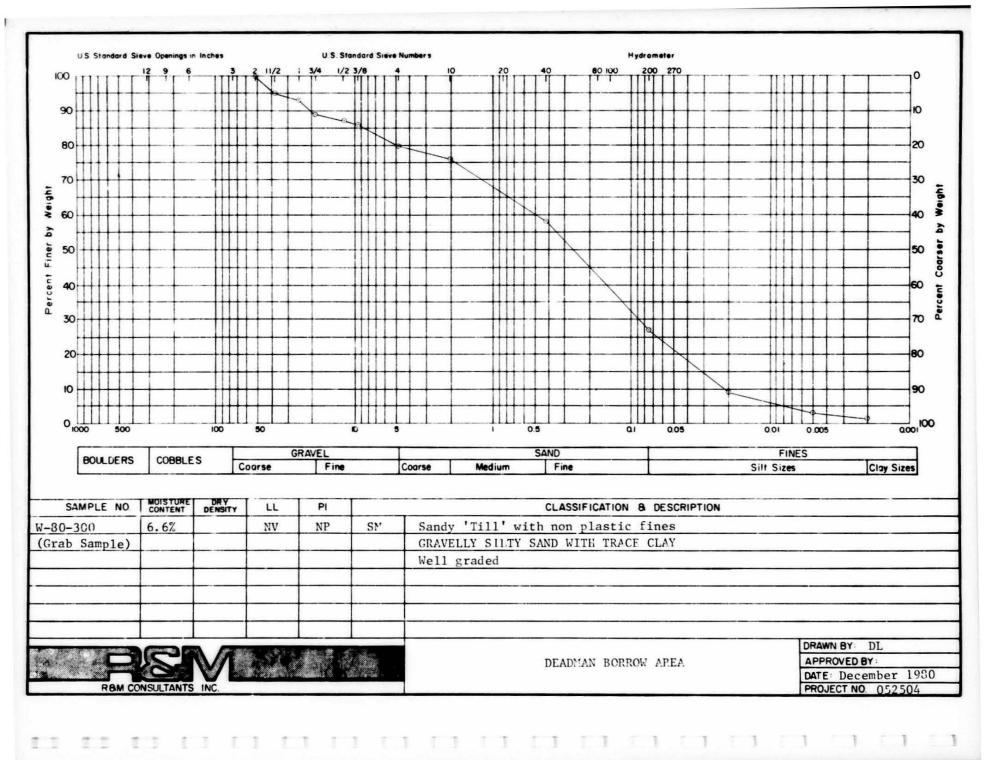


SAMPLE NO.	CONTENT	DENSITY	LL	PI			CLASSIFICATION & DESCRIPTION	
W-80-282	42.1%		55.9	33.2	CL-CH	SILT AND CLAY	Medium to High Plasticity	
(Grab Sample)								



DEADMAN BORROW AREA

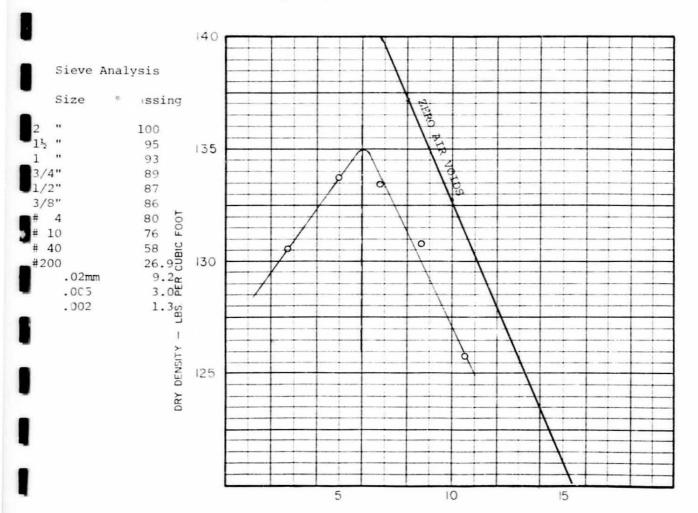
DRAWN BY: DL APPROVED BY: DATE: December 1980 PROJECT NO. 052504



Project No .	052504		
	11-20-80		
Date	11-20-00		

## R&M Consultant Inc. LABORATORY COMPACTION CONTROL REPORT

Jo	b Name and Location Susitna (Watana Dam	n Site)		
Ar	chitect or Engineer Acres American Inc.			
Со	ntractor			
А	Description of Soil: Well Graded 'Till'- G	GRAVELLY, SILTY	SAND W/TRAC	E CLAY
	Material MarkB	Unified Classification	SM	AASHO _Classification
	Source of Moterial Deadman Creek Sample N	W-80-300		
	Natural Water Content 6.6 % Natural D	ry Density	PCF Speci	fic Gravity
	Liquid Limit Non Viscous % Plastic Limit	% P10	asticity Index	Non Plastic
B.	Test Procedure UsedT-180 "D" - AASH	HTO		
С	Test Results Maximum Dry Density 135.0	PCF	Optimum Water	Content 6.0 %

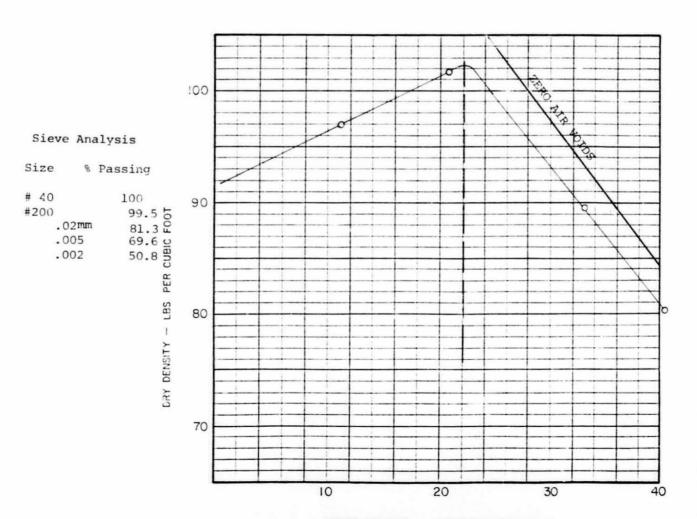


Project No.	052504
	11 20 00
Date	11-20-80

## R&M Consultant Inc.

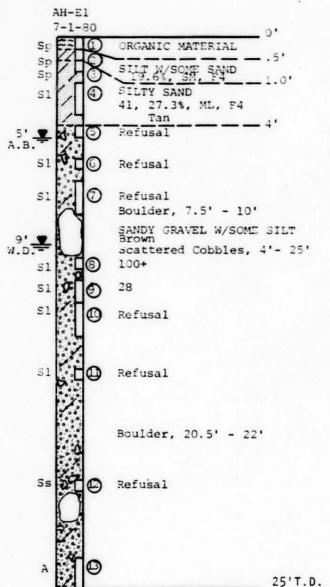
## LABORATORY COMPACTION CONTROL REPORT

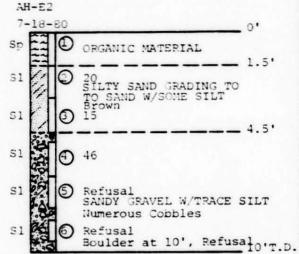
Jo	b Name and Location_	Susitna (	Watana Dan	n Site)		
Ar	chitect or Engineer	Acres Americ	an Inc.			
Со	ntractor					****
Д	Description of Soil_	SILT AND C	LAY			
	Material Mark	A		Unified Classification_	CL-CH	AASHOClassification
	Source of Material	Deadman Cre	ek Sample	No. W-80-282		
	Natural Water Conten	42.1%	% Natural Dr	ry Density	PCF Spe	ecific Gravity
	Liquid Limit	55.9 % P	lastic Limit_	% P	lasticity Index_	33.2
В.	Test Procedure Used	T-180 M	ethod "A"	- AASHTO		
С	Test Results Maximu	m Dry Density	102.5	PCF	Optimum Wate	er Content 22.0%



F.2 BORROW SITE E

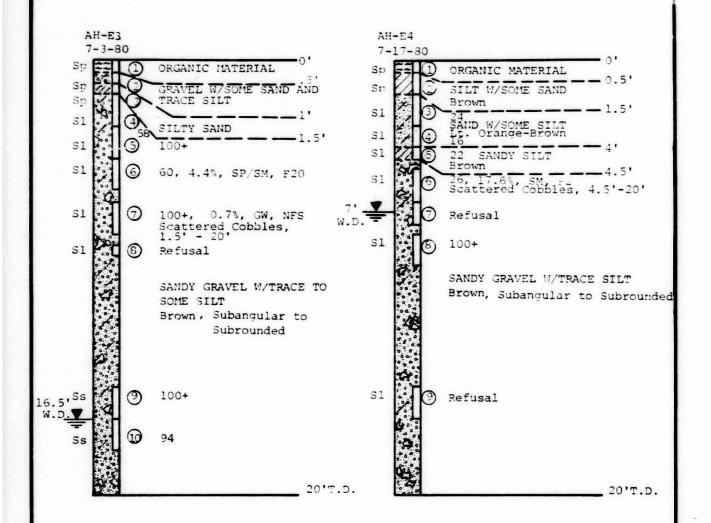
AUGER HOLE LOGS



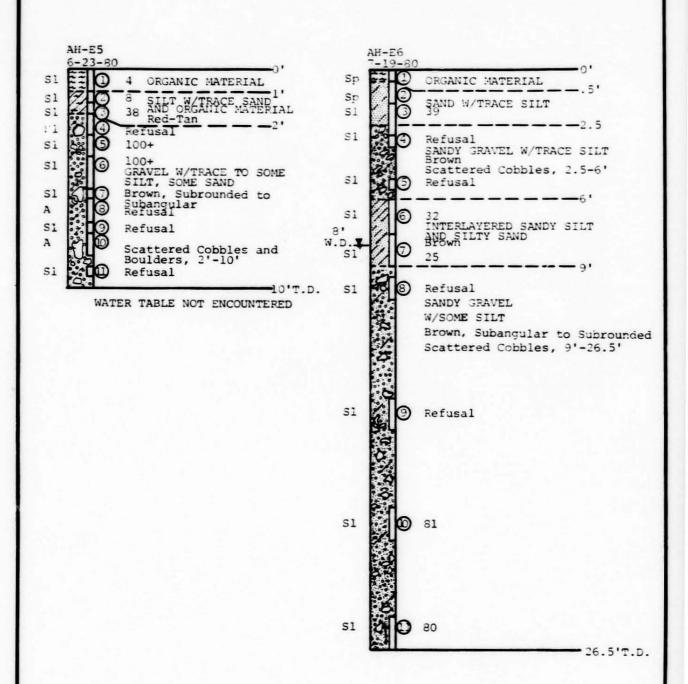




BORROW AREA E AUGER HOLES AH-E1 AND AH-E2 ACRES



BORRCY AREA E AUGER HOLES AH- E3 AND AH- E4

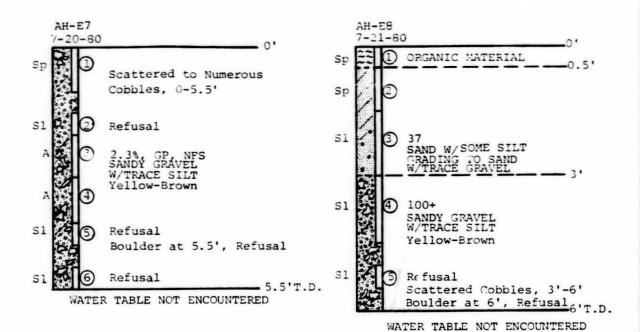


PREPARED FOR

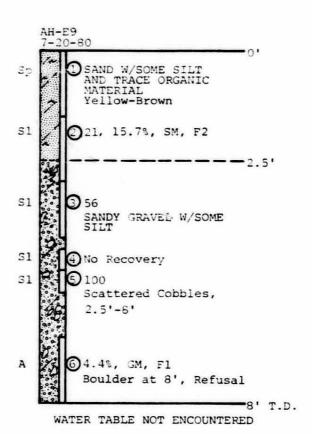


BORROW AREA E AUGER HOLES AH-E5 AND AH-E6





BORROW AREA E AUGER HOLES AH-E7 AND AH-E8



RAM CONSULTANTS, INC.

BORROW AREA E AUGER HOLE AH-E9 ACRES

TEST PIT/TEST TRENCH LOGS

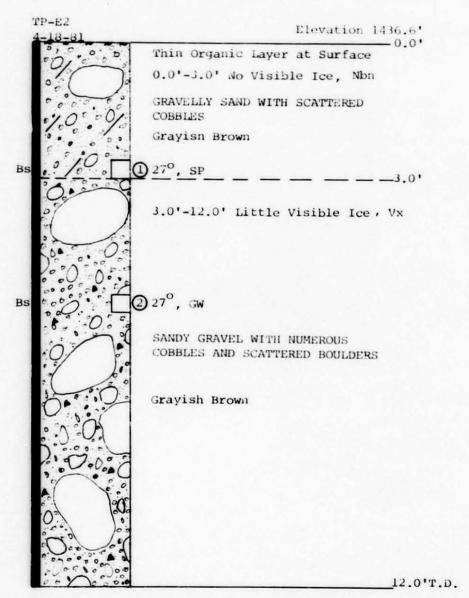
PREPARED BY

RAM CONSULTANTS, INC.

BORROW AREA E TEST PIT TP-E1

Scale: 1"=2"



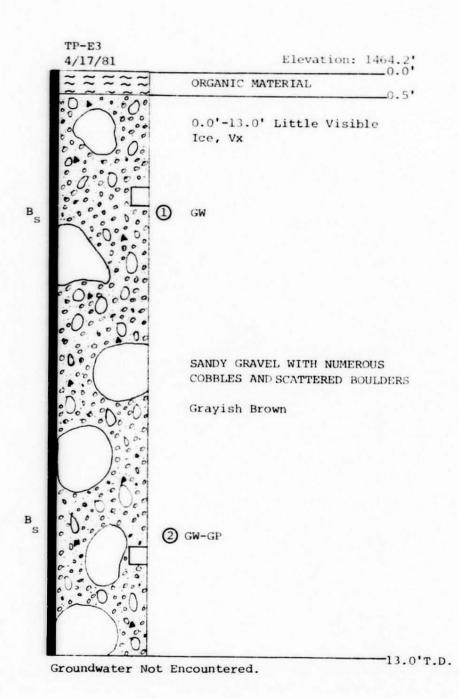


Groundwater Not Encountered.

PREPARED BY

BORROW AREA E TEST PIT TP-E2





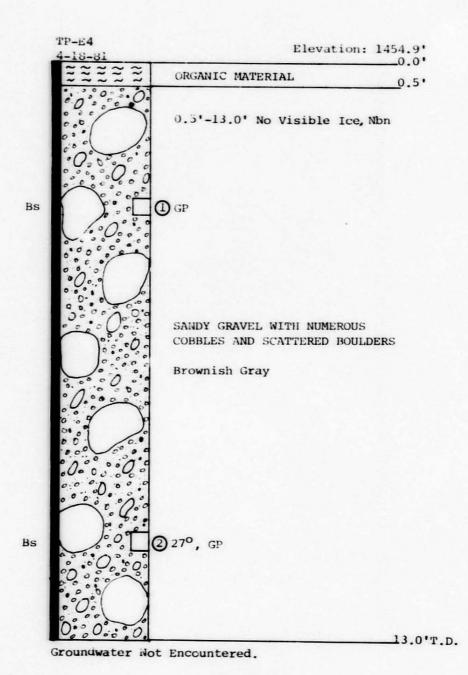
PREPARED FOR:



BORROW AREA E TEST PIT TP-E3

Scale: 1"=2'

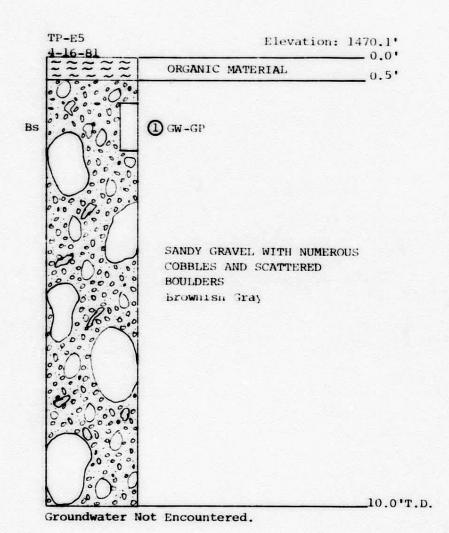




PREPARED FOR:

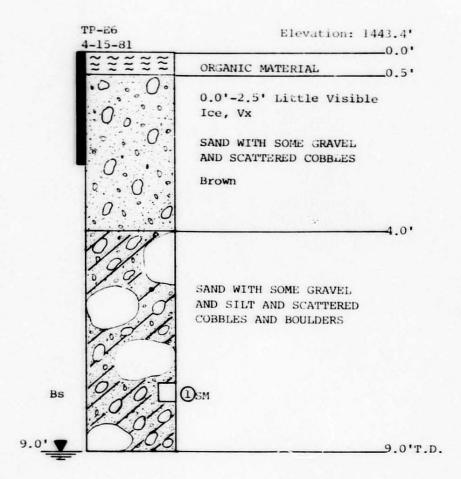






PASSILITANTS. NC.

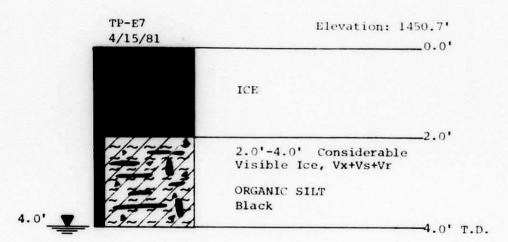
BORROW AREA E TEST PIT TP-ED



PREPARED FOR:



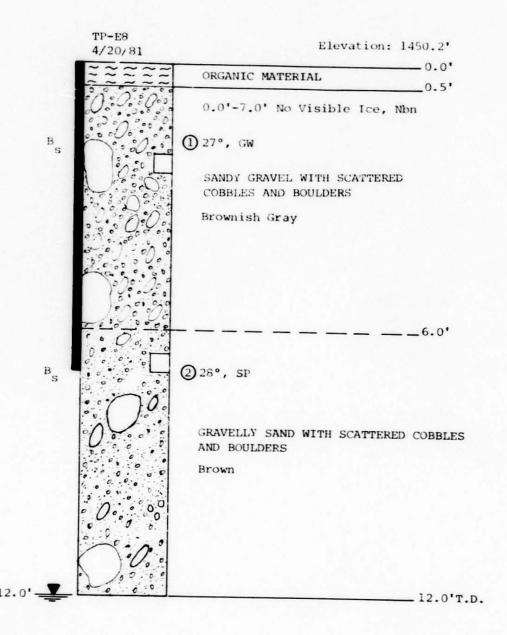




BORROW AREA E TEST PIT TP-E7

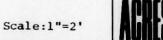
Scale: 1"=2'

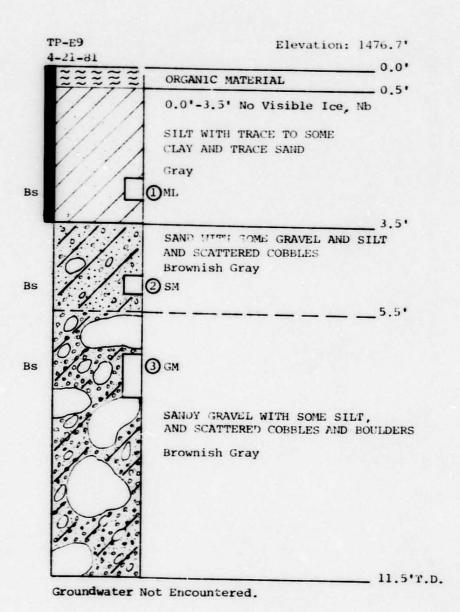




PREPARED FOR

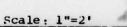


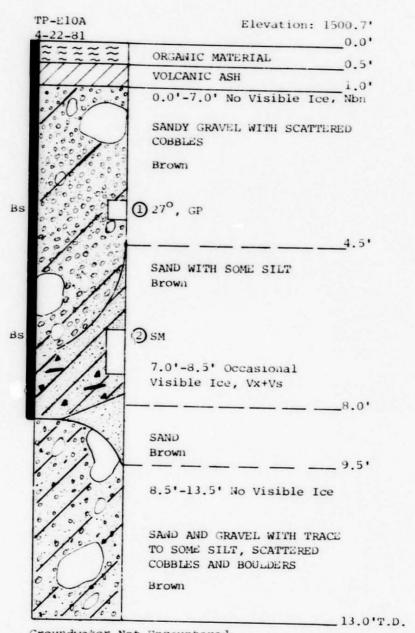




PREPARED FOR:







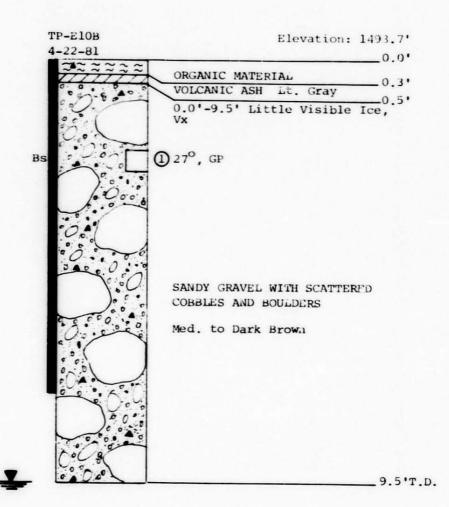
Groundwater Not Encountered.

PREPARED BY

PREPARED FOR:

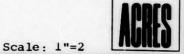


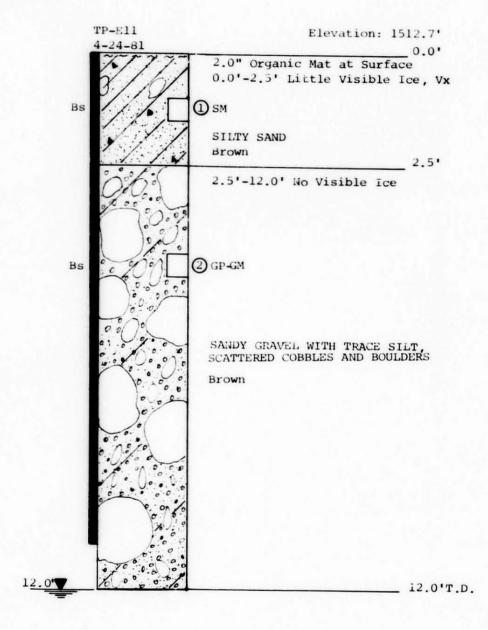




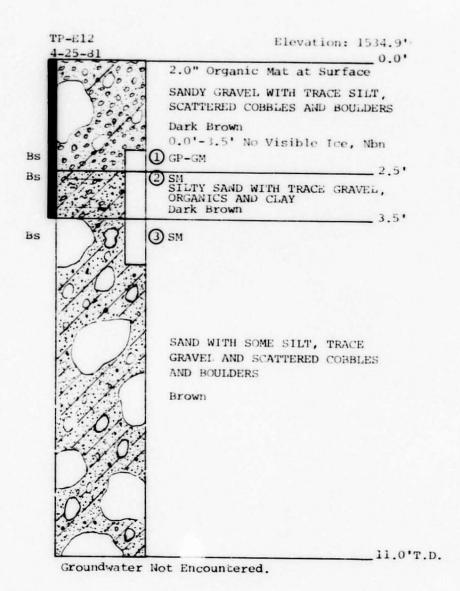
PREPARED FOR







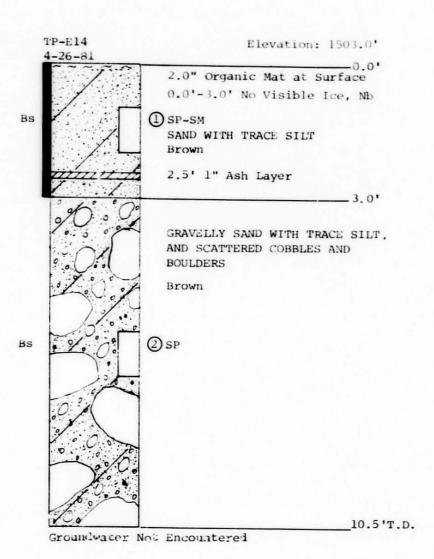
BORROW AREA E TEST PIT TP-E11 ACRES



PREPARED FOR

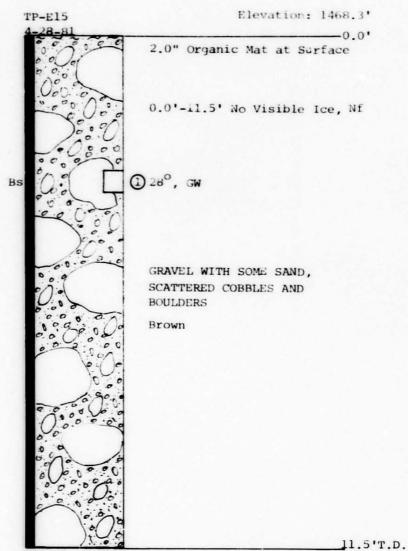






BORROW AREA E TEST PIT TP-E14





Groundwater Not Encountered.

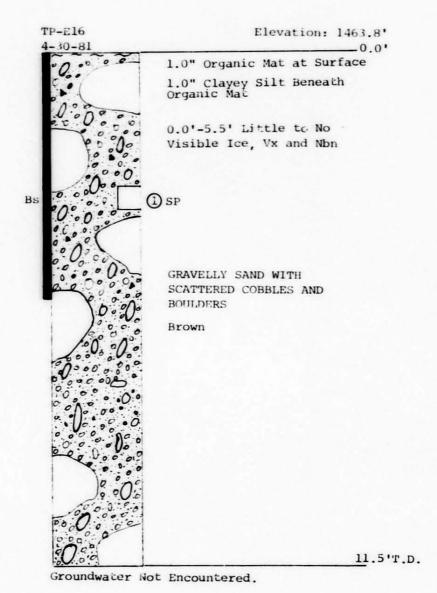
PREPARED BY

BORROW AREA E TEST PIT TP-E15



PREPARED FOR

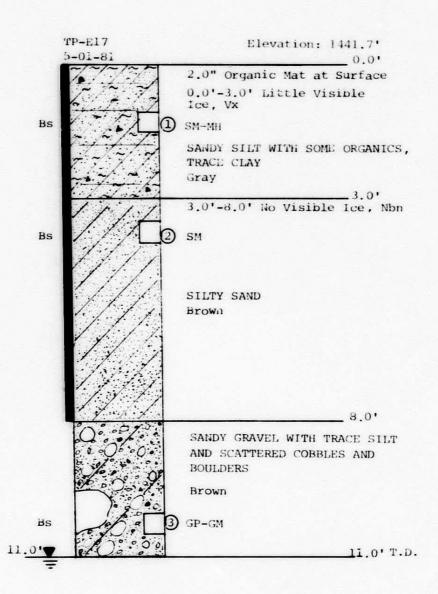
Scale: 1"=2



PREPARED FOR:



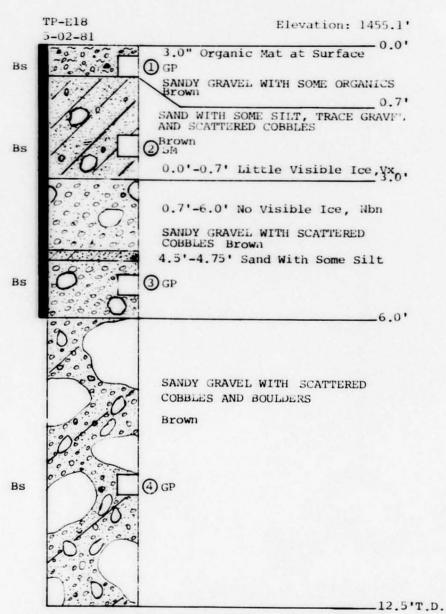




PREPARED FOR:







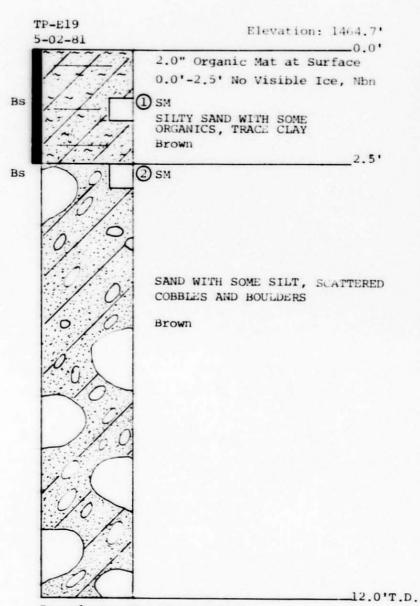
Groundwater Not Encountered.

PREPARED BY :

PREPARED FOR:







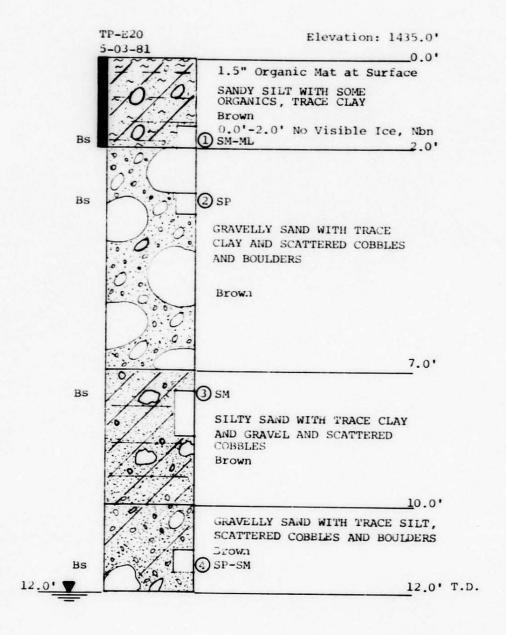
Groundwater Not Encountered.

PREPARED BY

PREPARED FOR:







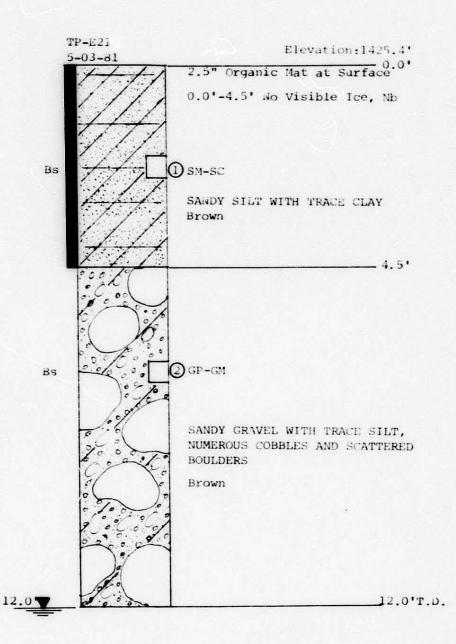
PREPARED BY



BORROW AREA E TEST PIT TP-E20



PREPARED FOR



PREPARED BY:

PREPARED FOR:



BORROW AREA E TEST PIT TP-E21



LABORATORY TEST ~4TA

PROJECT	NO.	052504

CLIENT: Acres American, Inc.
PROJECT NAME Susitna Hydroelectric

(Watana Dam Site)

REM	CONSULTANTS, INC.
, 14	

SUMMARY OF LABORATORY TEST DATA

DATE _	October	17, 1980	
DARTY	NO.	DAGE	NO

NO.	NO.	SAMPLE	DEPTH	4"	3"	2"	112"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200	.02	.005	.002	% Moist.	LL	PI	Unified Class.
AH-E		3	1.0'- 1.5'										100	99	48.0				19.6			SM
AH-E	£1	4	2.0'- 3.5'					_	_				100	98	59.5		-		_27_3			ML*
AH-E	:3	6	4.5'- 6.0'		100	89	89	83	80	76	72	62	52	28	6.2				4.4			SP-SM
AH-E	3	7	6.5'- 8.0'	-		**	100	90	76	62	57	40	31	16	3.7				0.7		-	GW
AH-E	24	6	5.0'- 6.5'							100	99	98	92	66	22.2				17.6			SM
AH-E	7	3	2.0'- 3.0'				100	85	73	56	49	39	31	12	2.1				2.3			GP.
AH-E	9	2	1.5'- 3.0'										100	99	28.6				15.7			SM
Ан-Е	9	6	6.5'- 8.0'					100	95	87	79	57	44	33	17.0				4.4			GM
+	-																	-			-	

REMARKS:	** 1-2" Rock	Present in Sample	
	* Estimated	Value	

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT	NO	052506
FROULCI	140.	

REM

CONSULTANTS, INC.

DATE \_\_\_\_\_6-15-81

PROJECT NAME Susitna Hydroelectric

SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_ PAGE NO . \_\_\_\_

BORING	SAMPLE NO.	DEPTH	+12"	7"	3"	2"	J: ,"	1"	3/4"	1/2"	3/8'	#4	#10	#20	#40	#80	<b>#100</b>	) 200	CLASS		
El	1	2.5'- 3.0'				96	92	82	72	61	56	47	38	33	27	18	15	8	GP-GM		
E1	2	7.0'- 7.5'		77	53	51	48	43	39	34	32	26	21	17	10	4	3	1.5	GP	and the second	_
E2	1	2.5'- 3.0'		84	79	79	77	73	68	62	58	51	46	38	22	5	4	2.4	SP		
E2	2	5.5'- 6.0'		64	55	54	52	45	40	35	3.1	23	17	12	7_	_2	_1_	.8	UN.		
E3	1	2.5'- 3.0'		78	54	54	49	41	37	32	28	22	16	:11	7	3	2	1.3	GW		
E3	2	10.5'-11.0'		75	57	56	55	49	43	37	33	26	19	11	6	3	2	1.6	GP-GW		
E4	1	3.0'-3.5'		58	39	38	35	30	27	24	22	18	15	10	5	2	2	1.0	GP		
E4	2	10.5'-11.0'		61	42	40	39	32	29	25	22	18	14	9	5	2	2	1.2	GP		
E5	1	1.0'- 2.0'		79	45	42	39	34	30	25	22	17	13	9	5	2	_2	1.0	GW-GP		 -
E6	1	7.5'- 8.0'				100	99	90	87	83 \	81	75	69	59	46	25	22	13.3	SM		
E3	1	2.5'- 3.0'		74	73	72	69	59	51	41	35	24	16	10	6	2	2	1.0	GW		
E8	2	6.5'- 7.0'	_			100	99	95	89	83	77	64	46	24	10	2	_2	9	_57		
E9	1	2.5'												100	99	96	95	90.5	ML		
E9	2	4.5'			21	89	87	86	85	83	81	78	76	74	70	45		19.9	SM		

REMARKS:		

NOTE: SIEVE ANALYSIS = PERCENT PASSIN

052506 PROJECT NO. \_

R & M\_\_\_\_CONSULTANTS, INC.

6-15-81 DATE \_\_\_

PROJECT NAME Susitna Hydroelectric

SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_ PAGE NO \_\_\_\_

BORING	SAMPLE NO.	DEPTH	+12"	7"	3"	2"	125"	1"	3/4'	1/2"	3/8	#4	#10	#20	#40	#80	#100	#200	CLASS		
E9	3	2.5'			95	81	77	71	67	63	60	55	50	45	41	28	25	16.6	GM	-	
El OA	1	3.5'- 4.0'			82	78	71	63	58	51	46	37	31	28	21	8	6	2.5	GP		
E10A	2	6.5'- 7.5'		-			_						100	99	89	43	35	16.5	SM		
ElOB	1	2.0'- 2.5'			100	91	86	77	66	54	48	36	28	18	11	4	3	2.1	GP		
E11	1	1.5'											100	99	94	65	58	37.7	Sif		
Ell	_2	5.0'		83	73	70	66	60	56	51	47	39	33	38	22	13	11	7,8	_GP-GM	-	
E12	1	2.0'- 2.5'		79	77	74	69	62	56	50	46	37	29	21	14.2	9	8	5.9	GP-GM		
E12	2	2.5'- 3.5'							100	94	91	90	88	86	80	59	53	38.4	SM		
E12	3	<u> 3.5'- 4.5'</u>			_	79	79	75	74	73	72	71	70	-66	58	40	35	23.8	SM	-	
E14	1	1.0'- 2.0'										100	97	85	61	20	14	5.3	SP-SM		
E14	2	6.0'- 7.0'		73	58	56	52	48	45	41	38	31	25	18	11	5	4	2.5	SP	-	
E15	1	3.0'- 3.5'	79	77	65	50	45	37	32	26	23	17	13	9	5	2	_2	9	GW		
E16	1	3.0'- 3.5'	74	72	61	61	59	53	50	45	41	34	24	13	7	3	2	1.5	SP		

REMARKS :			

NOTE: SIEVE ANALYSIS = PERCENT PASSIN

PROJECT	NO	052506

R & M CONSULTANTS, INC.

DATE	6-15-81	
		-

PROJECT NAME Susitna Hydroelectric

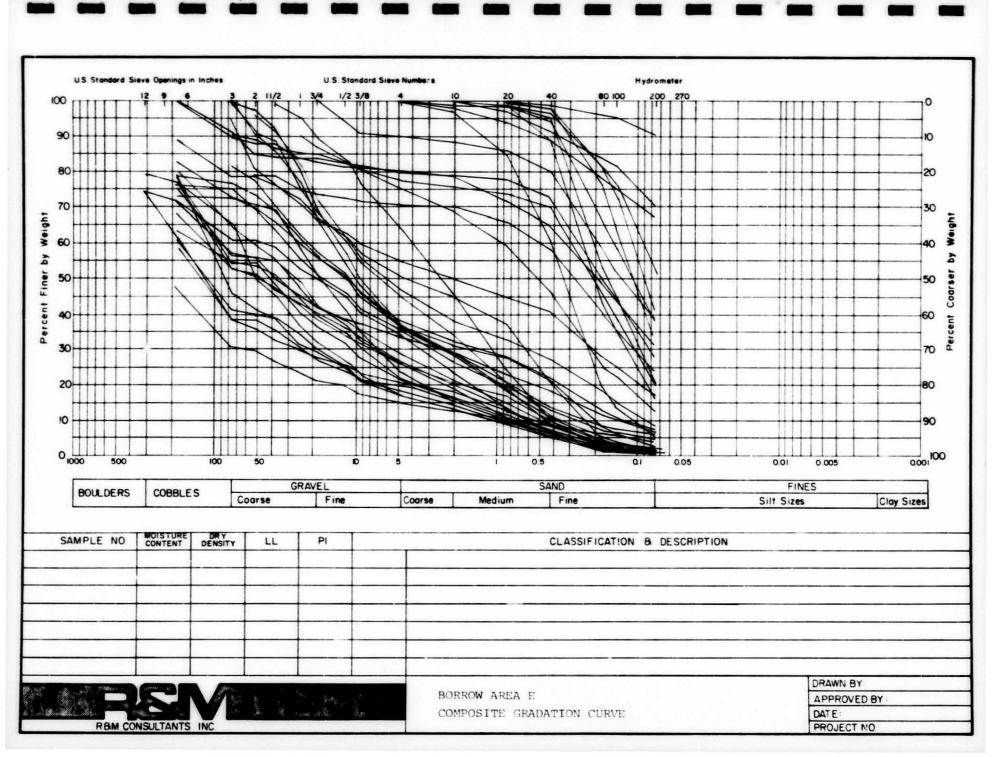
SUMMARY OF LABORATORY TEST DATA

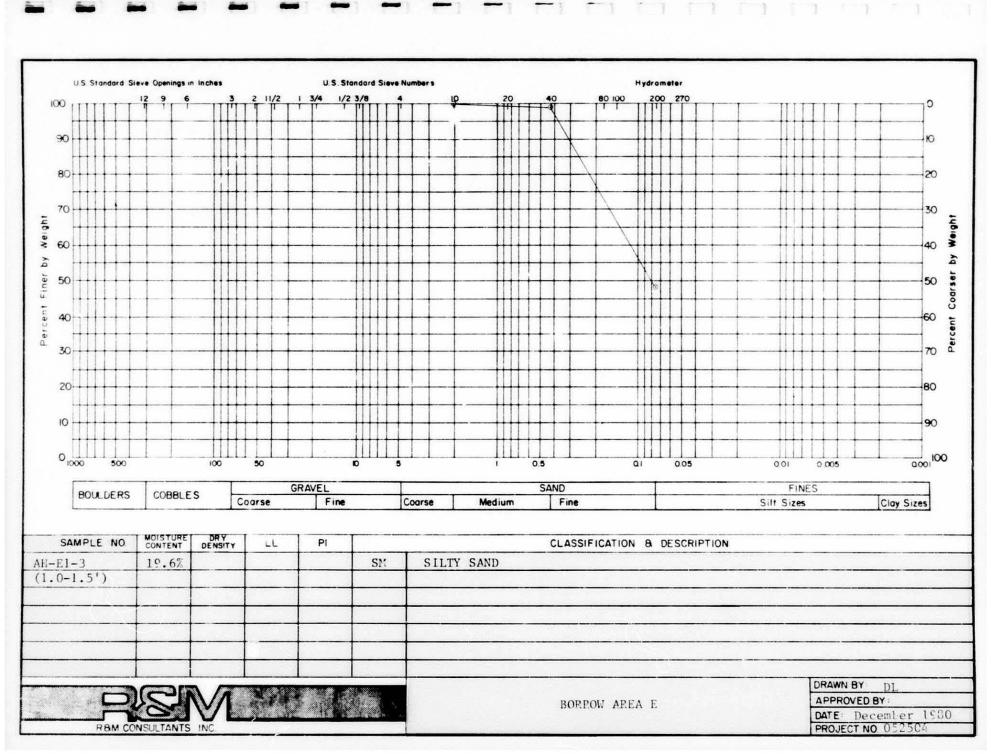
PARTY NO. \_\_\_\_\_ PAGE NO \_\_\_\_\_

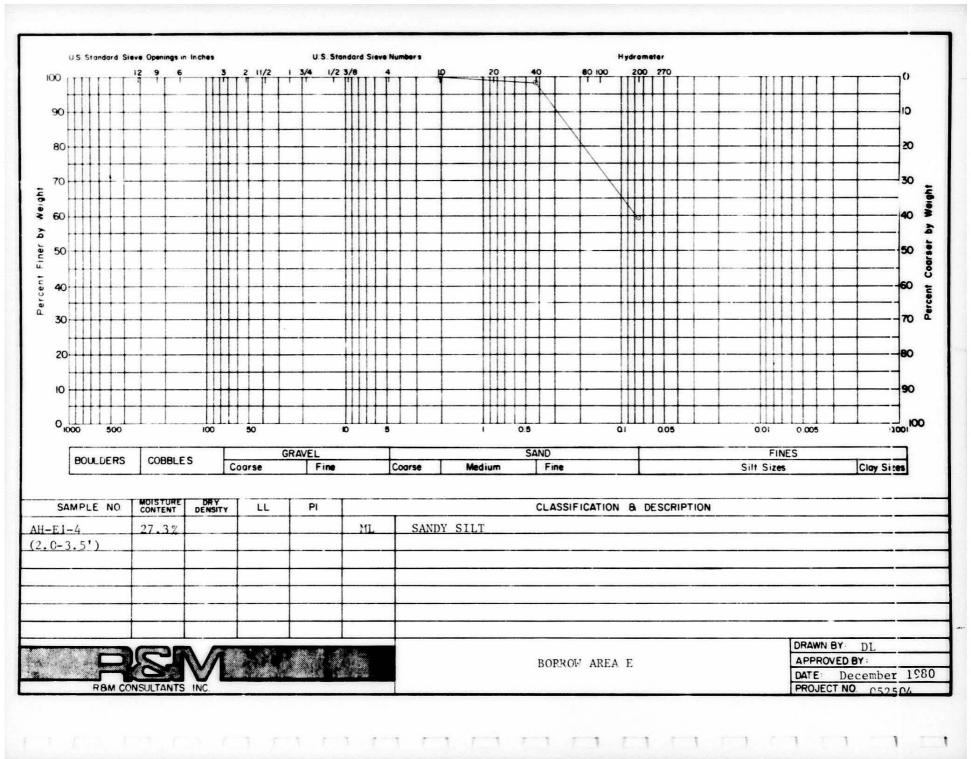
BORING	SAMPLE NO.	DEPTH	+12"	7"	3"	2"	1½"	1"	3/4"	1/2	3/8"	#4	#10	#20	#40	#80	100	#200	CLASS		
E17	1_	0.5'- 1.0'										100	98	94	89	79	76	67.7	SM-MH		
E17	2	3.5'- 4.0'												100	98	82	73	41.4	SM		
E17	3	10.0'-10.5'		76	75	70	64	56	51	46	42	35	27	19	13	7	6	4.5	GP-GM	-	-
E18	1	0.25'-0.75'			100	92	89	76	69	61	55	45	34	20	12	5	4	2.0	GP		
E18	2	2.5'		100	90	88	88	84	84	83	82	80	79	78	73	50	45	28.1	SM		
E18	3	5.0'- 5.5'			100	98	93	81	69	57	50	37	29	. 19	9	3	2	1.1	GP		
E18	4	10.0'-10.5'	_	80	65	60	56	48	43	39	36	29	22	15	9	4	4	2.4	GP		
E19	1	1.0'- 1.5'												100	98	76	65	3.6	SM		
E19	2	2.5'- 3.0'											100	99	95	53	44	21.2	SM		
E20	1	1.5'- 2.0'										100	99	99	97	81	76	53.4	SM-ML		
E20	2	3.0'- 3.5'	74	62	39	36	33	30	28	26	24	21	18	13	8	3	3	1.5	SP		
E20	3	7.5'- 8.5'		100	91	85	84	84	83	82	82	81	79	72	65	49	45	31.4	SM		
E20	4	11.0'-11.5'		72	58	56	50	46	43	39	38	34	29	23	18	11	10	6.4	SP-SM		
E21	1	2.0'- 2.5'											100	97	92	84	82	70.3	SP-SC		
E21	2	6.5'- 7.0'		48	31	30	27	24	22	20	18	15	13	11	9	6	6	4.3	GP-GM		

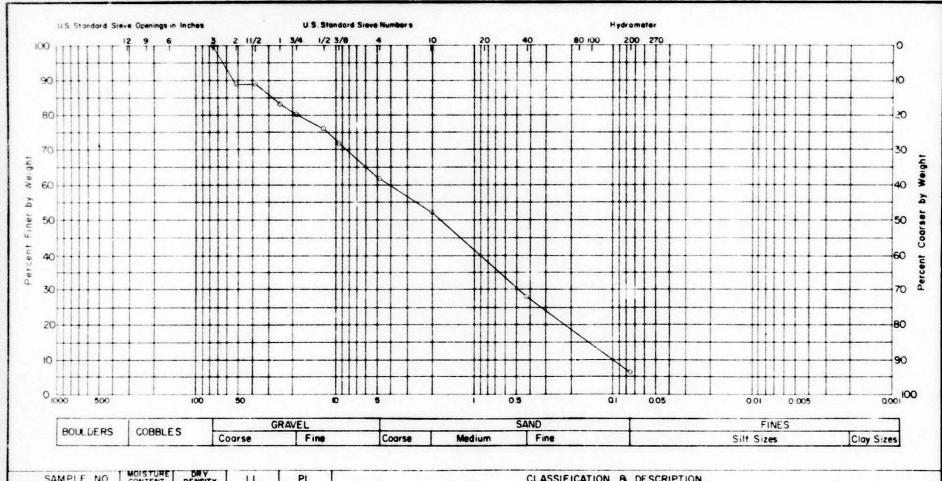
REMARKS :	 	 	

NOTE: SIEVE ANALYSIS = PERCENT PASSIN





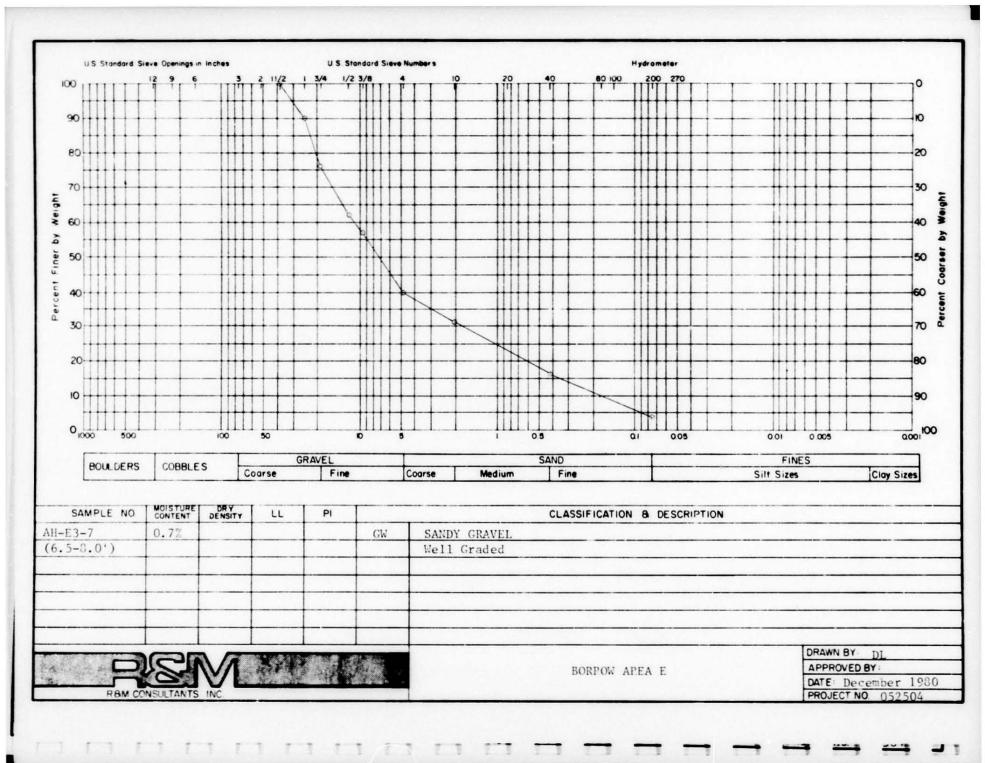


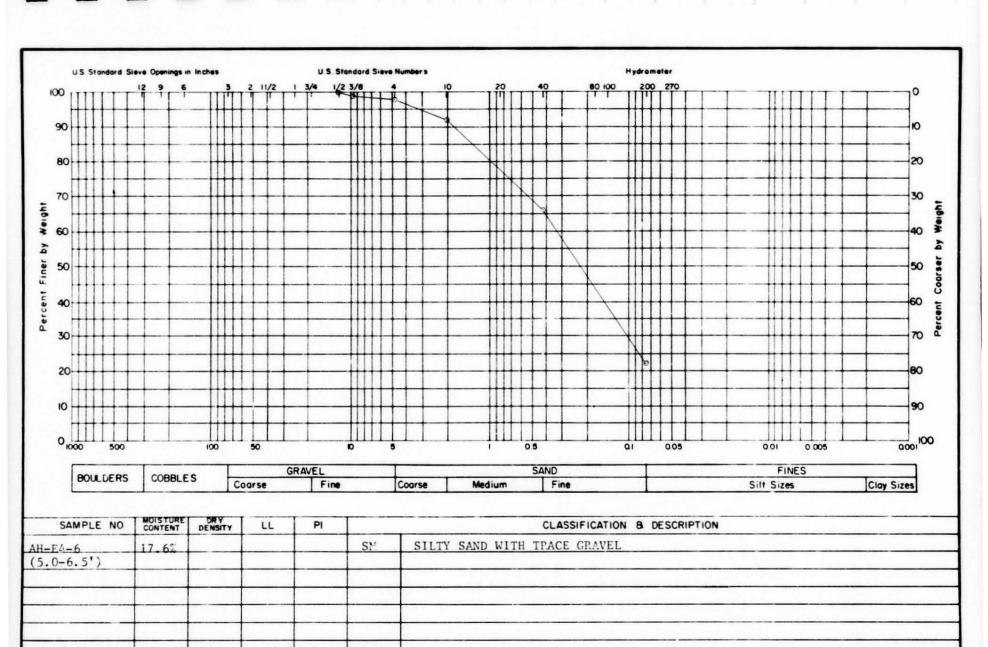


SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASSIFICATION & DESCRIPTION						
AH-E3-6	4.4%				SP-SN	GRAVELLY SAND					
(4.5-6.0')						Poorly Craded					
							DRAWN BY DL				

BORROW AREA E

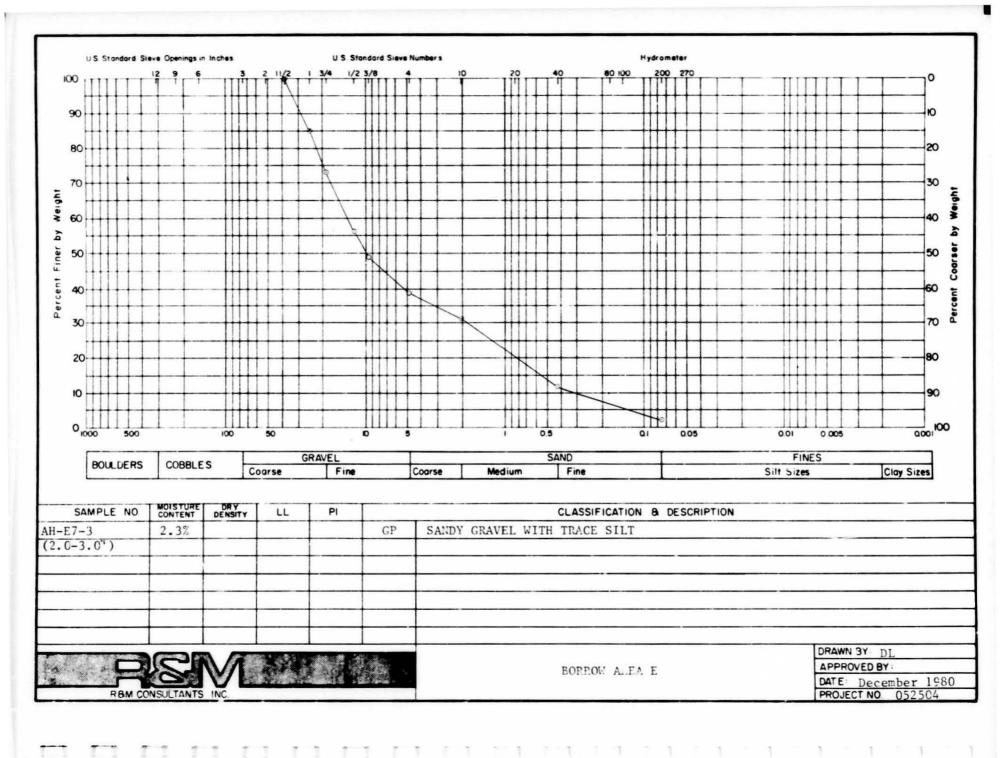
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APPROVED BY:
DATE: December 1980
PROJECT NO 052504

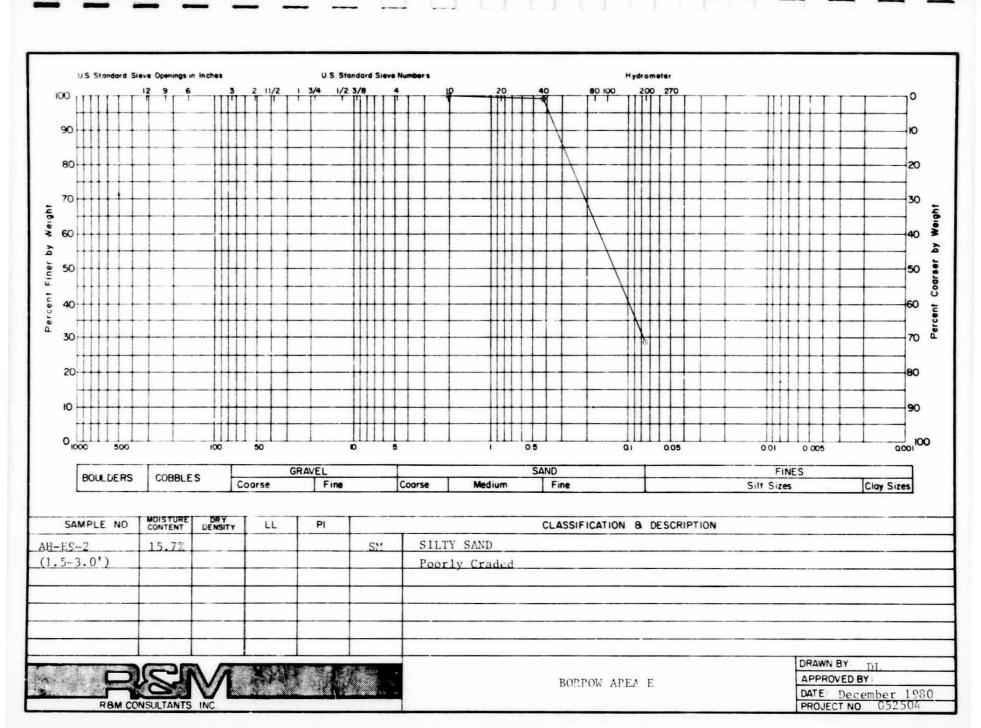


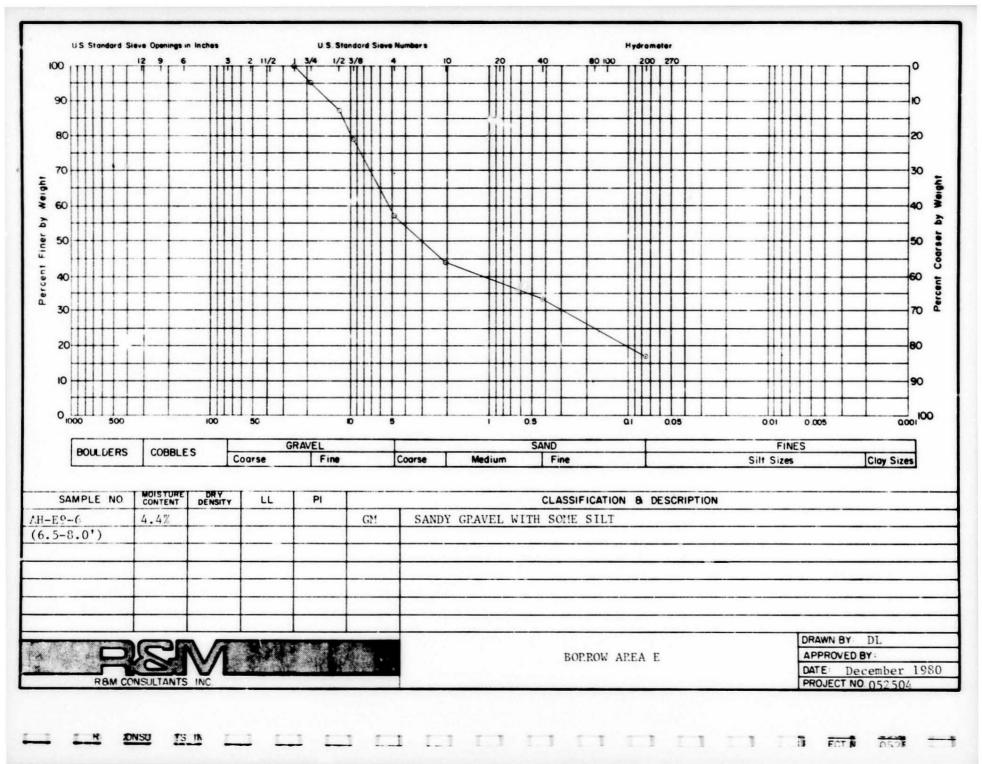


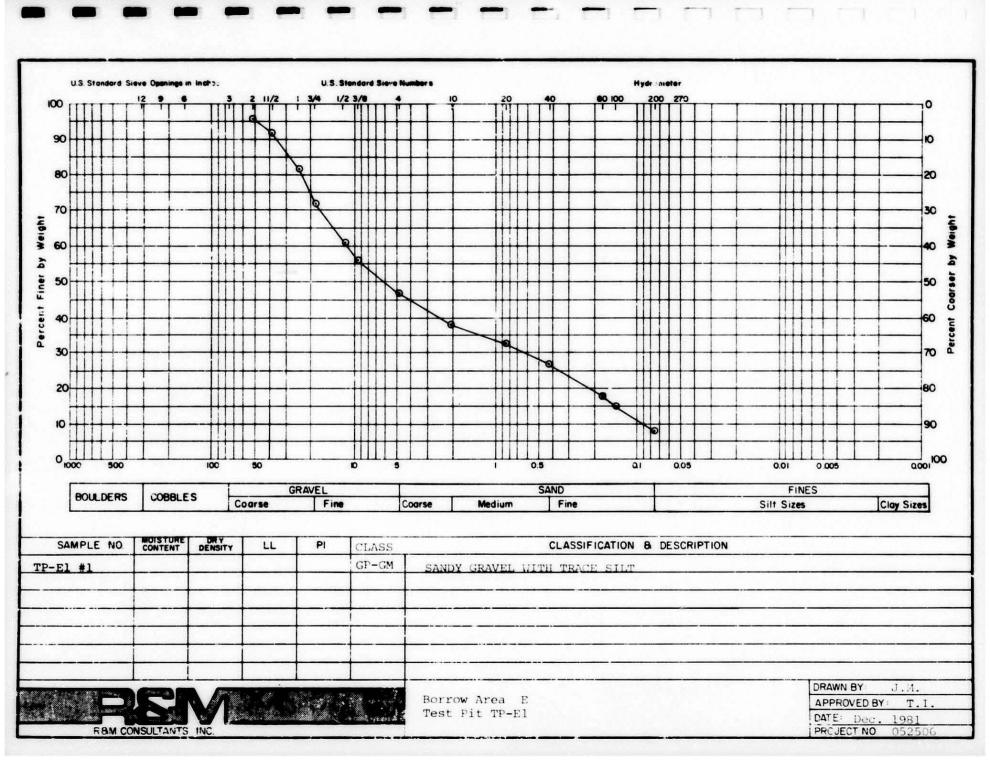
BORROW AREA E

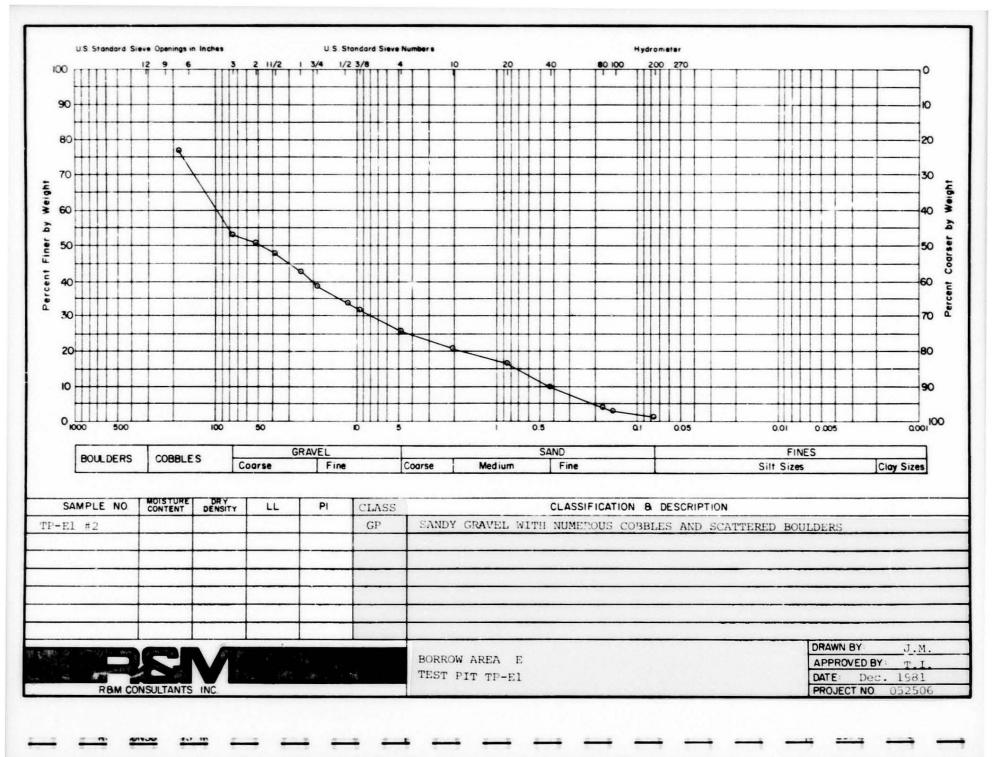
DRAWN BY: DI.
APPROVED BY:
DATE: December 1980
PROJECT NO. 052504

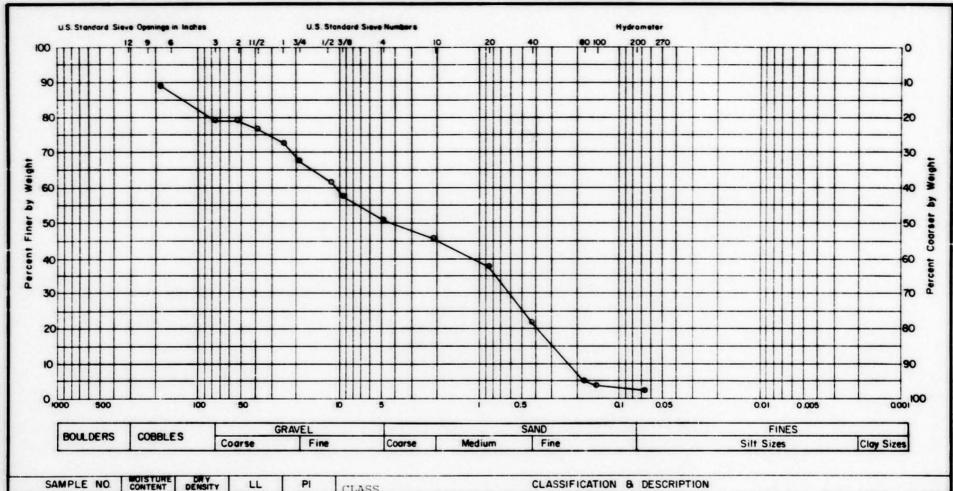






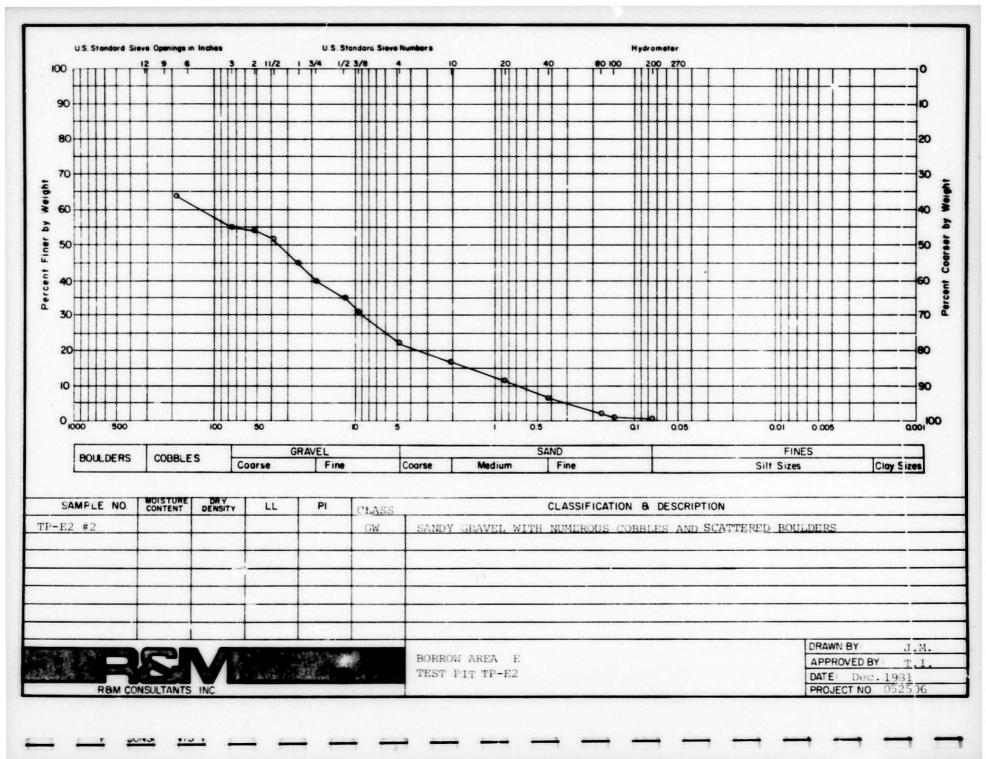


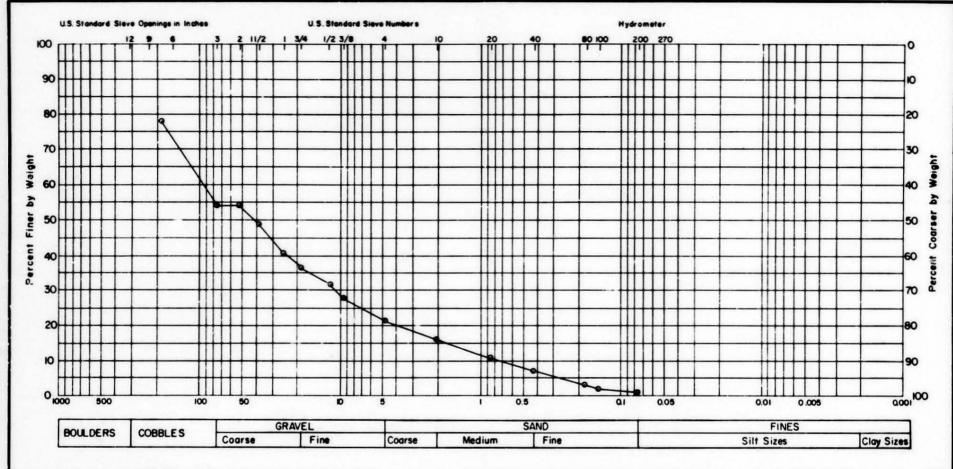




TP-E2 #1 SP GRAVELLY SAND WITH SCATTERED COBBLES	SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
	TP-E2 #1					SP	GRAVELLY SAND WITH SCATTERED COBBLES
			100				
					TYPE N		

BORROW AREA E TEST PIT TP-E2



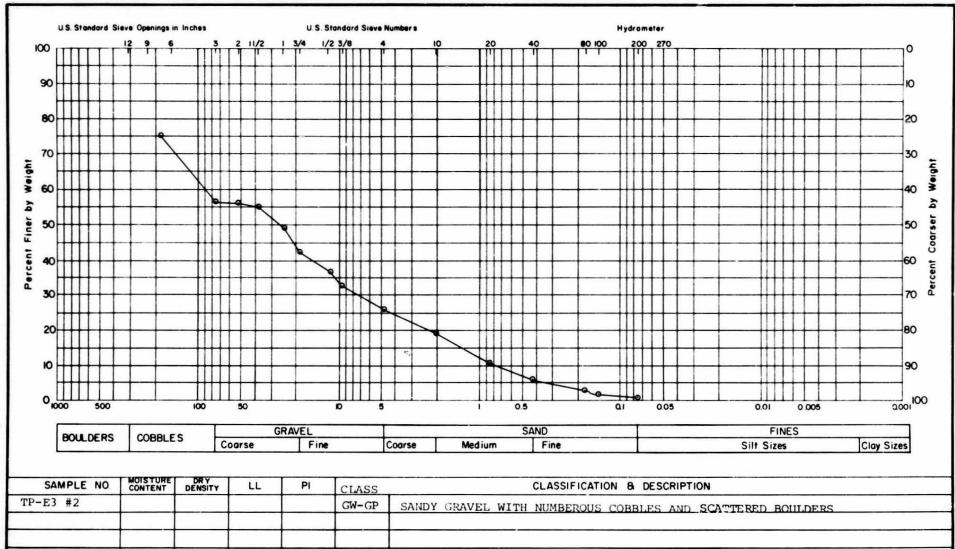


SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E3 #1					GW	SANDY GRAVEL WITH NUMEROUS COBBLES AND SCATTERED BOULDERS
No. 20 5 1 2 15 10 10 10 10 10 10 10 10 10 10 10 10 10		To the		and the latest and th		DRAWN BY: J.M.

BORROW AREA E TEST PIT TP-E3 APPROVED BY: T.1.

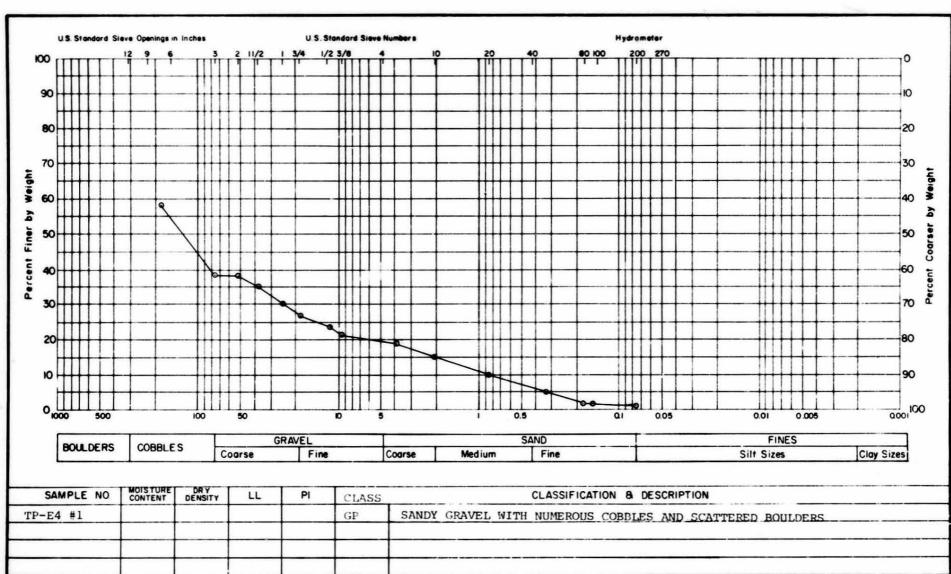
DATE: Dec. 1981

PROJECT NO. 052506



SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCR	RIPTION
ГР-E3 #2					GW-GP	SANDY GRAVEL WITH NUMBEROUS COBBLES A	ND SCATTERED BOULDERS
					+		
						BORROW AREA F	DRAWN BY: J.M.

BORROW AREA E TEST PIT TP-E3



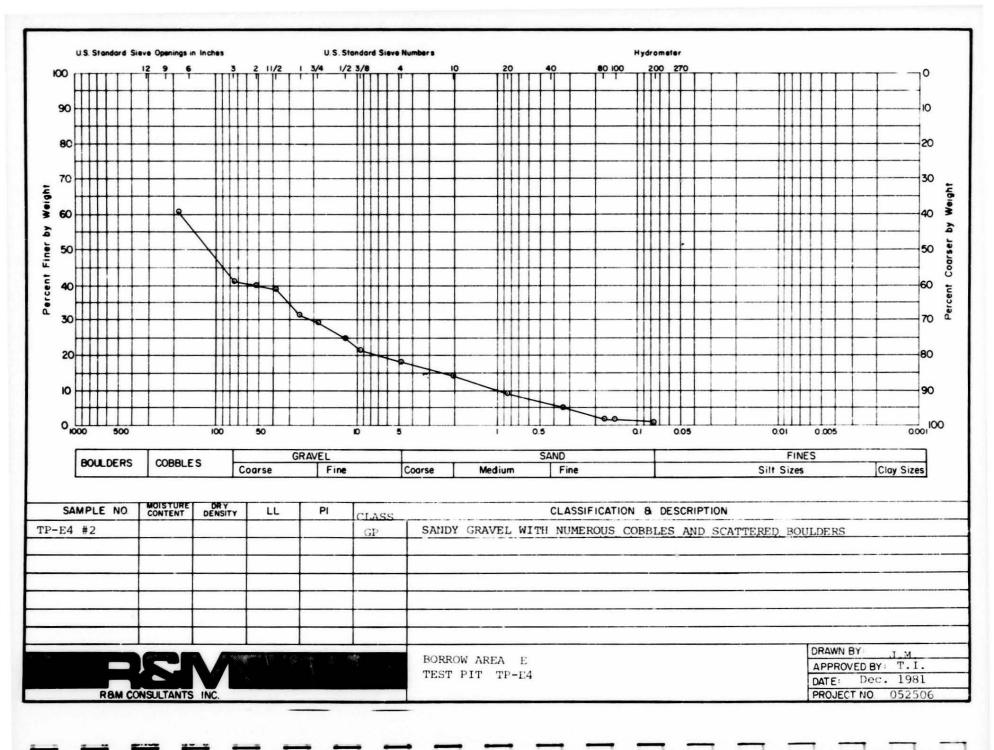
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRI	PTION
TP-E4 #1					GP	SANDY GRAVEL WITH NUMEROUS COBBLES AND	D_SCATTERED_BOULDERS
							DRAWN BY: J.M.
						BORROW AREA E	APPROVED BY: T.I.

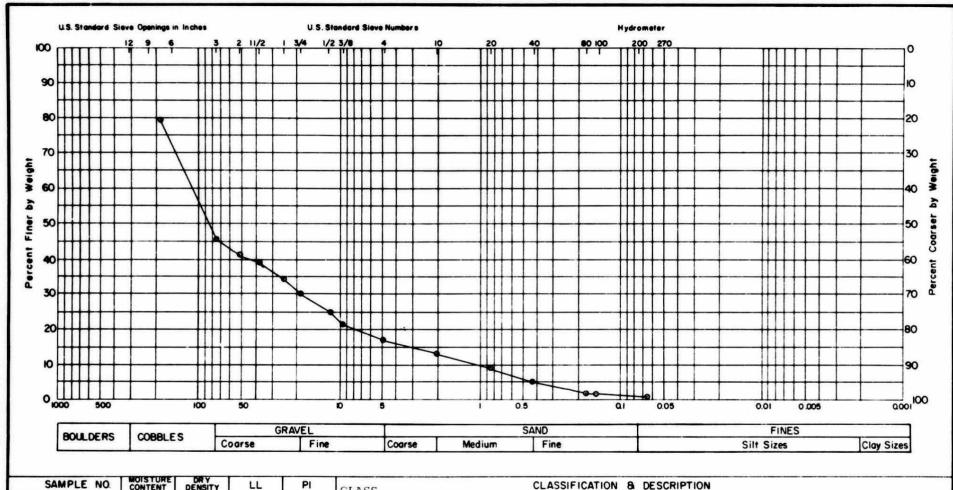
DATE: Dec. 1981

PROJECT NO. 052506

TEST PIT TR-E4

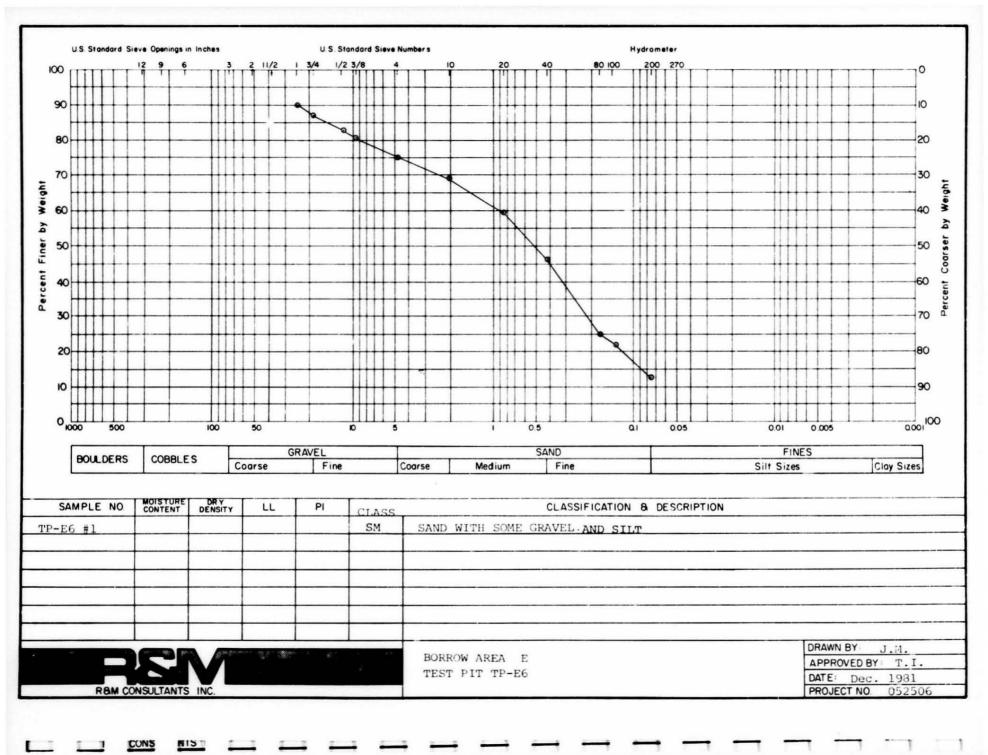
ROM CONSULTANTS INC.

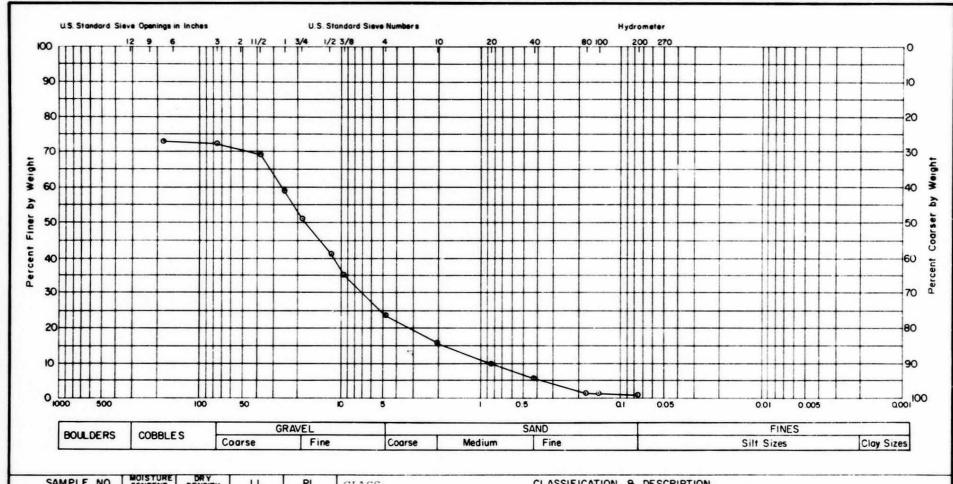




SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
P-E5 #1					GW-GP	SANDY GRAVEL WITH NUMEROUS COBBLES AND SCATTERED BOULDERS
					1	

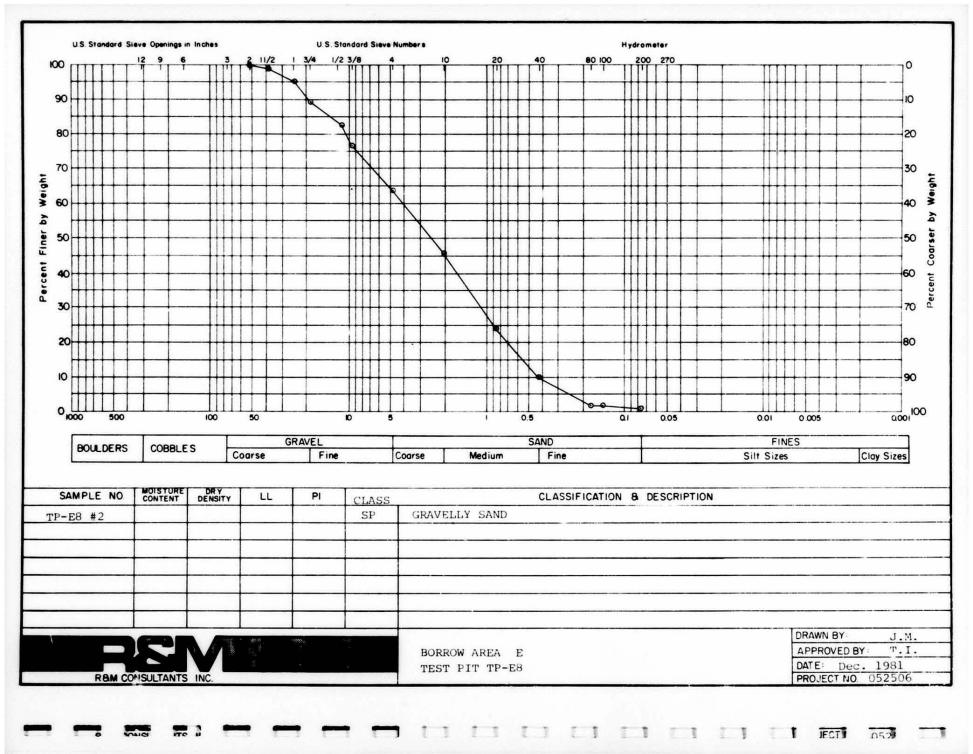
BORROW AREA E TEST PIT TP-E5

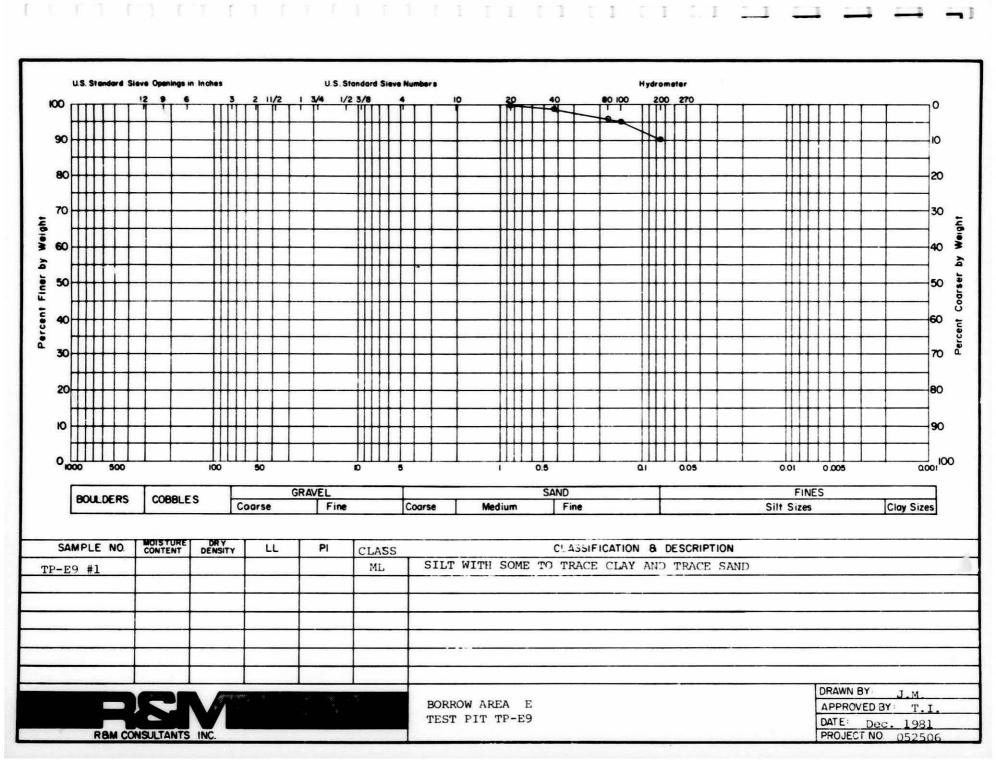


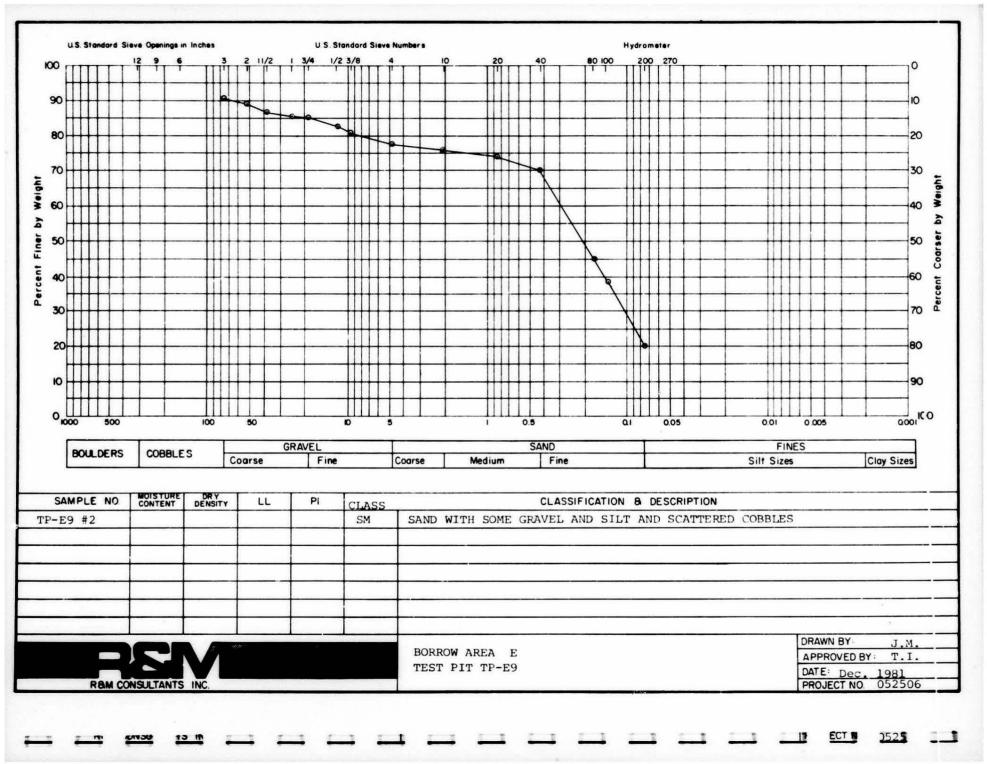


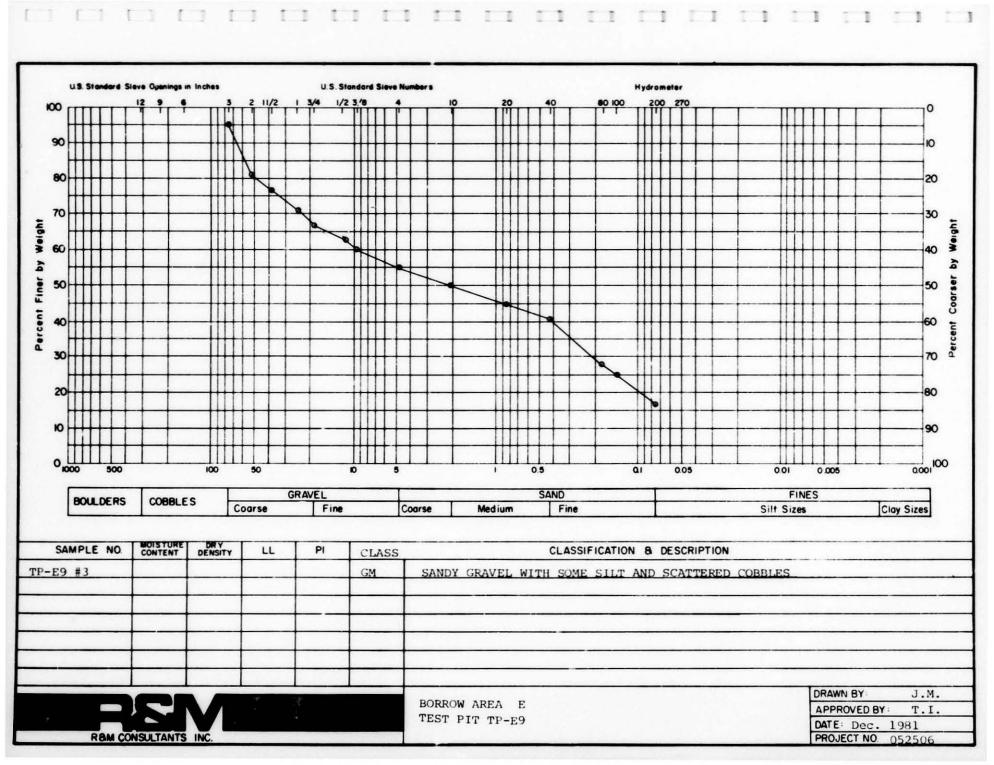
TP-E3 #1				
	 		GW	SANDY GRAVEL WITH SCATTERED COBBLES AND BOULDERS
		-		

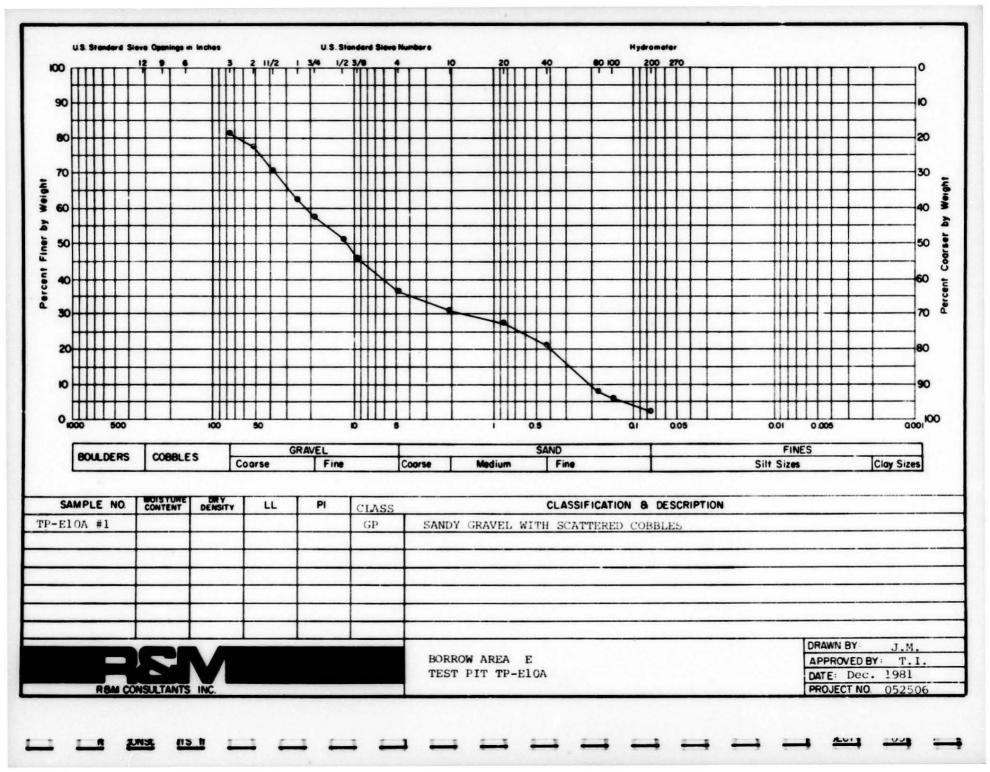
BORROW AREA E TEST PIT TP-E8

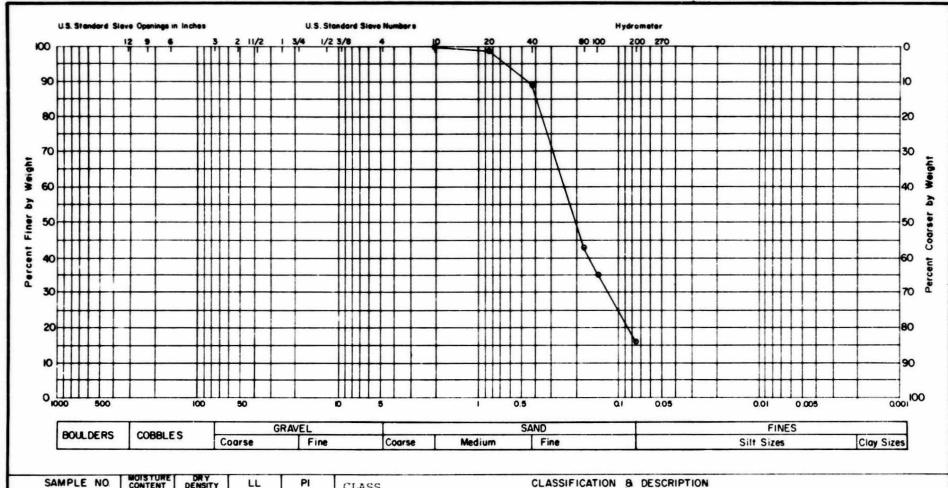






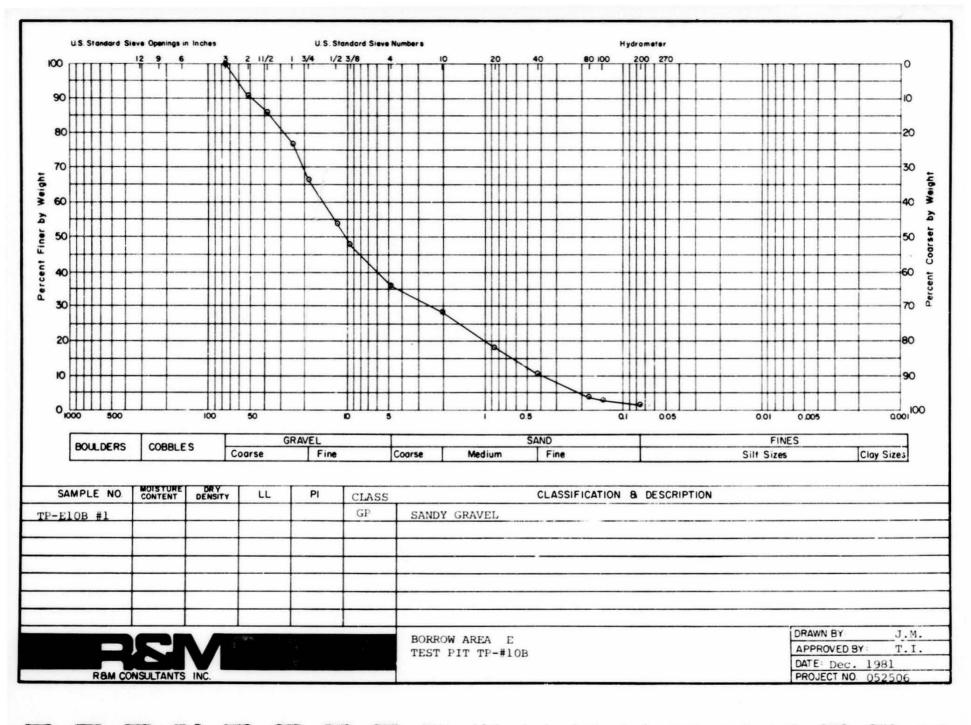


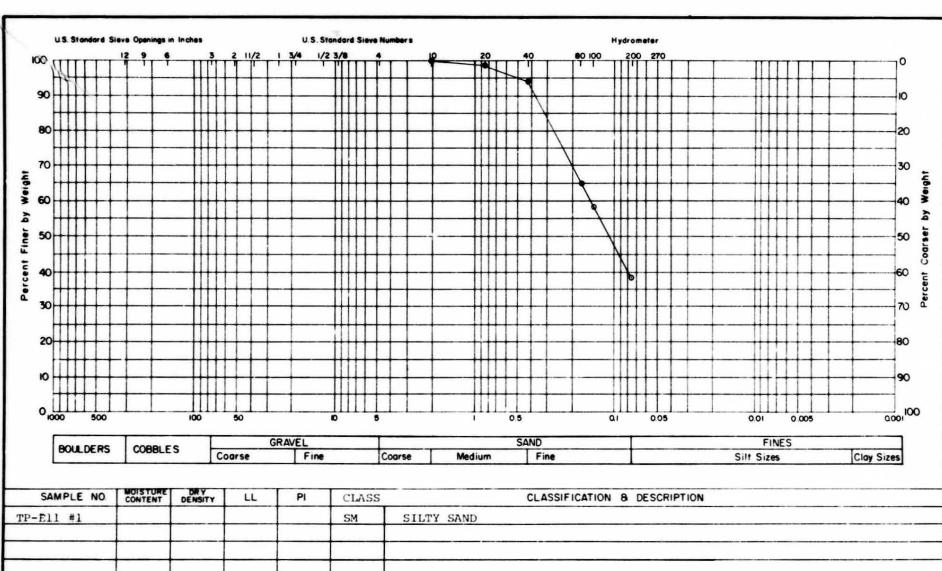




SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E10A #2					SM	SAND WITH SOME SILT
			,			

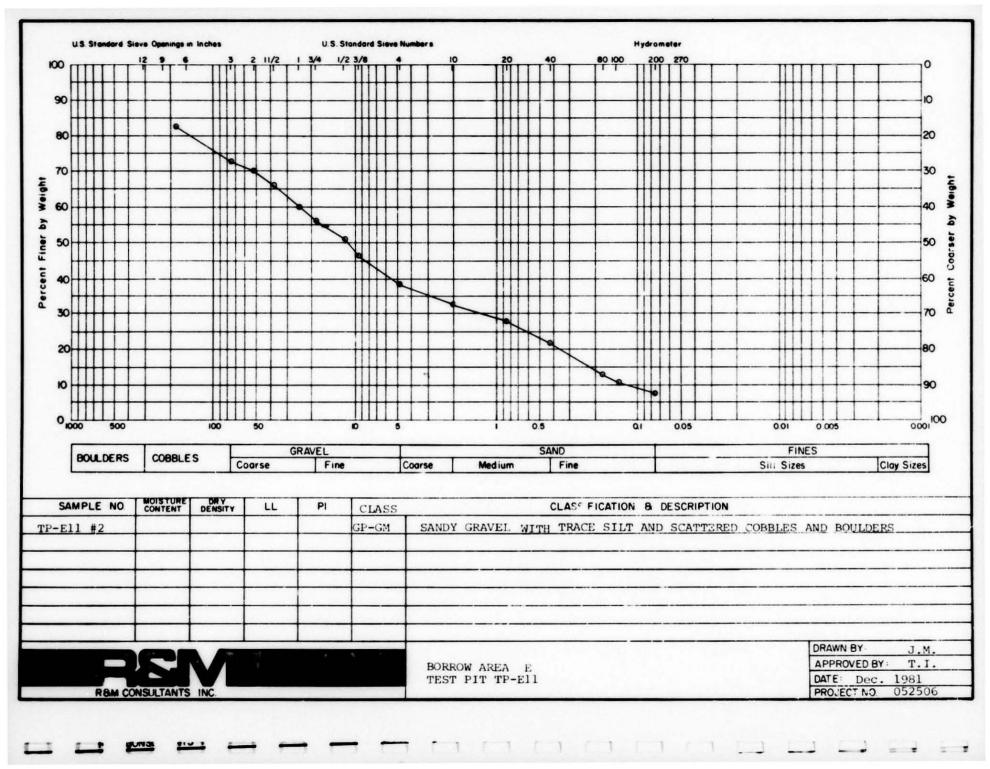
BORROW AREA E TEST PIT TP-E10A

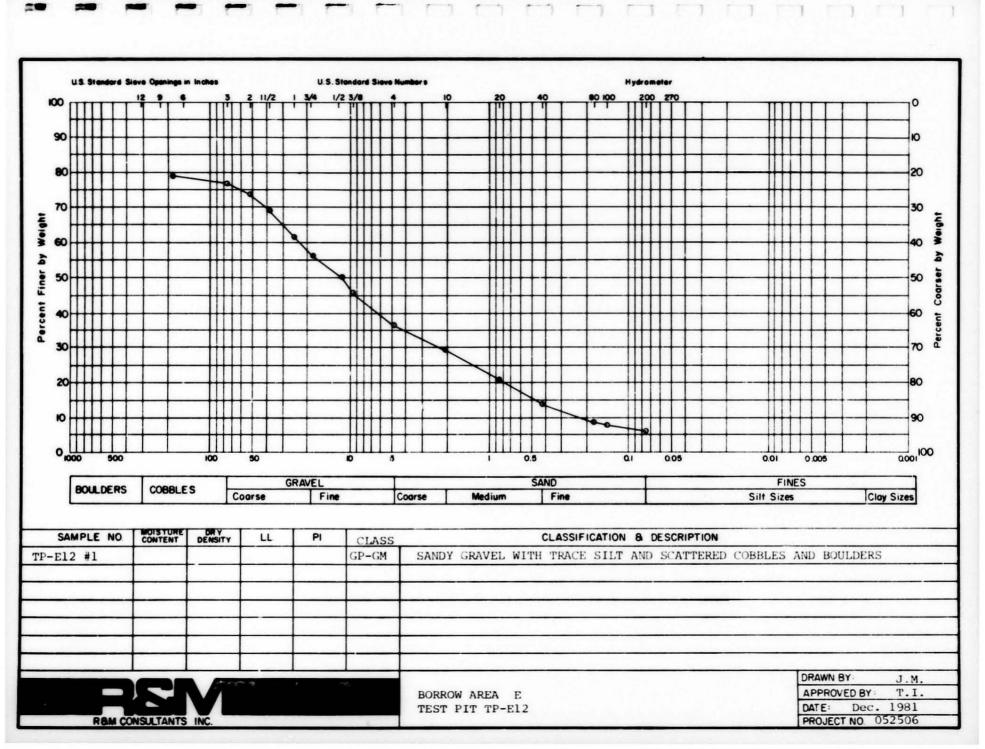


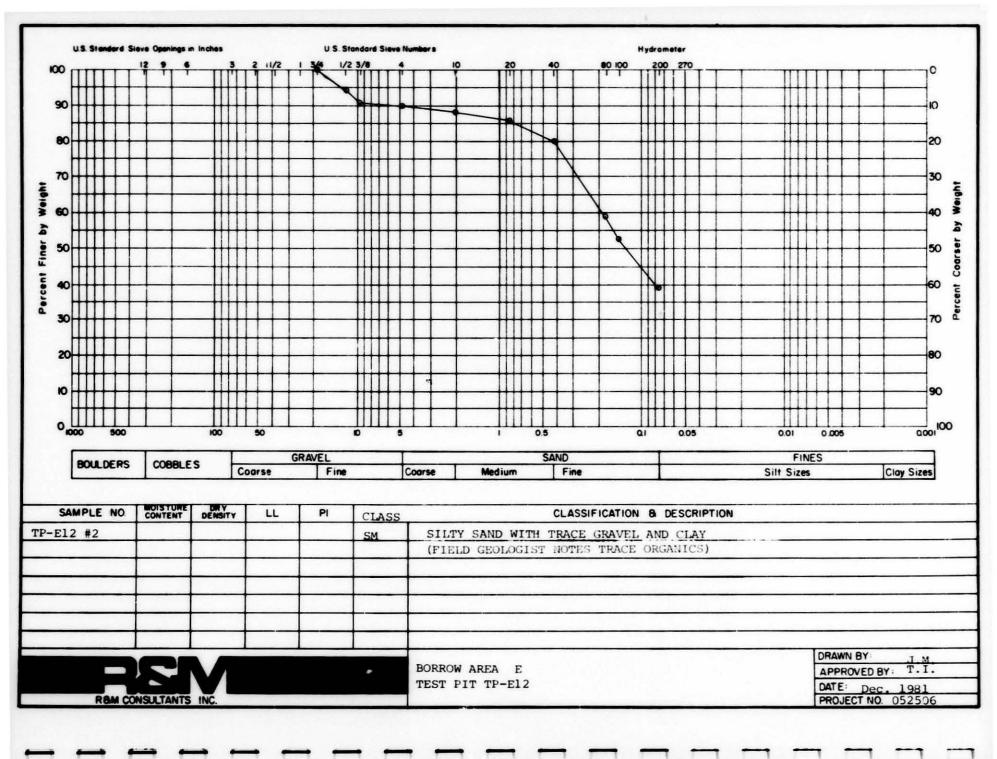


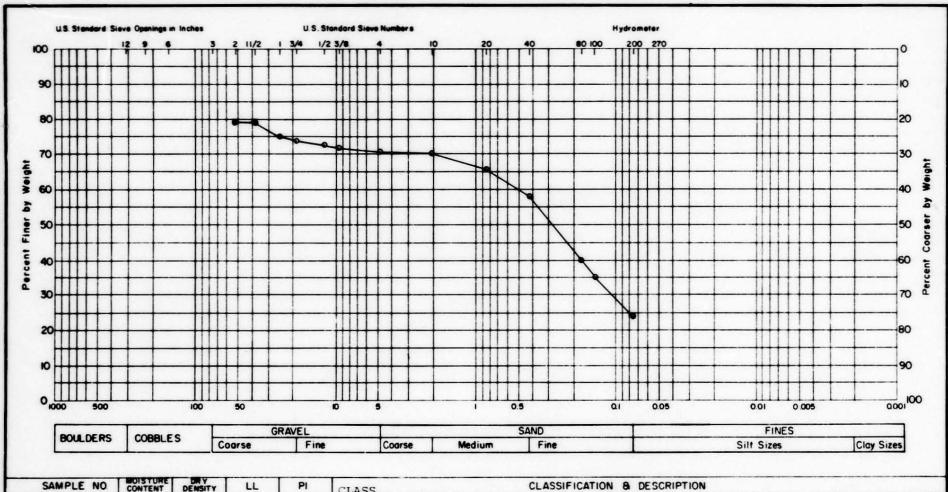
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTIO	N
TP-E11 #1					SM	SILTY SAND	
	-						
							Inquiri ov

BORROW AREA E TEST PIT TP-E11









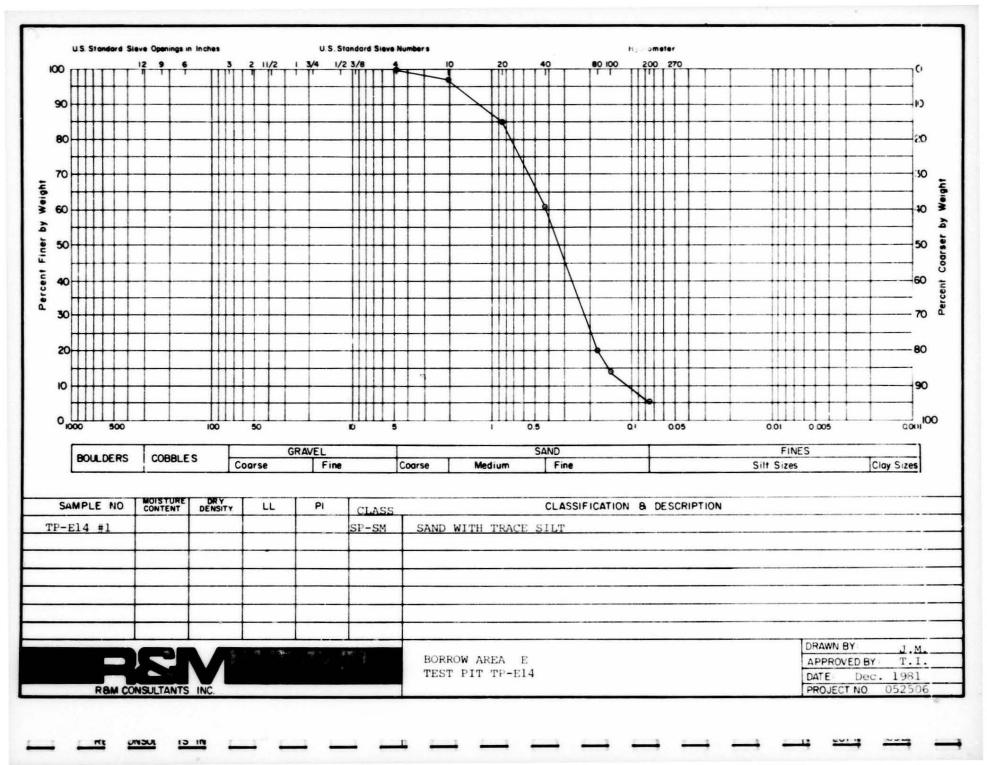
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E12 #3					SM	SAND WITH SOME SILT, TRACE GRAVEL AND SCATTERED COBBLES
					-	
	-				-	
						DRAWN BY

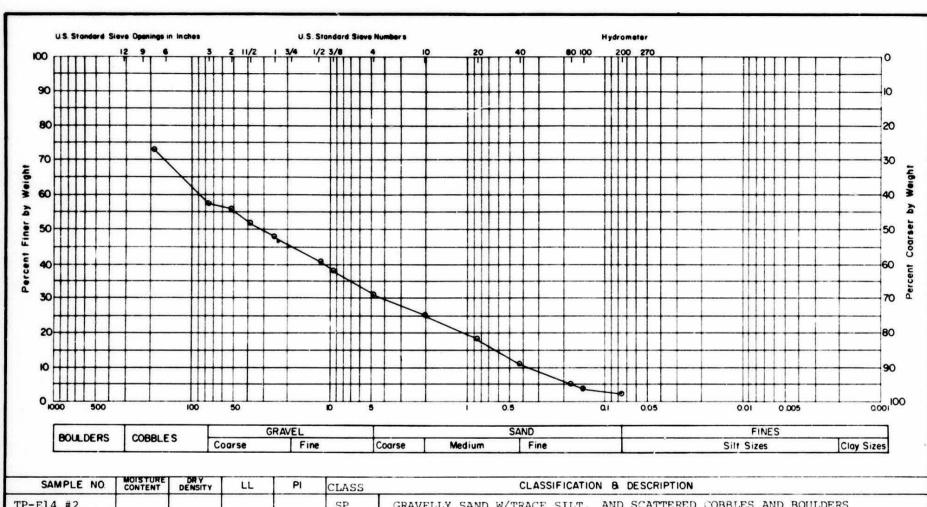
BORROW AREA E TEST PIT TP-E12 DRAWN BY J.M.

APPROVED BY T.I.

DATE: Dec. 1981

PROJECT NO 052506





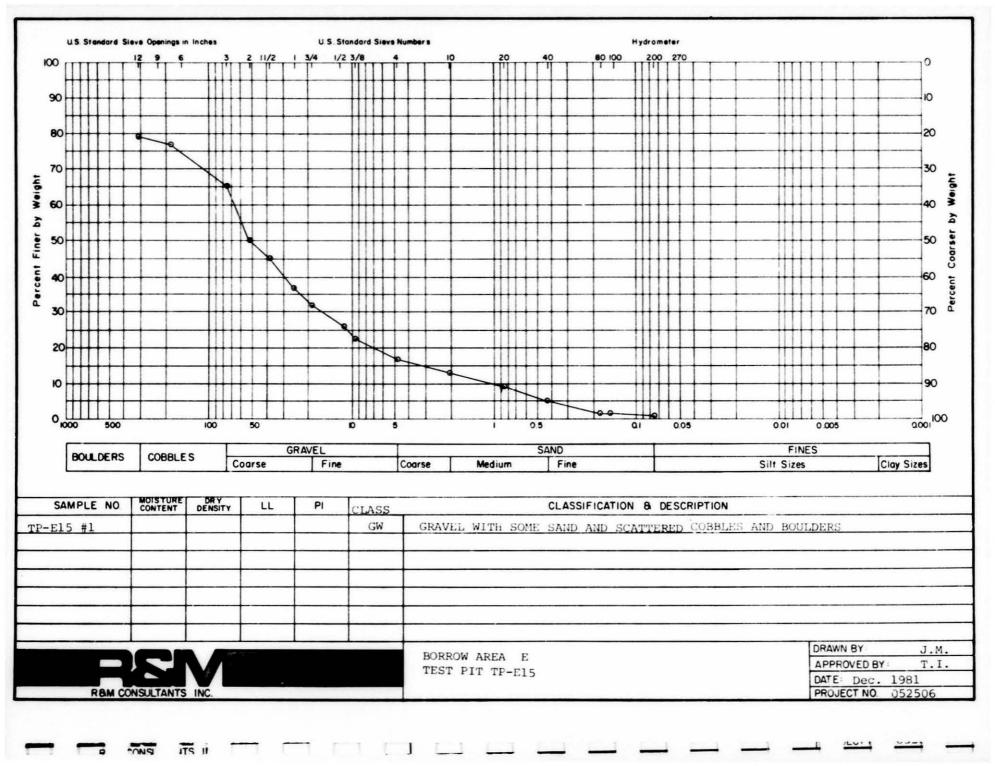
SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E14 #2					SP	GRAVELLY SAND W/TRACE SILT, AND SCATTERED COBBLES AND BOULDERS
						•
			B) \$0. * *\$2		AND THE RESIDENCE	DRAWN BY: J.M

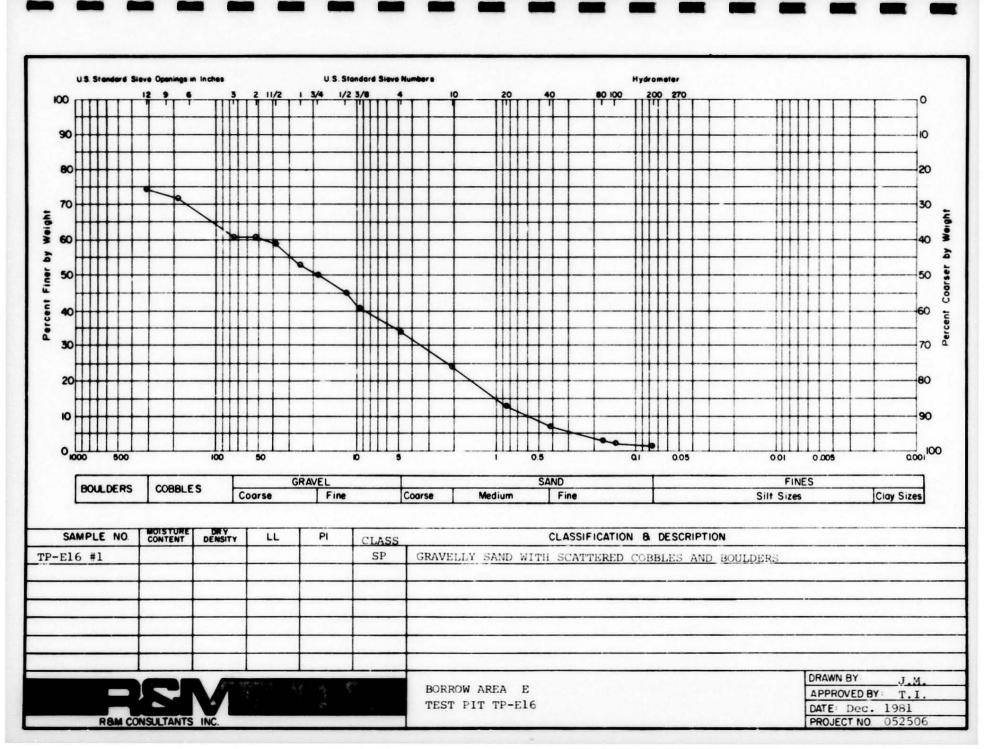
BORROW AREA E TEST PIT TP-E14 DRAWN BY: J.M.

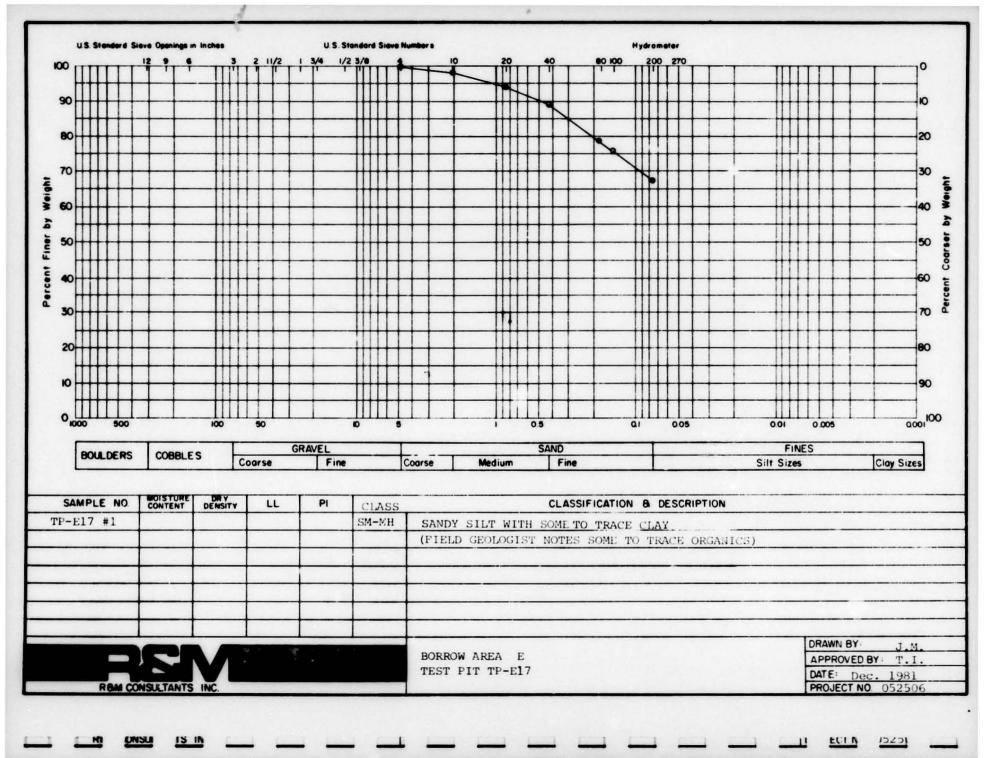
APPROVED BY: T.I.

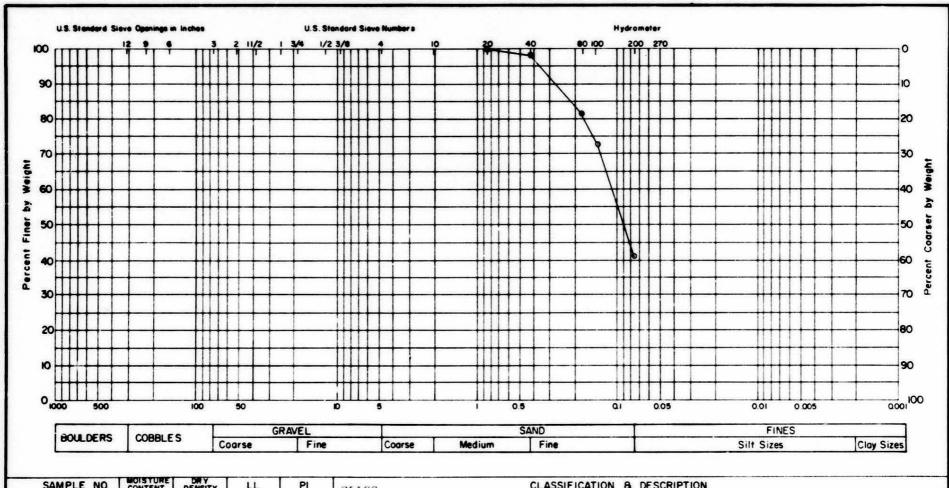
DATE: Dec. 1981

PROJECT NO. 052506









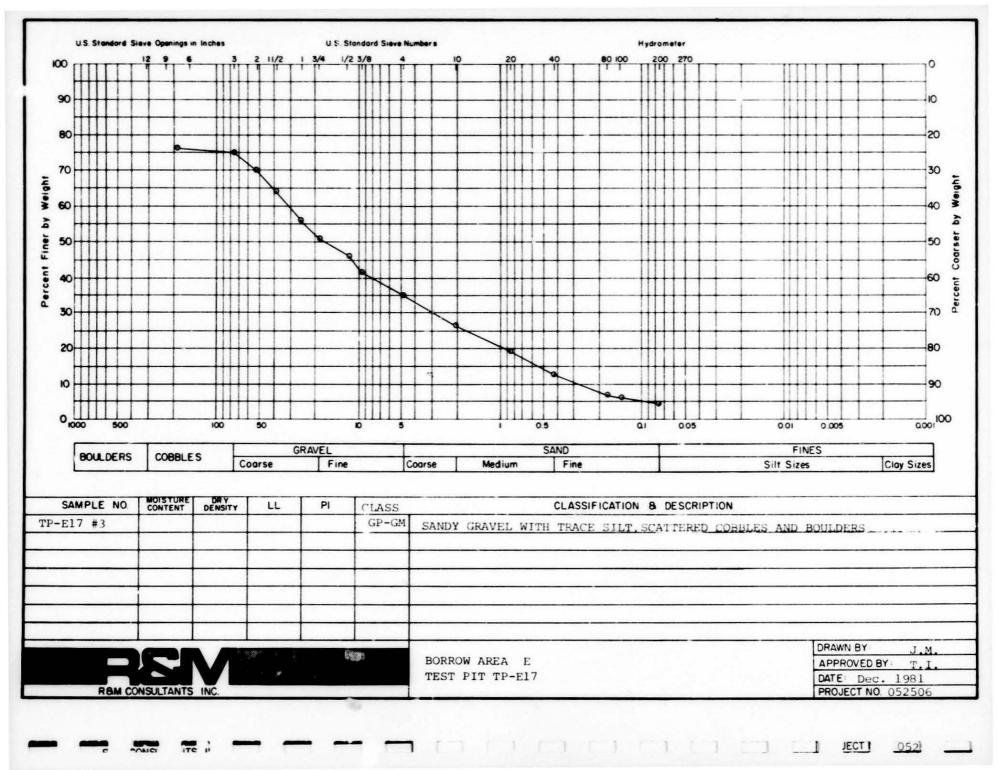
SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E17 #2					SM	SILTY SAND
					-	

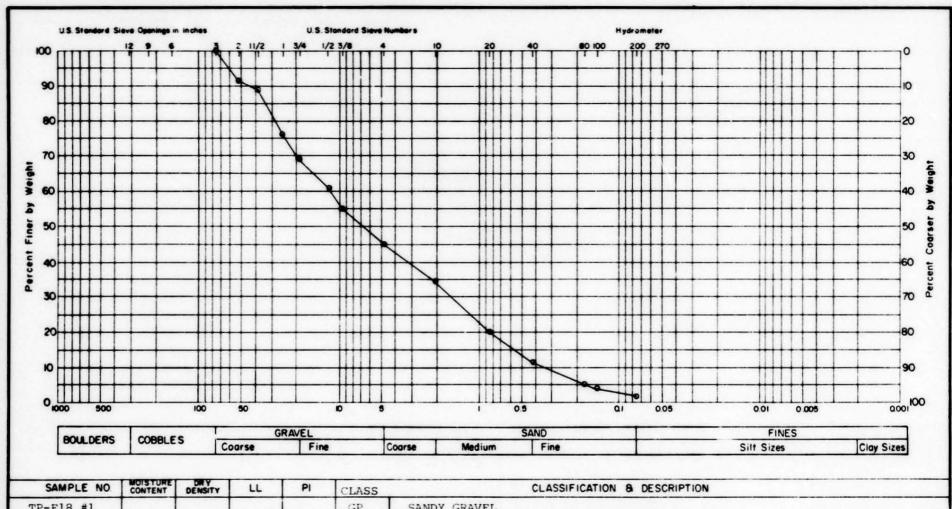
BORROW AREA E TEST PIT TP-E17 DRAWN BY: J.M.

APPROVED BY: T.I.

DATE: Dec. 1981

PROJECT NO. 052506





SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION		
P-E18 #1					GP	SANDY GRAVEL		
						(FIELD GEOLOGIST NOTES SOME ORGANICS)		
					1		*****	
					1	· <del></del>	DRAWN BY	J.M.

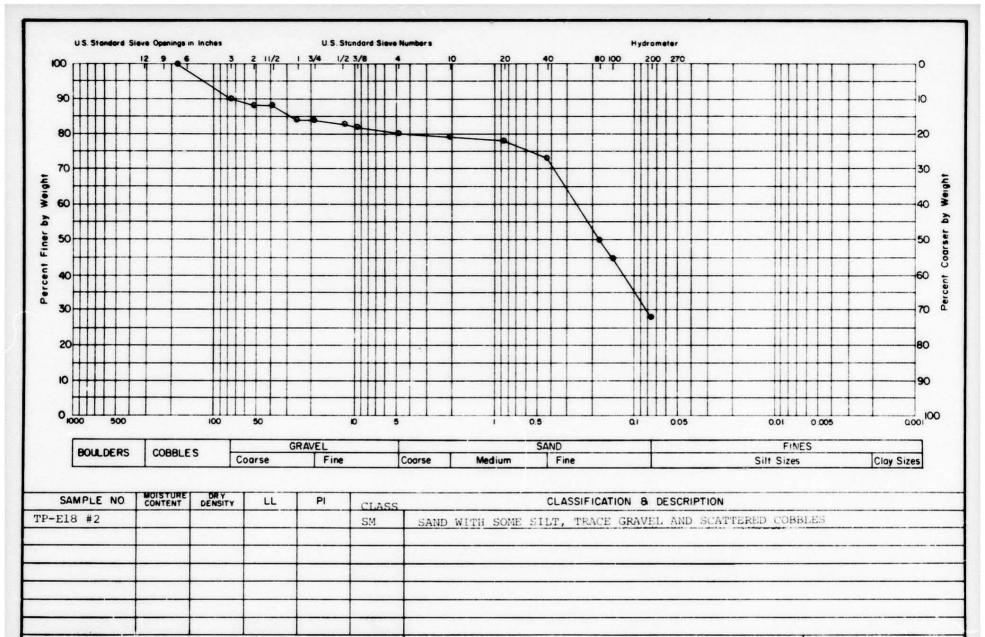
TEST PIT TP-E18

DRAWN BY J.M.

APPROVED BY T.I.

DATE: Dec. 1981

PROJECT NO. 052506

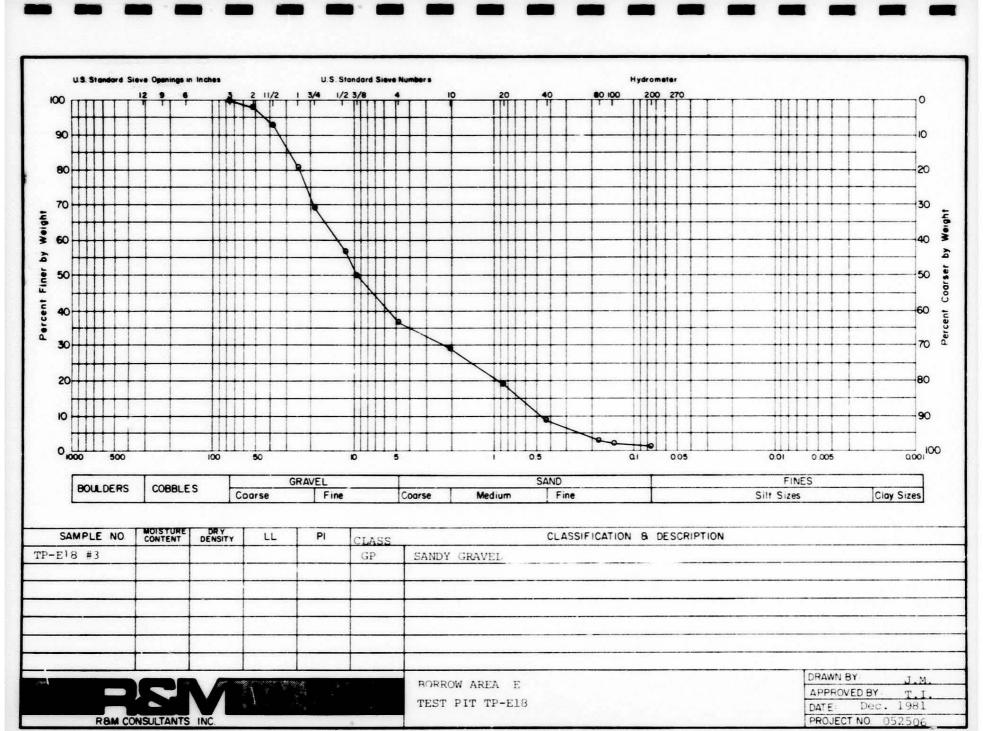


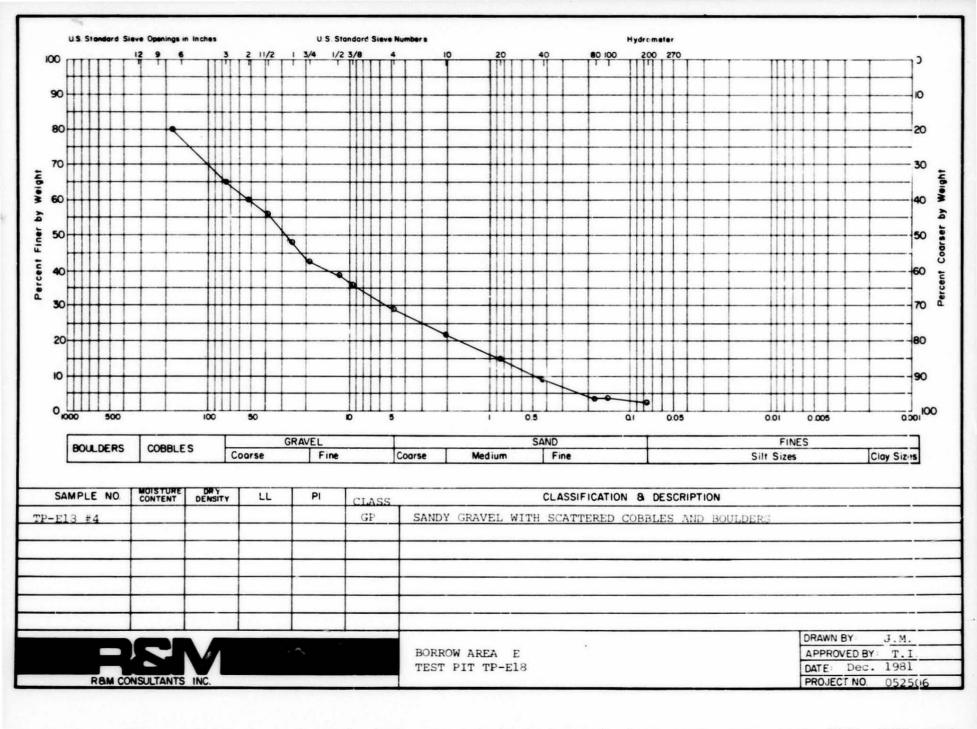
BORROW AREA E TEST PIT TP-E18 DRAWN BY J.M.

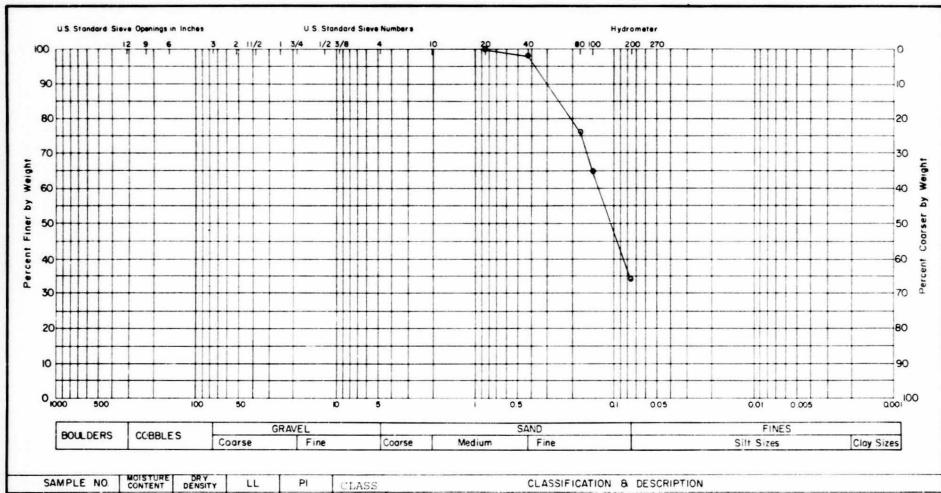
APPROVED BY: T.I.

DATE: Dec. 1981

PROJECT NO. 052506

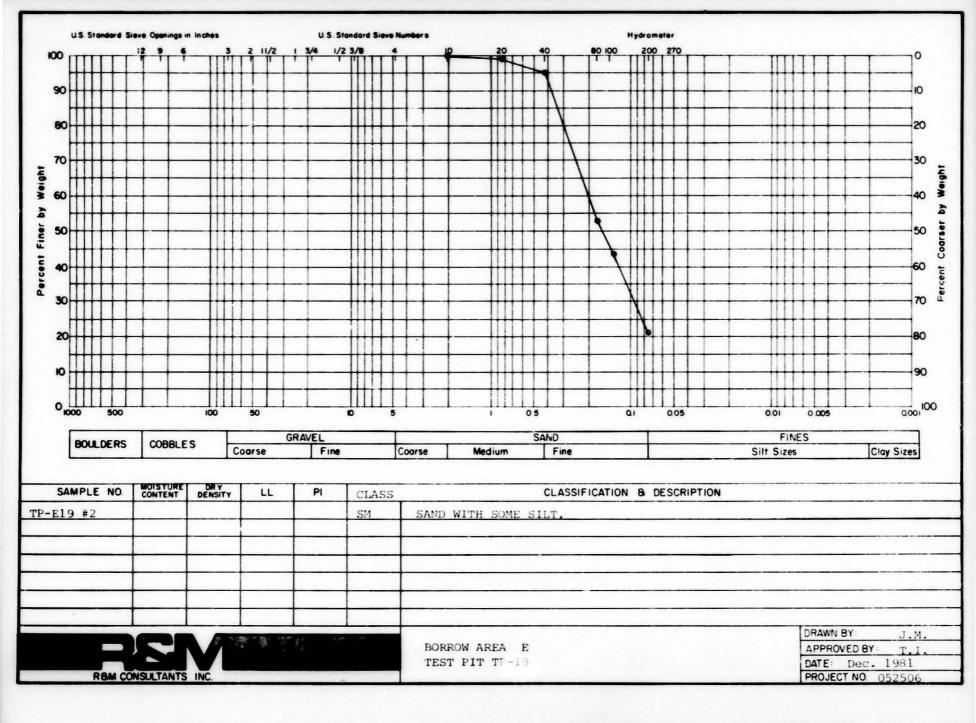


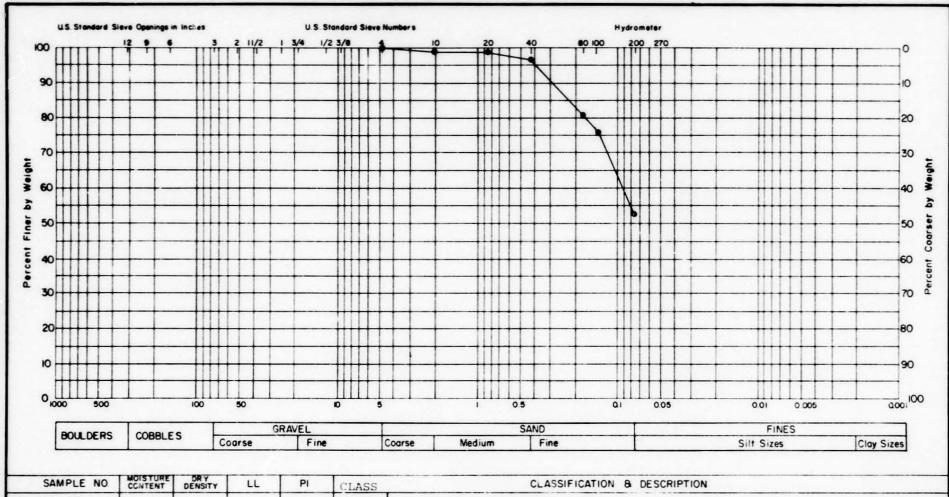




SAMPLE NO.	CONTENT	DRY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION		
TP-E19 #1					SM	SILTY SAND WITH TRACE CLAY.		
						(FIELD GEOLOGIST NOTES TRACE ORGANICS)		
					1			
							TORAWN BY	

BORROW AREA E TEST PIT TP-E19 DRAWN BY: J.M.
APPROVED BY: T.I.
DATE: Dec. 1981
PROJECT NO 052506





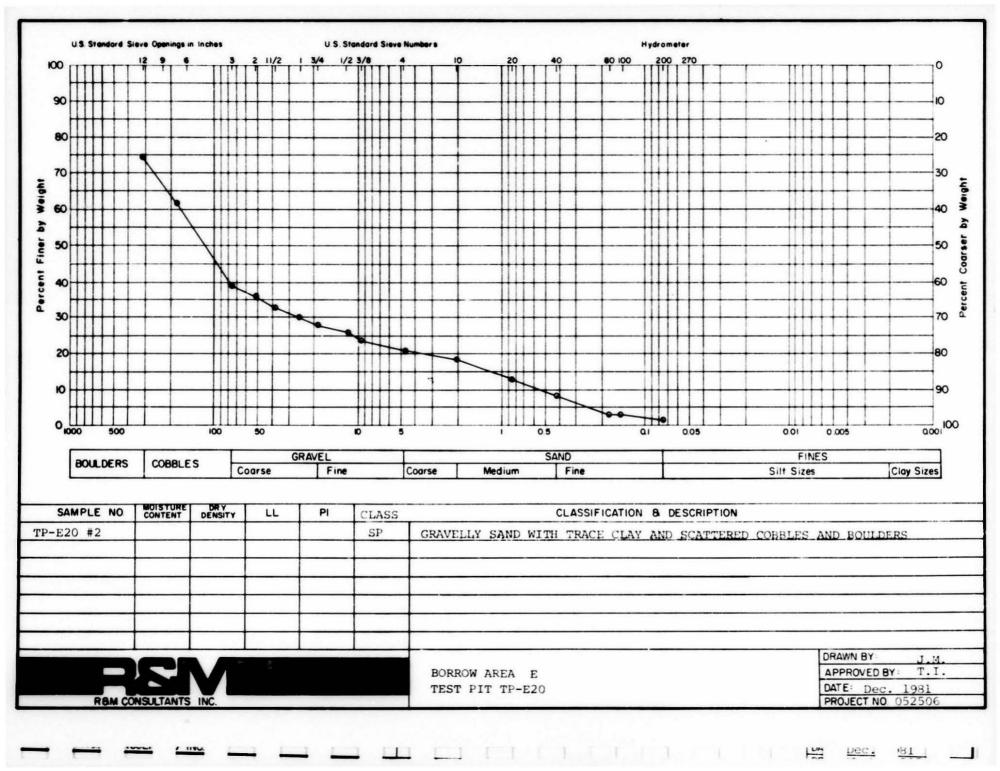
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E20 #1					SM-ML	SANDY SILT WITH TRACE CLAY
						(FIELD GEOLOGIST NOTES TRACE ORGANICS)
					1	CDANIA DV. T. M.

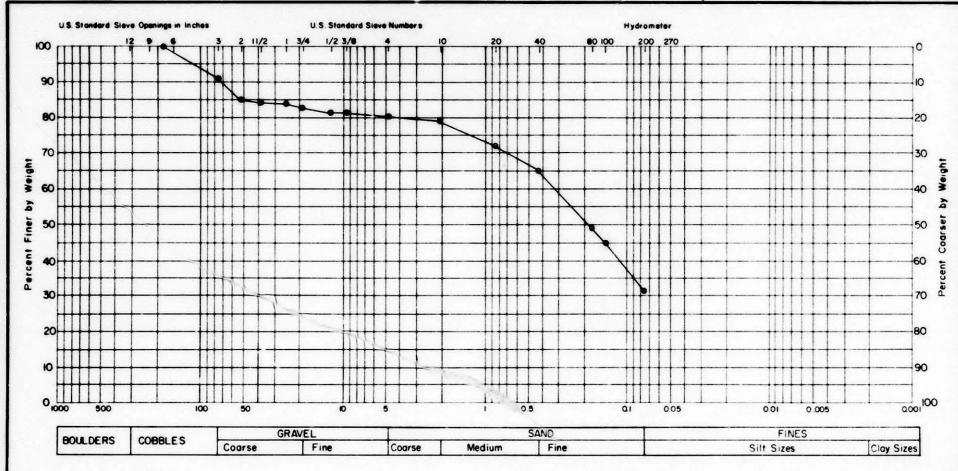
BORROW AREA E TEST PIT TP-E20 DRAWN BY: J.M.

APPROVED BY: T.I.

DATE: Dec. 1981

PROJECT NO 052506



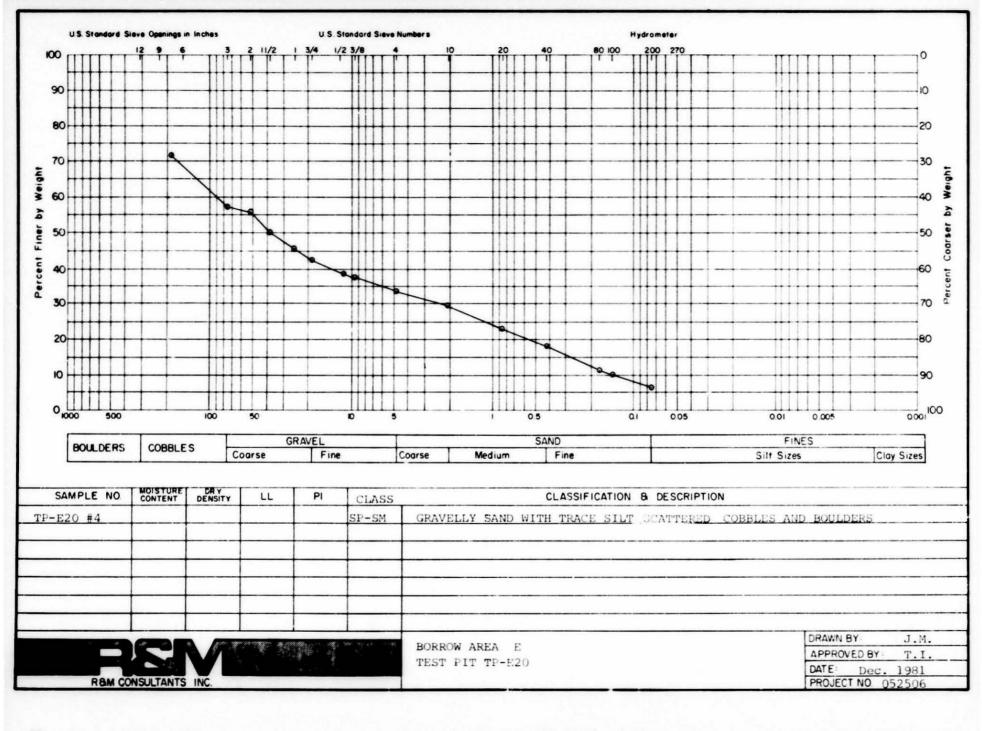


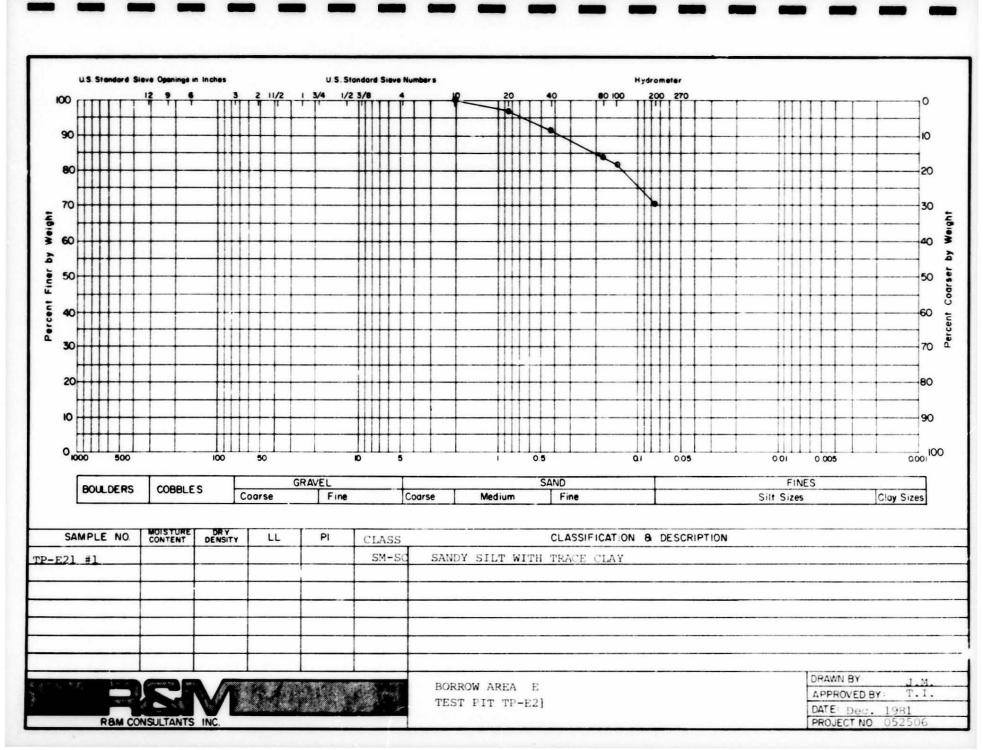
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASS	CLASSIFICATION & DESCRIPTION
TP-E20 #3					SM	SILTY SAND WITH TRACE CLAY AND GRAVEL AND SCATTERED COBBLES
				ļ		
	L	1				

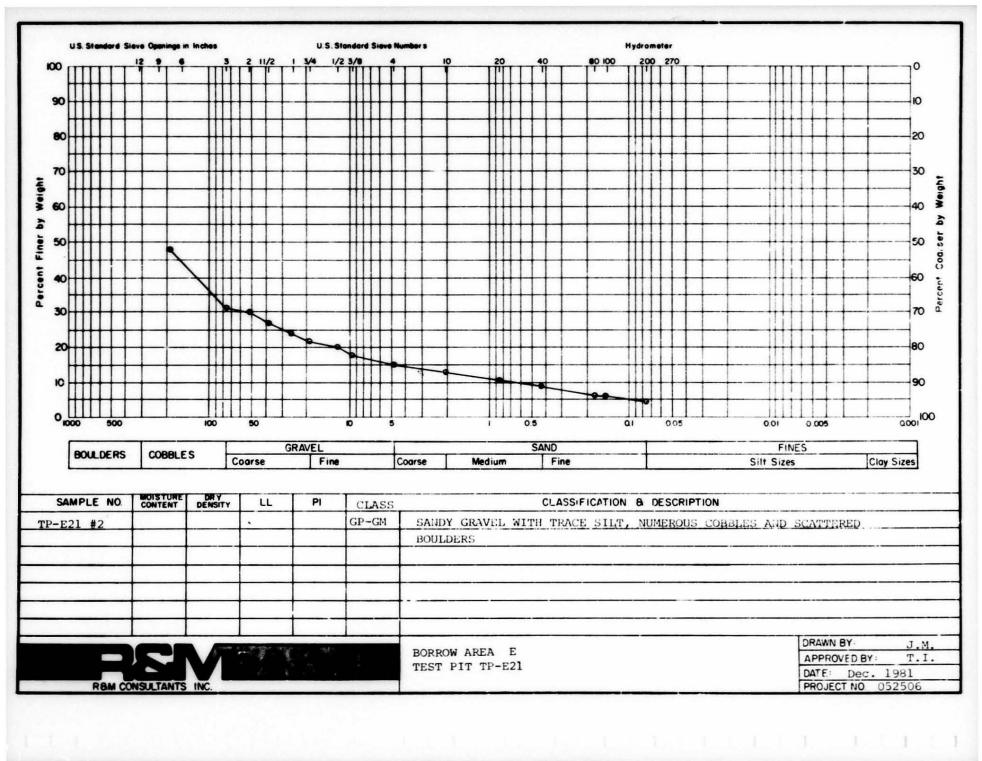
BORROW AREA E TEST PIT TP-E20 DRAWN BY J.M.

APPROVED BY: T.I.

DATE: Dec. 1981 PROJECT NO. 052506





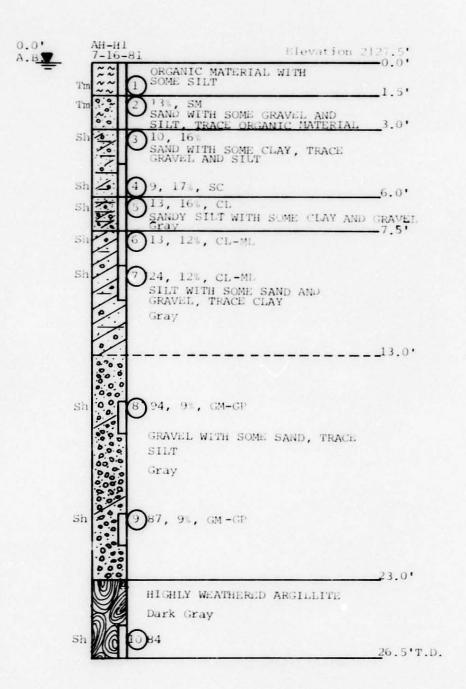


F.3 BORROW SITE H

AUGER HOLE LOGS

F.3 BORROW SITE H

AUGER HOLE LOGS

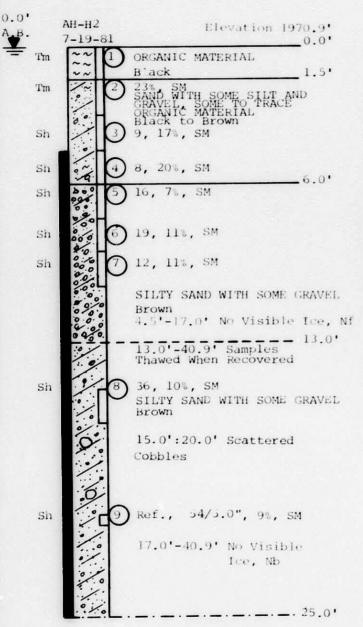


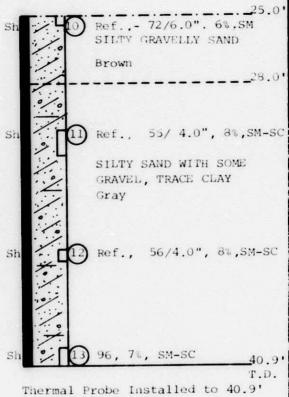
PREPARED BY

PREPARED FOR



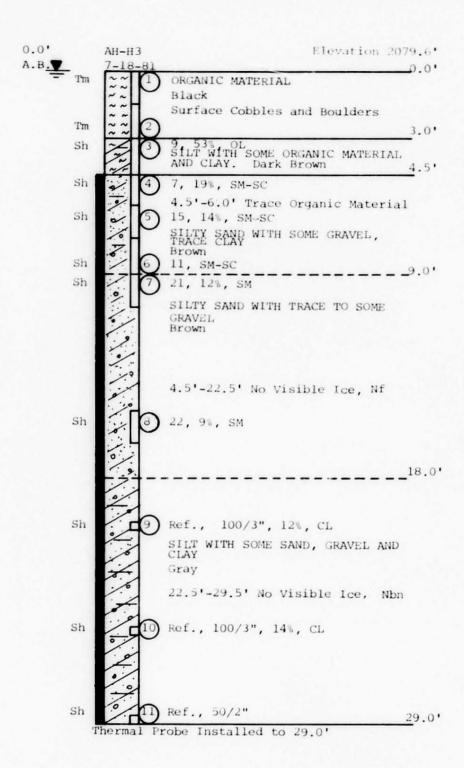






BORROW AREA H AUGER HOLE AH-H2 ACRES

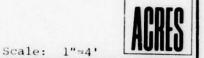
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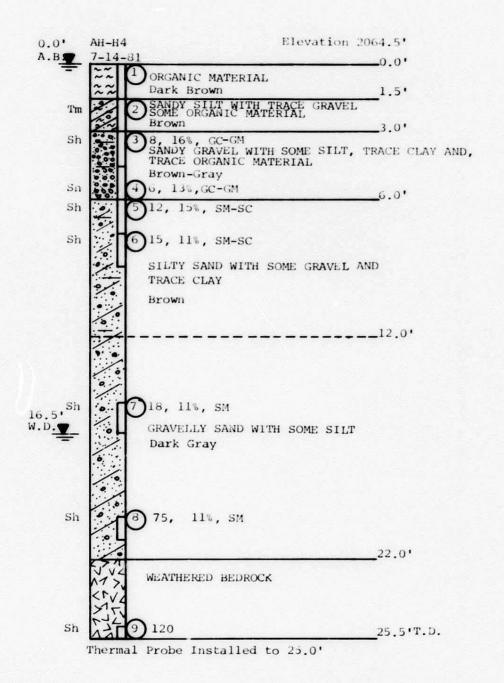


PREPARED BY :

PREPARED FOR





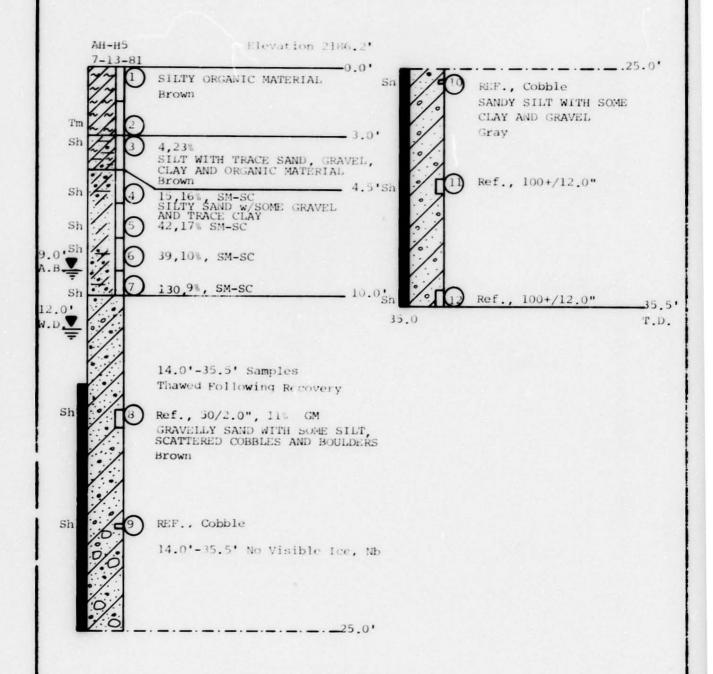


PREPARED BY :

RAM CONSULTANTS. INC.

BORROW AREA H AUGER HOLE AH-H4 ACRES

PREPARED FOR

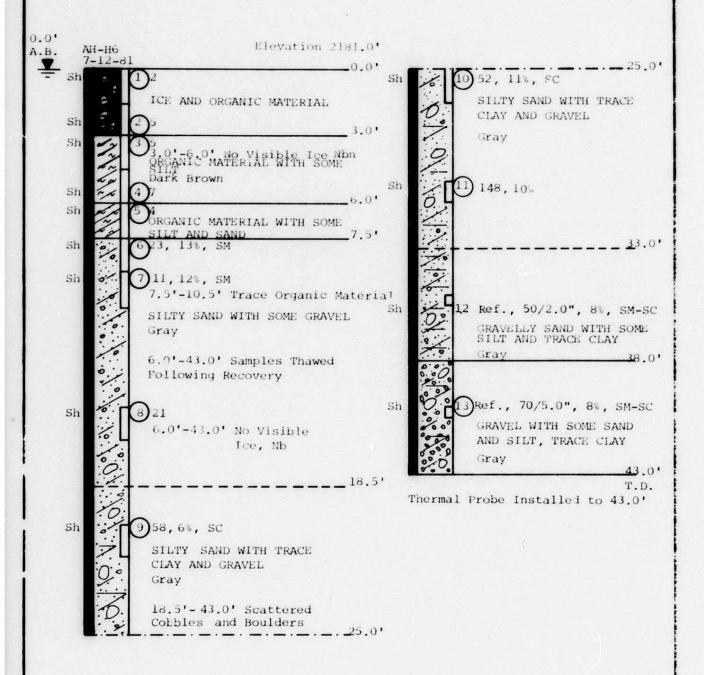


PREPARED BY:

PREPARED FOR





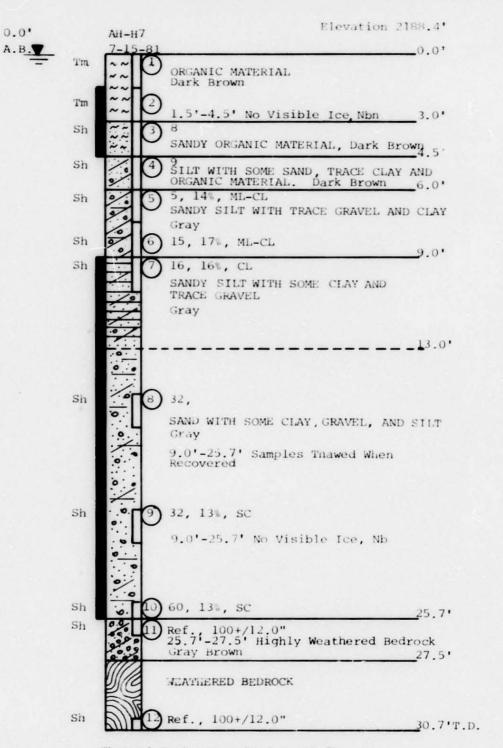


PREPARED BY :

PREPARED FOR







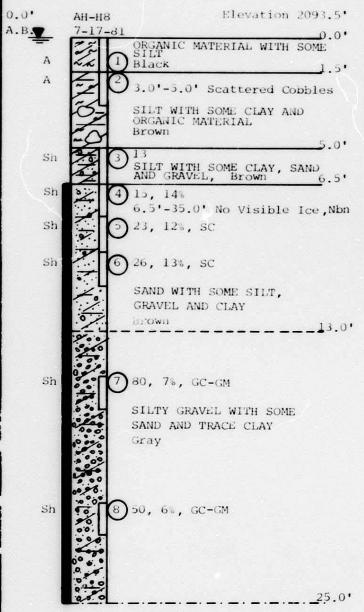
Thermal Probe Installed to 30.7'

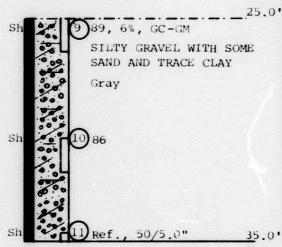
PREPARED BY:

PREPARED FOR









Thermal Probe Installed to 35.0'

PREPARED BY:

RAM CONSULTANTS. INC.

BORROW AREA H AUGER HOLE AH-H8 PREPARED FOR



LABORATORY TEST DATA

PROJECT NO052504  CLIENT: Acres American, Inc.  PROJECT NAME Susitna Hydroelectric (Watana Dam Site)							R & M CONSULTANTS, INC.											DATE October 17, 1980 PAGE NO PAGE NO					
	DE	SCR	IPTION	4"	3"	2"	15"	1"	3/4"	1/2"	3/8"	#4	#10	#40	#200	.02	.005	.002	% Moist.	LL	PI	Unified Class.	
BORR	OW		W-80-256 (Grab Sample)			100	95	88	84	81	78	71	64	53	38.2	24.3	13.6	8.6	10.9	21.7	9.2	GC-SC GM-SM	
BORR	OW		W-80-257 (Grab Sample)			100	97	92	89	84	81	73	66	54	36.0	19.6	8.9	5.2	12.3	17.1	2.5	GM-SM	
																						••	

REMARKS:

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO.		052506	
CT TENE.	Namaa	Amoriana	

Acres American

CONSULTANTS, INC.

DATE	October	5,	1981

PROJECT NAME Susitna Hydroelectric

SUMMARY OF LABORATORY TEST DATA

PARTY	NO	 PAGE	NO	_1

AB NO.	BORING	SAMPLE	DEPTH	3"	2"	15"	1"	3/4"	12"	3/8"	4	10	40	200	FINE SPG	L.L.	P.1.	W E T DENSITY	DRY DENSITY	MOISTURE CONTENT	CLASS
	н1	2	1.5'- 3.0'			100	92	89	85	82	74	59	46	24.8						13	SM
	Hl	3	3.0'- 4.0'																	16	
	Hl	4	4.5'- 6.0'			100	96	96	94	92	88	79	60	21.4		32	17			17	sc
	Hl	5	6.0'- 7.5'					100	93	90	86	77	66	51.7		34	21			16	CL
	н1	6,7	7.5'-10.5'			100	98	94	88	85	82	74	64	55.1		25	7			12,12	CL-ML
	н1	8,9	15.0'-21.5'*		100	69	57	50	45	41	34	28	20	12.1		21	NP			9	GM-GP
	Н2	2-4	1.5'- 6.0'					100	95	91	85	69	48	22.9		NV	NP			23,17,2	) SM
	Н2	5-7	6.0'-10.5'		100	88	83	82	78	74	67	61	50	35.0		18	NP			7,11,11	SM
	Н2	8	15.0'-16.5'				100	90	85	80	76	65	51	32.7						10	SM
	Н2	9,10	20.0'-25.5'*				100	93	84	78	73	62	48	31.5		17	NP			9,6	SM
	Н2	11-1	3 30.0'-40.8'*				100	95	89	87	82	71	61	39.7		18	5			8,8,7	SM-SC
	н3	3	3.0'- 4.5'																	53	
	Н3	4,5	4.5'- 7.5'*					100	94	91	86	74	59	42.0		18	5			19,14	SM-SC
	н3	7	9.0'-10.5'					100	99	97	93	82	63	40.6		NV	NP			12	SM
	нз	8	15.0'-16.5'					100	93	88	83	67	51	29.9		14	NP			9	SM
	нз	9	20.0'-20.3'																	12	
	Н3	10	25.0'-25.2'																	14	

REMARKS: \* Samples Combined for Gradation and Atterberg Limits

NV = Non-Viscous, NP = Non-Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO. \_\_\_\_\_052506

CLIENT: Acres American

PROJECT NAME Susitna Hydroelectric

R & M CONSULTANTS, INC.
-------------------------

DATE	October	1981	

## SUMMARY OF LABORATORY TEST DATA

PARTY	NO	PAGE	NO	_ 2

NO.	BORING	SAMPLE	DEPTH	3"	2"	1½"	1"	3/4"	, , , , , , , , , , , , , , , , , , ,	3/8"	4	10	40	200	FINE SPG	L.L.	P. I.	W E T DENSITY	DRY DENSITY	MOISTURE CONTENT	CLASS
		3,4	3.0'- 6.0'*		100	82	82	73	66	61	55	49	37	20.4		23	7			16,13	GM-GC
	Н4	5,6	6.0'- 9.0'*		100	89	87	86	85	81	74	67	55	39.5		20	4			15,11	SM-SC
	н4	7,8	15.0'-21.5'*		100	92	90	83	78	74	64	55	41	27.2	-	22	NP			11	SM
	Н5	3	3.0'- 4.5'																	23	
	Н5	4	4.5'- 6.0'			100	95	93	89	86	78	72	62	41.0		23	6			16	SM-SC
	нь	5	6.0'- 7.5'								100	89	73	45.2		22	6			17	SM-SC
	Н5	6,7	7.5'-10.0'		100	81	76	. 76	76	76	76	61	49	33.3		21	4			10,9	SM-SC
_	Н5	8	15.0'-15.7'																	11	
	Н6	6,7	7.5'-10.5'			100	97	93	91	88	. 78	69	53	32.5		NV	NP			13,12	SM
	Н6	9	20.0'-21.5'																	6	.2207
	Н6	10	25.0'-26.5'					100	95	93	90	79	63	45.5		23	9			11	SC
	Н6	11	30.0'-31.0'																	10	
	н6	12	35.0'-35.6'			100	82	82	73	71	66	47	34	19.2		21	6			8	SM-SC
	Н6	13	40.0'-40.4'					-							_	-	-			8	

REMARKS:*	Samples Combined for Gradation and Atterberg Limits
	NV = Non-Viscous, NP = Non-Plastic
	The state of the s

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO. \_\_\_\_ 052506

CLIENT: Acres American

PROJECT NAME Susitna Hydroelectric

## CONSULTANTS, INC.

DATE \_\_\_\_October 1981

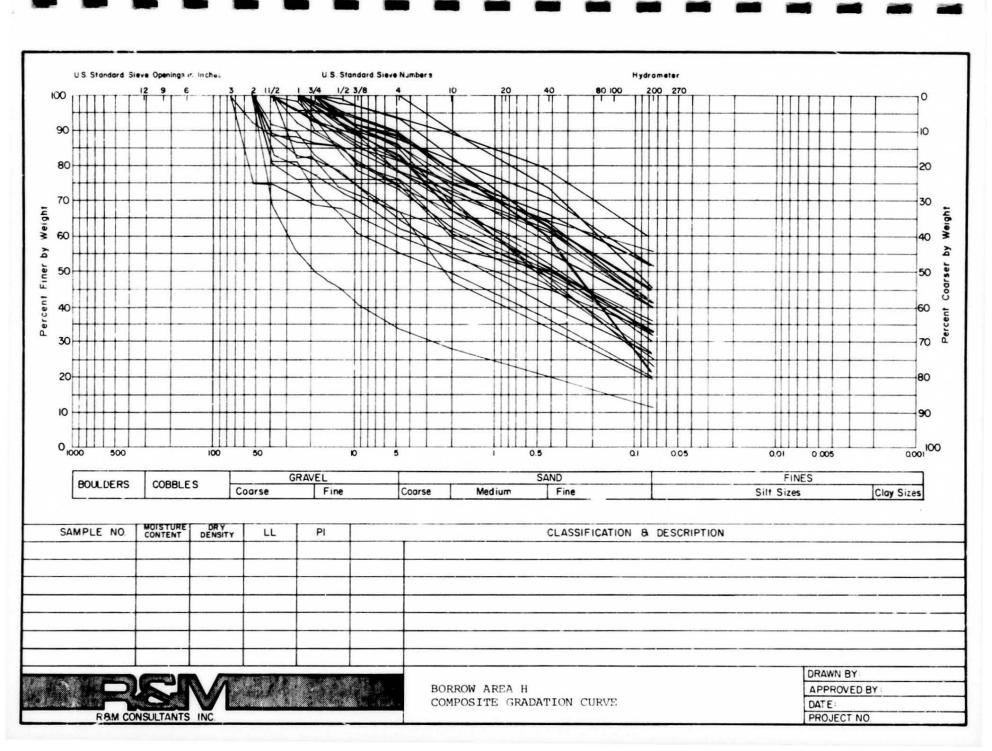
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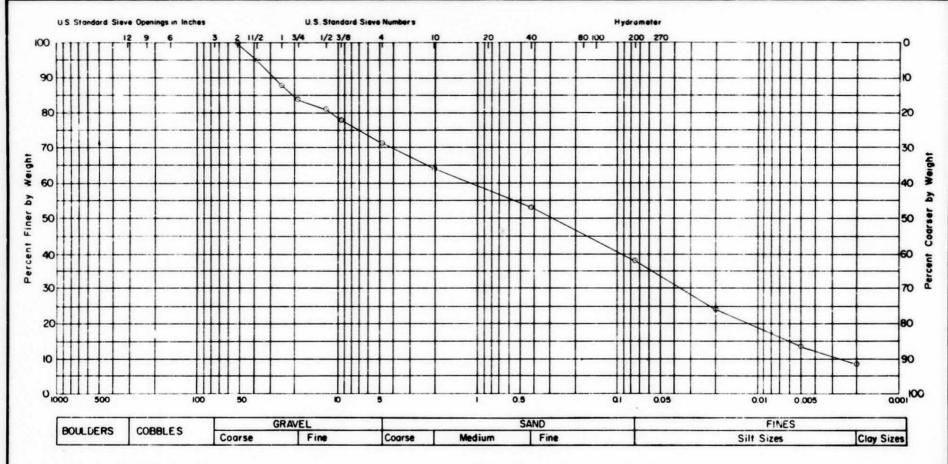
## SUMMARY OF LABORATORY TEST DATA

AB NO.	BORING	SAMPLE NO.	DEPTH	3"	2"	11/2"	1"	3/4"	1 <sub>2</sub> "	3/8"	4	10	40	200	FINE SPG	L.L.	P. I.	WET	DRY DENSITY	MOISTURE CONTENT	CLASS
	н7	5,6	6.0'- 9.0'				100	98	94	92	88	82	71	51.5		17	4			14,17	ML-CL
	н7	7	9.0'-10.5'					100	98	97	93	89	79	58.7		29	14			16	CL
	Н7	9,10	20.0'-25.7'	100	92	88	88	87	86	84	78	71	48	27.4		33	19			13,13	sc
	н8	4	6.5'- 8.0'													NV	NP			14	
	Н8	5,6	8.0'-11.0'				100	97	92	89	82	75.	64	42.4		25	11			12,13	SC
	Н8	7	15.0'-16.5'		100	83	79	77	72	70	62	56	50	36.3		21	7			7	GC-GM
-	Н8	8,9	20.0'-26.5'	100	75	75	72		68					32.9		21	7_			6,6	GC-GM
	BORI	ROW	Н			100	95	92	87	79	57	51	44	30.5		23	6				
	Bull	k S	ample																		
_																					
1																-		İ			

EMARKS:*	Samples Combined for Gradation and Atterberg Limits
	NV = Non-Viscous, NP = Non-Plastic

NOTE: SIEVE ANALYSIS = PERCENT PASSING

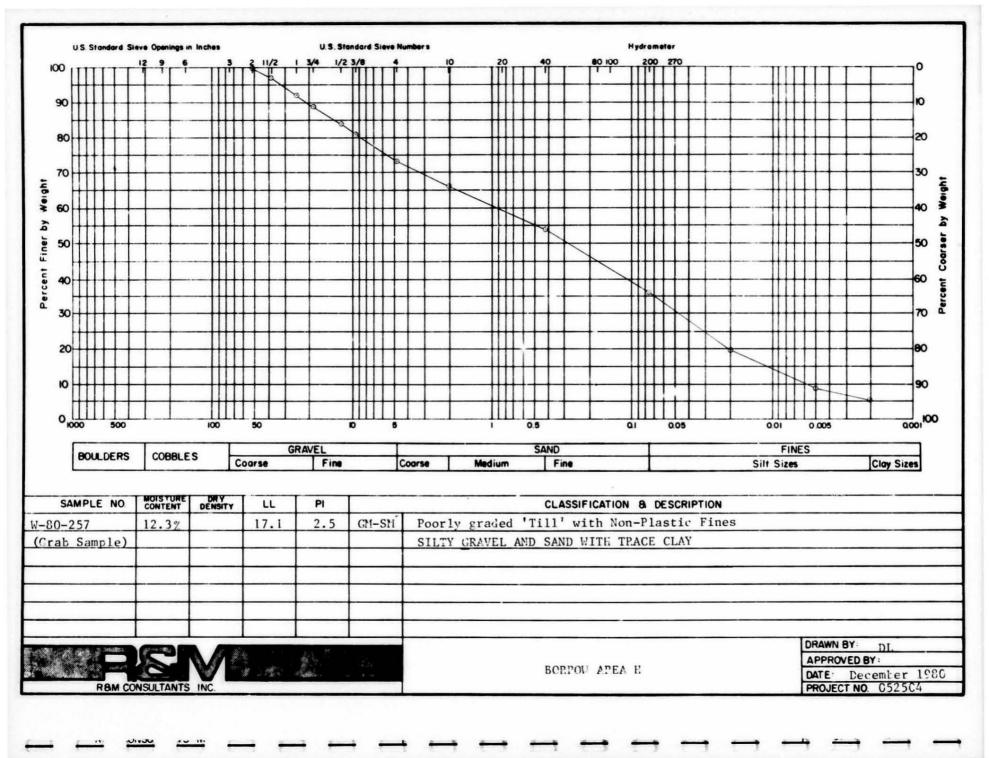


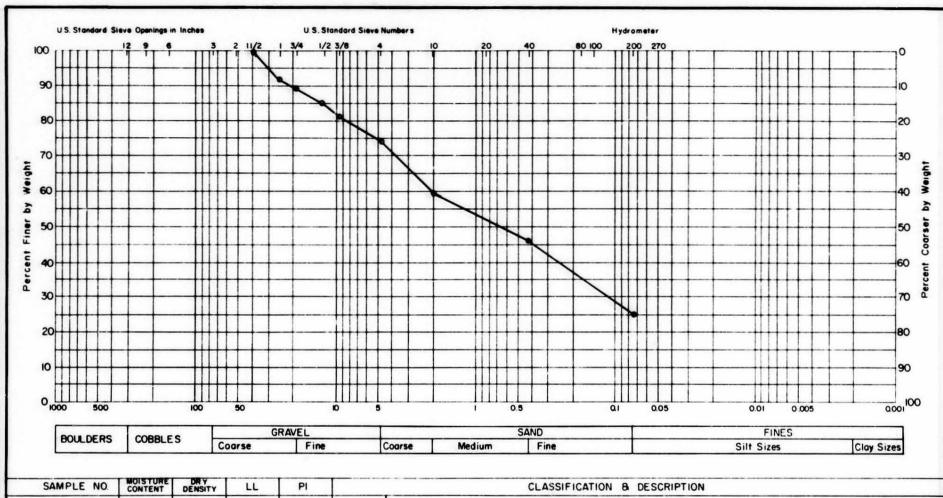


SAMPLE NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
W-80-256	10.9%		21.7	9.2	GC-SC	Poorly graded 'Till' with low Plasticity
(Grab Sample)						SILTY CRAVEL AND SAND WITH TRACE CLAY
					-	

BORPOW AREA H

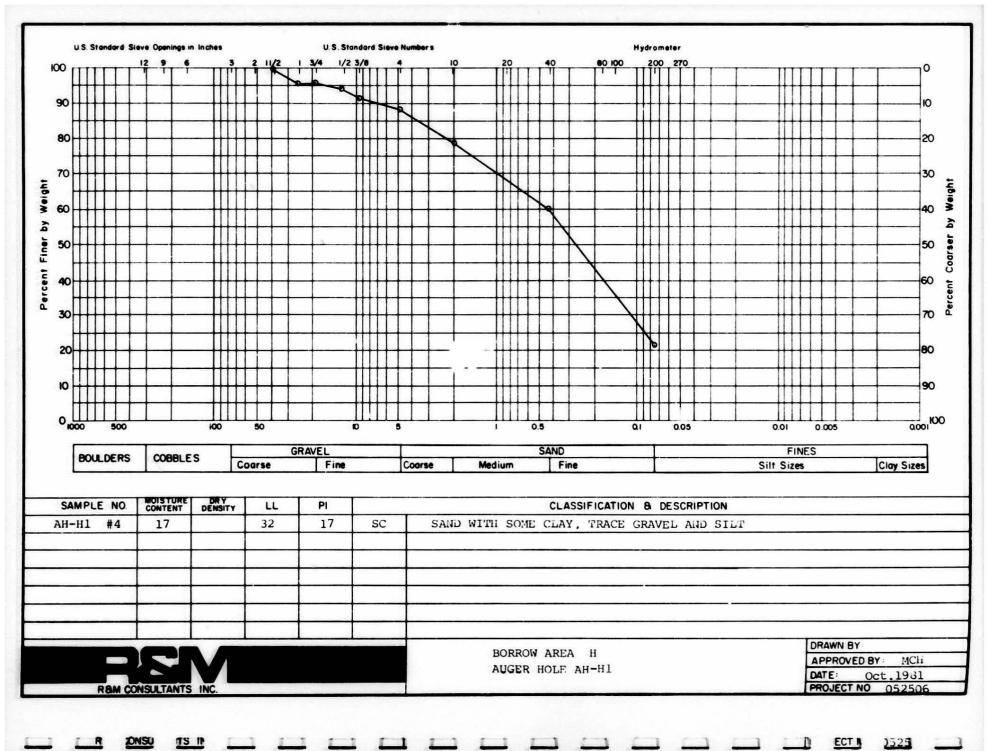
DRAWN BY: DL
APPROVED BY:
DATE: December 1980
PROJECT NO. 0525C4

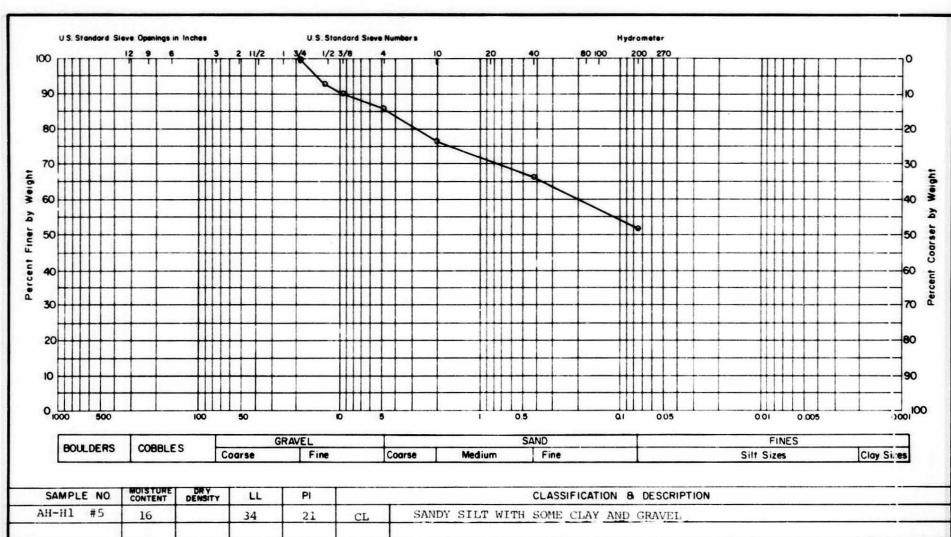




SAMPLE	NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-Hl	#2	13				SM	SAND WITH SOME GRAVEL AND SILT, TRACE ORGANIC MATERIAL
						-	
		-				-	
	-					-	
						+	
						-	

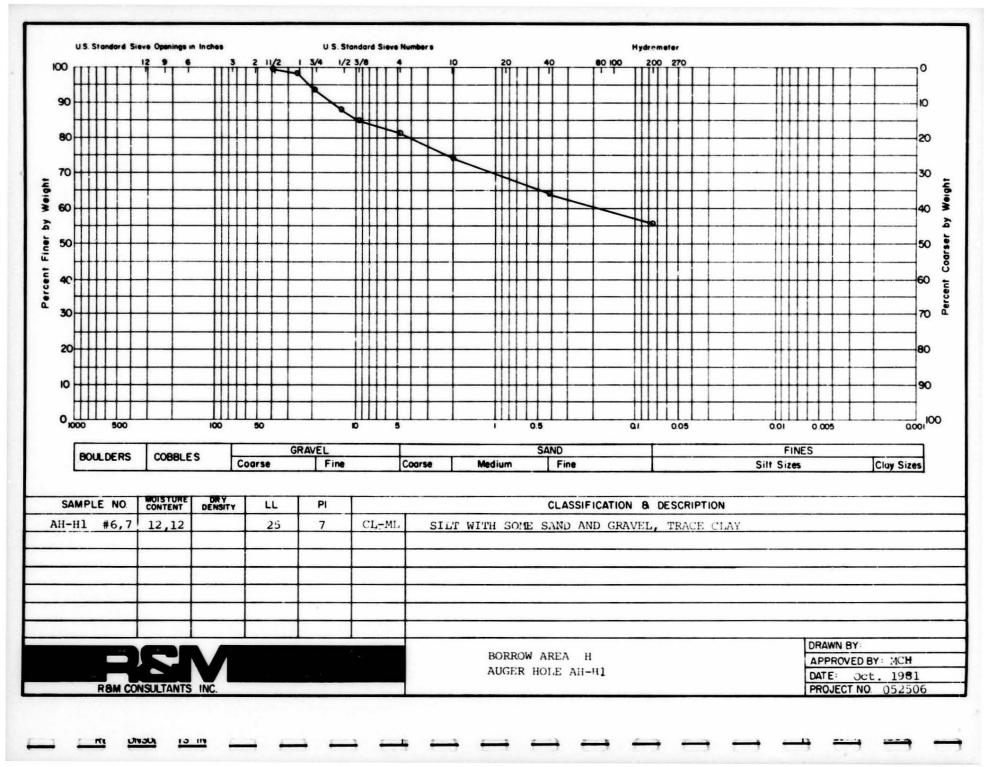
BORROW AREA H AUGER HOLE AH-H1

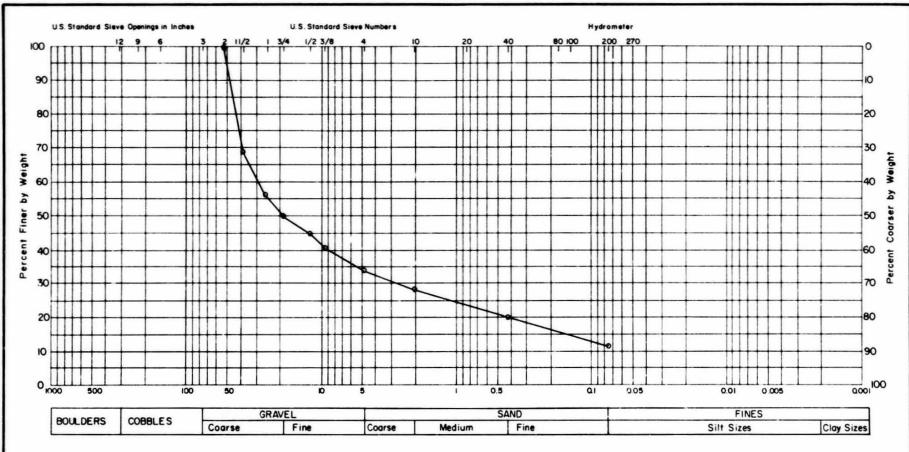




AH-H1 #5 16 34 21 CL SANDY SILT WITH SOME CLAY AND GRAVEL	AH-H1 #5 16 34 21 CL SANDY SILT WITH SOME CLAY AND GRAVEL	

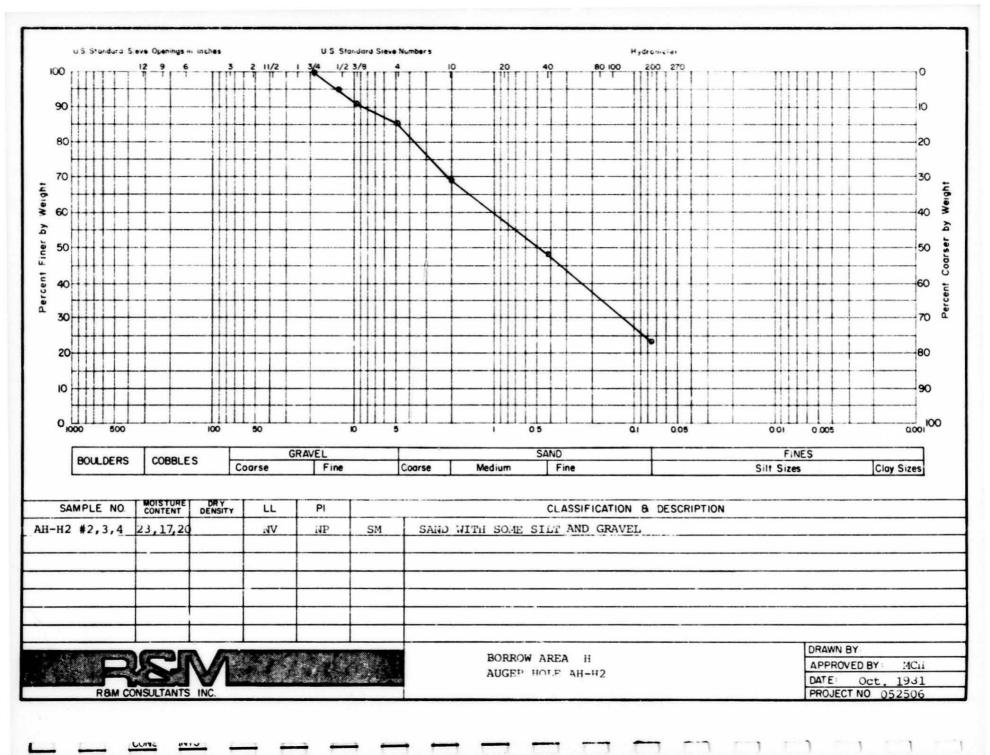
BORROW AREA H AUGER HOLE AH-H1 APPROVED BY: MCh
DATE: Oct. 19d1
PROJECT NO 052506

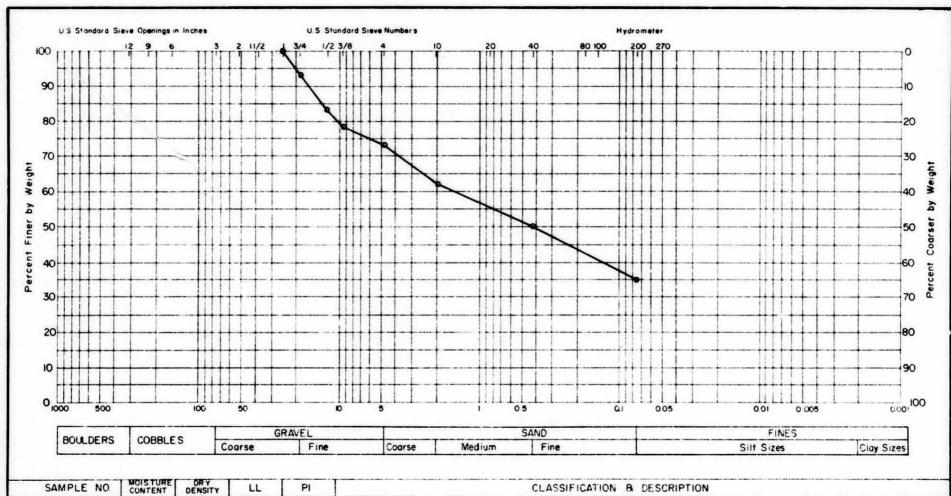




SAMPLE NO	CONTENT	DRY	LL	PI		CLASSIFICATION & DESCRIPTION	
M-н1 #8,	9 9		21	ijР	GP-GM	GRAVEL WITH SOME SAND, TRACE SILT	
	+				++		
					-		
	1			1			DRAWN BY:

AUGER HOLE AH-H1

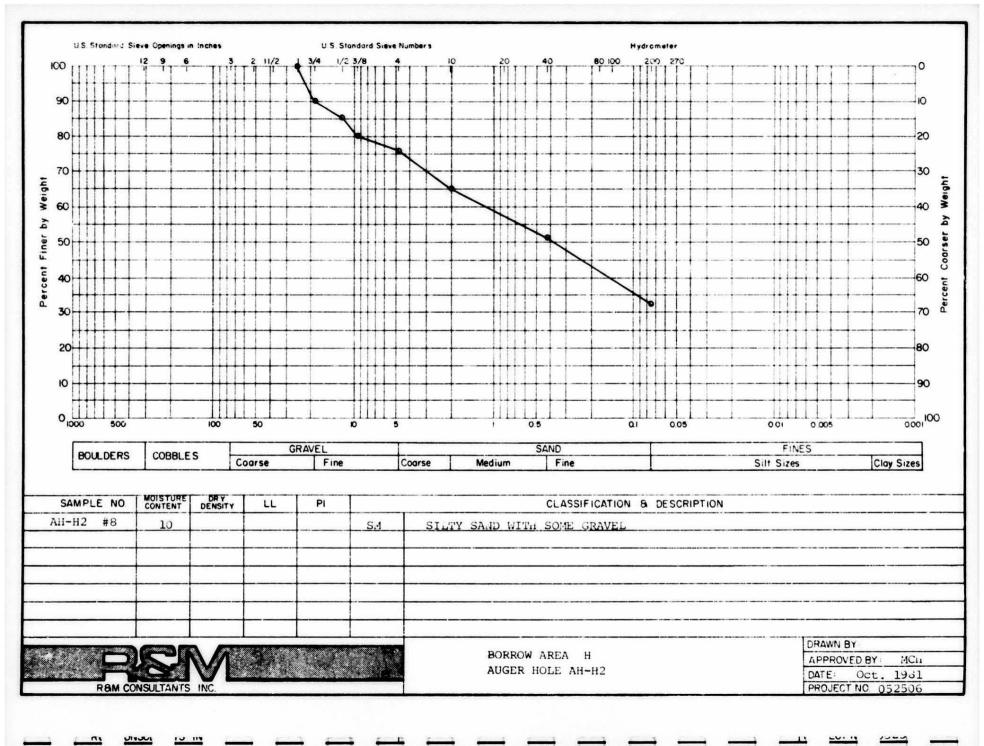


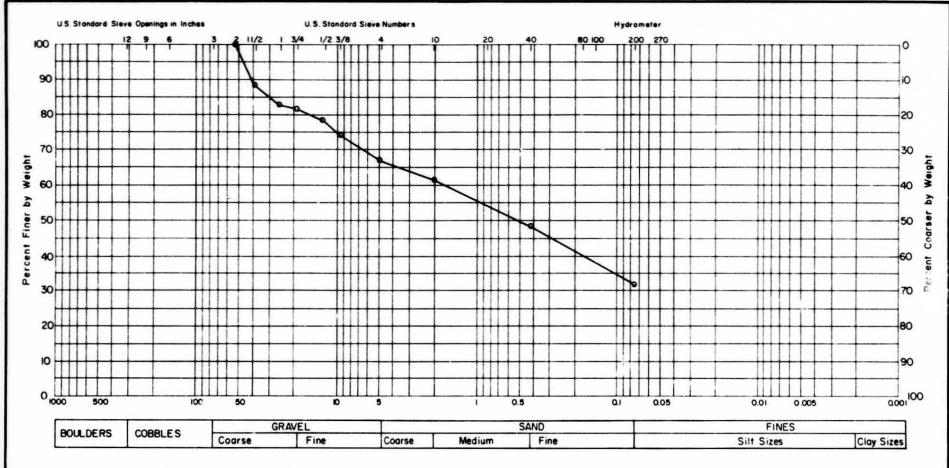


АН-Н2 #5,6,7		DRY DENSITY	LL	PI NP	CLASSIFICATION 8 DESCRIPTION			
H 112 #3,0,7	7,11,11		18		SM	SILTY SAND WITH SOME GRAVEL		
				<del> </del>				
	1		-	-	1			

PSIV.
ROM CONSULTANTS INC.

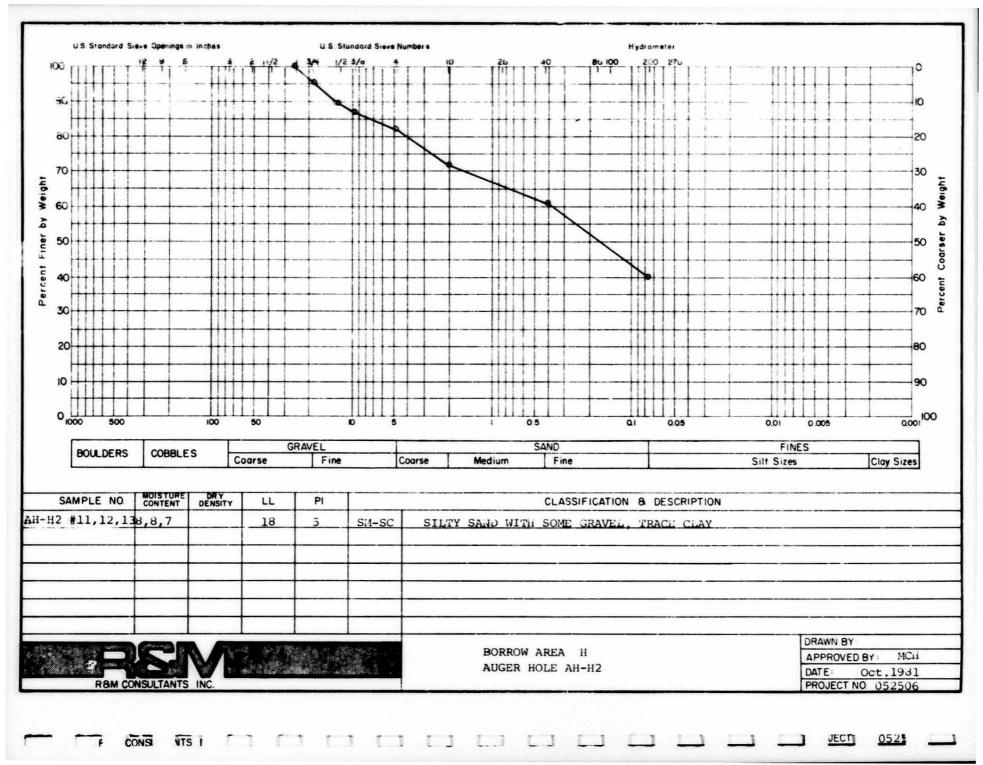
BORROW AREA H AUGER HOLE AH-II2 APPROVED BY MCH DATE: Oct. 1981 PROJECT NO 052506

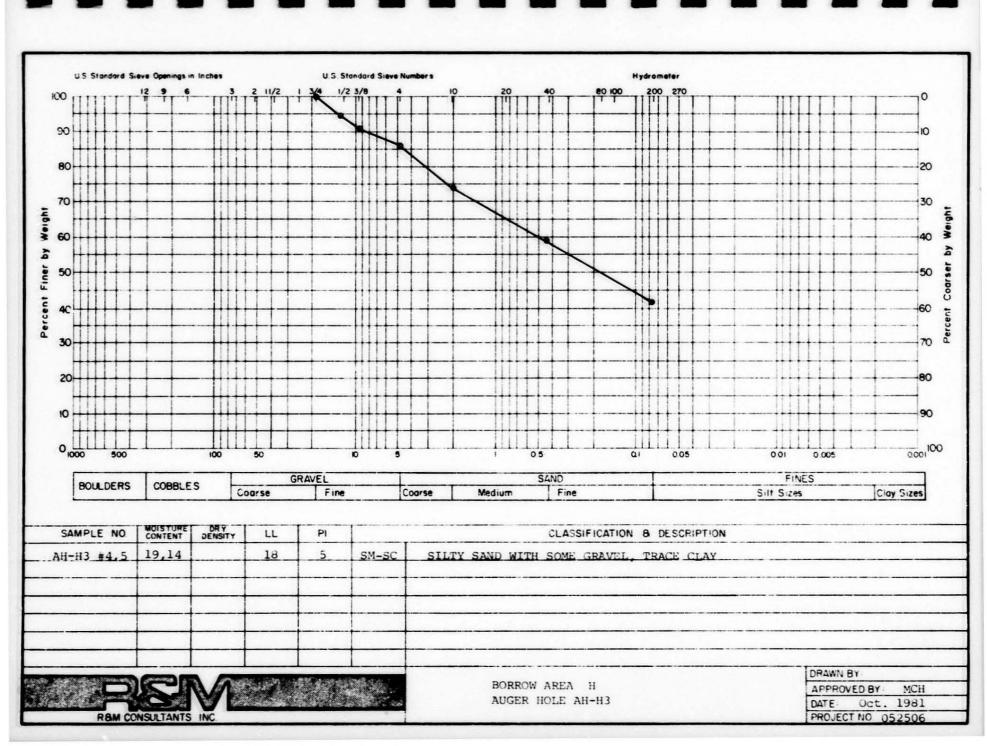


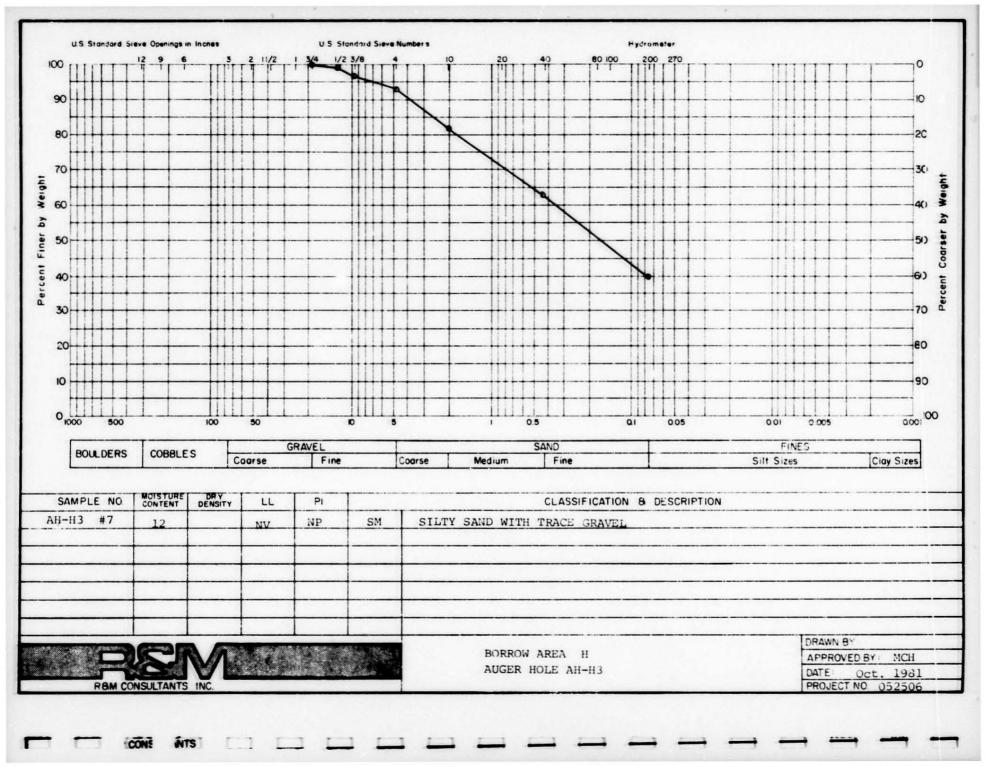


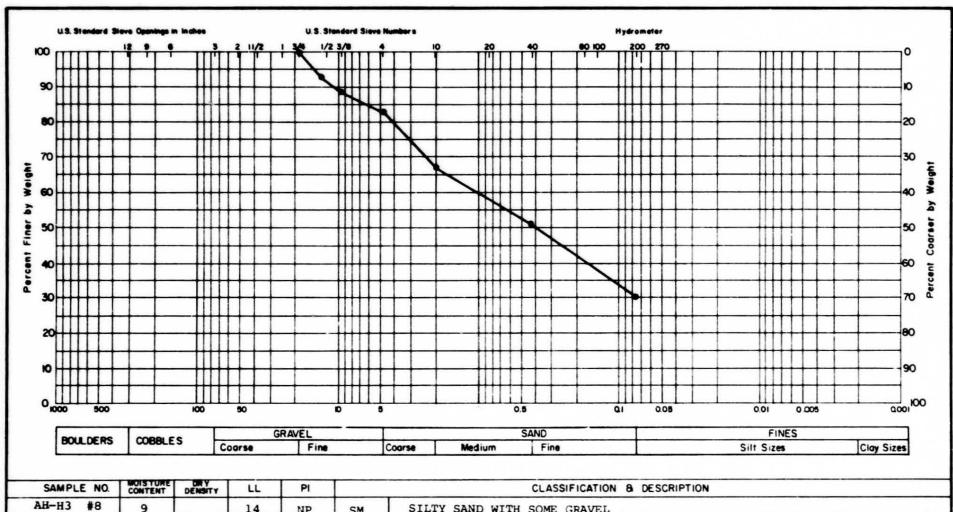
SAMPLE NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-H2 #9,10	9,6		17	MP	SM	SILTY, GRAVELLY SAND
	-					

BORROW AREA H AUGER HOLE AH-H2









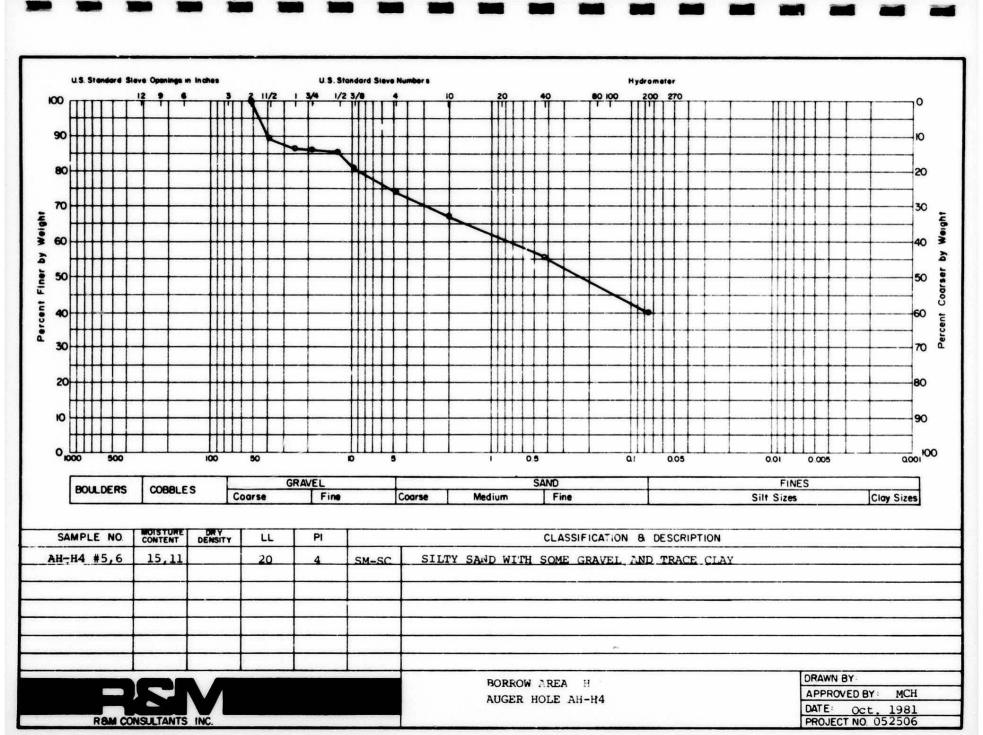
SAMPLE	E NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
н-нз	#8	9		14	NP	SM	SILTY SAND WITH SOME GRAVEL
					-	<b>-</b>	
			-				

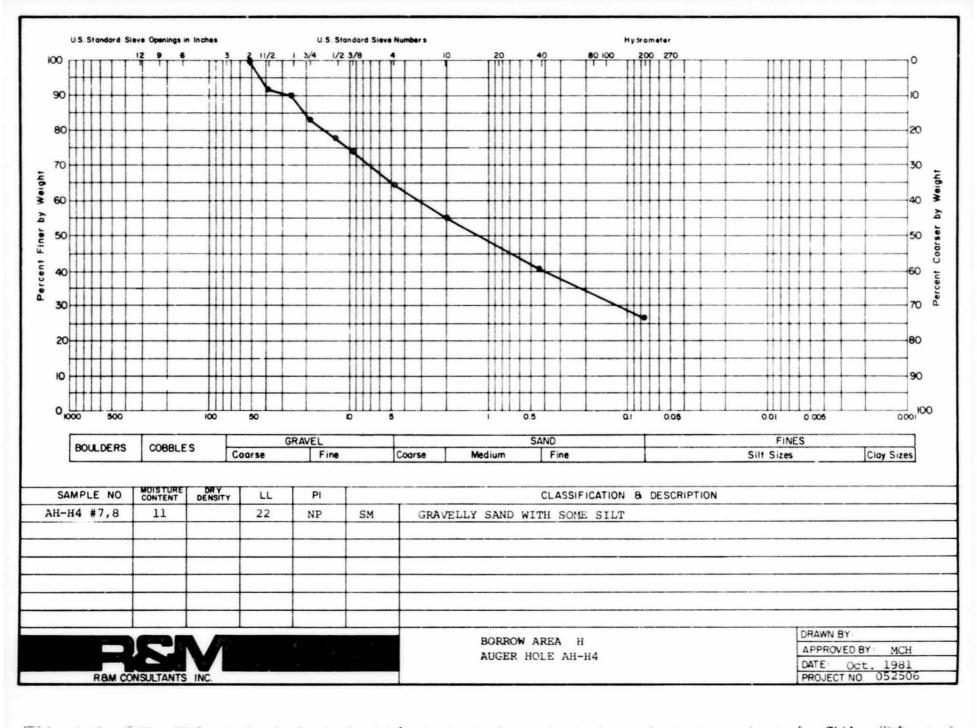
BORROW AREA H AUGER HOLE AH-H3

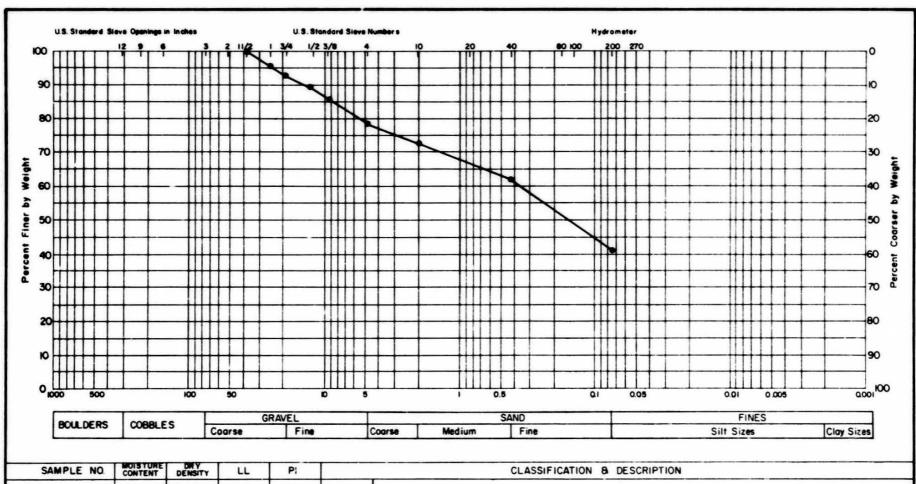


SAMPL	E NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
АН-Н4	#3,4	16,13		23	7	GC-GM	SANDY GRAVEL WITH SOME SILT AND TRACE CLAY
						++	
						-	

BORROW AREA H AUGER HOLE AH-H4

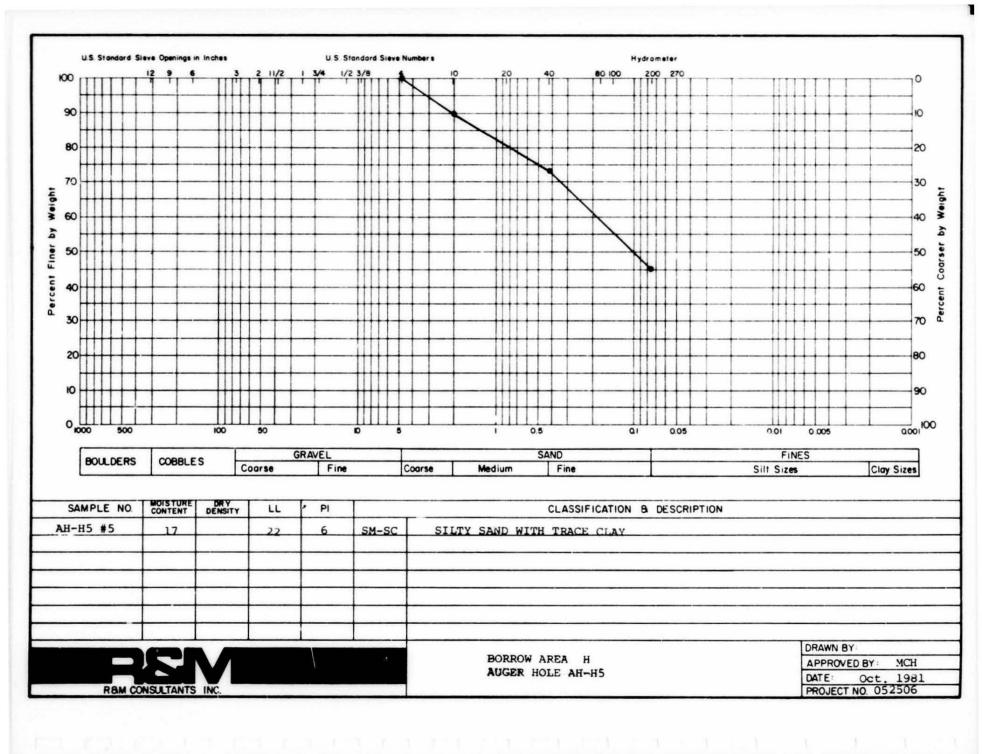


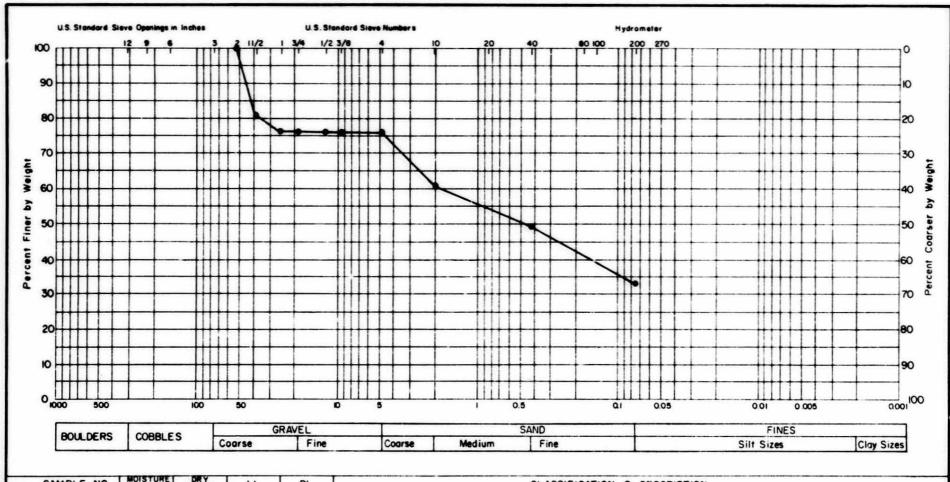




SAMPLE NO.	CONTENT	DENSITY	LL	Pi		CLASSIFICATION & DESCRIPTION
AH-H5 #4	16		23	6	SM-SC	SILTY SAND WITH SOME GRAVEL AND TRACE CLAY
					1 1	
				-	+	
	11	1		L		DRAWN BY:

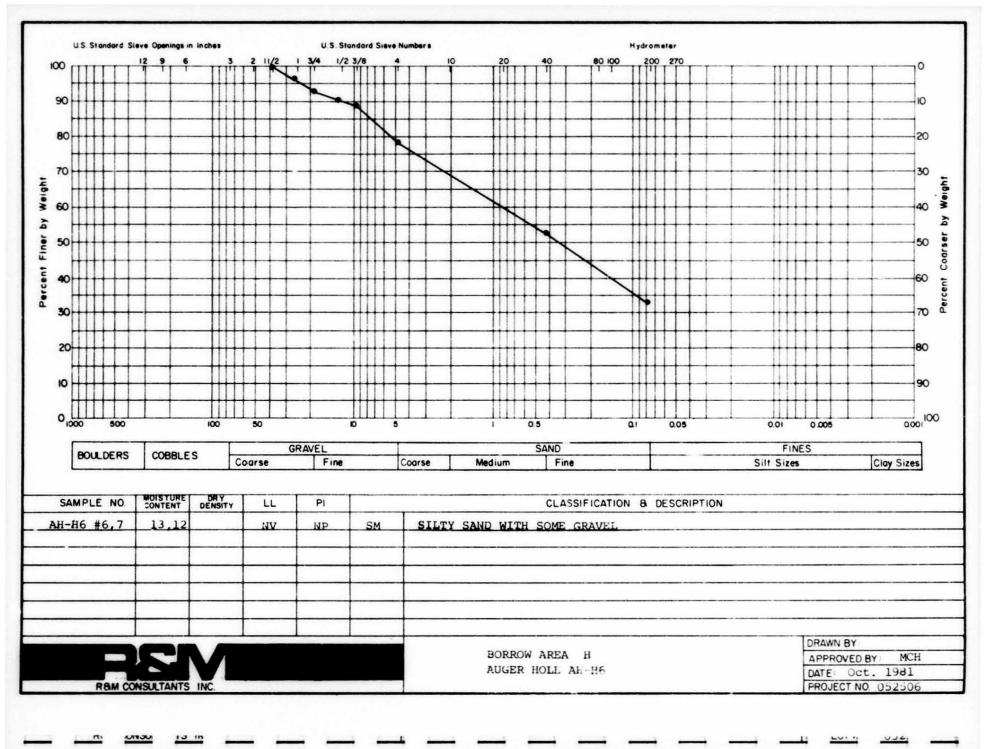
BORROW AREA H AUGER HOLE AH-H5 APPROVED BY: MCH
DATE: Oct. 1981
PROJECT NO 052506

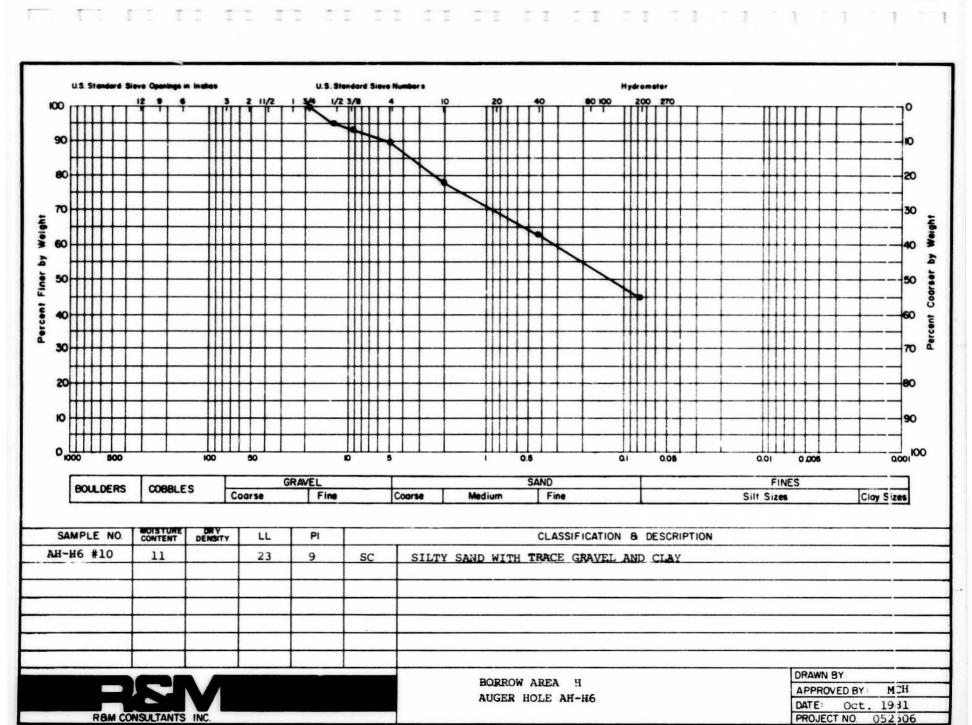


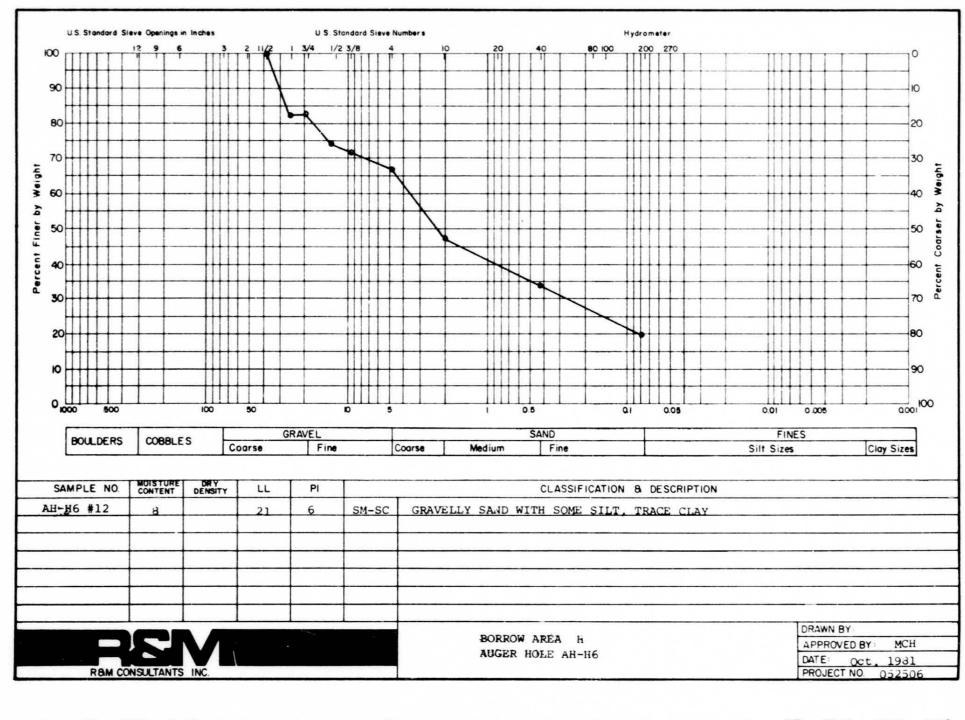


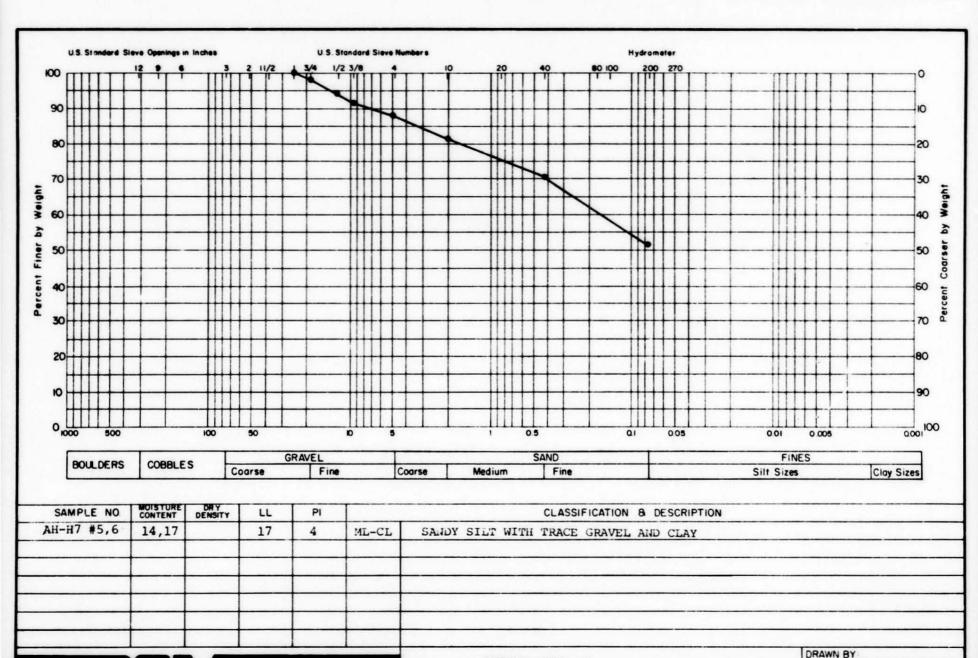
SAMPLE NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-H5 #6,7	10,9		21	4	SM-SC	SILTY SAND WITH SOME GRAVEL AND TRACE CLAY
					++	
					1	

BORROW AREA H AUGER HOLE AH-H5

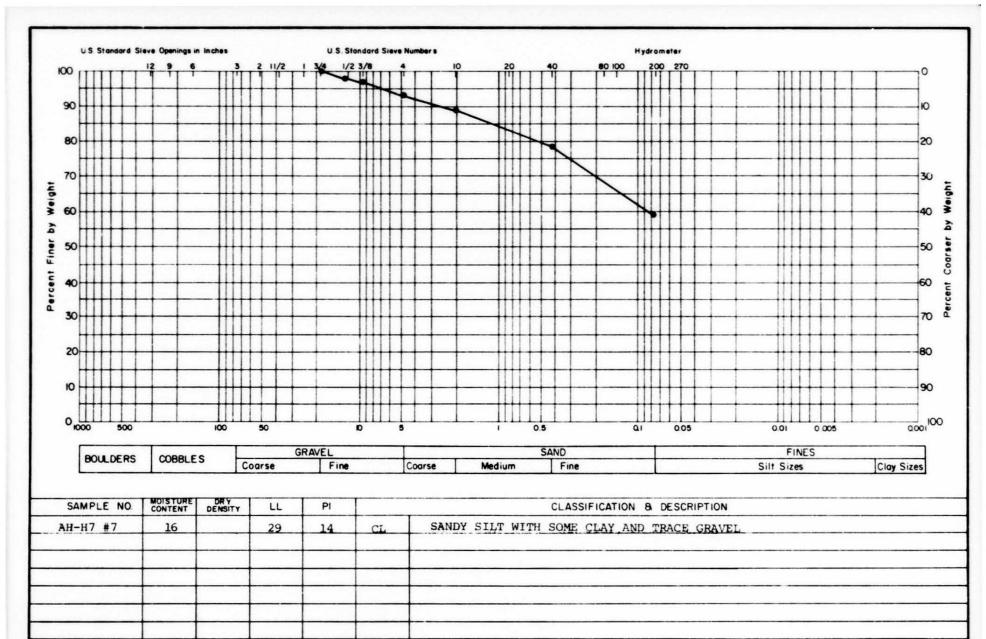




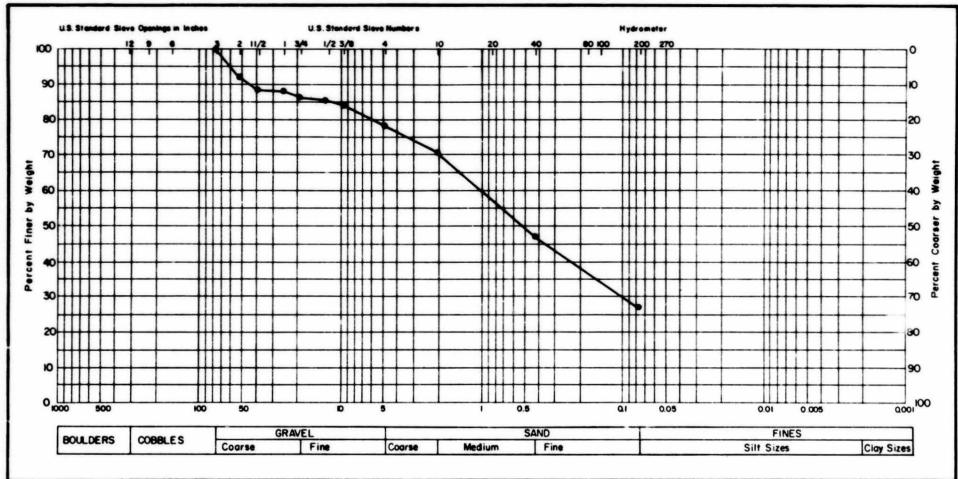




BORROW AREA H AUGER HOLE AH-H7 APPROVED BY: MCII
DATE: Oct. 1981
PROJECT NO. 052506

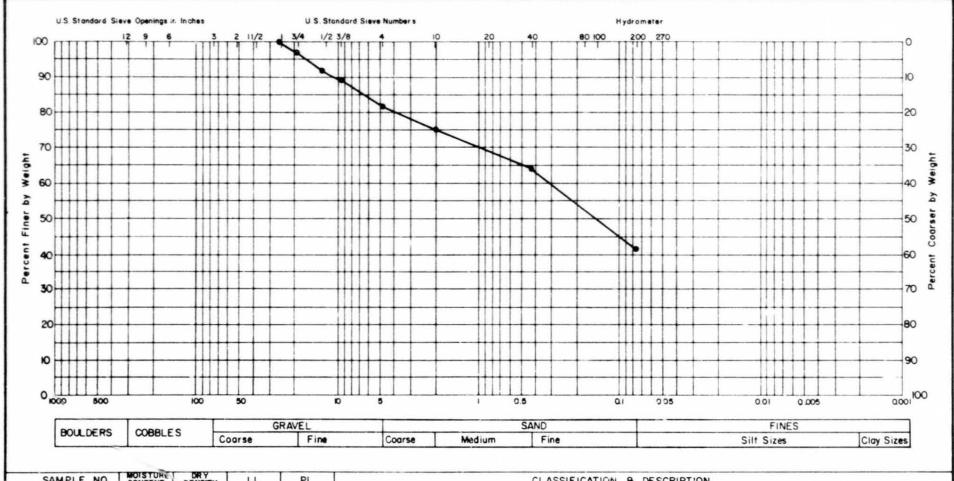


BORROW AREA H AUGER HOLE AH-H7



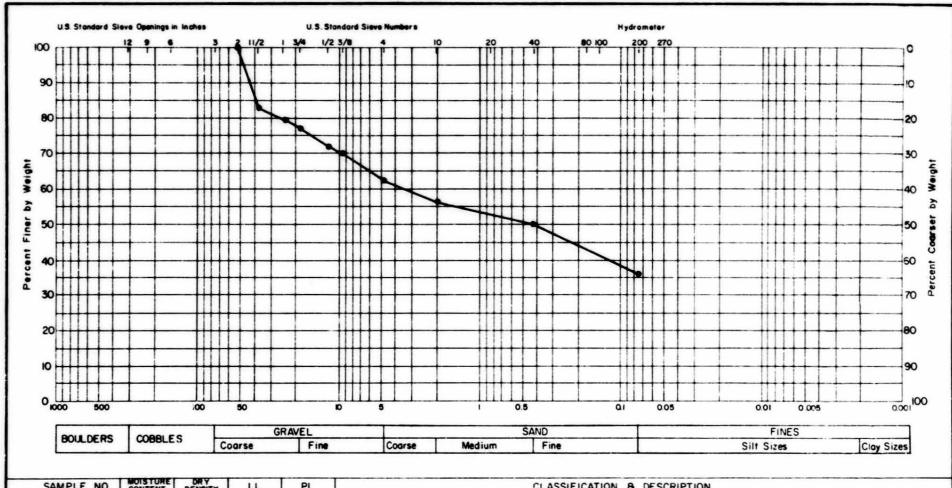
SAMPLE NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-H7 #9,10	13,13		33	19	sc	SAND WITH SOME CLAY, GRAVEL, AND SILT
		-		-		
					+	
				<del></del>		

BORROW AREA H AUGER HOLE AH-H7



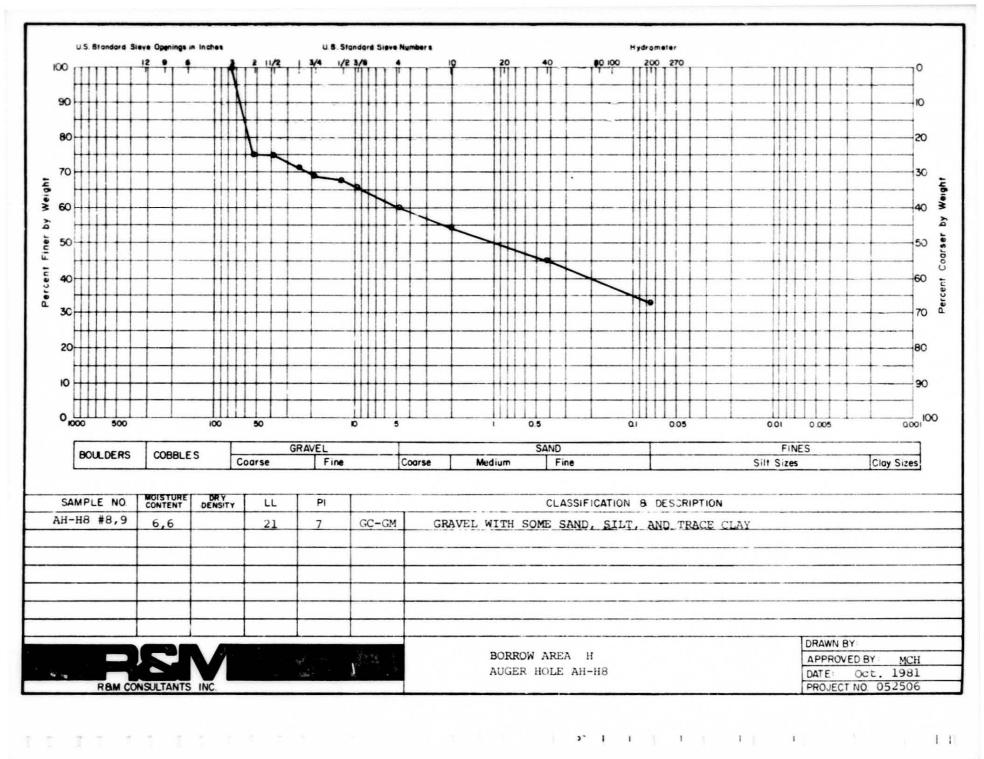
SAMPLE NO.	CONTENT	DRY	LL	PI		CLASSIFICATION & DESCRIPTION
AH-H8 #5,6	12,13	- 5	25	11	SC	SAND WITH SOME SILT, GRAVEL, AND CLAY
					-	
					-	
	-			-		
						DRAWN BY

BORROW AREA H AUGER HOLE AH-H8



SAMPLE NO.	CONTENT	DENSITY	LL 21	PI 7	CLASSIFICATION & DESCRIPTION		
АН-Н8 #7	7				GÇ-GM	SILTY GRAVEL WITH SOME SAND, TRACE CLAY	
				-	+		

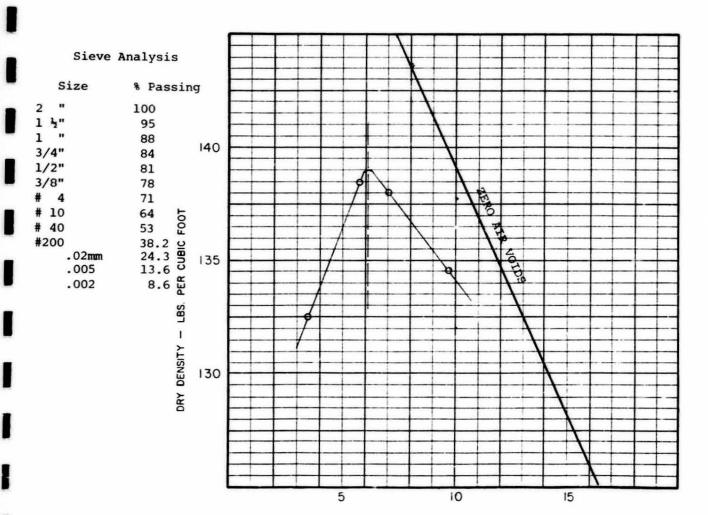
BORROW AREA H AUGER HOLE AH-H8



Project No.	052504		
ate	11-20-80		

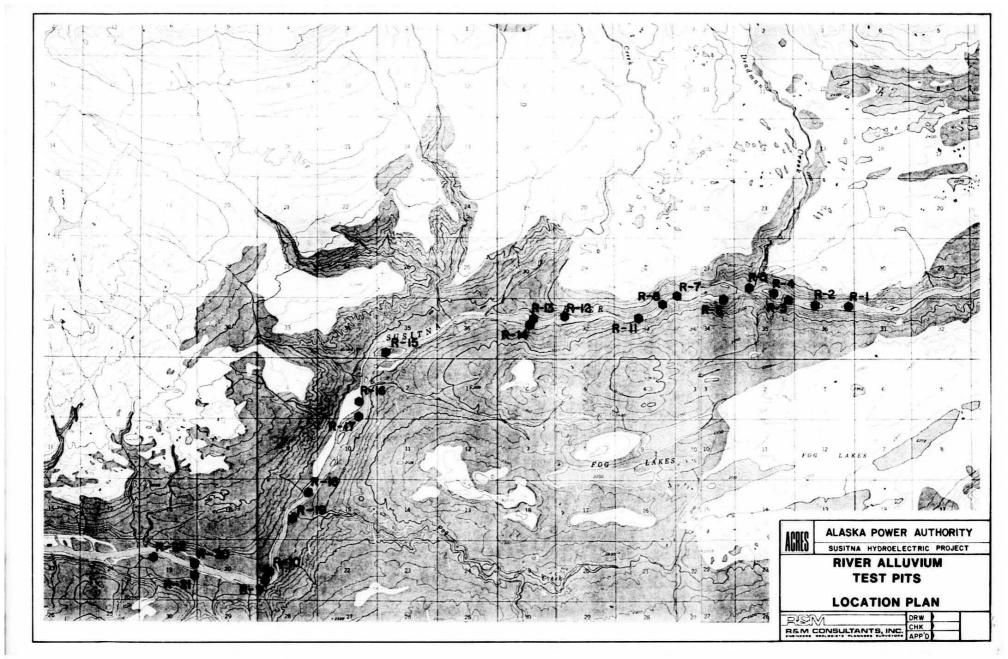
## R&M Consultant Inc. LABORATORY COMPACTION CONTROL REPORT

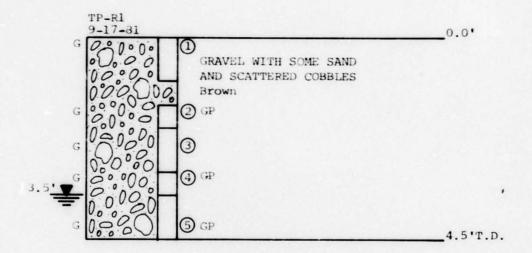
Jo	b Name and Location Susitna (Watana Dam S	ite)					
Architect or Engineer Acres American Inc.							
Co	ntractor						
A.	A Description of Soil: Poorly Graded 'Till', SILTY GRAVEL AND SAND W/TRACE CI						
	Material MarkC	Unified Classification	GC-SC	AASHO Classification			
	Source of Material Borrow Area H Sample	No. W-80-256					
	latural Water Content 10.9 % Natural Dry Density PCF Specific Gravity		fic Gravity				
	Liquid Limit% Plastic Limit	%PI	asticity Index	9.2			
В.	Test Procedure Used	- AASHTO					
C.	Test Results: Maximum Dry Density 139.0	PCF	Optimum Water	Content6.2%			

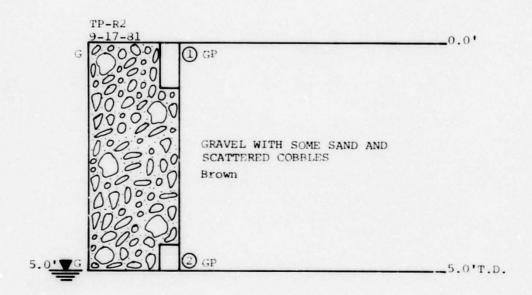


F.4 BORROW SITES I AND J

TEST PIT/TEST TRENCH LOGS





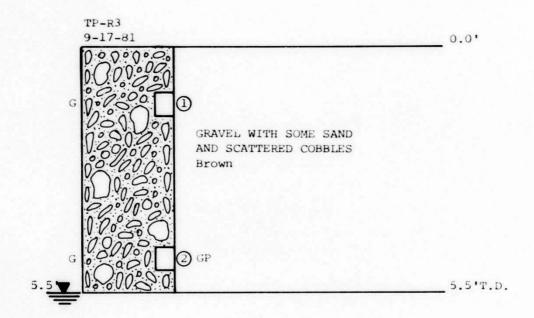


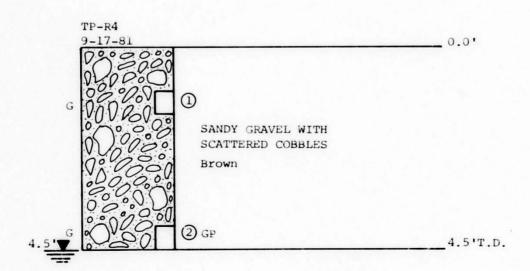
Prepared for:



RIVER ALLUVIUM TEST PITS TP-R1, R2





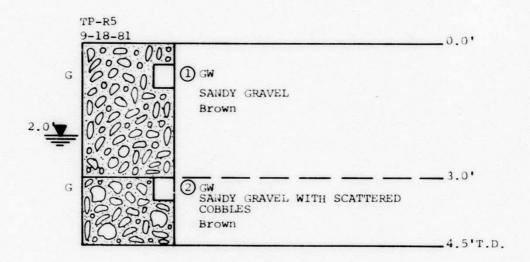


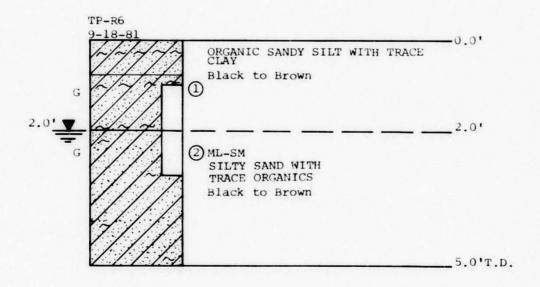
Prepared for:



RIVER ALLUVIUM TEST PITS TP-R3, R4





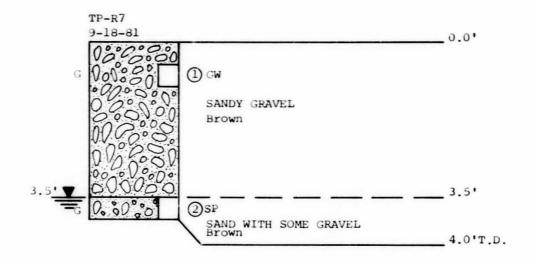


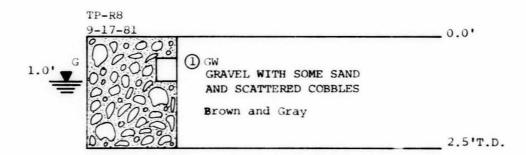
Prepared for:



RIVER ALLUVIUM TEST PITS TP-R5, R6



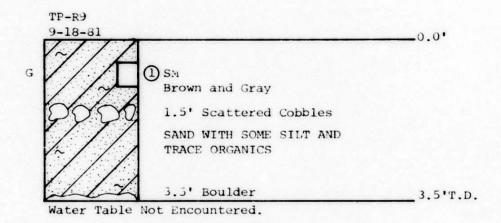


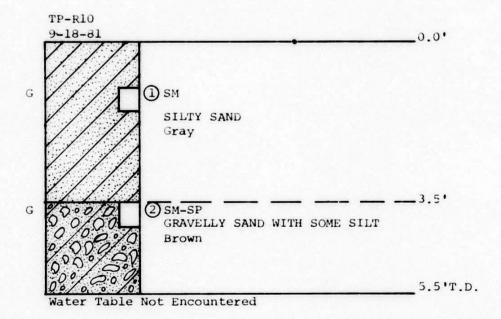


REM CONSULTANTS, INC.

RIVER ALLUVIUM TEST PITS TP-R7, R8



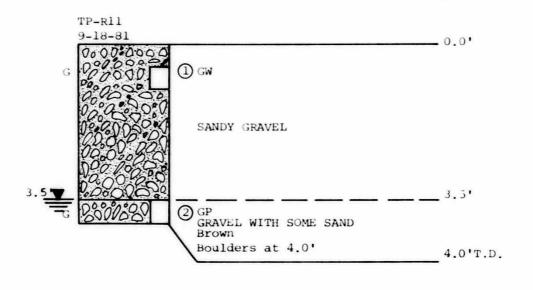


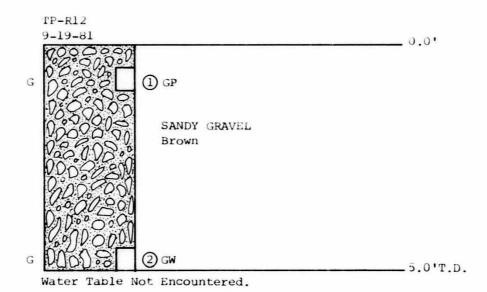


REM CONSULTANTS, INC.

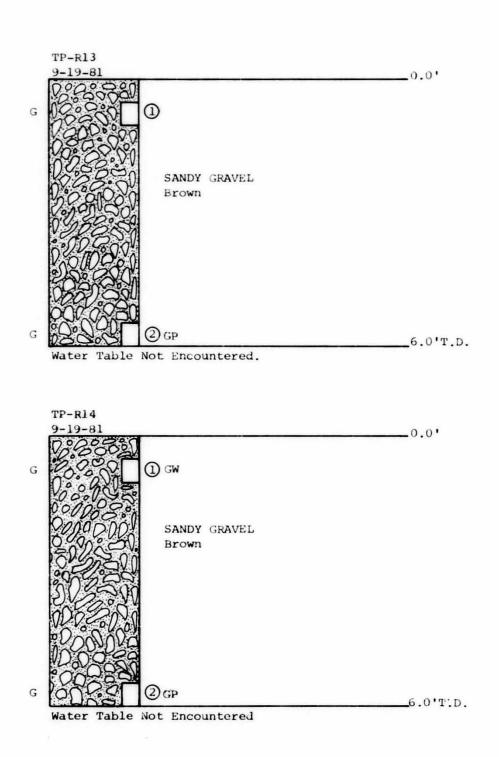
RIVER ALLUVIUM TEST PITS TP-R9, R10







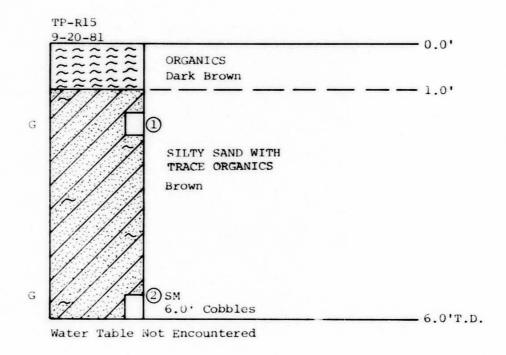
RIVER ALLUVIUM TEST PITS TP-R11, R12

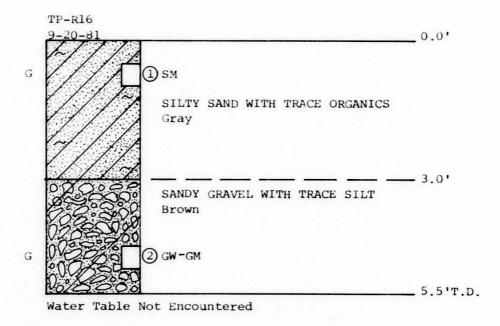


REM CONSULTANTS, INC.

RIVER ALLUVIUM TEST PITS TP-R13, R14



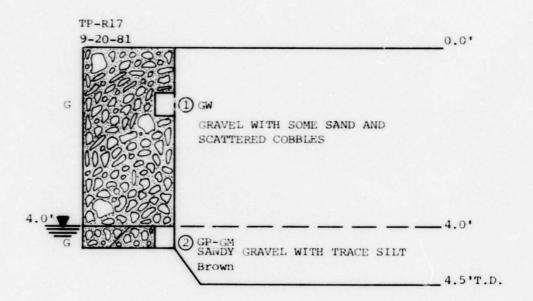


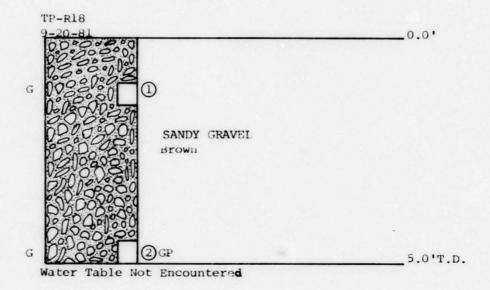


REM CONSULTANTS, INC.

RIVER ALLUVIUM TEST PITS TP-R15, R16



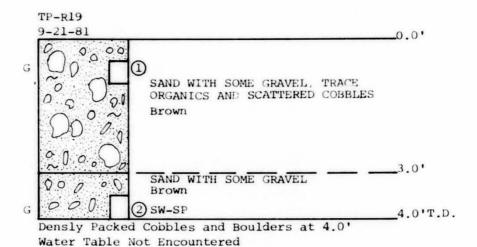


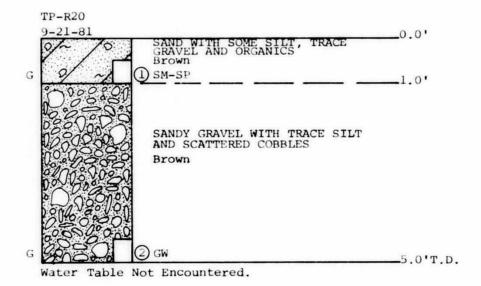


REM CONSULTANTS, INC.

RIVER ALLUVIUM TEST PITS TP-R17, R18



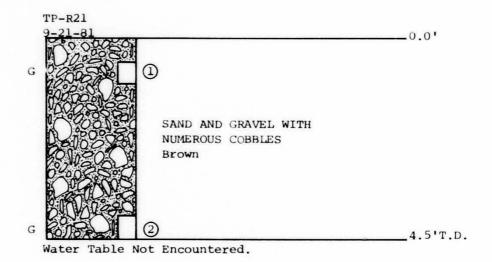


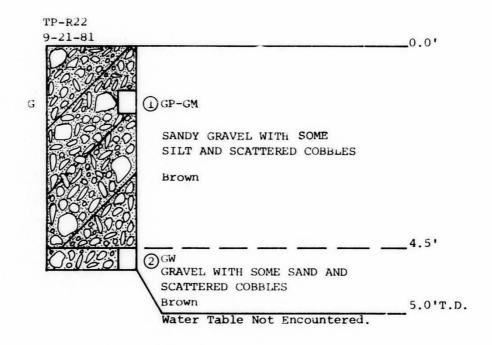


REM CONSULTANTS, INC.

RIVER ALLUVIUM TEST PITS TP-R19, R20







Prepared for:



RIVER ALLUVIUM TEST PITS TP-R21, R22



LABORATORY TEST DATA

PROJECT NO. 05250 CLIENT: Acres Americ PROJECT NAME Susitna (Watana	an, In Hydro	elect	<b>tri</b> c			¢ M					TS, I	NC.	- ATA			Octobe			
DESCRIPTION	4"	3"	2"	112"	1"	3/4"	1/2"	3/8"	#4	#10	# 40	#200	.02	.005	.002	% Moist.	LL	PI	Unified Class.
STREAM ALLUVIUM W-80-302 (Crab Sampl	100 e)	92	90	82	69	58	45	38	27	23	14	2,6							GP

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PROJECT	NO	052506
PROJECT	NO	

CLIENT: Acres American, Inc.
PROJECT NAME Susitna Hydroelectric

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.,	ε	NA.
		IAL

CONSULTANTS, INC.

DATE \_\_October 29, 1981

SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_ PAGE NO 1 of 3

BORING	SAMPLE NO.	UEFIR	4½"	4"	3"	2"	1½"	1"	3/4'	1/2"	3/8'	#4	#10	#20	#40	#80	#100	#200	.02	.005	.002	CLASS
TP-R1	2	1.5'-2.0'		100	95	89	78	67	59	49	43	31	22	16	13_	6	4	2.2		ļ		GP
TP-R1	4	3.0'-3.5'		100	99	87	79	65	56	45	39	28	20	14	13	5	4	1.5				GP
TP-Rl	5	3.5'-4.5'	-	100	98	94	79	67	57	46	39	29	21	17	13		4	1.5			-	GP
TF-R3	1	0.0'-1.0'		100	77	64	54	44	39	33	29	23	18	16	15	7	5	2.0				GP
TP-R2	2	4.5'-5.0'	100	94	89	74	63	50	42	34	30	21	14	11	11	_6_	_5_	2.0				GP
TP-R3	2	4.5'-5.0'	-		100	96	89	72	60	47	40	29	22	:17	14	_5	_3.	1.2			-	GP
TP-R4	2	4.0'-4.5'		100	97	86	_77	65	58	49	43	_31	25	17	11		_2	0.7				GP
TP-R5	1	0.5'-1.0'			100	90	79	69	61	53	47	36	23	12	8	5	4	2.2				GW
TP-RS	2	3.0'-3.5'	100	95	90	80	75	66	60	51	44	32	21	10	8		_2	1.1				GW
TP-R6	2	2.0'-3.0'									100	99	95	92	89	72	65	47.2	15.6	3.8	2.4	ML-SM
TP-R7	1	0.5'-1.0'			100	95	86	71	62	52	45	32	24	18	11	7	1	0.5				GW
TP-R7	2	3.5'-4.0'				100	91	91	87	86	84	77	75	72	47_		3	1.0				SP
TP-R8	1	0.5'-1.0'		100	92	73	67	57	51	44	39	28	19	15	11	 5	4	1.7				GW

REMARKS : _	River	Alluvium	Test	Pits,	Watana	Area	
					7		

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT NO. \_\_\_\_\_052506

CLIENT: ACRES AMERICAN, INC.
PROJECT NAME Susitna Hydroelectric

## R & M\_\_\_\_CONSULTANTS, INC.

DATE \_\_October 29, 1981

SUMMARY OF LABORATORY TEST DATA

PARTY NO. \_\_\_\_\_ PAGE NO 2 of 3

BORING	SAMPLE NO.	DEPTH	4½"	4"	3"	2"	1½"	1"	3/4	1/2"	3/8	#4	#10	#20	#40	#80	#10	D#200	.02	.005	002	CLASS
TP-R9	1	0.5'-1.0'						_	_					100_	99	62	50	24.	4.0	1.5	1,3	SM
TP-R1	1	1.0'-1.5'												100	99	82	68	30.0				SM
TP-R1	2	3.5'-4.0'	_		100	92	88	81	76	71	68	64	61	59	55	38	1	14.		.67	.63	SM-SP
TP-R1	. 1	0.5'-1.0'			100	90	80	66	58	48	42	33	27	24	19	7	_6	2.4				GW
TP-Rl	. 2	3.5'-4.0'	-		100	92	81	_68	60	49	42	30	22	:19	14	5	4_	2.0				GP
TP-Rl	1	0.5'-1.0'			100	92	77	65	58	49	43	33	26	23	21		7	3.3				GP
TP-R1	2	4.5'-5.0'			100	89	79	67	59	49	43	32	.25	_20	14_	5	3	1.5				GW
TF-R13	2	5.5'-6.0'			100	93	85	74	65	54	49	38	31	22	12	4	3	1.7				GP
TP-R1	1	0.5'-1.0'			100	95	88	75	66	55	48	36	28	22	20	7	5	1.7				GW
TP-R1	2	5.5'-6.0'			100	93	84	69	61	52	47	36	27	19	13	5	4_	1.4				GP
TP-R15	2	5.5'-6.0'													100	91	82	44.7	4.8	1.1	0.7	SM
TP-R16	1	0.5'-1.0'					_				_	_			100	89	78	36.8				SM
TP-R1	2	4.5'-5.0'			100	93	85	72	64	56	51	41	31	24	20	13	11	6.0	1.2	0.59	0.44	GW-GM

REMARKS: \_\_\_ River Alluvium Test Pits, Watana Area

NOTE: SIEVE ANALYSIS = PERCENT PASSING

PROJECT	NO.	052506	
~= ====			122

CLIENT: Acres American, Inc.

PROJECT NAME Susitna Hydroelectric

## R & M CONSULTANTS, INC.

DATE \_\_October 29, 1981 .

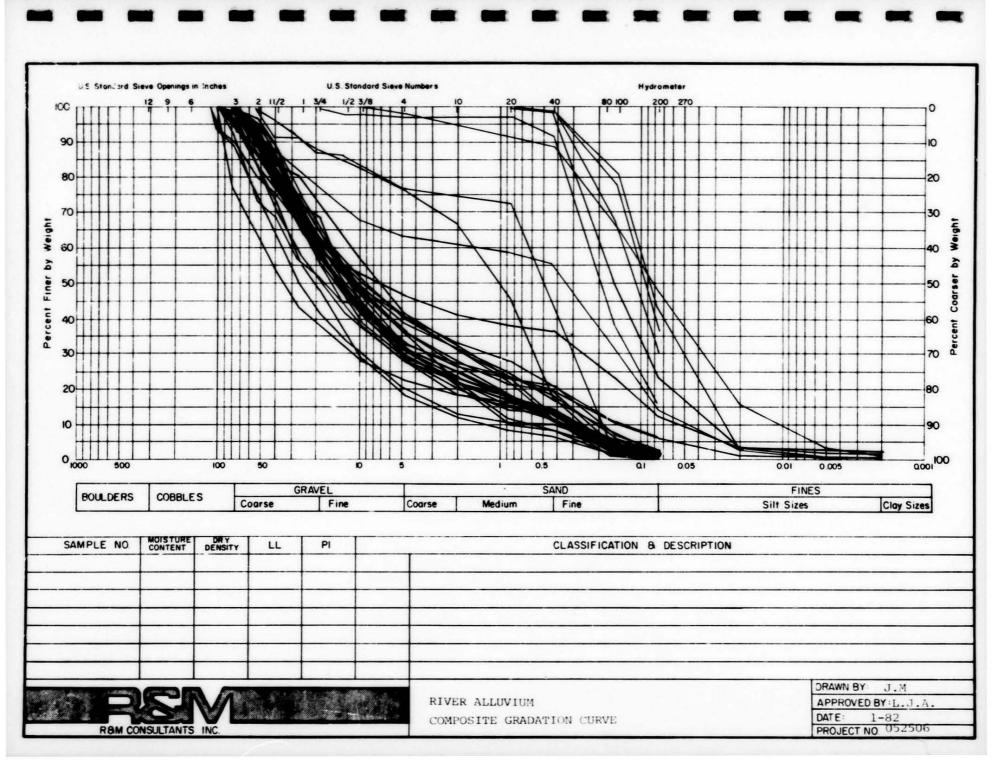
SUMMARY OF LABORATORY TEST DATA

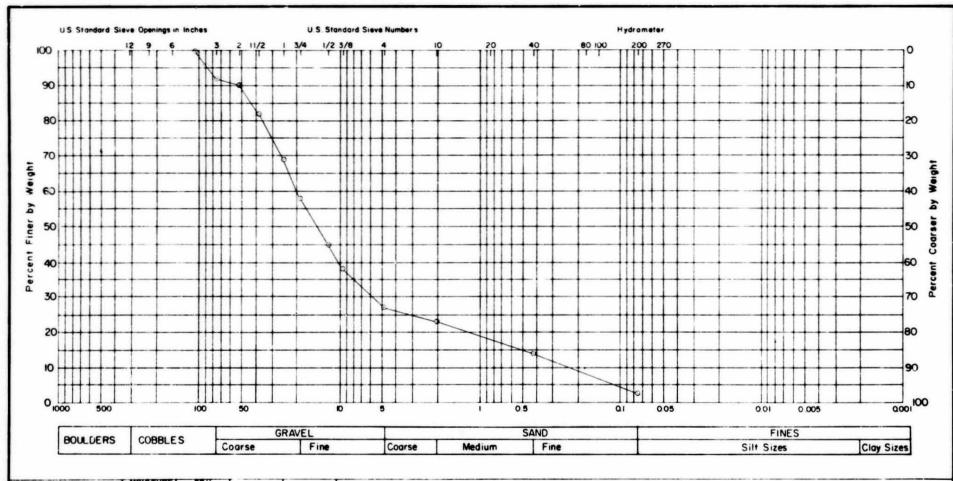
PARTY NO. \_\_\_\_\_ PAGE NO 3 OF 3

	GP-GM
	GP
	GP
	-
	SW-SP
	SM-SP
	GW
2.4 1.0 0.6	GP-GM
	_GW
	4 1.0 0.6

EMARKS:	 	1000	- 100/	Watana Area	 

NOTE: SIEVE ANALYSIS = PERCENT PASSIN





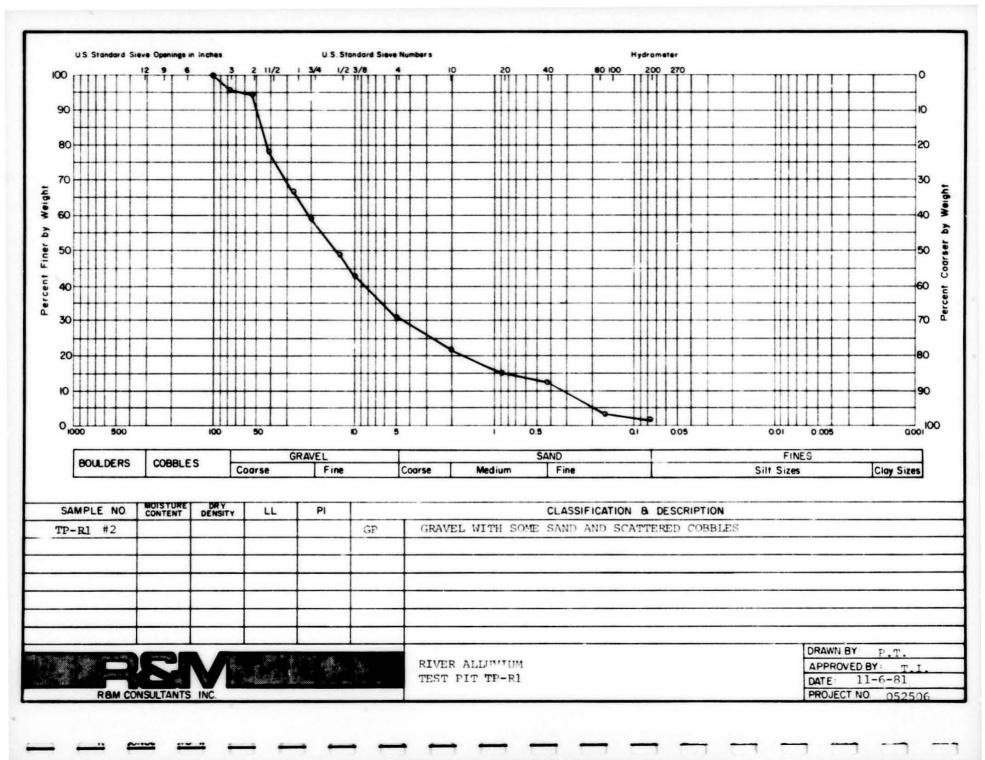
SAMPLE NO	CONTENT	DRY	LL	PI		CLASSIFICATION & DESCRIPTION	
W-80-302					GP	SANDY GRAVEL W/TRACE SILT	
(Grab Sample)						Poorly Graded	

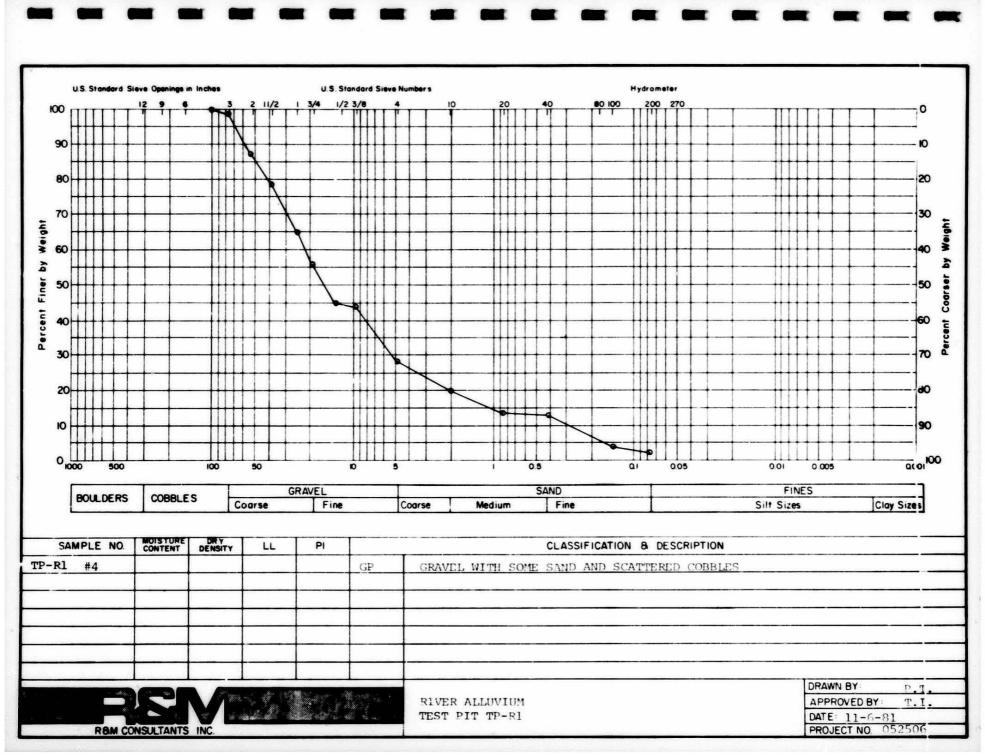


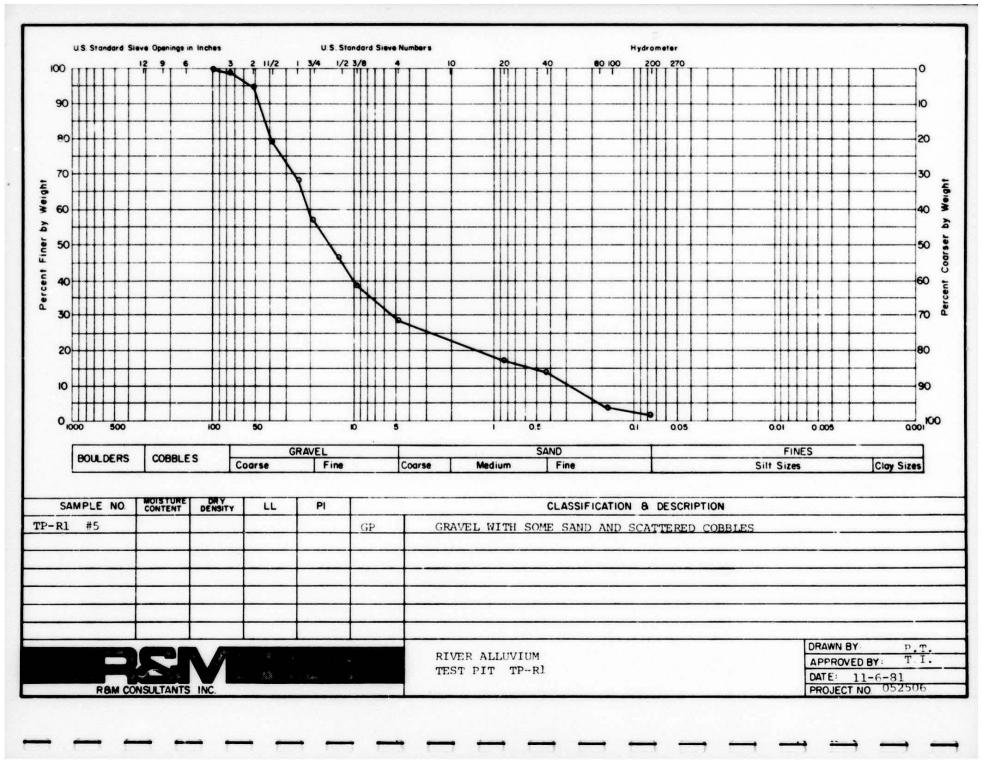
STREAM ALUVIUM

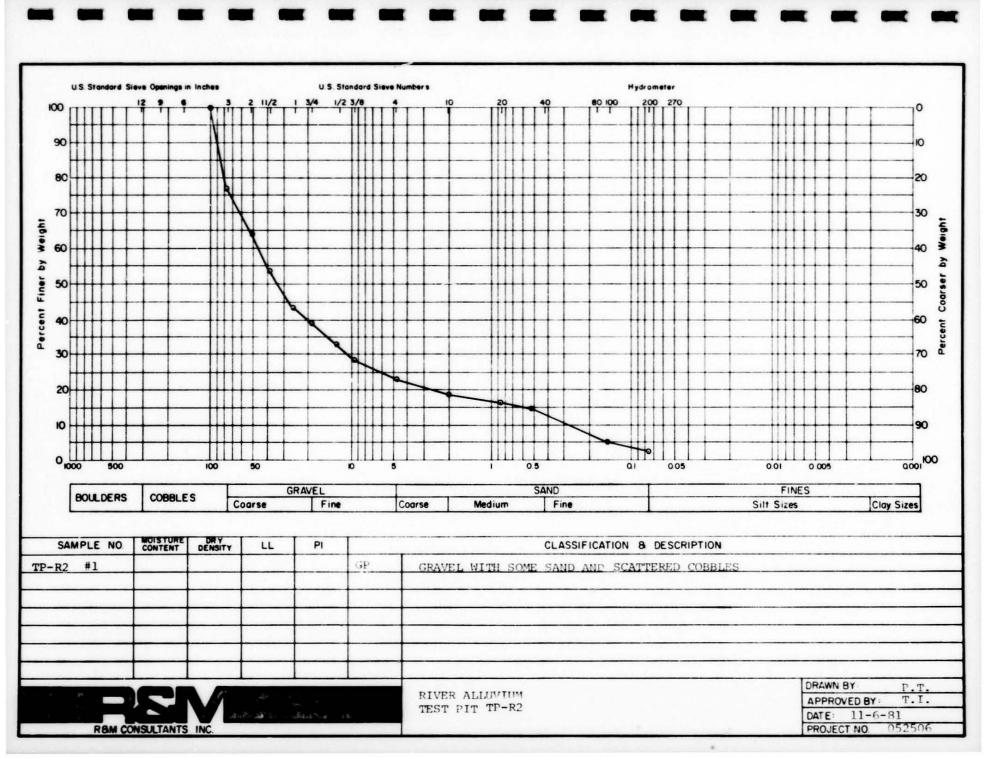
DRAWN BY DL.
APPROVED BY:

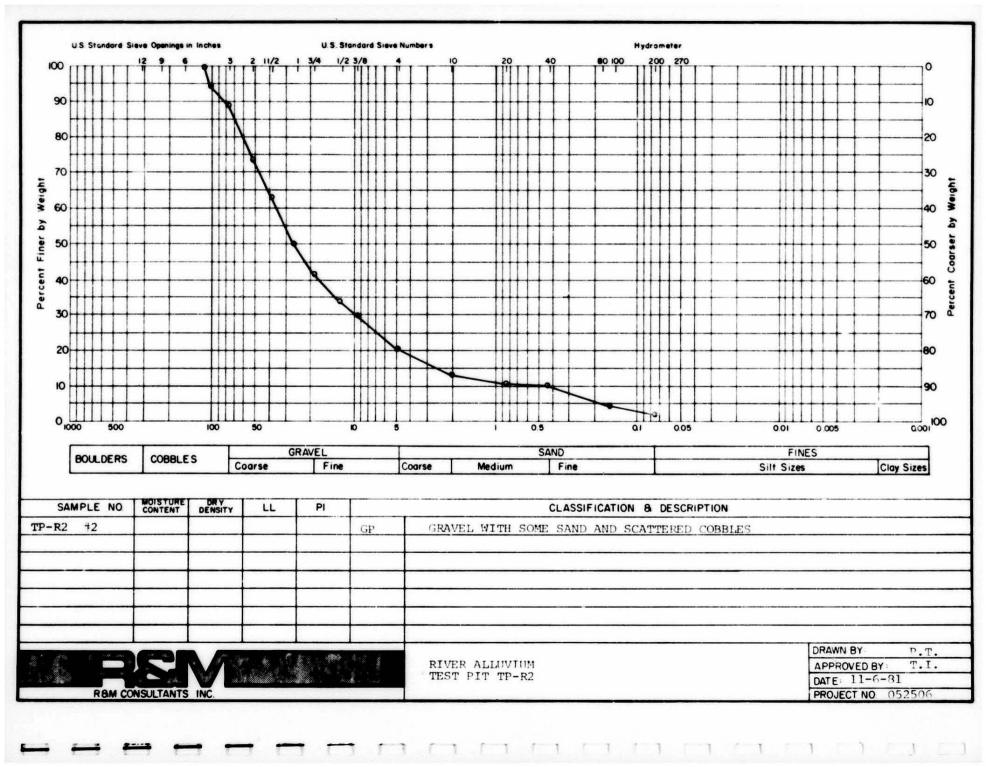
DATE: December 1980 PROJECT NO. 052504

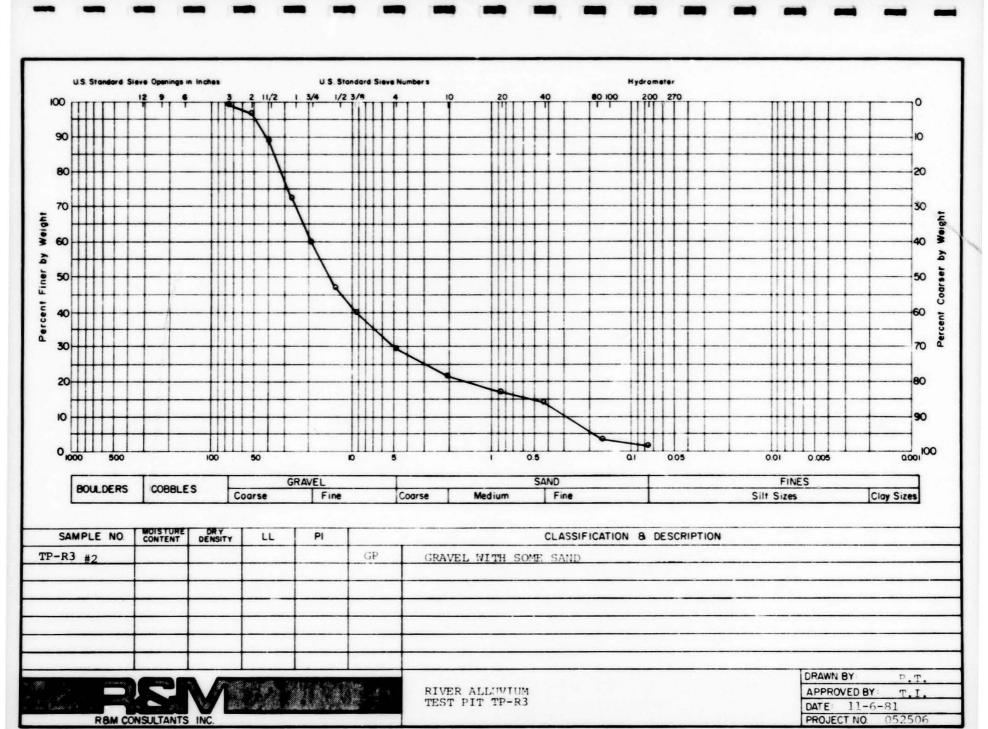


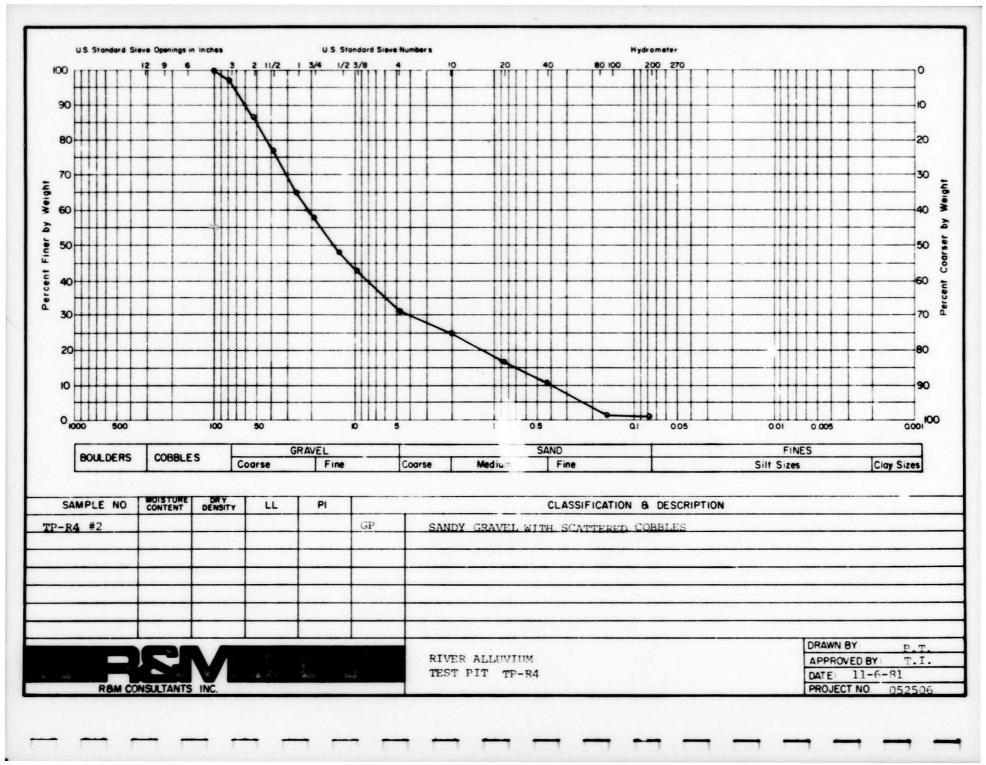


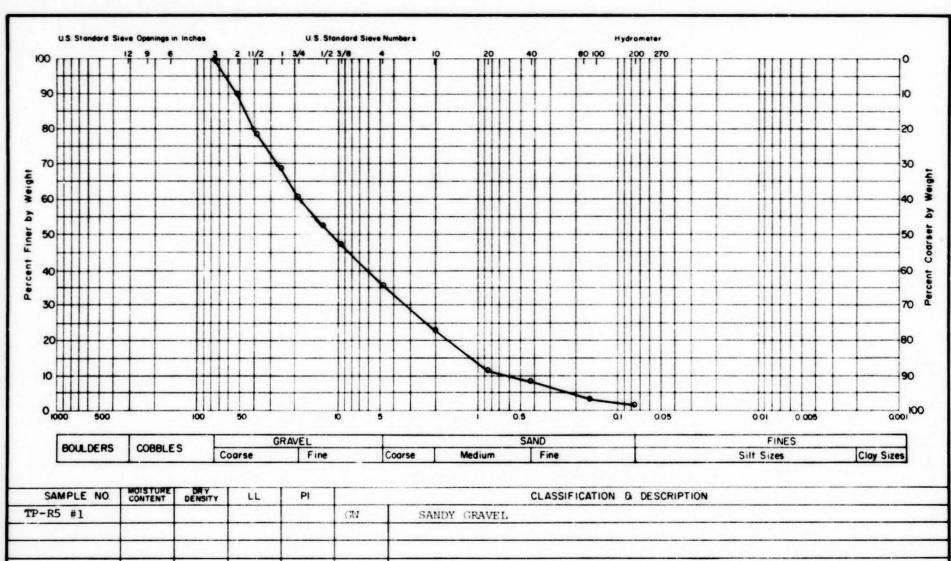












SAMPLE NO	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTIO	N
TP-R5 #1					GW	SANDY GRAVEL	
	-						
	-						
	<b>+</b> ·						
v 4	120	Total State of the last of the	. 2.	484 5			DRAWN BY P.T.
1		1	18. 3	33.18	1 1	RIVER ALLUVIUM	APPROVED BY: T

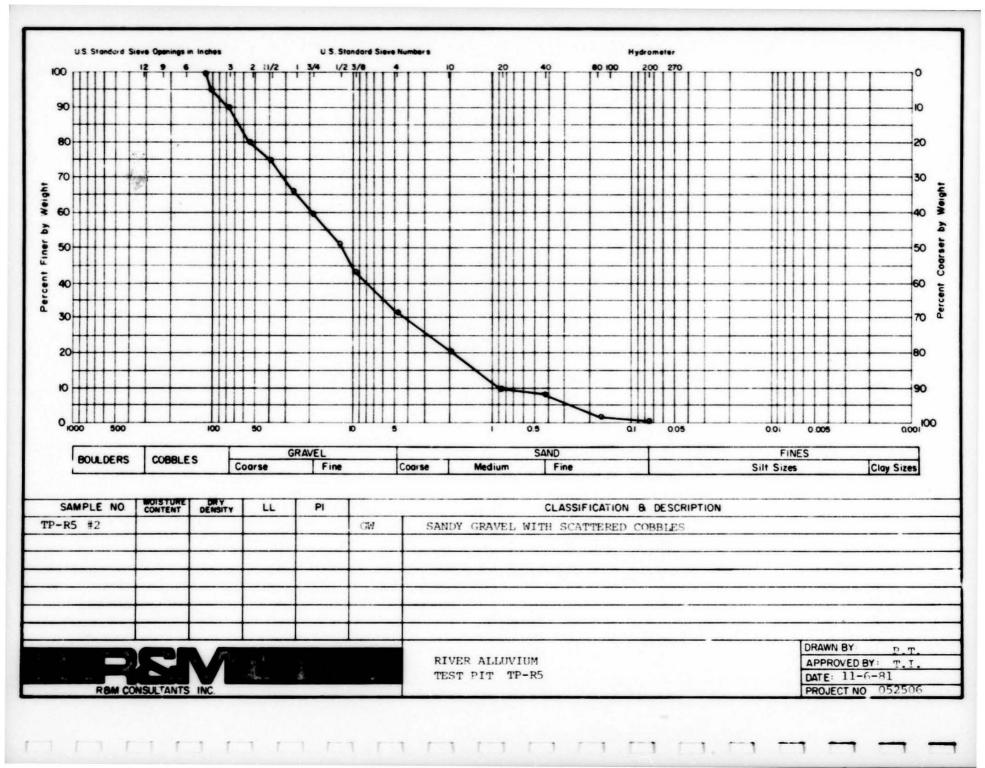
TEST PIT TP-R5

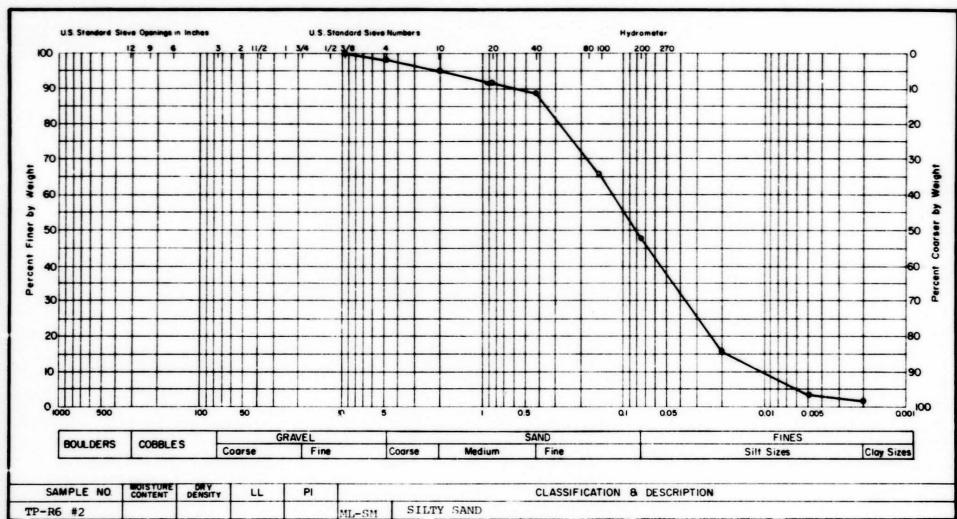
DATE: 11-6-81

PROJECT NO. 052506

2 Marin - 1

ROM CONSULTANTS INC.





SAMPLE NO	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION		
TP-R6 #2					ML-SM	SILTY SAND		
						(FIELD GEOLOGIST NOTES TRACE ORGANICS)		
	-			-				
	-				-			
					-			
							DRAWN BY	P.T.
			1.000	577 An	388.7	RIVER ALLUVIUM	APPROVED BY:	T. T.

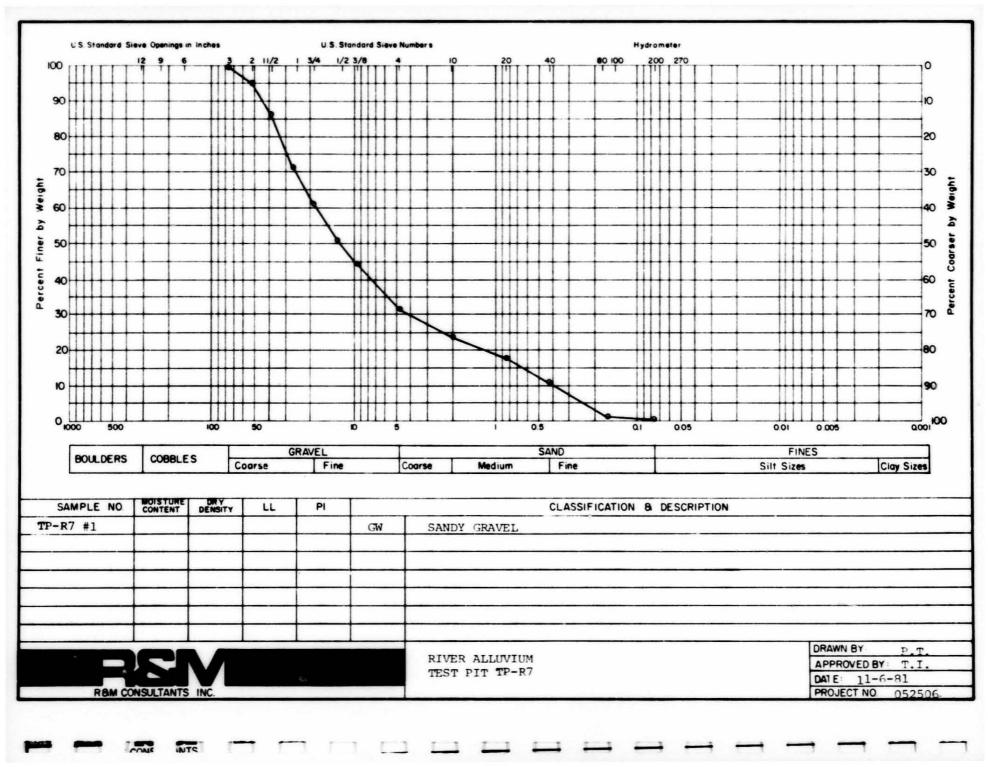
TEST PIT TP-R6

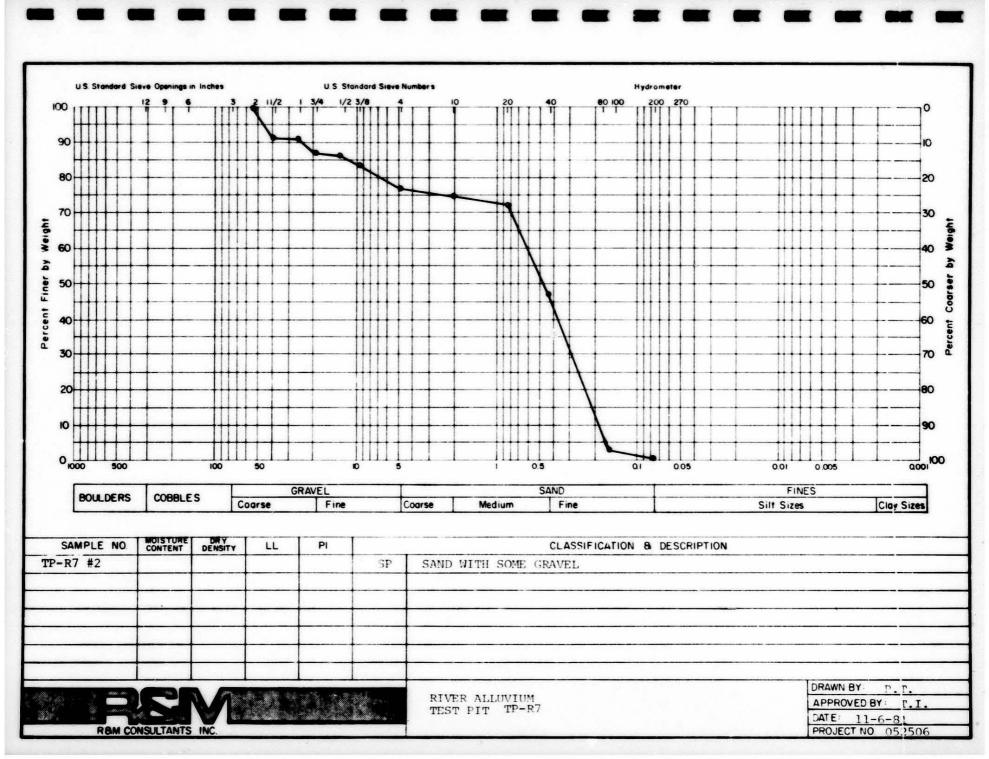
ROM CONSULTANTS INC.

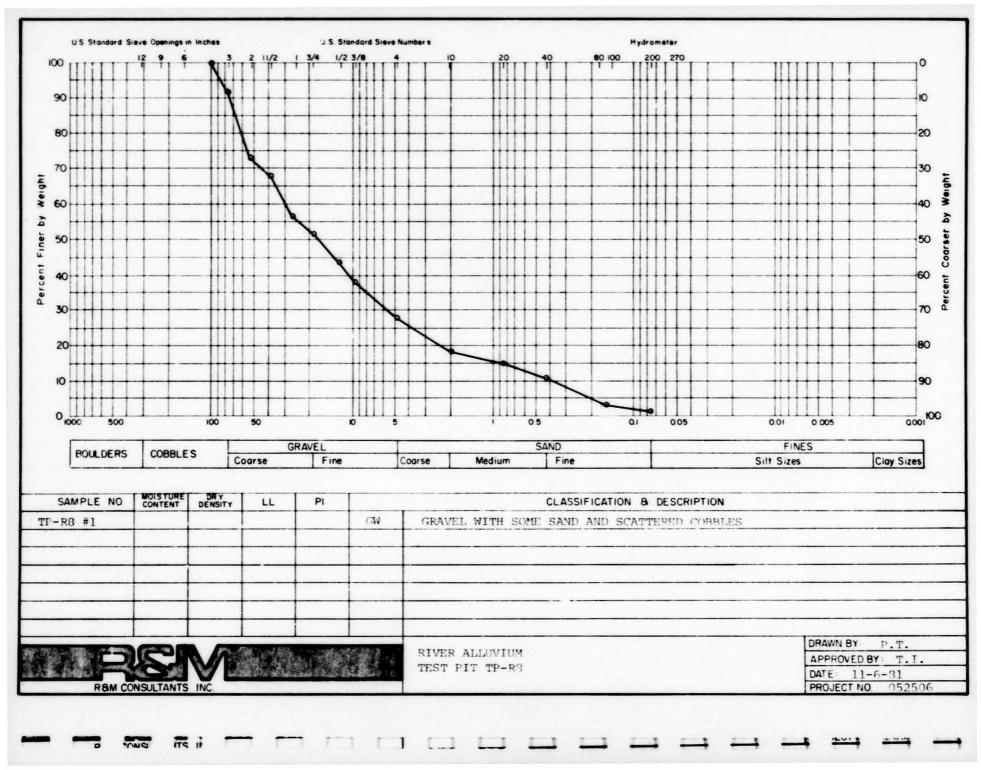
APPROVED BY: T.I.

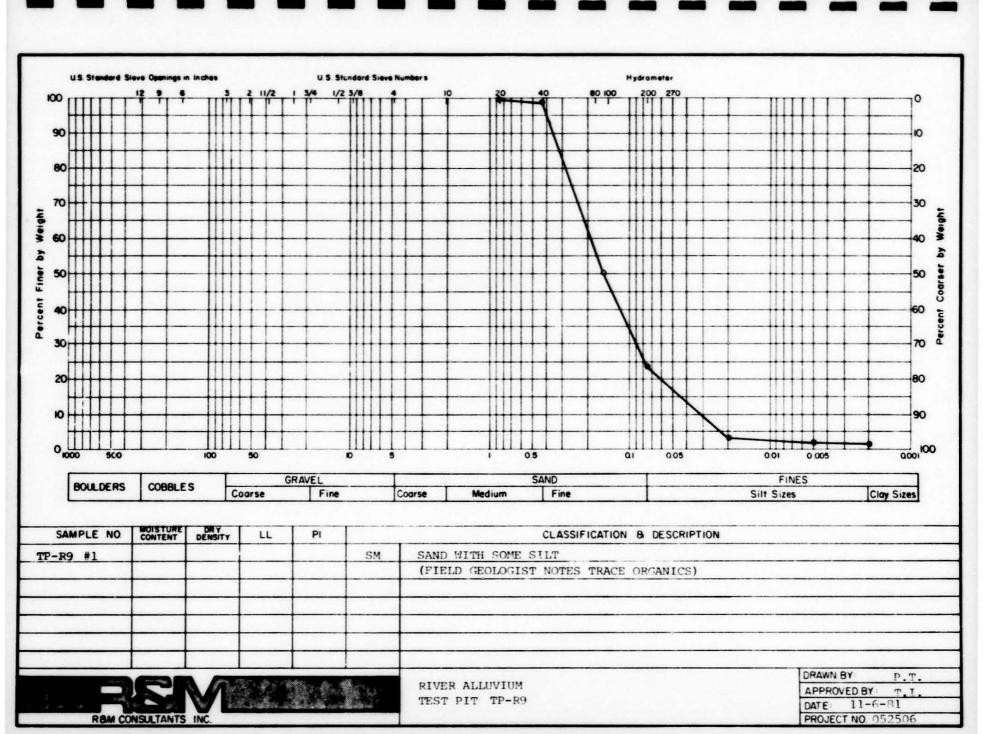
PROJECT NO 052506

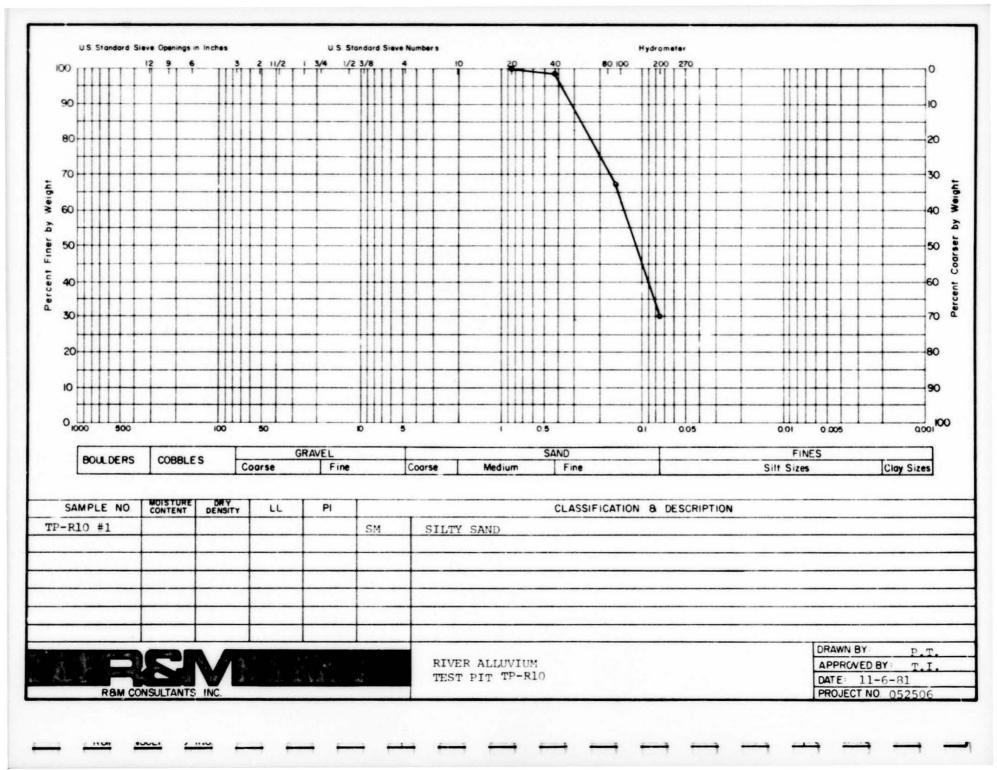
DATE: 11-6-81

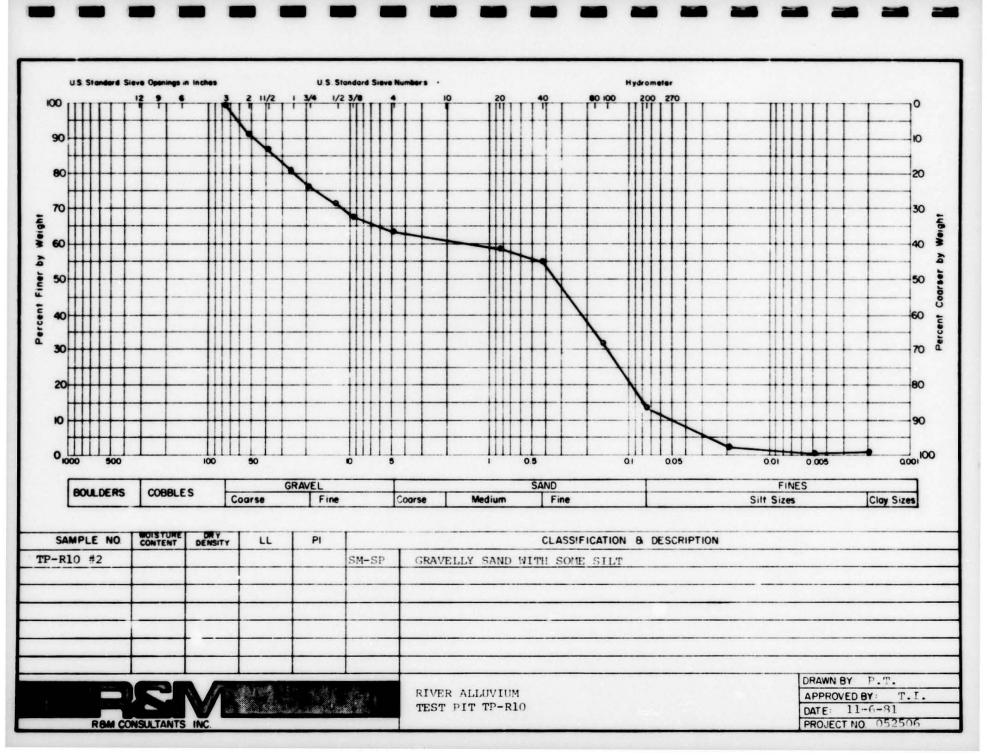


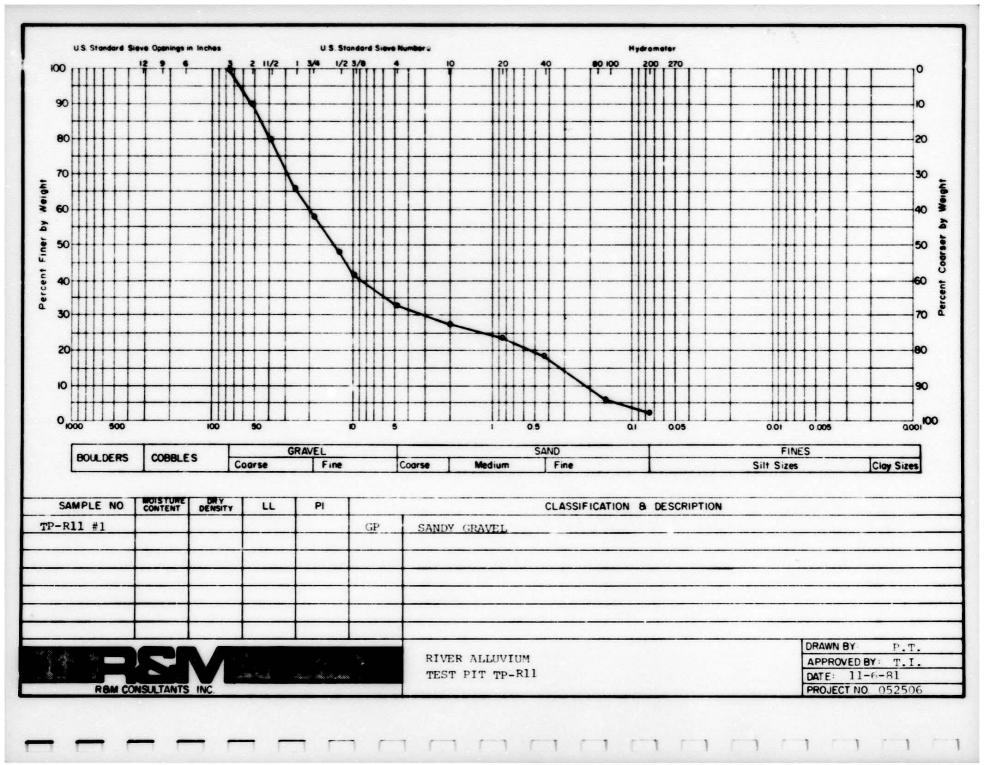


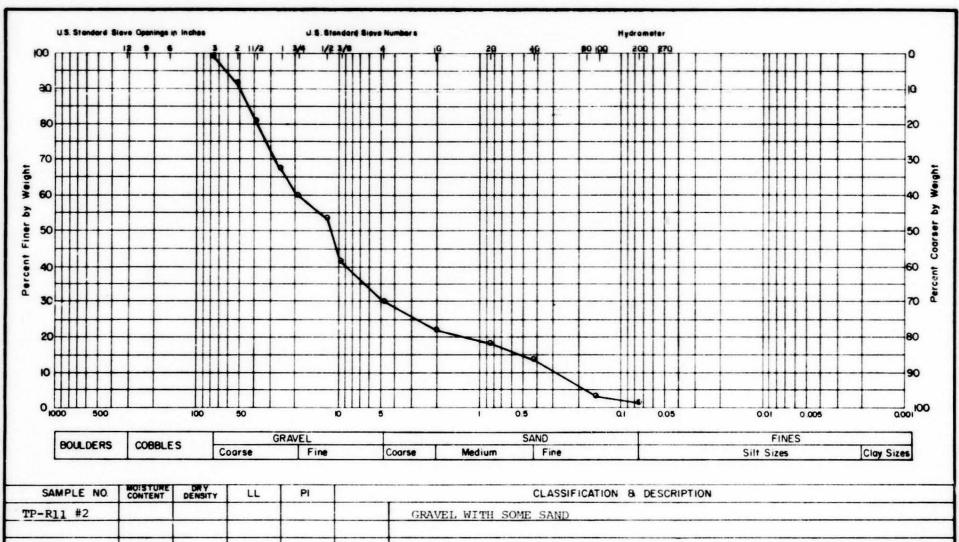












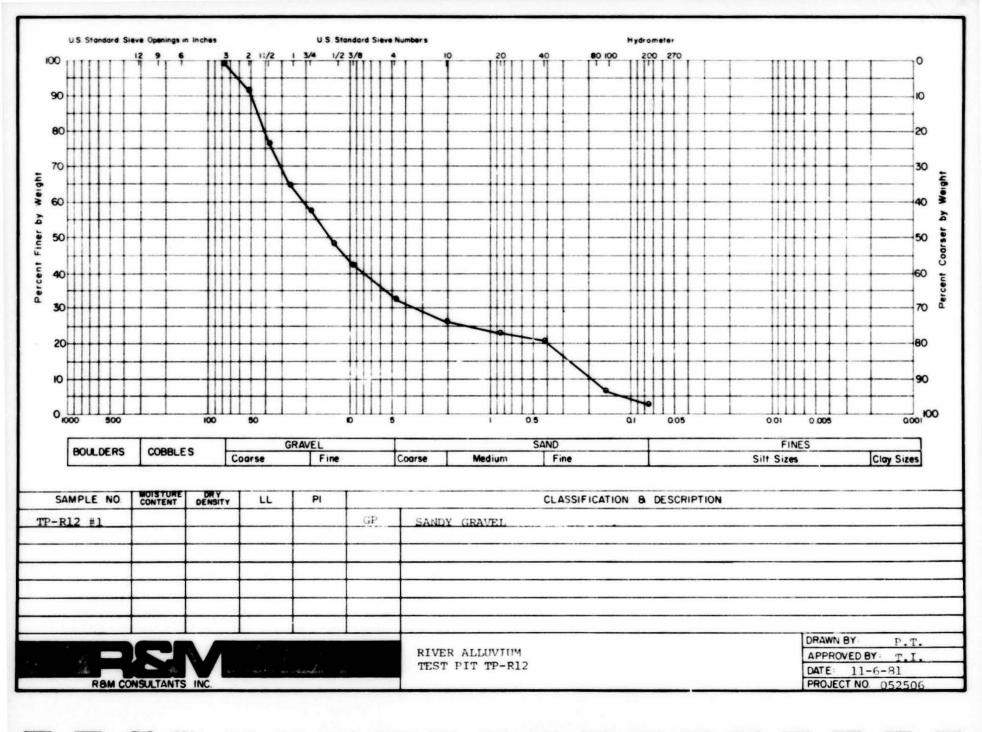
SAMPLE NO.	CONTENT	DENSITY	LL	PI	CLASSIFICATION & DESCRIPTION				
TP-R11 #2					GRAVEL WITH SOME SAND				
						DRAWN BY P.T.			
					RIVER ALLUVIUM	APPROVED BY: T.I.			

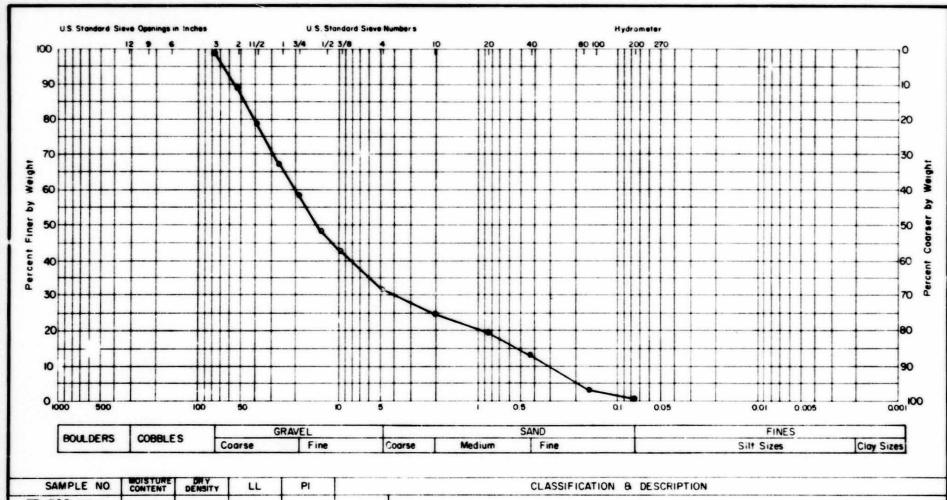
TEST PIT TP-R11

RAM CONSULTANTS INC.

DATE: 11-6-81

PROJECT NO 052506





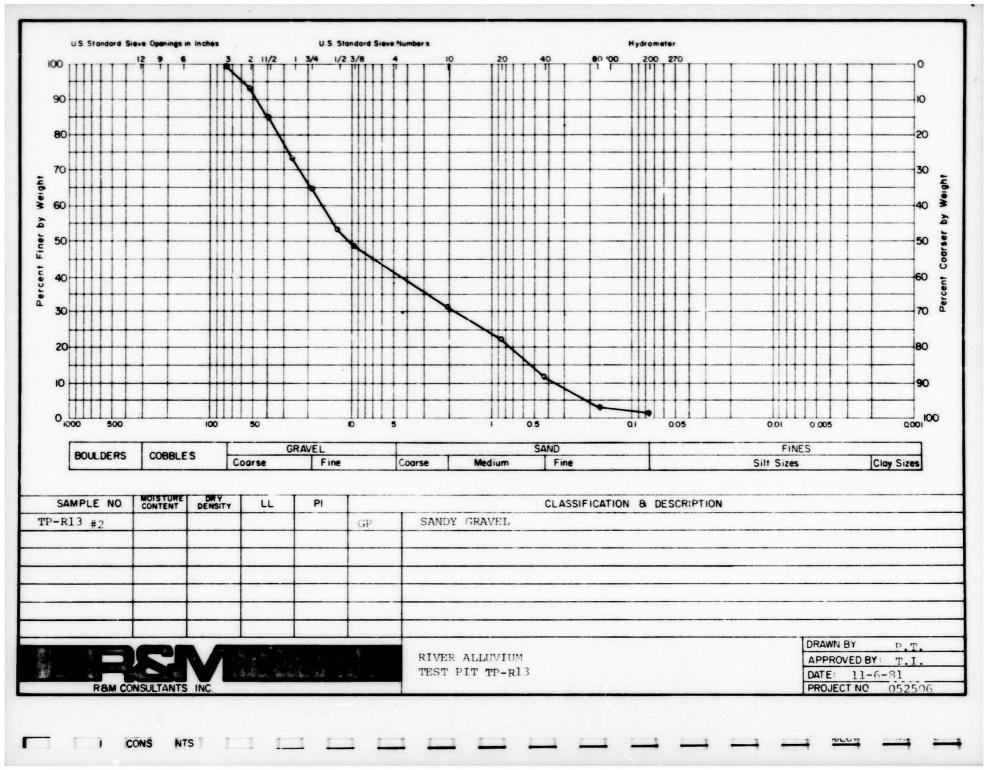
SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASSIFICATION & DESCRIPTION		
TP-R12 #2					GM	SANDY GRAVEL	
	ļ						
					-		
	$\vdash$			-	-		
					-		

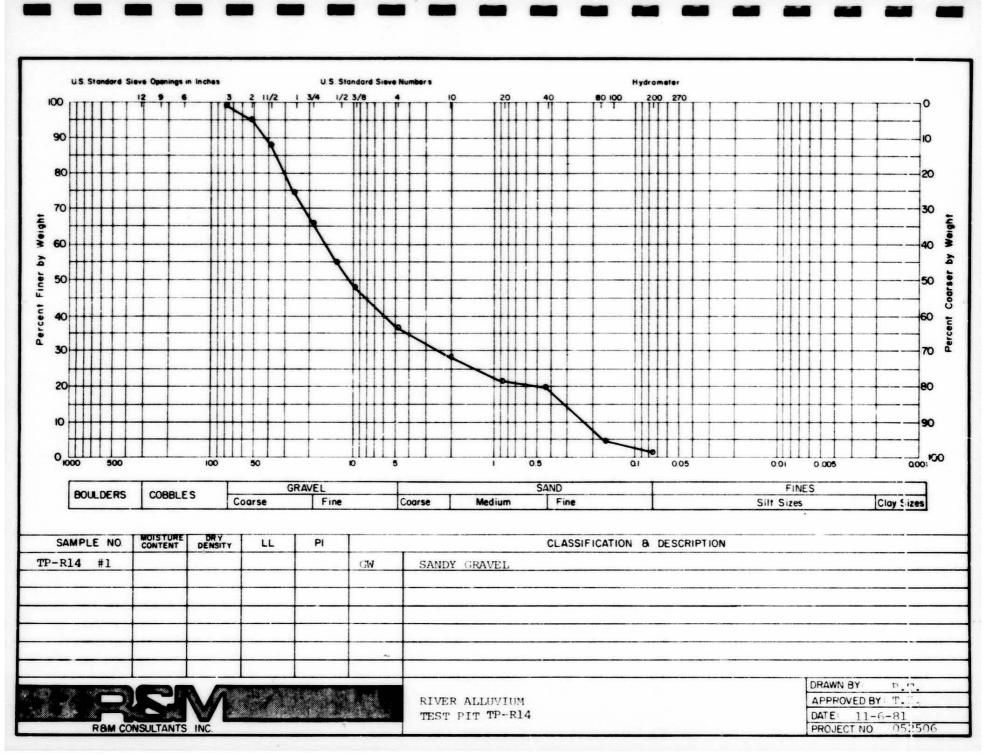
RBM CONSULTANTS INC.

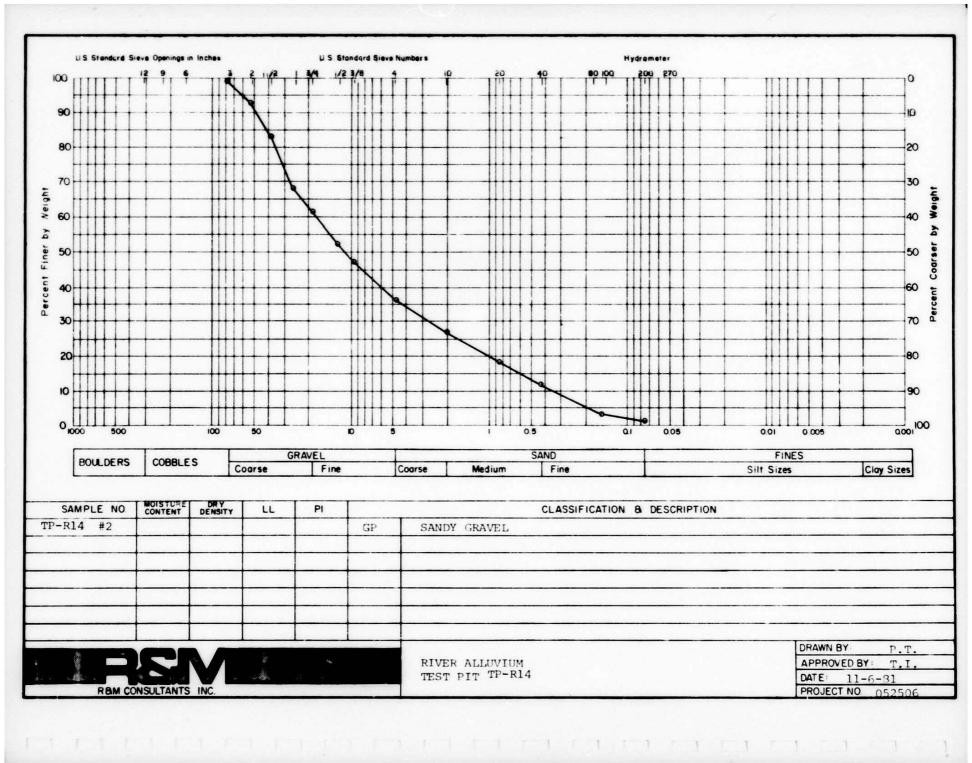
RIVER ALLUVIUM TEST PIT TP-R12 APPROVED BY: T. I.

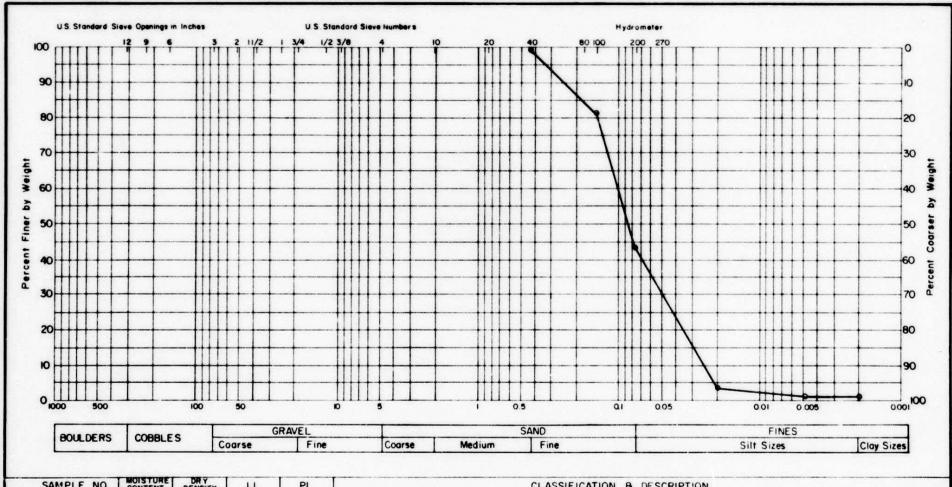
DATE: 11-6-81

PROJECT NO 052506









SAMPLE NO.	CONTENT	DENSITY	LL	PI		CLASSIFICATION & DESCRIPTION
TP-R15 #2					SM	SILTY SAND
						(FIELD GEOLOGIST NOTES TRACE ORGANICS)
				L	4	DRAWN BY: P. T.

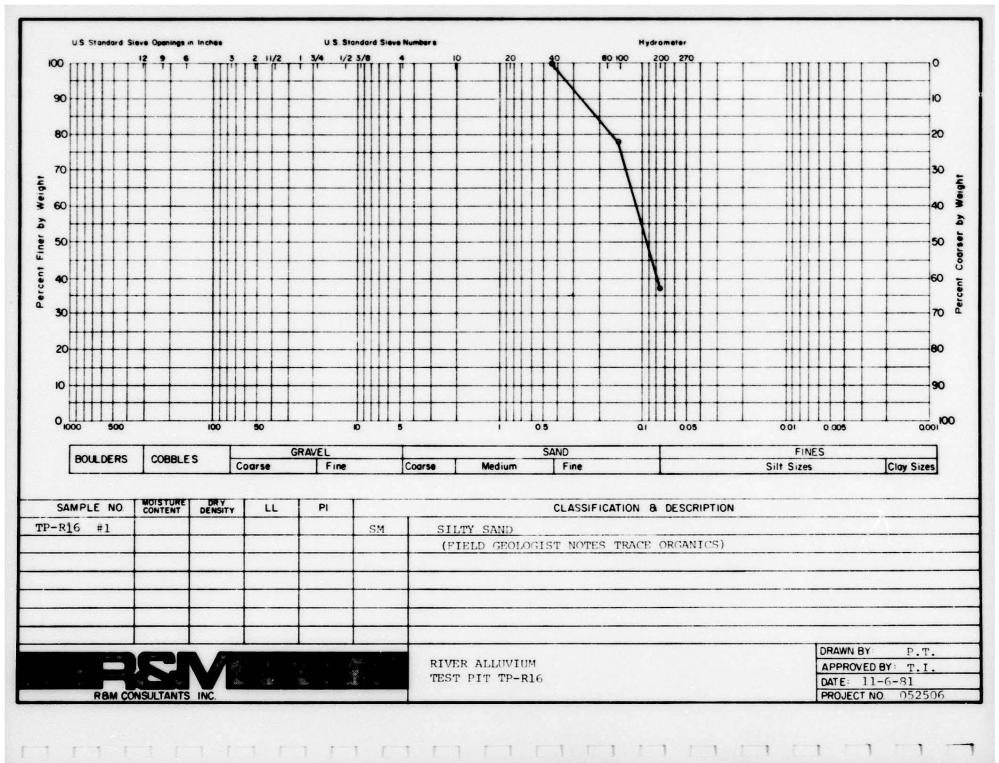
R&M CONSULTANTS INC.

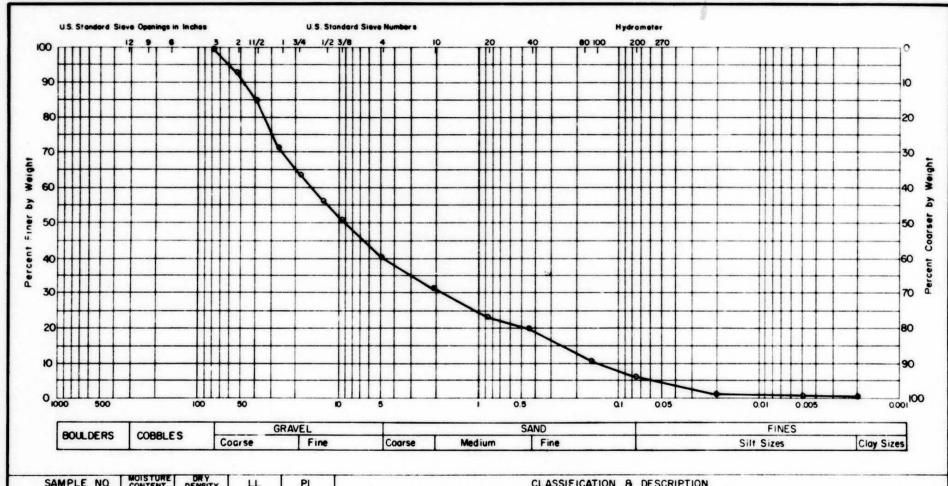
RIVER ALLUVIUM TEST PIT TP-R15 DRAWN BY: P.T.

APPROVED BY: T.I.

DATE: 11-6-81

PROJECT NO 052506





SAMPLE NO	CONTENT	DRY	LL		CLASSIFICATION & DESCRIPTION			
P-R16 #2					GW-GM	SANDY GRAVEL WITH TRACE SILT		
					1			
					-			
	11			L	44	DRAWN BY D. T.		

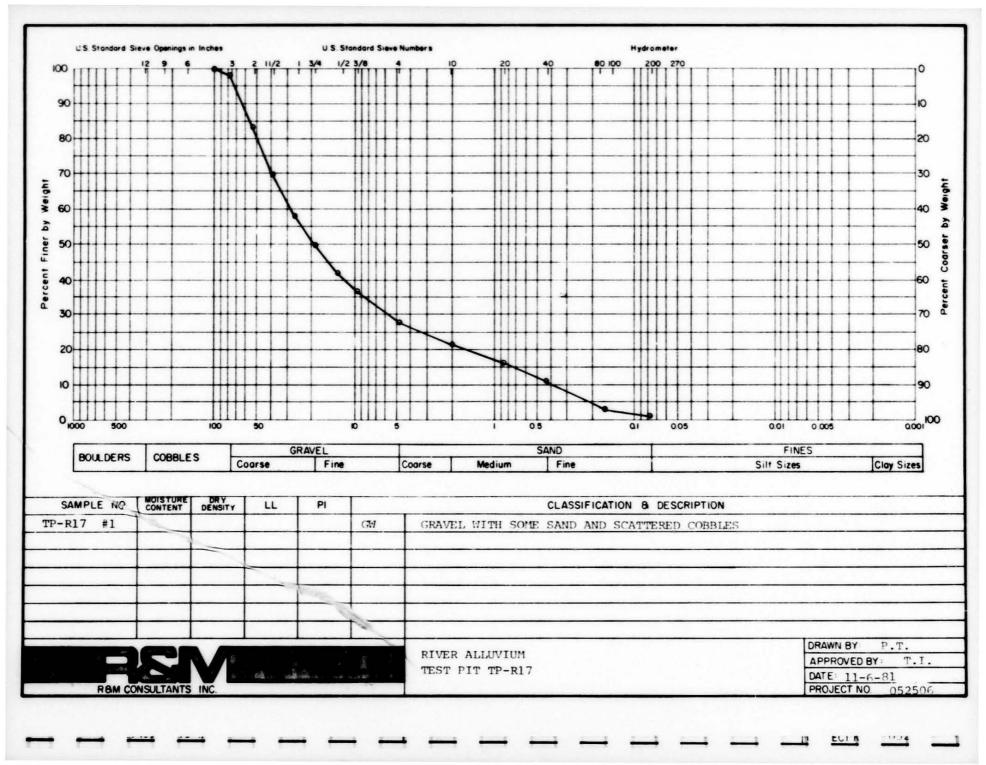
R8M CONSULTANTS INC.

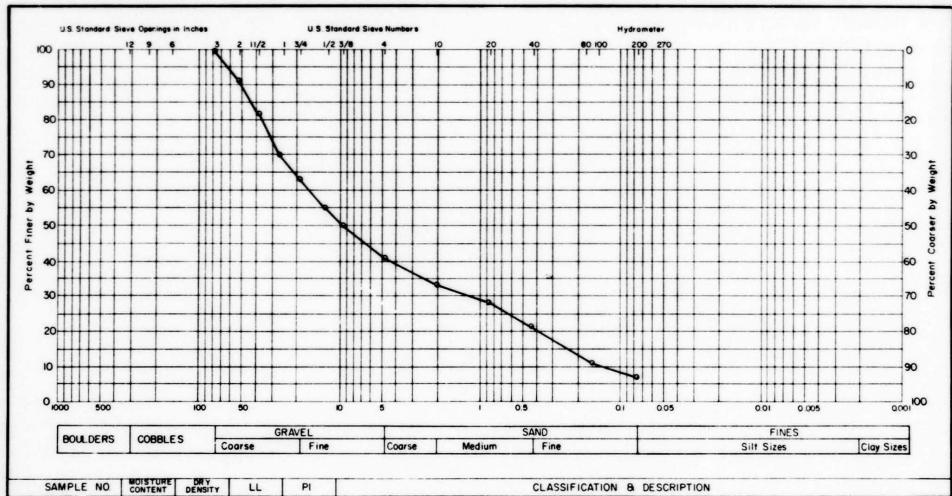
RIVER ALLUVIUM TEST PIT TP-R16 DRAWN BY: P.T.

APPROVED BY: T.I.

DATE: 11-6-81

PROJECT NO: 052506





SAMPLE NO	CONTENT	DENSITY	LL	LL PI	CLASSIFICATION & DESCRIPTION			
TP-R17 #2					GP-GM	SANDY GRAVEL WITH TRACE SILT		
					-			
					+			
	1				+			
					1	· ·		

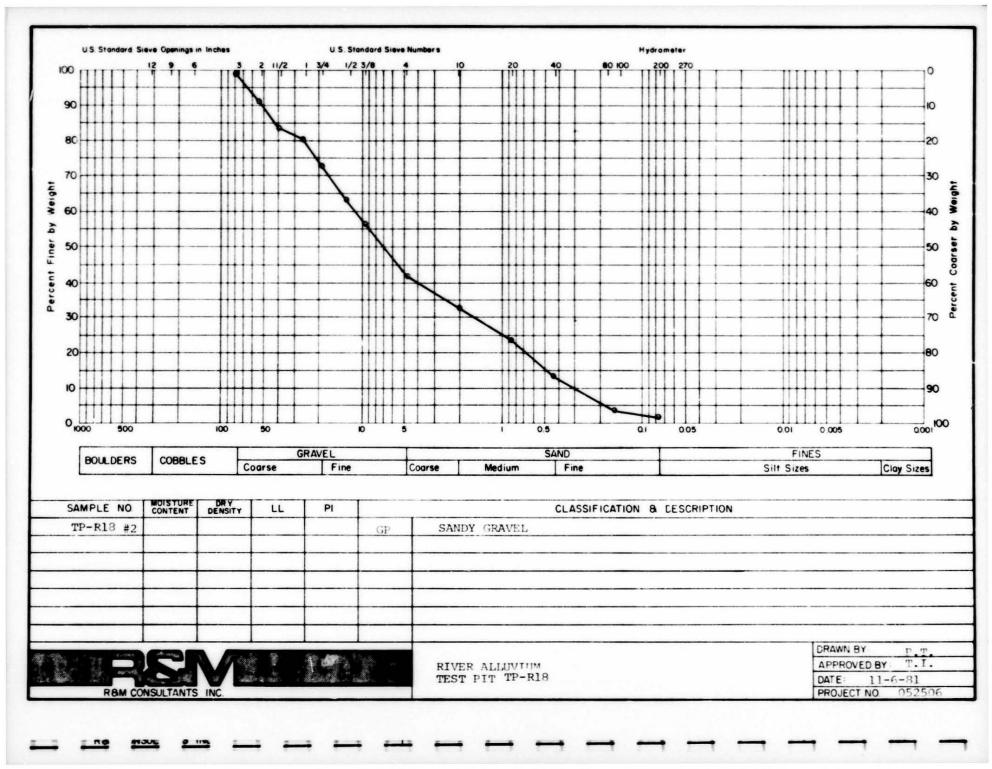
RBM CONSULTANTS INC.

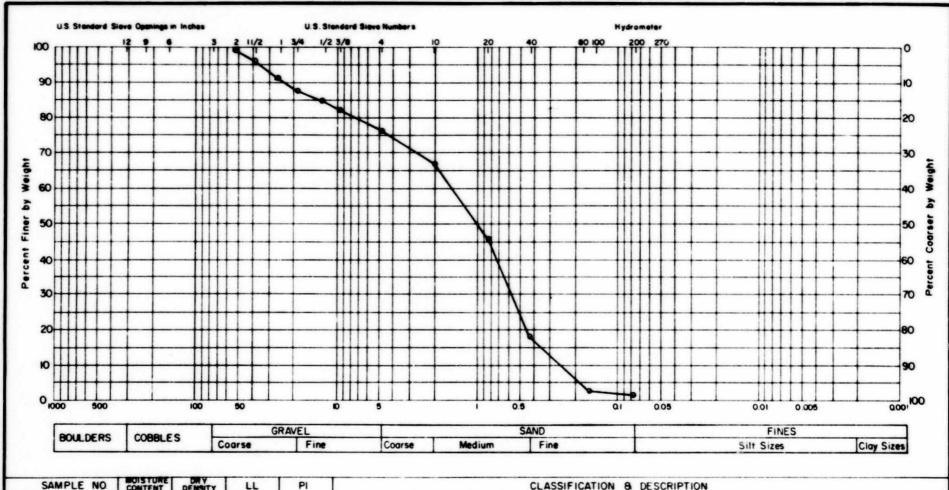
RIVER ALLUVIUM TEST PIT TP-R17 DRAWN BY P.T.

APPROVED BY: T.I.

DATE: 11-6-31

PROJECT NO 052506





SAMPLE NO CONTENT		DENSITY	LL	PI	CLASSIFICATION & DESCRIPTION
TP-R19 #2				SW	-SP SAND WITH SOME GRAVEL
	-				
				-	

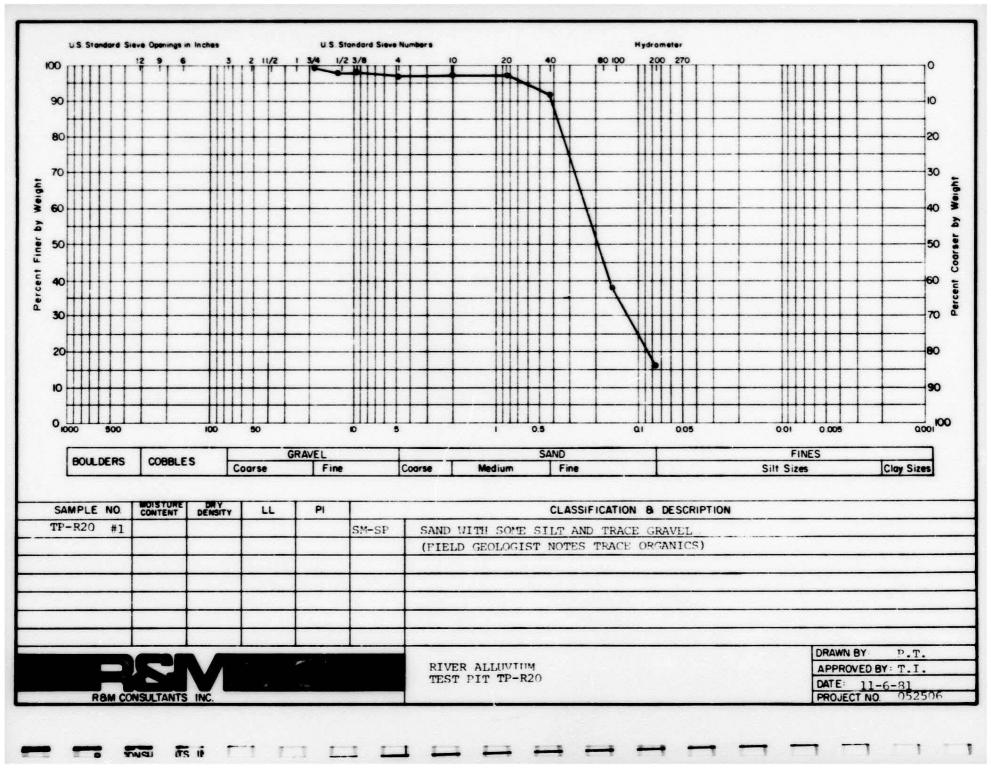
ROM CONSULTANTS INC.

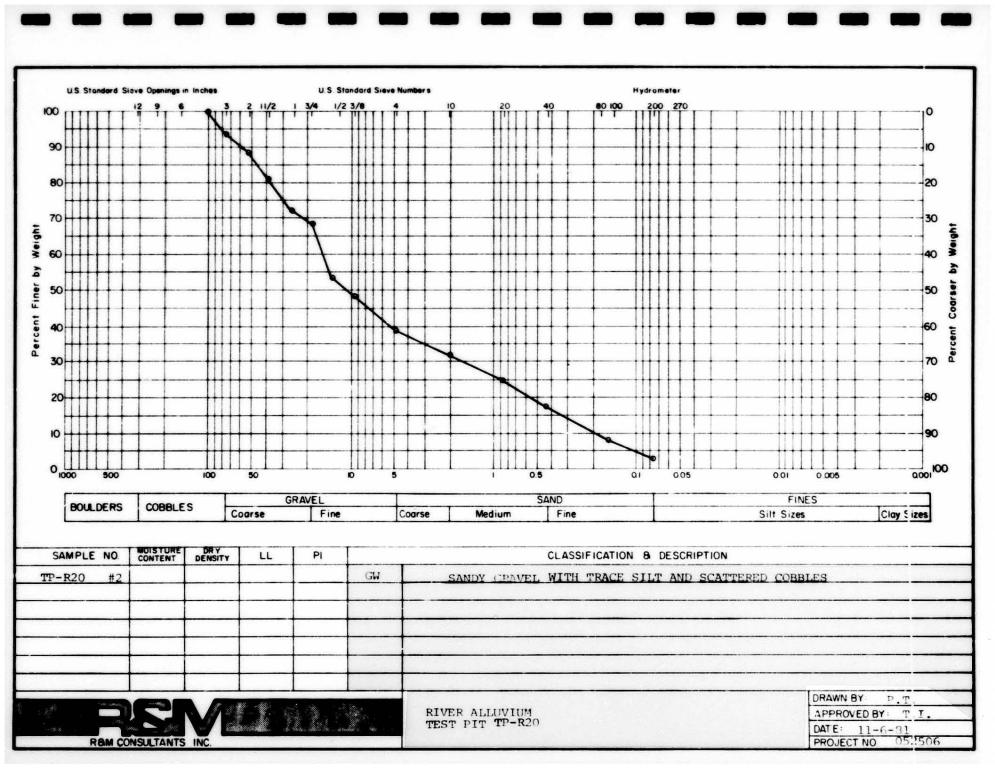
RIVER ALLUVIUM TEST PIT TP-R19 DRAWN BY: D.T.

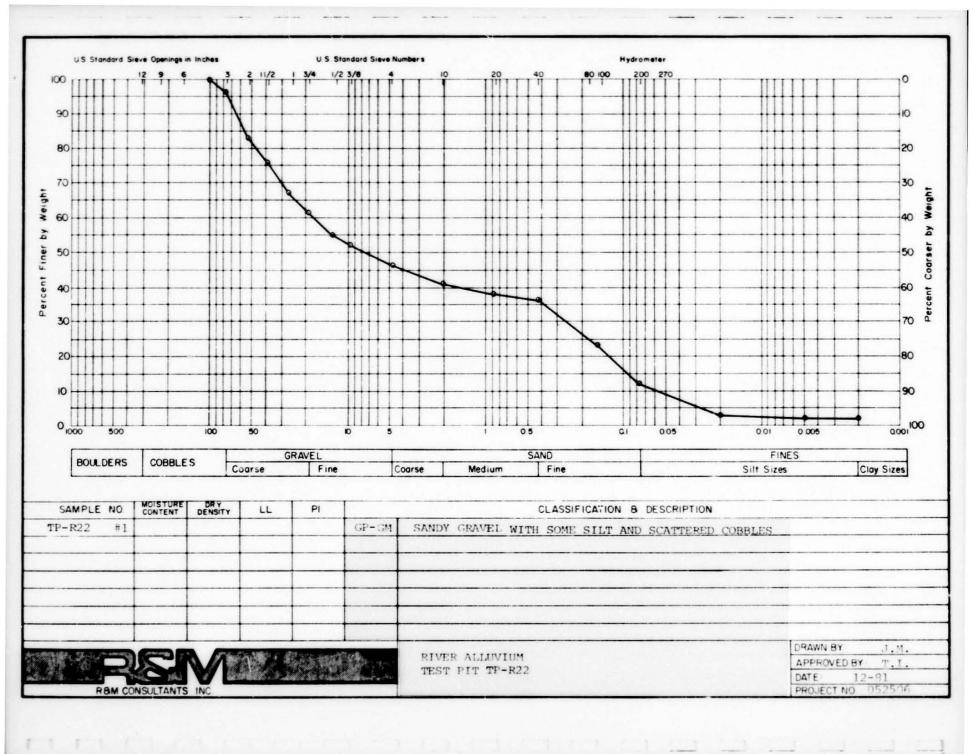
APPROVED BY: T.I.

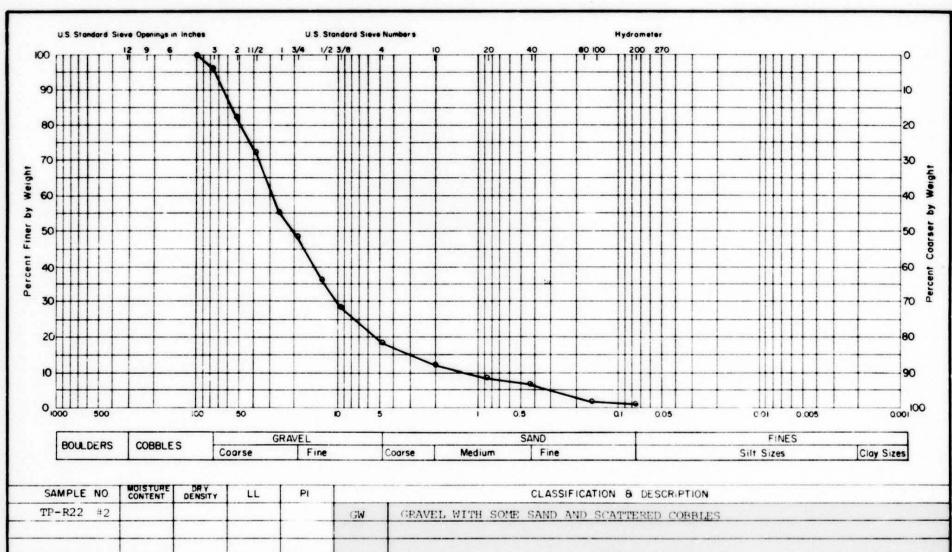
DATE: 11-6-81

PROJECT NO. 052506









SAMPLE NO	CONTENT	DENSITY	LL	PI	CLASSIFICATION 8 DESCRIPTION		
TP-R22 #2					GW	GRAVEL WITH SOME SAND AND SCATTERED COBE	BLES
				200 m		DIVED ALTOUTOM	DRAWN BY P.T.

R8M CONSULTANTS INC

TEST PIT TP-R22

DRAWN BY P.T.

APPROVED BY T.I.

DATE 11-6-81

PROJECT NO 052506

Filmed at
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