

FINAL SUBMITTAL



GROUNDWATER MONITORING REPORT

KENAI RIVER BLUFF EROSION

KENAI, ALASKA

**CONTRACT NO. W911KB-05-D-0004
DELIVERY ORDER NO. 0010
MODIFICATION NO. 01**

Prepared for:

**U.S. ARMY ENGINEER
DISTRICT, ALASKA**
P.O. Box 6898
Elmendorf AFB, Alaska 99506

January, 2008

R&M

R&M CONSULTANTS, INC.



R&M CONSULTANTS, INC.
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January 15, 2008

R&M No. 1209.10

U.S. Army Engineer District, Alaska
ATTN: Mr. Chuck Wilson (CEPOA-EN-ES-SG)
P.O. Box 6898
Elmendorf AFB, Alaska 99506

RE: Groundwater Monitoring Report
Kenai River Bluff Erosion
Kenai, Alaska
Contract No. W911KB-05-D-0004, Delivery Order No. 0010, Modification No. 01

Gentlemen:

Attached find our final submittal for the above-referenced groundwater monitoring. This report was prepared under the terms of Contract No. W911KB-05-D-0004, Delivery Order No. 0010, Modification No. 01.

We trust that this final report is found to be responsive to your requirements. Should you have any questions or require further information, please contact us.

Very truly yours,

R&M CONSULTANTS, INC.

Charles H. Riddle, C.P.G.
Vice President

CHR:ATB*slv

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GROUNDWATER MONITORING REPORT

KENAI RIVER BLUFF EROSION

KENAI, ALASKA

1.0 INTRODUCTION

1.1 Background

For many years, the City of Kenai has been concerned with the ongoing erosion of a one mile portion of the steep bluff along the right bank of the Kenai River within the city. This erosion has required the relocation of privately owned buildings as well as city infrastructure and utilities. Unless measures to control the erosion and protect the bluff are implemented, bluff erosion is expected to continue, further threatening existing buildings, infrastructure, and utilities within proximity to the bluff.

The U.S. Army Corps of Engineers - Alaska District (USACE-AD) has conducted a geotechnical investigation to provide design-level information for the Kenai River Bluff Erosion Project. The geotechnical investigation provides site-specific geotechnical design information necessary to establish an erosion control method that is technically feasible and satisfies resource agency needs. The work consisted of drilling and logging test borings, installing groundwater monitoring wells, laboratory testing, and the preparation of various reports. Ultimately, the geotechnical data obtained will be used, in conjunction with other considerations, in developing the specifications and design criteria for the project.

R&M Consultants, Inc. (R&M) was tasked by the USACE-AD to provide professional geotechnical services for the project. Drilling, sampling, and groundwater monitoring well installation services were performed by Discovery Drilling, Inc. of Anchorage, Alaska under direct contract to R&M. During the geotechnical field investigations, a total of 20 test borings were drilled and sampled at the project site. Fourteen (14) of these test borings were completed as groundwater monitoring wells.

The regional setting, site conditions, geotechnical conditions, bluff mapping results, and groundwater conditions are discussed in R&M's prior Geotechnical Investigation and Site Conditions Report (R&M, 2007).

1.2 Contract Authorization

This work was completed under the terms of Contract No. W911KB-05-D-0004 between the U.S. Army Corps of Engineers – Alaska District and R&M Consultants, Inc. The groundwater monitoring and this report were completed in specific fulfillment of Delivery Order No. 0010, Modification No. 01.

Measurements and weights presented in this report are generally shown as U.S. customary units. Where previous investigations and reports have utilized SI units, we have retained the units expressed in the original document. A conversion chart is included as Table 1 for use in conversion from U.S. customary units to the International System (SI) units. Actual conversion should be made with the appropriate numbers carried to three or more significant figures.

1.3 Purpose and Scope-of-Work

The intent of this groundwater monitoring program has been to provide a monthly cycle of groundwater table elevation information to evaluate the hydraulic conditions for the analysis and design of a bluff stabilization project. This report presents a summary of the results of R&M's monthly groundwater monitoring program.

This work was performed under a Statement-of-Work prepared by the USACE-AD, revised 13 September 2006.

No hydrogeologic analysis or recommendations were required under the Statement-of-Work.

1.4 Existing Information

The following document is a predecessor to the current report and provides detailed information concerning our site investigation.

R&M Consultants, Inc. (R&M), "Geotechnical Investigation and Site Conditions Report, Kenai River Bluff Erosion, Kenai, Alaska", Final Submittal, Contract No. W911KB-05-D-0004, Delivery Order 0010, prepared for U.S. Army Engineer District, Alaska, 14 February 2007.

Additionally, a number of pertinent U.S. Geological Survey documents and other technical reports are cited and listed within the References section of the February 2007 report.

2.0 GROUNDWATER MONITORING

Methods of groundwater monitoring for the Kenai River Bluff Erosion project can be divided into the following categories.

- Test Borings
- Groundwater Monitoring Well Installation
- Groundwater Monitoring
- Monitoring Well Location Surveys

2.1 Test Borings

Test borings were located and drilled to meet two primary objectives. Both of which are presented in R&M's Geotechnical Investigation and Site Conditions Report (R&M, 2007). The first objective involves delineating the subsurface soil conditions, and the second entails a study of the groundwater regime in the area.

A total of twenty (20) test borings were drilled by R&M at the project site during the period of November 9, 2006 through December 16, 2006, fourteen (14) of which were completed as groundwater monitoring wells. Each of the borings was logged in accordance with standard engineering practices, and data obtained in this manner were utilized to determine geotechnical site conditions. The depth of the test borings ranged from 30 to 101.5 feet. The total number of feet drilled during the field program was approximately 1,135. Drilling and sampling operations were performed by Discovery Drilling, Inc. of Anchorage, Alaska under direct contract to R&M. Approximate test boring locations are shown on Drawings A-02 through A-07 of Appendix A. Logs of the monitoring well test borings, including logs provided by others are illustrated in Appendix B, Drawings B-03 through B-29. A key to the test hole log general notes and an example of a typical log are illustrated on Drawings B-01 and B-02, respectively. Table 2 provides a summary of R&M monitoring well test borings performed for the project.

Soil boring, sampling, and groundwater well installation on the bluff crest were performed utilizing a truck-mounted CME-75 drill rig. Test borings were advanced using continuous flight, hollow-stem augers. Representative soil samples were generally obtained at the surface, at 2.5 feet and five feet, and then at approximately five-foot intervals or at obvious changes in soil strata. However at each grouping of three groundwater monitoring well installations (e.g. AP-608-MW through AP-610-MW), only one of the three borings was sampled and logged in detail. The other two borings were only sampled at the bottom of the boring.

The drilling program was conducted under the supervision of an experienced engineering geologist who maintained a detailed log of the materials encountered and the samples attempted and recovered. Representative soil samples generally were collected either by means of grab samples taken directly off of the augers, in the case of the surface sample, or via split-spoon samplers. In all but one boring, disturbed samples were obtained using a 2.5-inch I.D. (3.0-inch O.D.) split-spoon sampler driven by means of a 340-lb hammer with a 30-inch free-fall stroke.

Both manual (rope and cathead) and automatic (hydraulic) hammers were used on this project, as denoted for each sample on the logs of test borings in Appendix B. The penetration resistance, defined as the number of blows required to drive the sampler the last 12 inches of an 18-inch interval, gives an indication of the in-place relative density for unfrozen cohesionless soils. Blow counts reported per six-inch interval are shown on boring logs in Appendix B. Penetration resistances thus obtained can be corrected to approximate the Standard Penetration Test (SPT) “N” values by an energy to area ratio adjustment. A correction factor should be used to convert actual blow counts to the corresponding approximate SPT blow counts. Note, however, that the blow counts appearing on the logs of test borings are actual values, not converted SPT values. The Standard Penetration Test (SPT) was performed in the upper 40 feet of Test Boring AP-617-MW utilizing the 1.4-inch I.D. (2.0-inch O.D.) drive sampler and a 140-pound automatic drop hammer.

It should be noted that heaving or flowing sands interfered with sampling in the deeper test borings located on the bluff crest. The logs of test borings in Appendix B include notes on whether a sampler was overfilled with heaving sand, or whether samples were not attempted below a certain depth due to heaving sand flowing up into the augers.

All soils recovered were visually classified and logged in the field following ASTM Designation D 2488. After visual and tactile classification in the field, all soil samples were returned to the R&M laboratory. Representative samples were then selected for further examination and testing.

2.2 Groundwater Monitoring Well Installation

After completion of drilling, fourteen (14) of the test borings on the crest of the bluff were completed as groundwater monitoring wells. Groundwater monitoring wells were installed in general accordance with ASTM Designation D 5092, “Design and Installation of Groundwater Monitoring Wells in Aquifers”. Each monitoring well was constructed to allow for the accurate measurement of groundwater depths relative to the top of the well riser. The well riser pipe was constructed of 2-inch I.D. polyvinyl chloride (PVC) pipe. A locking steel protective over casing was installed around the well riser pipe extending approximately three feet below and three feet above the top of ground surface. Bollards were placed around some of the installations to protect the wells from traffic and snow removal equipment.

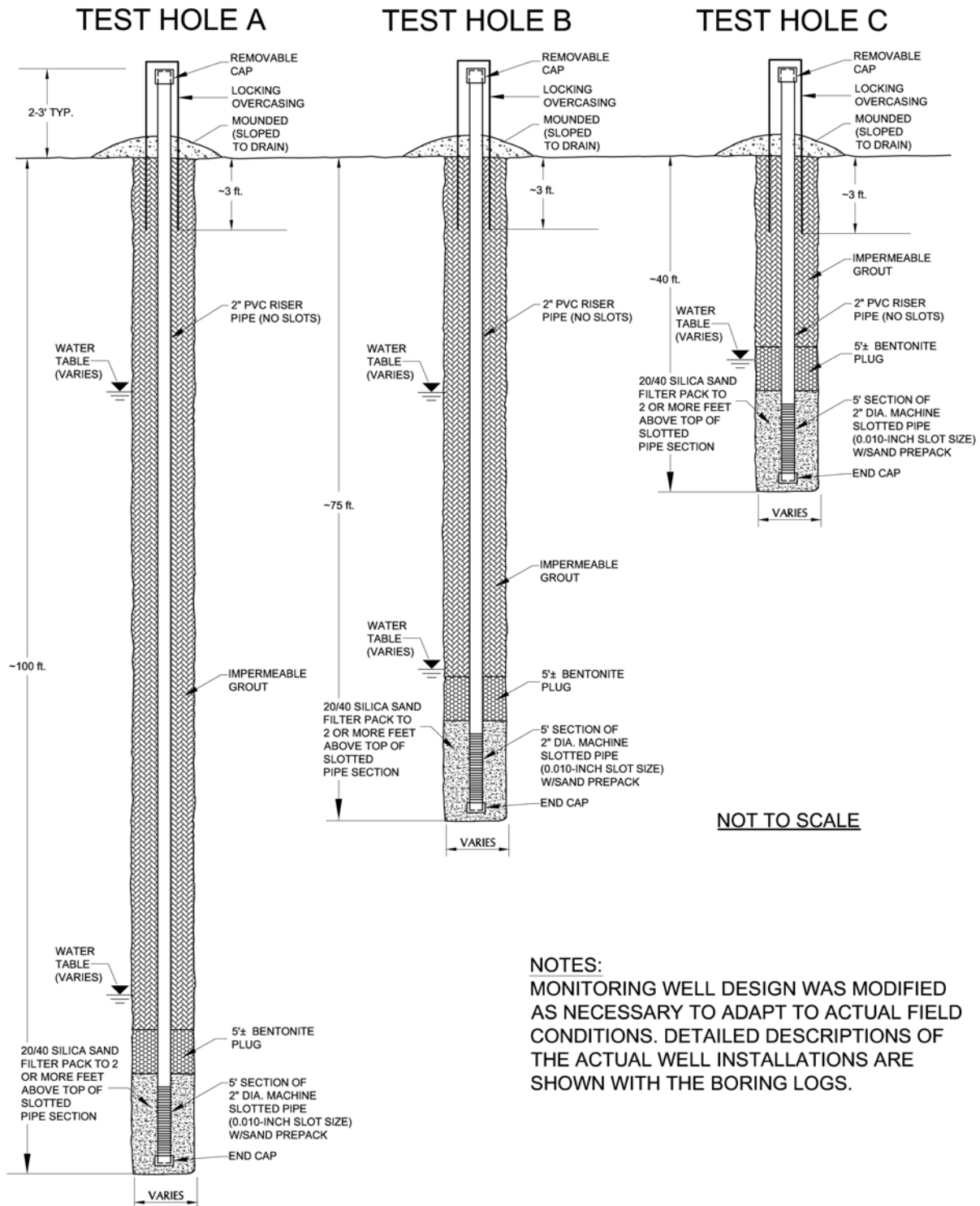
A typical groundwater monitoring well schematic for wells installed by R&M is presented as Figure 1. Monitoring well photographs are shown in Figure 2.

2.3 Groundwater Monitoring

Groundwater monitoring occurred on a monthly basis in the 14 R&M test borings that were converted to monitoring wells and the three pre-existing American Environmental monitoring wells. Prior to the fifth reading, groundwater monitoring was expanded, at the request of the USACE, to include the four pre-existing USACE monitoring wells. This monitoring continued to occur on this basis for a period of one year from the installation date of the original 14 R&M monitoring wells.

FIGURE 1

TYPICAL GROUNDWATER MONITORING WELL GROUP



NOTES:
MONITORING WELL DESIGN WAS MODIFIED
AS NECESSARY TO ADAPT TO ACTUAL FIELD
CONDITIONS. DETAILED DESCRIPTIONS OF
THE ACTUAL WELL INSTALLATIONS ARE
SHOWN WITH THE BORING LOGS.

FIGURE 2
PHOTOGRAPHS SHOWING MONITORING WELLS



a. Monitoring well installation at Group 3 borings with protective bollards. December, 2006.



b. Grouting at Group 2 borings. November, 2006.

Access to the protective over casings was gained and a Solinst Model 101 water level meter was lowered down the well to measure the groundwater level. The water level meter tape is measured against a constant point on each well casing to ensure a consistent measuring point.

Two exceptions to this process were with regard to Monitoring Wells AP-606 and AP-607, which were installed by the USACE. Monitoring Well AP-606 was unable to be located in the field and no readings were obtained. Monitoring Well AP-607 was constructed with ¾-inch nominal O.D. PVC piping, and a wooden dowel float was lowered down the well until reaching equilibrium. The measuring point along the float line was then marked against a constant point on the well casing and the groundwater depth was measured with a tape after removal.

Groundwater levels were measured upon completion of the monitoring well installation and were measured monthly for one year, with a total of 13 readings for most monitoring wells. A summary presenting monitoring well identification, date, time, and groundwater elevations is provided in Appendix C as Table C-01. A summary of groundwater elevation trends for the year-long monitoring period is presented in Appendix C as Figures C-02 through C-06.

2.4 Monitoring Well Location Surveys

Survey information was based on a field survey performed by R&M Consultants, Inc. during January, 2007. The project coordinates are ACS83 Zone 4, U.S. Survey Feet. The project datum is NAD83 (CORS). The project coordinates and datum were established by ties to CP 1 and USC&GS BM NO. 3 1966 from the DOWL Engineers drawing “Kenai River Bluff Erosion Survey Topography” dated July 16, 2003. The vertical datum was established by holding USC&GS BM NO. 3 1966 with an elevation of 31.44 feet. The drawing indicates that the vertical datum is referenced to Mean Lower Low Water (2003) in U.S. Survey Feet.

Monitor wells and test borings were located horizontally using RTK GPS techniques and vertically by a combination of RTK GPS and differential leveling techniques. The RTK GPS accuracy was quality controlled by taking three-dimensional check shots on established control positions. All of the check positions fell within the tolerances defined in the scope of the project.

The elevations for the top of the pipe of the monitor wells were determined by differential levels run from TBMs with elevations established by RTK GPS. The wells were broken up into four groups based on proximity. One TBM was established for each group of wells with RTK GPS. Differential levels were then run from the TBM to the group of wells in the surrounding area. All level loops closed well within the tolerances defined in the scope of the project.

Elevations for Monitoring Wells AP-604 through AP-607 were based on information provided on the monitoring well installation logs provided by the USACE. Distances between the collar elevations and the well casing measuring points are approximate and accuracy of groundwater elevations within these wells should also be considered approximate.

3.0 CLOSURE

R&M Consultants, Inc. performed this work in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No warranty, express or implied, beyond exercise of reasonable care and professional diligence, is made. This report is intended for use only in accordance with the purposes of study described within.

We appreciate the opportunity to perform this groundwater monitoring program. Should you require further information concerning the monitoring or this report, please contact us at your convenience.

Very truly yours,

R&M CONSULTANTS, INC.



Aaron T. Banks
Engineering Geologist



Robert M. Pintner, P.E.
Senior Geotechnical Engineer



Charles H. Riddle, C.P.G.
Vice President

CHR:ATB*slv

TABLE 1
CONVERSION FACTORS FOR SI UNITS

CONVERSION TO THE SI INTERNATIONAL SYSTEM OF UNITS		
To Convert From	To	Multiply By
Mile	Kilometer (km)	1.609344
Mile	Meter (m)	1,609.344
Foot	Meter (m)	0.3048
Foot	Centimeter (cm)	30.48
Inch	Centimeter (cm)	2.54
Square Foot	Square Meter (m ²)	0.09290304
Square Yard	Square Meter (m ²)	0.8361274
Acre	Square Meter (m ²)	4,046.825
Cubic Foot (cf)	Cubic Meter (m ³)	0.02831685
Cubic Yard (cy)	Cubic Meter (m ³)	0.7645549
Gallon (U.S. Liquid)	Cubic Meter (m ³)	0.003785412
Pound-Mass (lbf)	Kilogram (kg)	0.4535924
Ton (short)	Kilogram (kg)	907.1847
Pound-Force (lbf)	Newton (N)	4.448222
Degree Fahrenheit (°F)	Degree Celsius (°C)	T°C=(T°F-32)/1.8
Pound per Square Foot (psf)	Kilonewtons per Square Meter (kN/m ²)	0.47880
Pound per Cubic Foot (pcf)	Kilonewtons per Cubic Meter (kN/m ³)	0.157087

TABLE 2
SUMMARY OF MONITORING WELL TEST BORINGS
KENAI RIVER BLUFF EROSION
KENAI, ALASKA

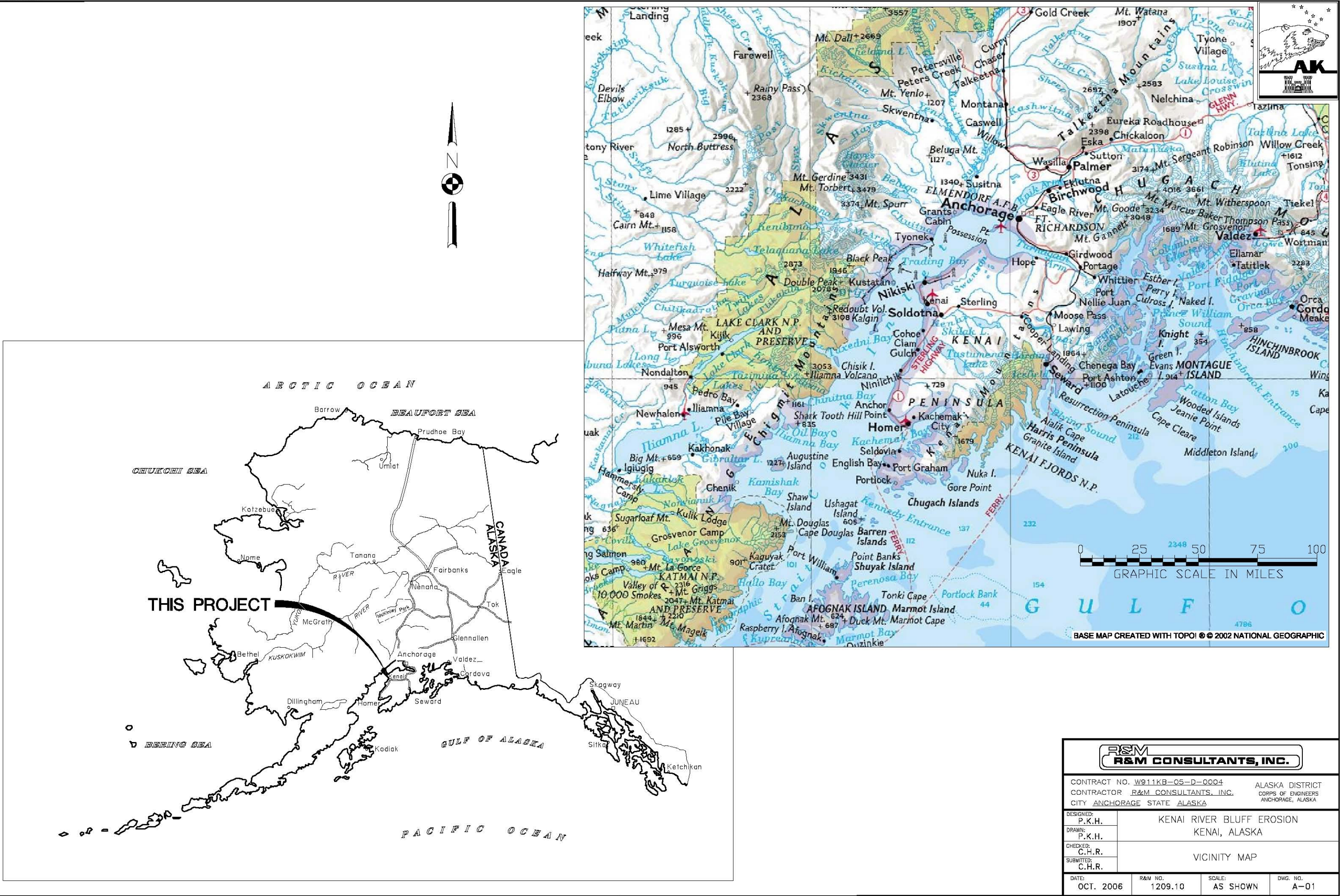
TEST BORING NUMBER (FINAL)	TEST BORING NUMBER (FIELD)	COORDINATES (FEET)		COLLAR ELEVATION (FEET)	TOTAL DEPTH (FEET)
		NORTHING	EASTING		
AP-608-MW	TB-1A	2,395,412.81	1,413,139.72	88.4	101.2
AP-609-MW	TB-1B	2,395,415.41	1,413,150.90	88.6	76.5
AP-610-MW	TB-1C	2,395,430.86	1,413,141.62	88.9	41.3
AP-611-MW	TB-2C	2,395,775.73	1,414,431.97	91.1	101.5
AP-612-MW	TB-2B	2,395,786.22	1,414,437.68	91.3	76.5
AP-613-MW	TB-2A	2,395,795.10	1,414,440.67	91.0	41.5
AP-614-MW	TB-3A	2,396,258.31	1,415,755.43	93.9	101.5
AP-615-MW	TB-3B	2,396,268.68	1,415,756.19	93.5	76.5
AP-616-MW	TB-3C	2,396,280.50	1,415,756.60	93.7	41.5
AP-617-MW	TB-4A	2,396,189.80	1,416,979.96	92.9	101.5
AP-618-MW	TB-4B	2,396,207.48	1,416,981.72	93.1	70.0
AP-619-MW	TB-4C	2,396,224.77	1,416,982.32	93.1	40.0
AP-620-MW	TB-02	2,396,321.05	1,414,354.82	92.2	41.4
AP-621-MW	TB-03	2,396,759.77	1,417,031.71	92.7	41.0

AP = Auger Point
TB = Test Boring
MW = Monitoring Well

APPENDIX A SITE MAPS

Vicinity Map	A-01
Monitoring Well Plan	A-02 and A-03
Monitoring Well Location Maps	A-04 thru A-07

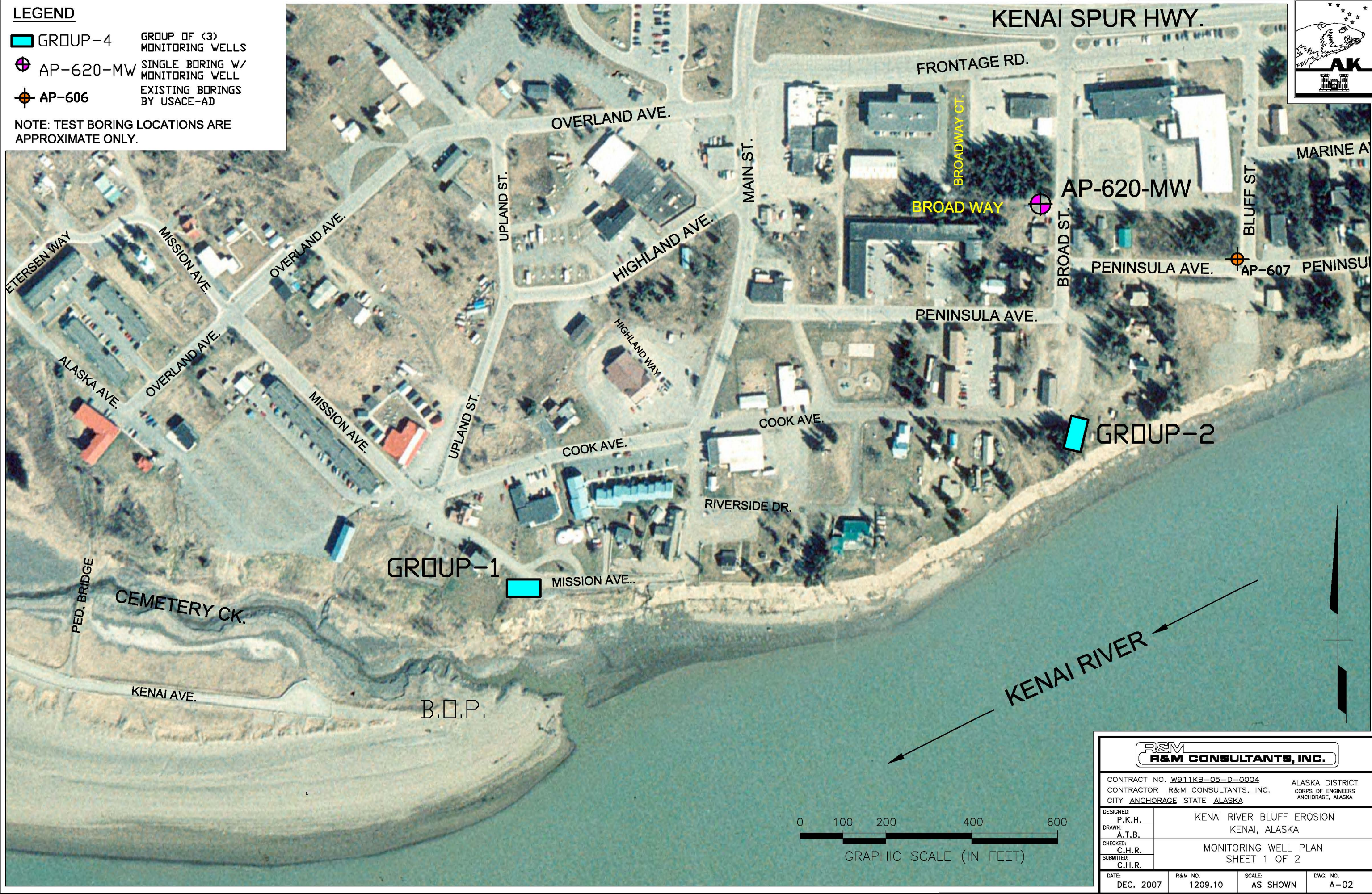
project\1209.10\geo\Kenai Bluff-A-01, 1=1, 10/03/06 at 08:42 by pkh



LEGEND

- GROUP-4
- GROUP OF (3) MONITORING WELLS
- AP-620-MW
- SINGLE BORING W/ MONITORING WELL
- AP-606
- EXISTING BORINGS BY USACE-AD

NOTE: TEST BORING LOCATIONS ARE APPROXIMATE ONLY.



R&M CONSULTANTS, INC.

CONTRACT NO. W911KB-05-D-0004
CONTRACTOR R&M CONSULTANTS, INC.
CITY ANCHORAGE STATE ALASKA

ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED: P.K.H.
DRAWN: A.T.B.
CHECKED: C.H.R.
SUBMITTED: C.H.R.

KENAI RIVER BLUFF EROSION
KENAI, ALASKA

MONITORING WELL PLAN
SHEET 1 OF 2

DATE: DEC. 2007
R&M NO. 1209.10
SCALE: AS SHOWN
DWG. NO. A-02



LEGEND

- GROUP-4 GROUP OF (3) MONITORING WELLS
- AP-620-MW SINGLE SOILS BORING W/MONITORING WELL
- AP-606 EXISTING BORINGS BY USACE-AD
- MW-1 EXISTING BORINGS BY AMER. ENV.

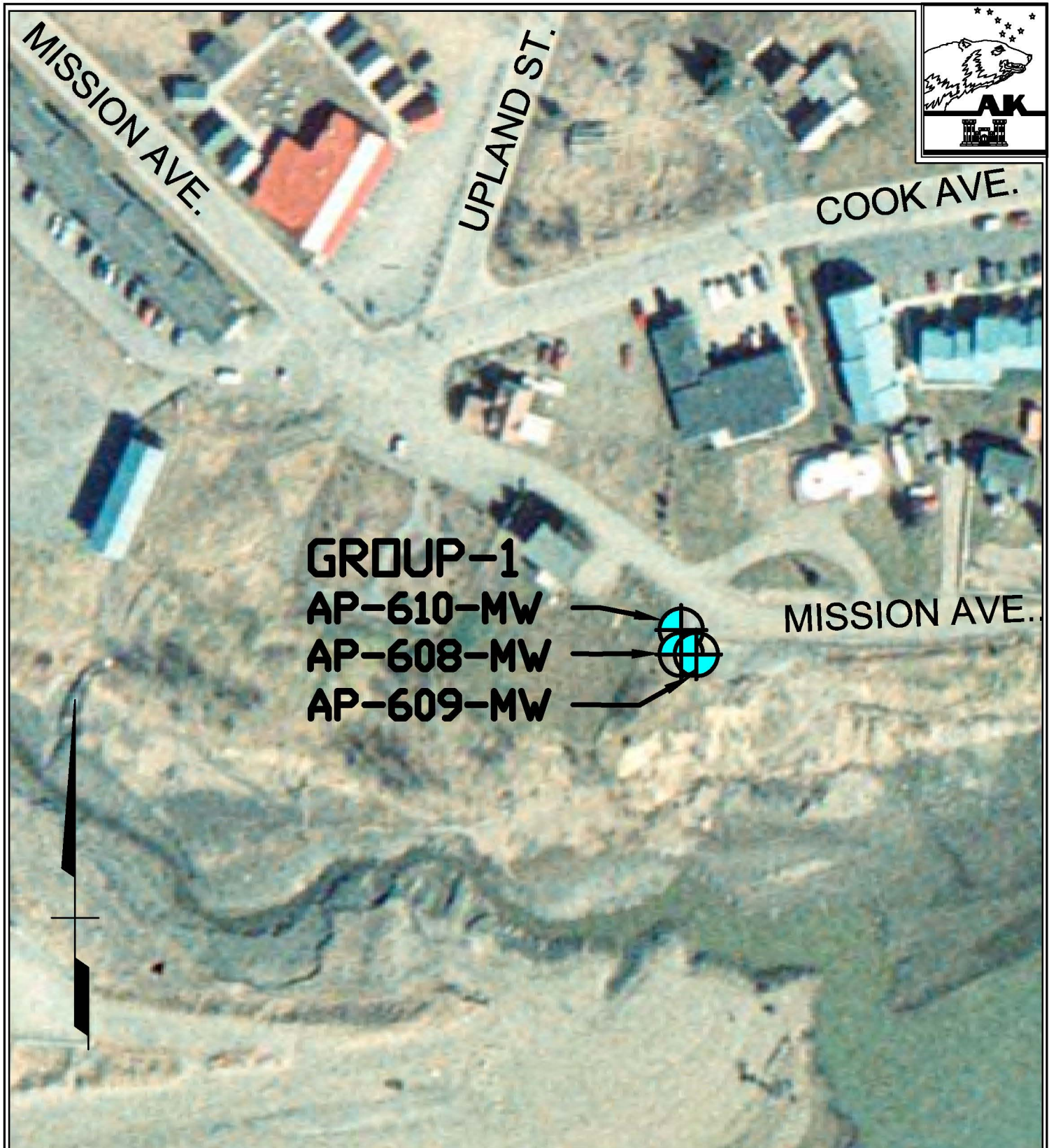
NOTE: TEST BORING LOCATIONS ARE APPROXIMATE ONLY.



GRAPHIC SCALE (IN FEET)



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CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: A.T.B.			
CHECKED: C.H.R.	MONITORING WELL PLAN SHEET 2 OF 2		
SUBMITTED: C.H.R.			
DATE: DEC. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. A-03



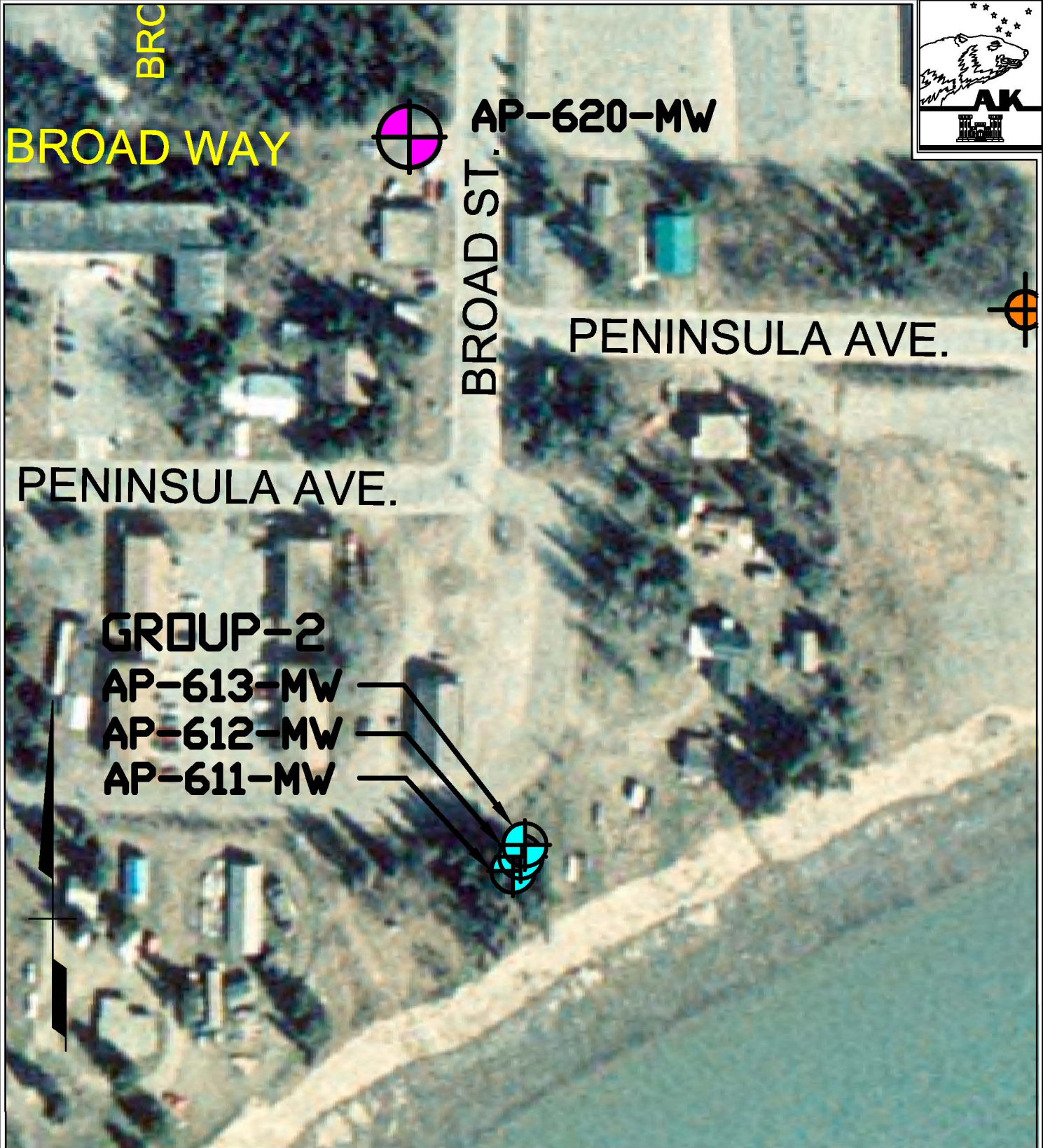
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ALASKA DISTRICT
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 ANCHORAGE, ALASKA

DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: A.T.B.			
CHECKED: C.H.R.	MONITORING WELL LOCATION MAP GROUP 1 AND VICINITY		
SUBMITTED: C.H.R.			
DATE: DEC. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. A-04



NOTE: TEST BORING LOCATIONS ARE APPROXIMATE ONLY.



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C.H.R.

SUBMITTED:
C.H.R.

**KENAI RIVER BLUFF EROSION
KENAI, ALASKA**

**MONITORING WELL LOCATION MAP
GROUP 2 AND VICINITY**

DATE:
DEC. 2007

R&M NO.
1209.10

SCALE:
AS SHOWN

DWG. NO.
A-05



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KENAI RIVER BLUFF EROSION
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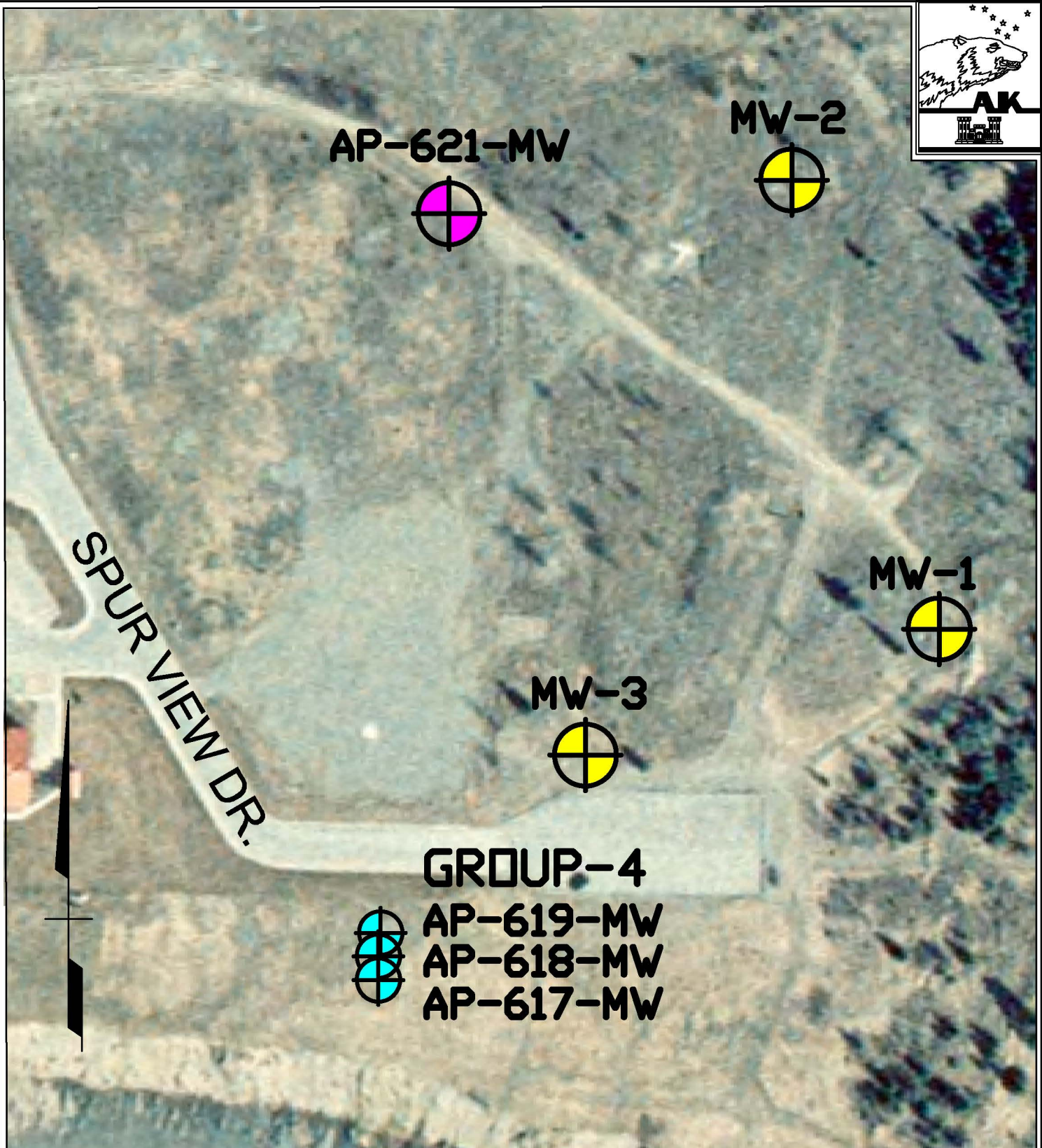
MONITORING WELL LOCATION MAP
 GROUP 3 AND VICINITY

DATE:
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KENAI RIVER BLUFF EROSION
 KENAI, ALASKA

MONITORING WELL LOCATION MAP
 GROUP 4 AND VICINITY

DATE:
DEC. 2007

R&M NO.
1209.10

SCALE:
AS SHOWN

DWG. NO.
A-07

APPENDIX B

LOGS OF TEST BORINGS

General Notes.....	B-01
Explanation of Selected Symbols	B-02
Logs of Test Borings (R&M).....	B-03 thru B-15
Well Logs (American Environmental).....	B-16 thru B-18
Exploration Logs (USACE-AD).....	B-19 thru B-29

SOILS CONSISTENCY AND SYMBOLS

CLASSIFICATION: Identification and classification of the soil is accomplished in accordance with the ASTM version of the Unified Soil Classification System. When laboratory testing data on material passing the 75-mm sieve is available Standard D 2487 (Classification of Soils for Engineering Purposes) is used and when laboratory data is not available D 2488 Visual-Manual Procedure) is used. This classification system identifies three major soil divisions: coarse-grained soils, fine-grained soils, and highly organic soils. These three divisions are further subdivided into a total of 15 basic soils groups. Based on the results of visual observations and prescribed laboratory tests, a soil is catalogued according to the basic soil groups, assigned a group symbol(s) and name, and thereby classified. Flow charts contained in the two standards can be used to assign the appropriate group symbol(s) and name.

SOIL DENSITY/CONSISTENCY - CRITERIA: Soil density/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 soil may vary significantly and inexplicably with ice content, thermal regime and soil type.

COHESIONLESS

<u>Description</u>	<u>N * (blows/FT.)</u>	<u>Relative Density</u>
Loose	0 - 10	0 to 40%
Medium Dense	10 - 30	40 to 70%
Dense	30 - 60	70 to 90%
Very Dense	> 60	90 to 100%

* Standard Penetration "N": Blows per 12 inches of a 140-pound manual hammer (lifted with rope & cathead) falling 30 inches on a 2-inch O.D. split-spoon sampler except where noted.

COHESIVE

<u>Consistency</u>	<u>Shear Strength (TSF)</u>	<u>Unconfined Compressive Strength (TSF)</u>
Very Soft	0.0 - 0.25	0.0 - 0.5
Soft	0.25 - 0.5	0.5 - 1.0
Firm	0.5 - 1.0	1.0 - 2.0
Stiff	1.0 - 2.0	2.0 - 4.0
Very Stiff	2.0 - 4.0	4.0 - 8.0
Hard	OVER 4.0	OVER 8.0

KEY TO TEST RESULTS

DD - Dry Density	PP - Pocket Penetrometer
LL - Liquid Limit	P200 - % Passing No. 200 Screen
MC - Moisture Content	P.02 - % Passing 0.02 mm
Org - Organic Content	SG - Specific Gravity
PI - Plastic Index	TV - Torvane
PL - Plastic Limit	

DWN: K.J.P.

CKD: R.M.P.

DATE: FEB 06

SCALE: NONE

R&M
R&M CONSULTANTS, INC.
ENGINEERING • SURVEYING • EARTH SCIENCES
CONSTRUCTION SERVICES
9101 Vanguard Drive, Anchorage, Alaska 99507 (907) 522-1707

**GENERAL
NOTES**

FB: N/A

GRID: N/A

PROJ.NO: GENERAL

DWG.NO: B-01

STANDARD SYMBOLS

SYMBOL	NAME	PARTICLE SIZE	SYMBOL	NAME
	CLAY	< 0.002mm, Plastic		ORGANICS
	SILT	0.002mm, - #200		ICE
	SAND	#200, - #4		ICE W/SOIL INCLUSIONS
	GRAVEL	#4, - 3"		ICE LENSE IN SILT
	COBBLES & BOULDERS	3" - 12" & > 12"		ICE CRYSTALS IN CLAY

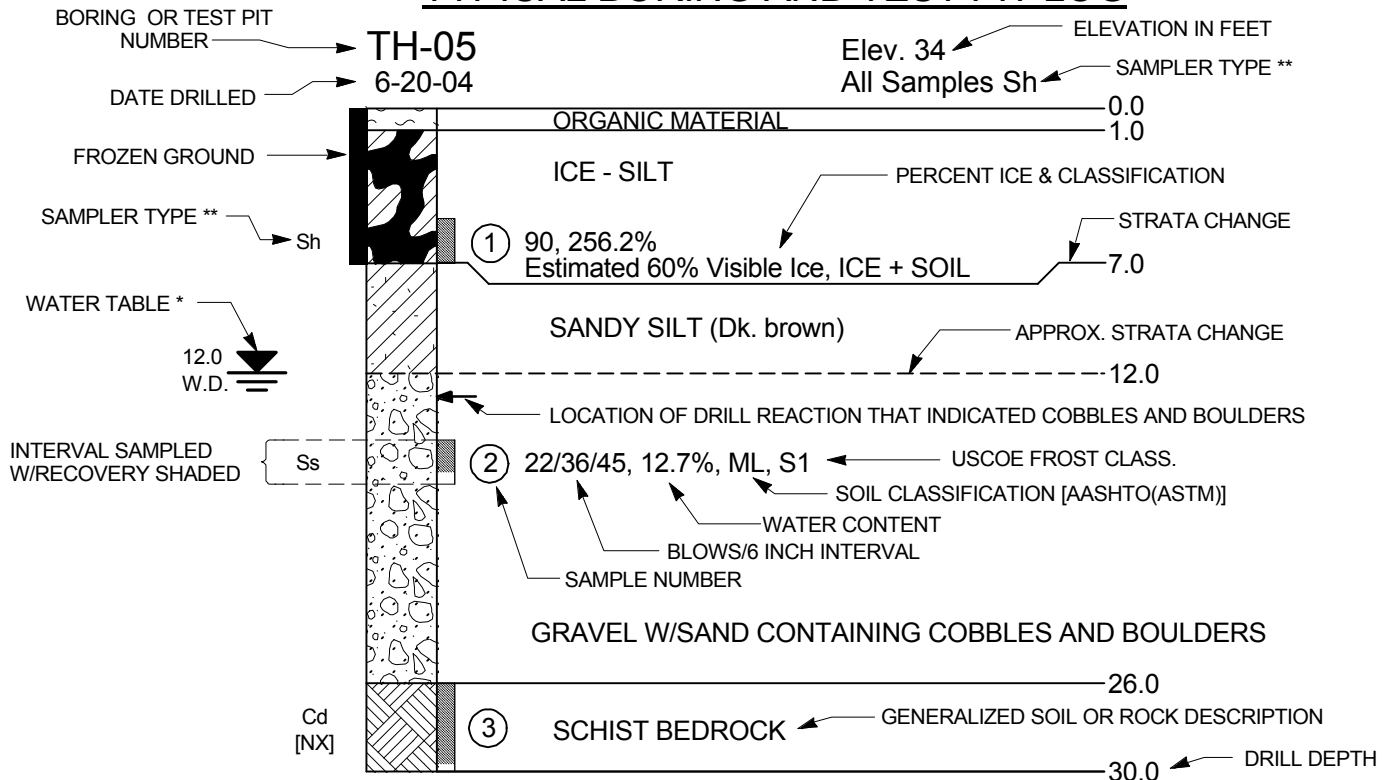
(The symbols shown above are frequently used in combinations, e. g. GRAVEL W/SILT AND SAND)

SAMPLER TYPE SYMBOLS

A Auger Sample	Sh 2.5 In. Split Spoon w/340 lb. Manual Hammer	Sp 2.5 In. Split Spoon Pushed
C Cuttings Sample	Sha 2.5 In. Split Spoon w/340 lb. Auto Hammer	Sz 1.4 In. Split Spoon w/340 lb. Hammer
Cd Double Tube Core Barrel	Sl 2.5 In. Split Spoon w/140 lb. Hammer	Ts Shelby Tube
Ct Triple Tube Core Barrel	Ss 1.4 In. Split Spoon w/140 lb. Manual Hammer	Tm Modified Shelby Tube
Cs Auger Core Barrel	Ssa 1.4 In. Split Spoon w/140 lb. Auto Hammer	[x] Sampler I. D. (Added to Symbol)
G Grab Sample		

NOTE: Sampler types are either noted above the boring log or adjacent to it at the respective depth. An individual log may not utilize all of the items listed.

TYPICAL BORING AND TEST PIT LOG



* W.D. - WHILE DRILLING, A.B. - AFTER BORING, Ref. - SAMPLER REFUSAL

** - REFER TO SAMPLER SYMBOL (Ss, Sh, ETC.) FOR SAMPLER I.D. & HAMMER WEIGHT/TYPE

NOTE: Water levels shown on the boring logs are the levels measured in the boring at the times indicated.

DWN: P.K.H.

CKD: C.H.R.

DATE: JUNE 04

SCALE: NONE

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 9101 Vanguard Drive, Anchorage, Alaska 99507 (907) 522-1707

**EXPLANATION OF
SELECTED SYMBOLS**

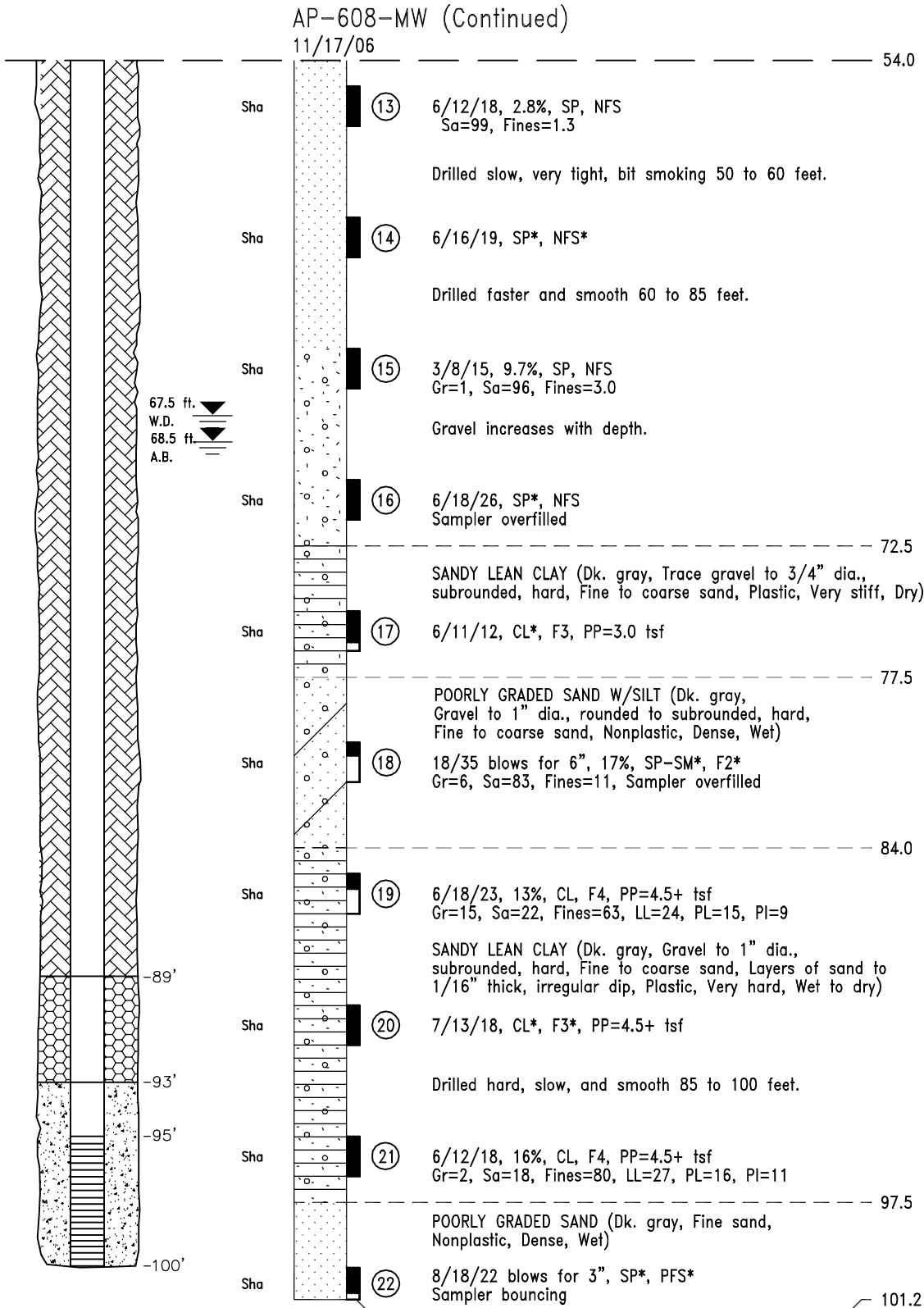
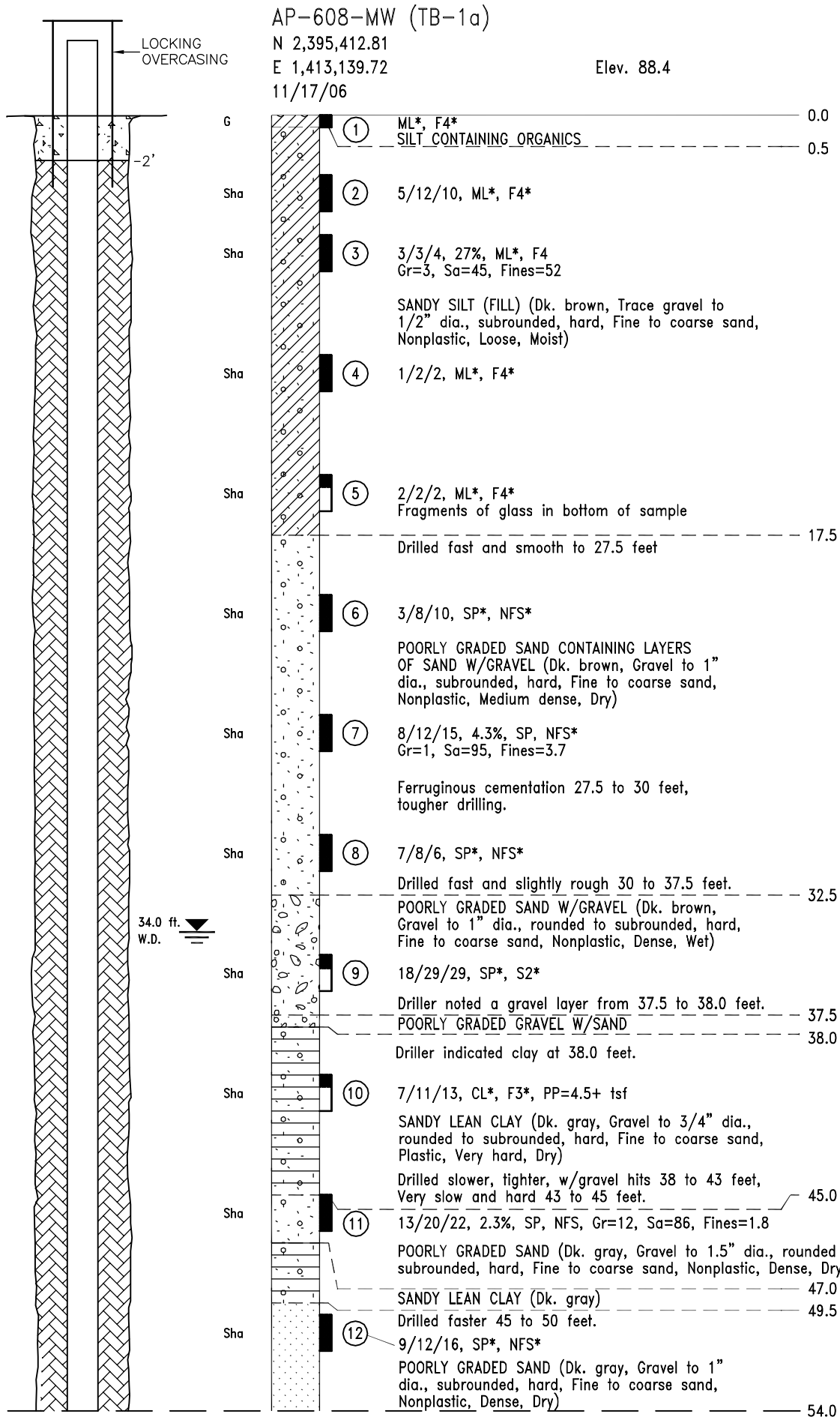
FB: N/A

GRID: N/A

PROJ.NO: GENERAL

DWG.NO: B-02

project\1209.10\geo\KENAI AP-608-MW (1a), 1=1, 01/17/07 at 11:29 by pkh



* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey



MONITORING WELL LEGEND

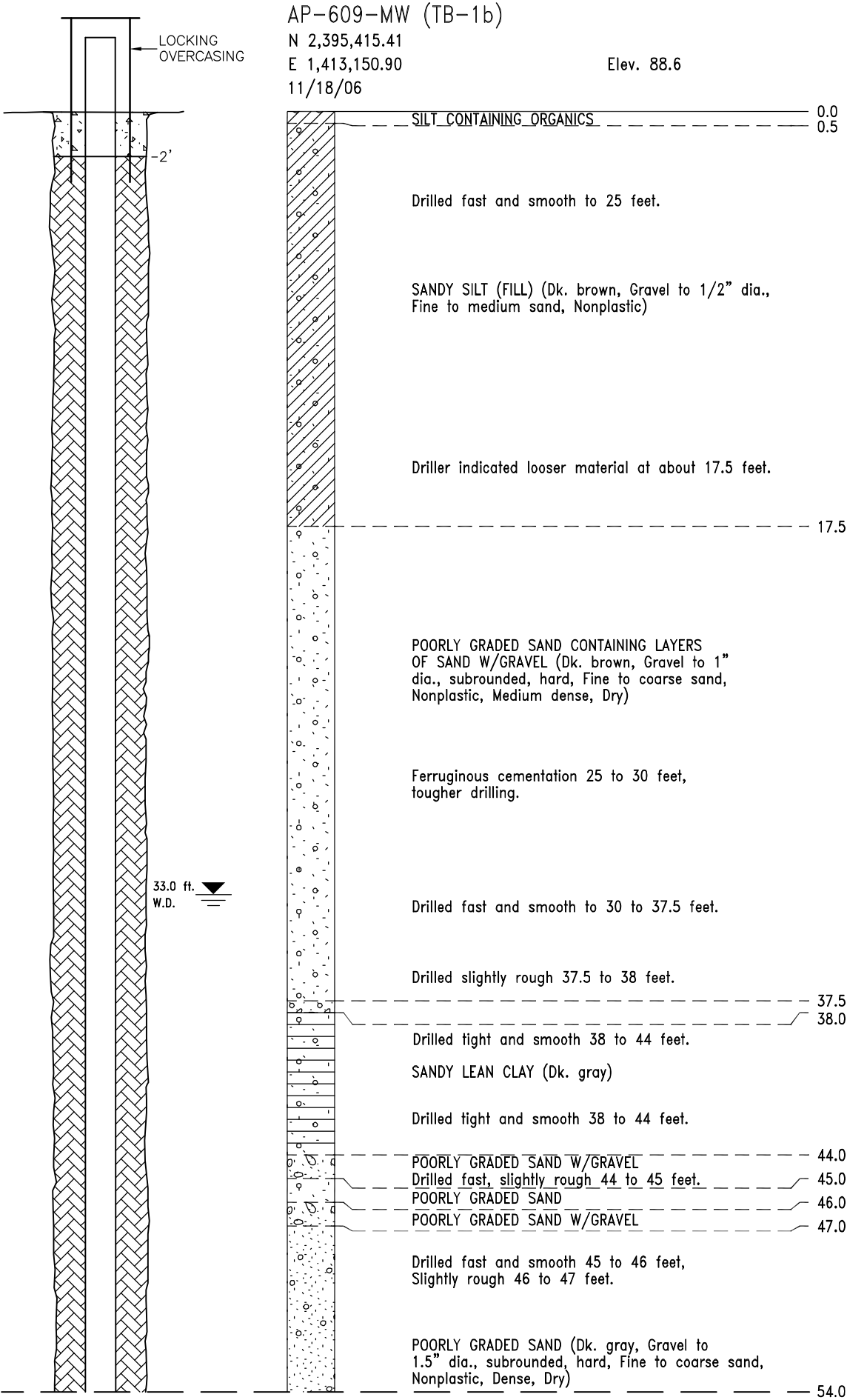
- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

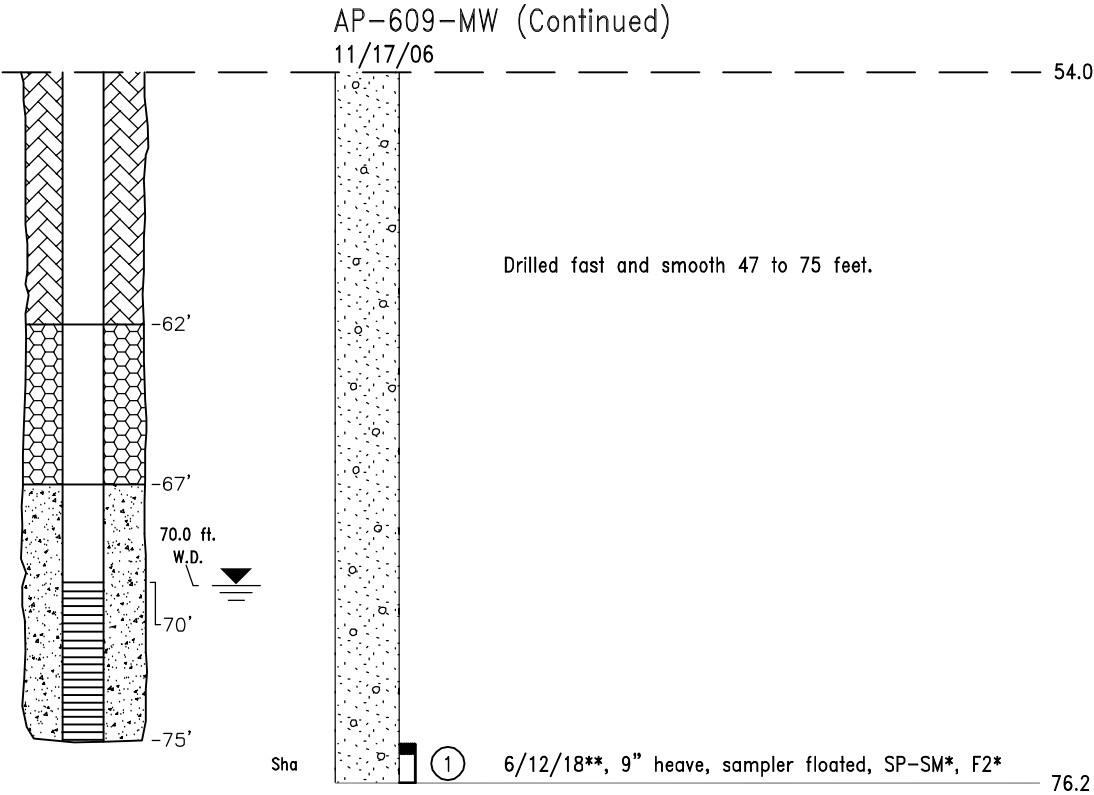
- 1. Screen w/prepacked sand was installed between 95 and 100 ft.
- 2. Installation was uneventful.

See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

<div>R&M CONSULTANTS, INC.</div>			
CONTRACT NO. W911KB-05-D-0004		ALASKA DISTRICT	
CONTRACTOR R&M CONSULTANTS, INC.		CORPS OF ENGINEERS	
CITY ANCHORAGE STATE ALASKA		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION		
DRAWN: P.K.H.	KENAI, ALASKA		
CHECKED: C.H.R.	TEST BORING LOG		
SUBMITTED: C.H.R.	AP-608-MW		
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-03



(Continued Above)



* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

- Screen w/prepacked sand was installed between 70 and 75 ft.
- Installation was uneventful.

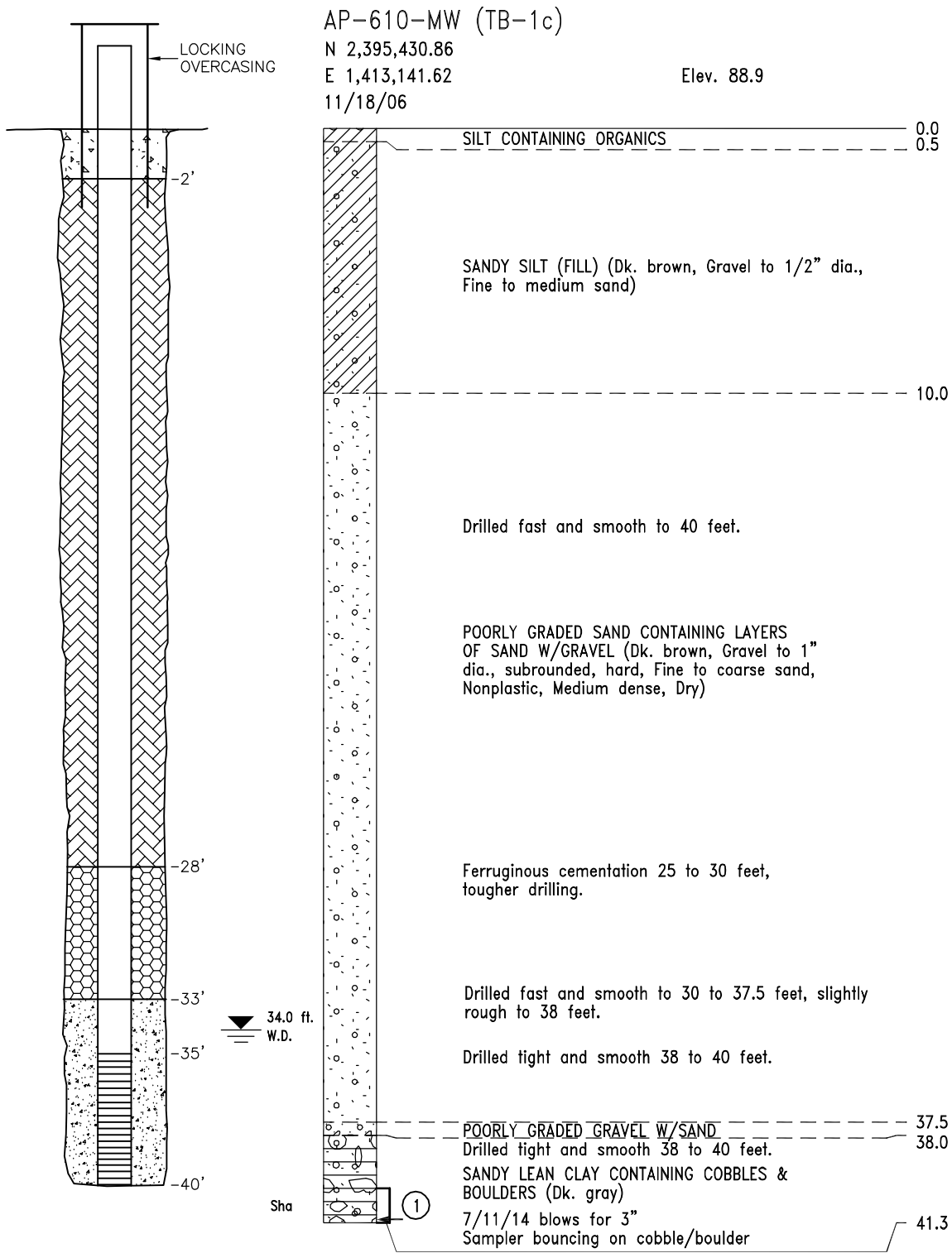
See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.



CONTRACT NO. W911KB-Q5-D-0004
CONTRACTOR R&M CONSULTANTS, INC.
CITY ANCHORAGE STATE ALASKA
ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED: P.K.H.
DRAWN: P.K.H.
CHECKED: C.H.R.
SUBMITTED: C.H.R.
KENAI RIVER BLUFF EROSION
KENAI, ALASKA
TEST BORING LOG
AP-609-MW

DATE: JAN. 2007
R&M NO. 1209.10
SCALE: AS SHOWN
DWG. NO. B-04



MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

1. Screen w/prepacked sand was installed between 35 and 40 ft.
2. Installation was uneventful.

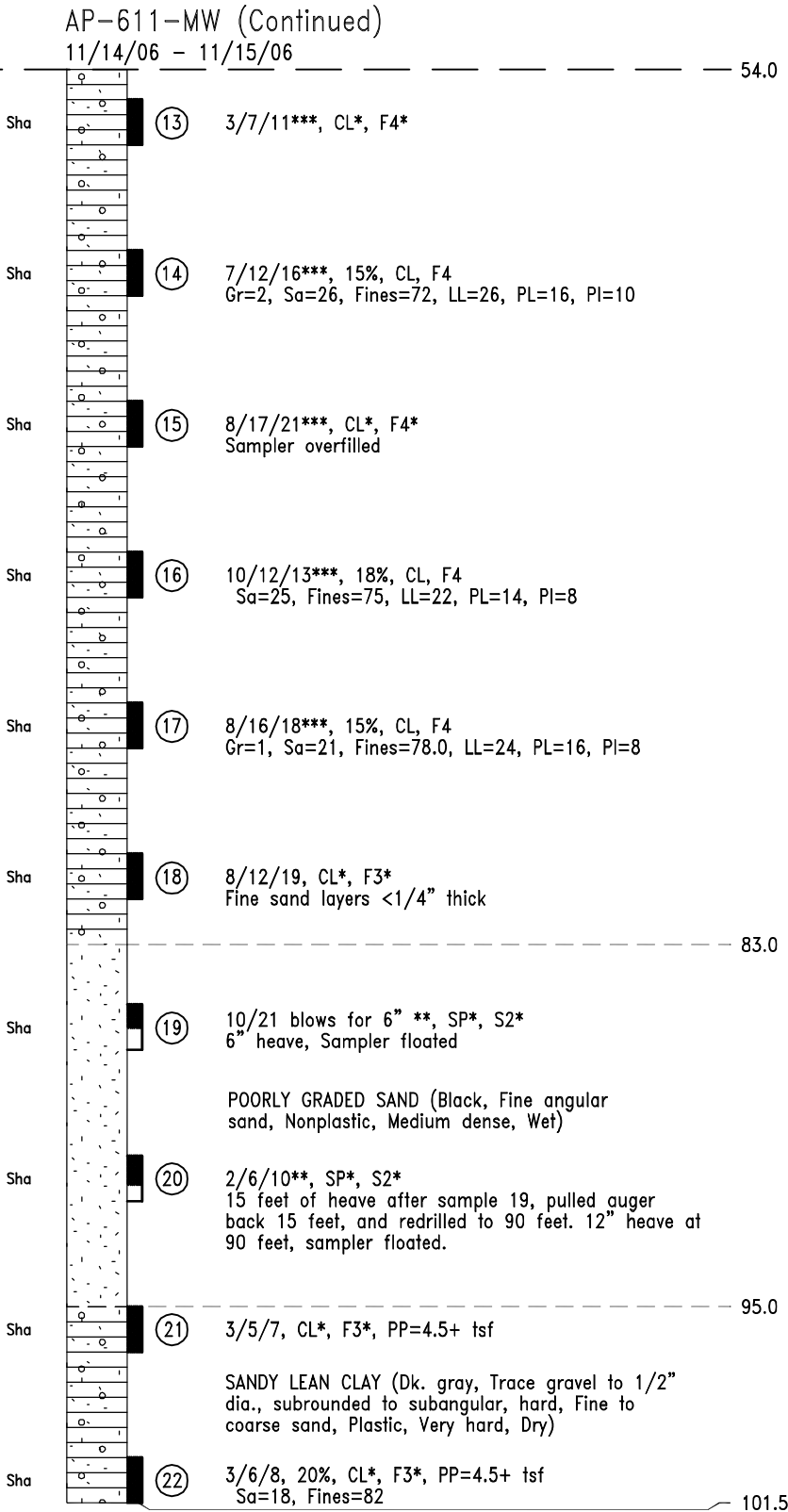
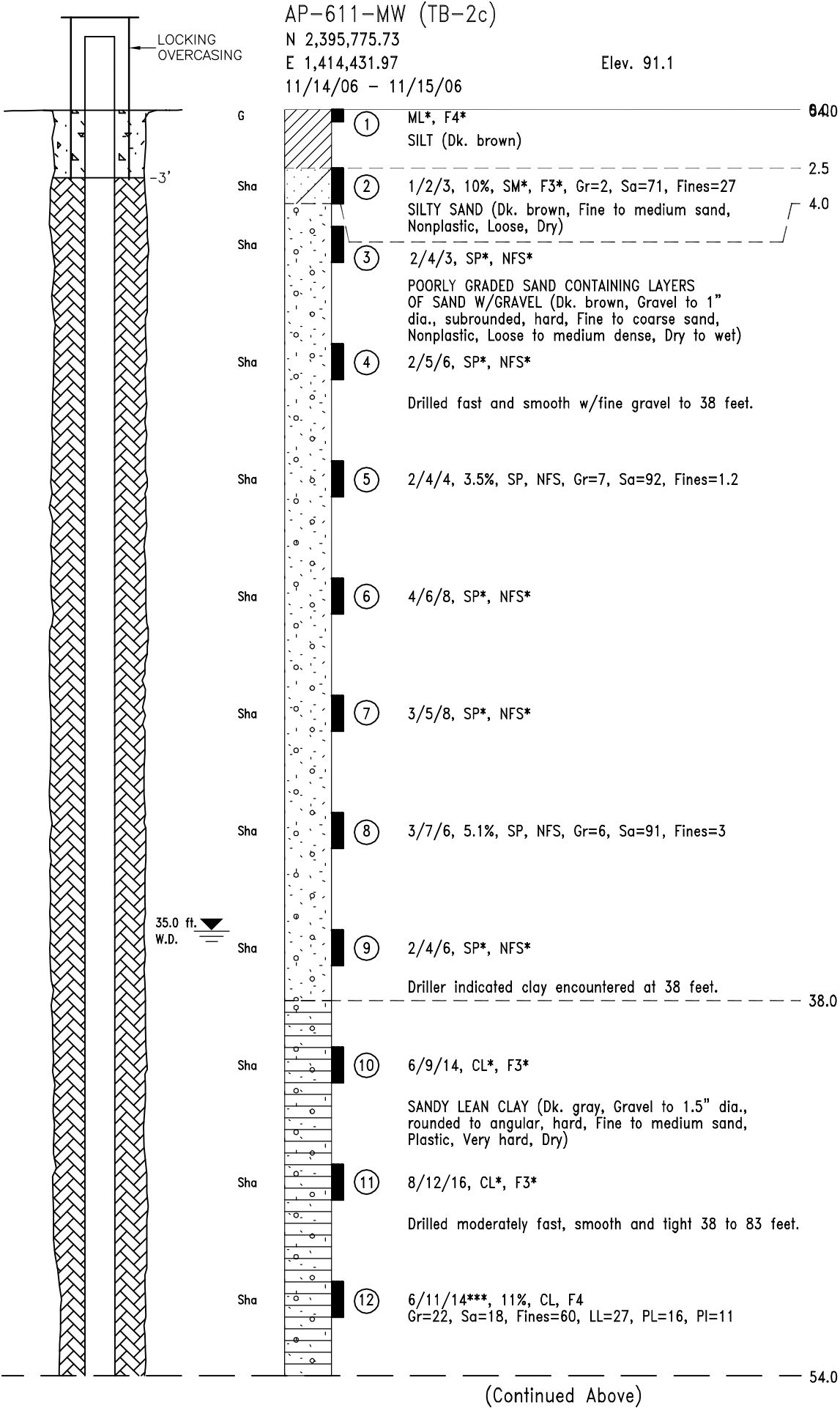
See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey



CONTRACT NO. <u>W911KB-05-D-0004</u>		ALASKA DISTRICT	
CONTRACTOR <u>R&M CONSULTANTS, INC.</u>		CORPS OF ENGINEERS	
CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG AP-610-MW		
SUBMITTED: C.H.R.			
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-05

project\1209.10\geo\KENAI AP-610-MW (1c), 1=1, 01/17/07 at 09:13 by pkh



MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

- Screen w/prepacked sand was installed between 91 and 96 ft.
- Installation was uneventful.

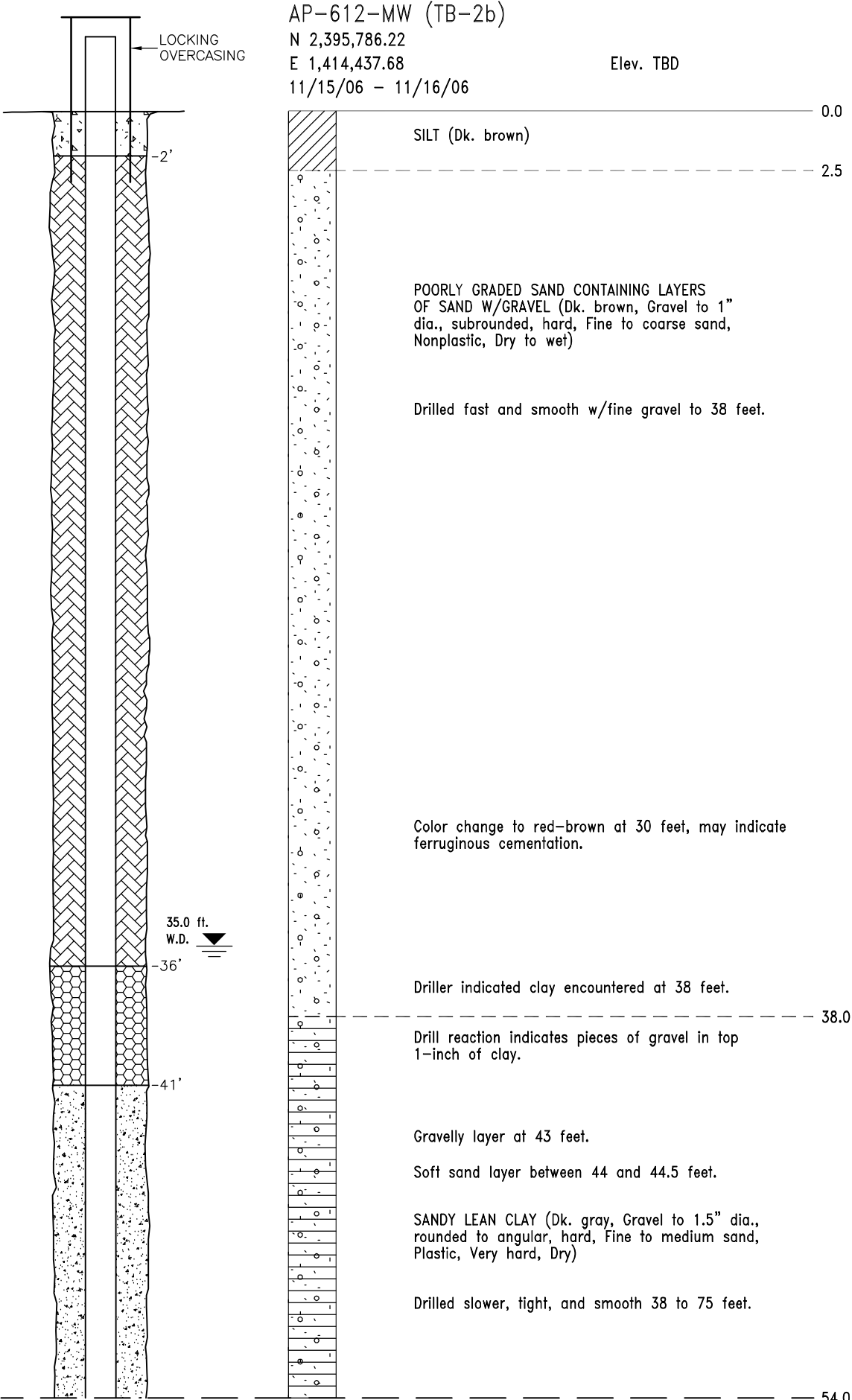
Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

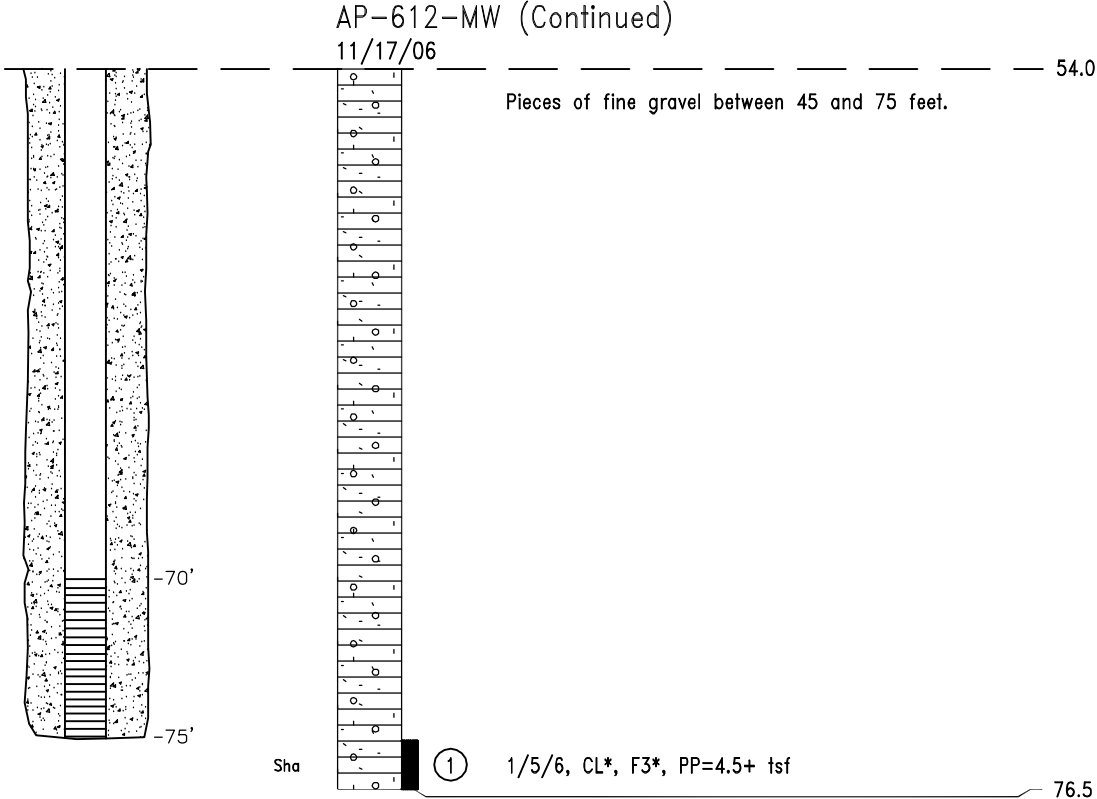


CONTRACT NO. <u>W911KB-05-D-0004</u>		ALASKA DISTRICT	
CONTRACTOR <u>R&M CONSULTANTS, INC.</u>		CORPS OF ENGINEERS	
CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG AP-611-MW		
SUBMITTED: C.H.R.			
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-06

* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.
*** Sampler driven with plastic liners.
Unconsolidated-undrained triaxial compression test performed on samples #12, #14, and #16.



(Continued Above)



* Estimated Classification

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

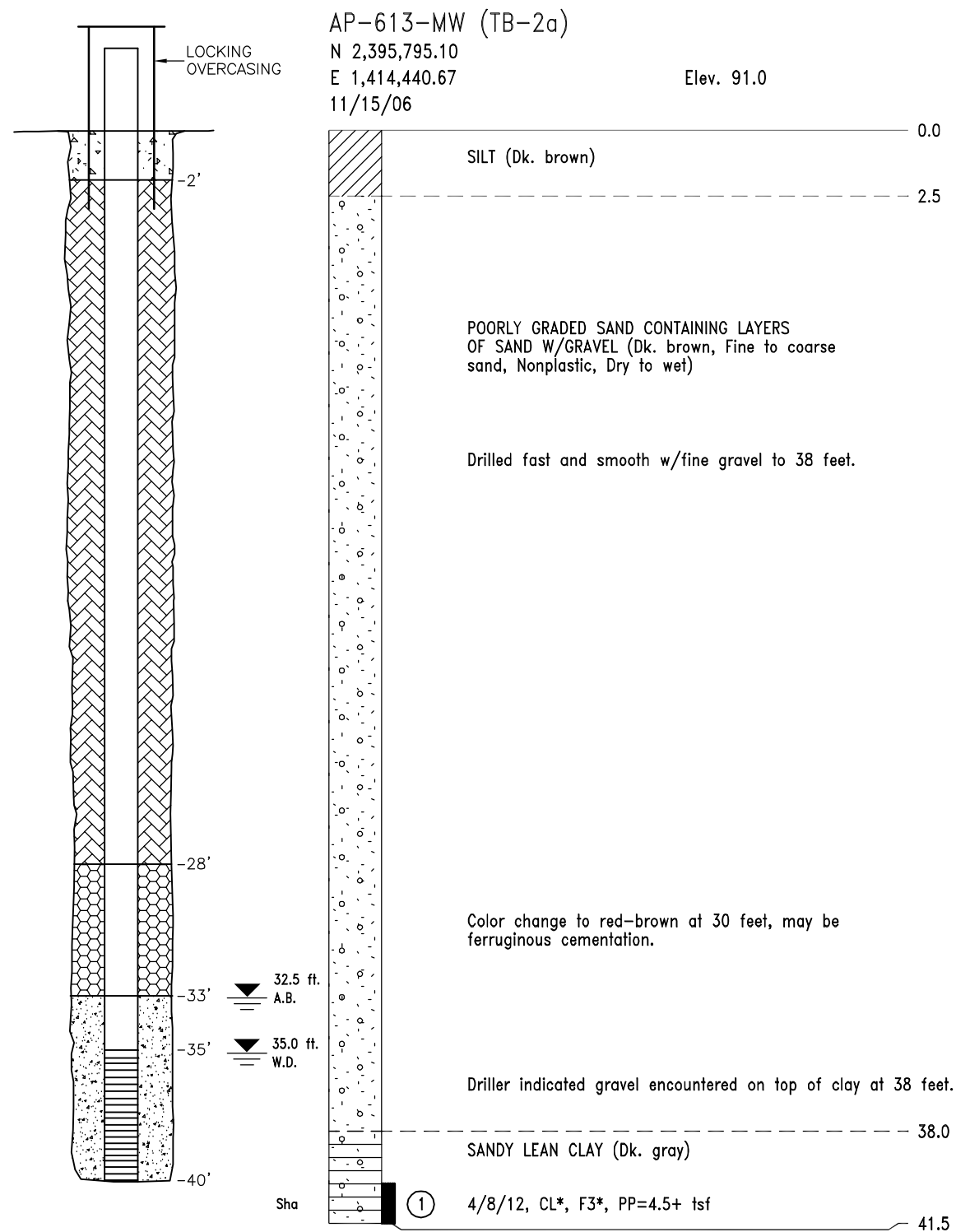
MONITORING WELL NOTES :

- Screen w/prepacked sand was installed between 70 and 75 ft.
- Silica sand bridged in augers and bridge could not be removed until augers were pulled to 40 feet.
- Sand from upper sand unit caved into hole to a depth of 41 feet.
- Well appeared to be measuring water level of upper aquifer.






See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.



CONTRACT NO. <u>W911KB-05-D-0004</u>		ALASKA DISTRICT	
CONTRACTOR <u>R&M CONSULTANTS, INC.</u>		CORPS OF ENGINEERS	
CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG AP-612-MW		
SUBMITTED: C.H.R.			
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-07




MONITORING WELL LEGEND

- | | |
|---|----------------------|
|  | SCREEN - 0.010" SLOT |
|  | 20/40 SILICA SAND |
|  | BENTONITE (CHIPS) |
|  | VOLCLAY GROUT |
|  | CONCRETE |

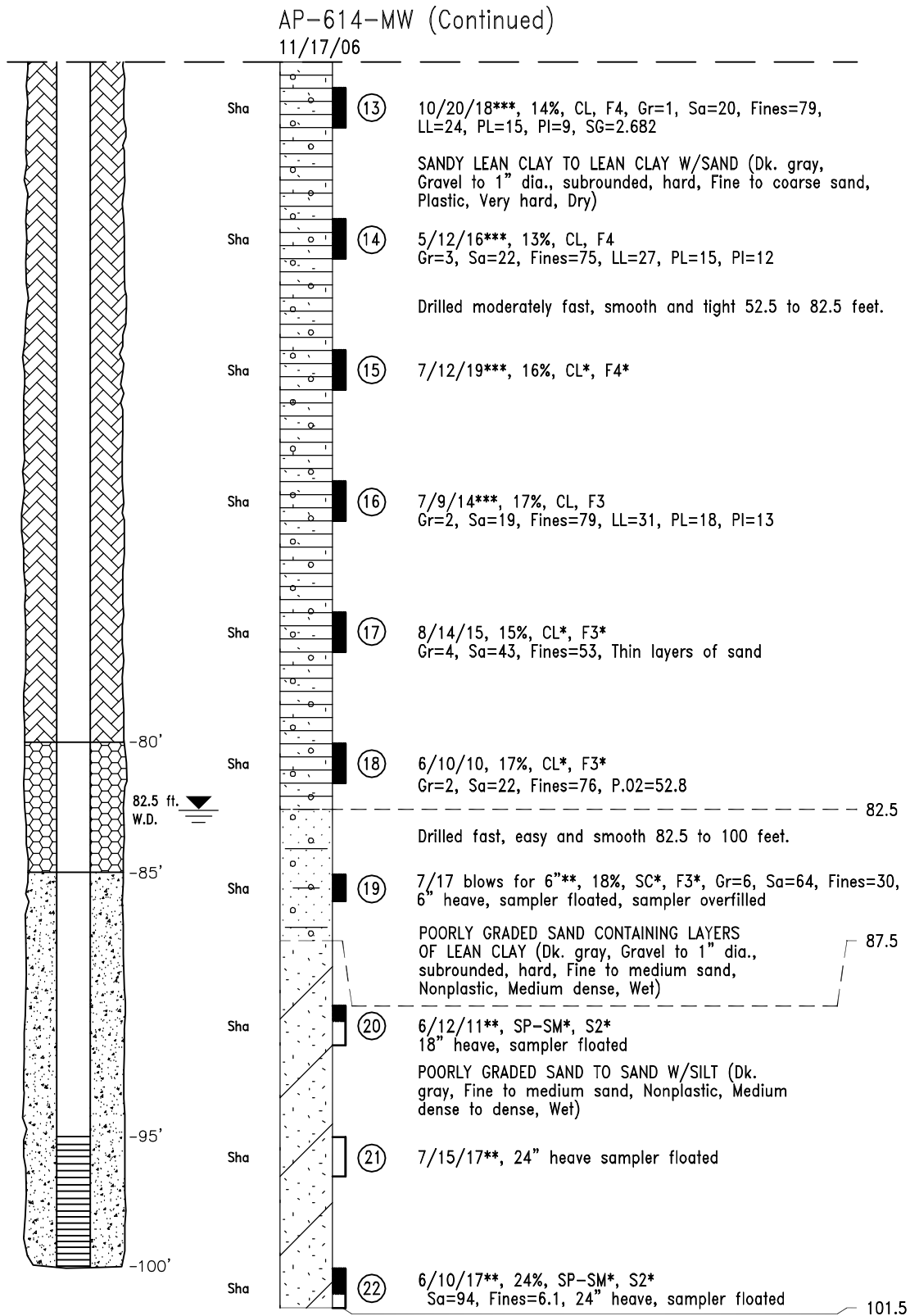
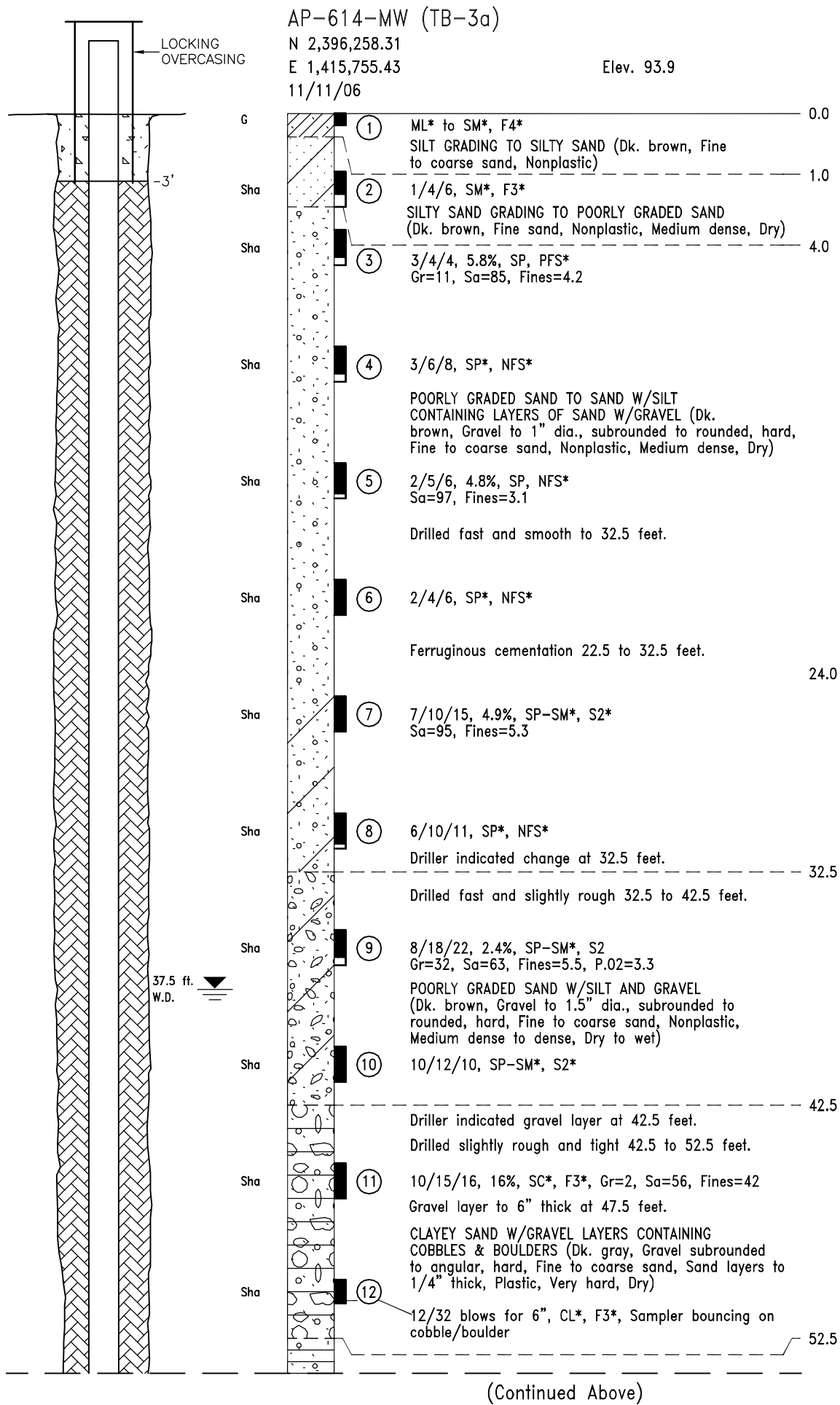
MONITORING WELL NOTES :

1. Screen w/prepacked sand was installed between 35 and 40 ft.
2. Installation was uneventful.

See Drawings B-01 and B-02 for
Explanation of Boring Log Symbols.

<div style="text-align: center;">  </div>			
CONTRACT NO. <u>W911KB-Q5-D-0004</u> CONTRACTOR <u>R&M CONSULTANTS, INC.</u> CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ALASKA DISTRICT CORPS OF ENGINEERS ANCHORAGE, ALASKA	
DESIGNED: <u>P.K.H.</u> DRAWN: <u>P.K.H.</u> CHECKED: <u>C.H.R.</u> SUBMITTED: <u>C.H.R.</u>	KENAI RIVER BLUFF EROSION KENAI, ALASKA TEST BORING LOG AP-613-MW		
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-08

project\1209.10\geo\KENAI AP-613-MW (2a), 1=1, 01/17/07 at 09:37 by pkh



MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

- Screen w/prepacked sand was installed between 95 and 100 ft.
- Due to heaving conditions the screen could not be placed down the hole and the augers were reinstalled with a wooden plug. Otherwise installation was uneventful.

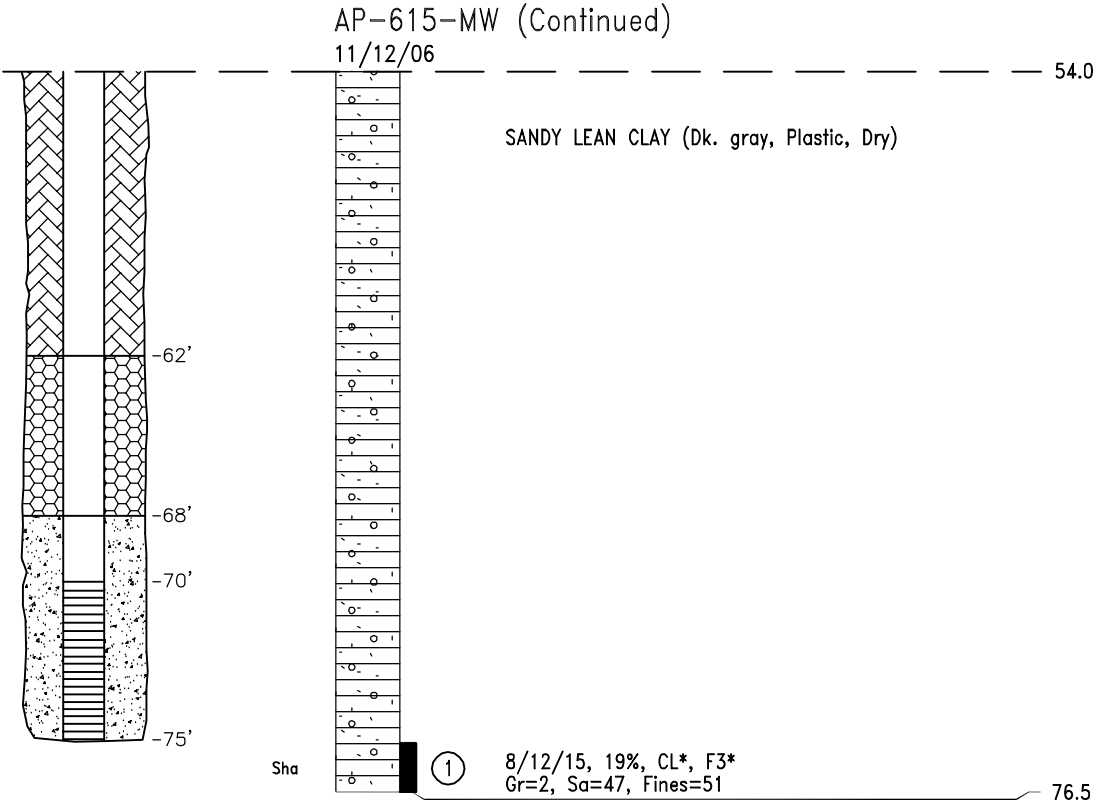
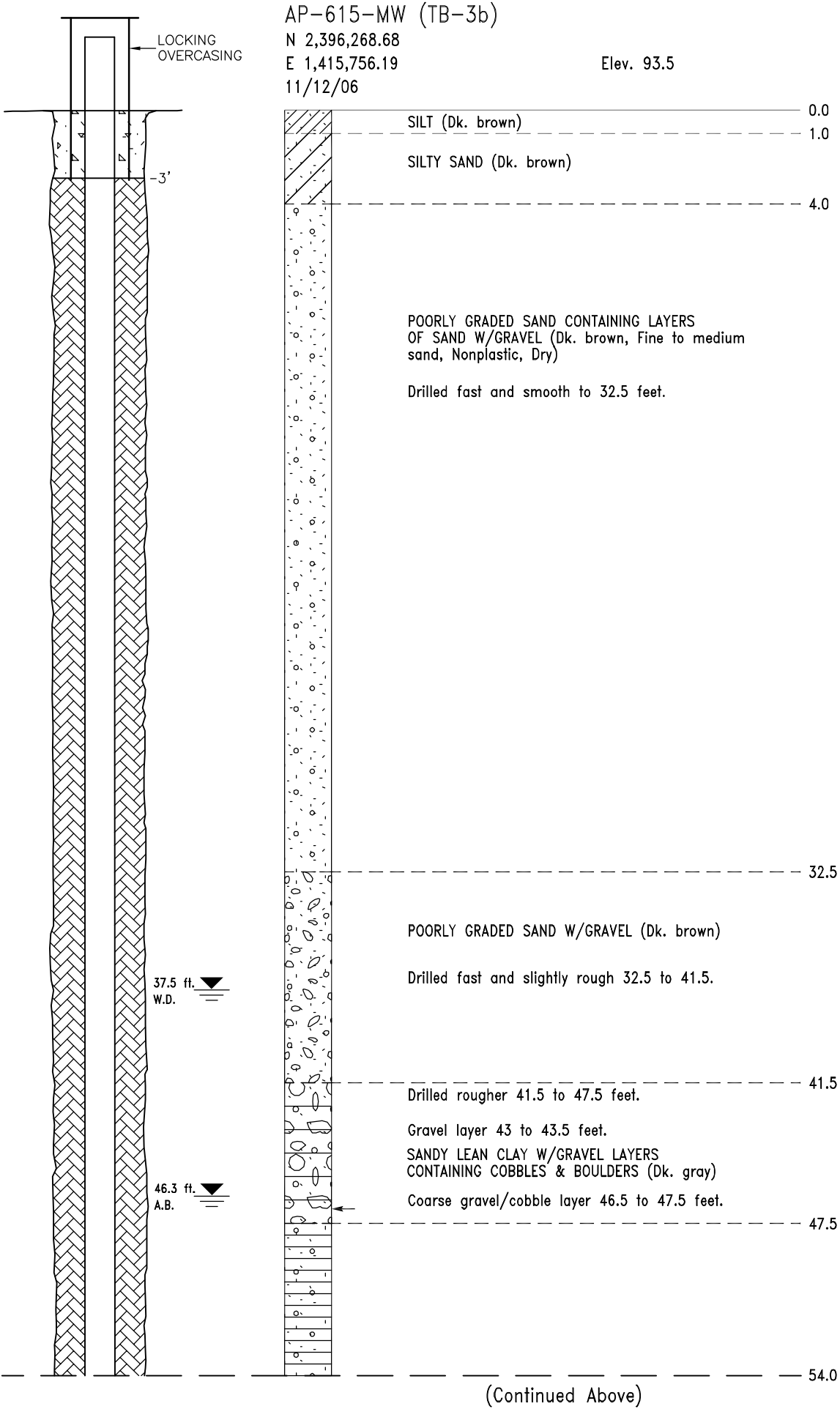
Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.



CONTRACT NO. <u>W911KB-05-D-0004</u>		ALASKA DISTRICT	
CONTRACTOR <u>R&M CONSULTANTS, INC.</u>		CORPS OF ENGINEERS	
CITY <u>ANCHORAGE</u> STATE <u>ALASKA</u>		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.		KENAI RIVER BLUFF EROSION KENAI, ALASKA	
DRAWN: P.K.H.			
CHECKED: C.H.R.		TEST BORING LOG AP-614-MW	
SUBMITTED: C.H.R.			
DATE: FEB. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-09

* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.
*** Sampler driven with plastic liners.
Consolidated undrained triaxial compression test performed on samples #13, #14, and #15.



* Estimated Classification

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

1. Screen w/prepacked sand was installed between 70 and 75 ft.
2. Installation was uneventful.

See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

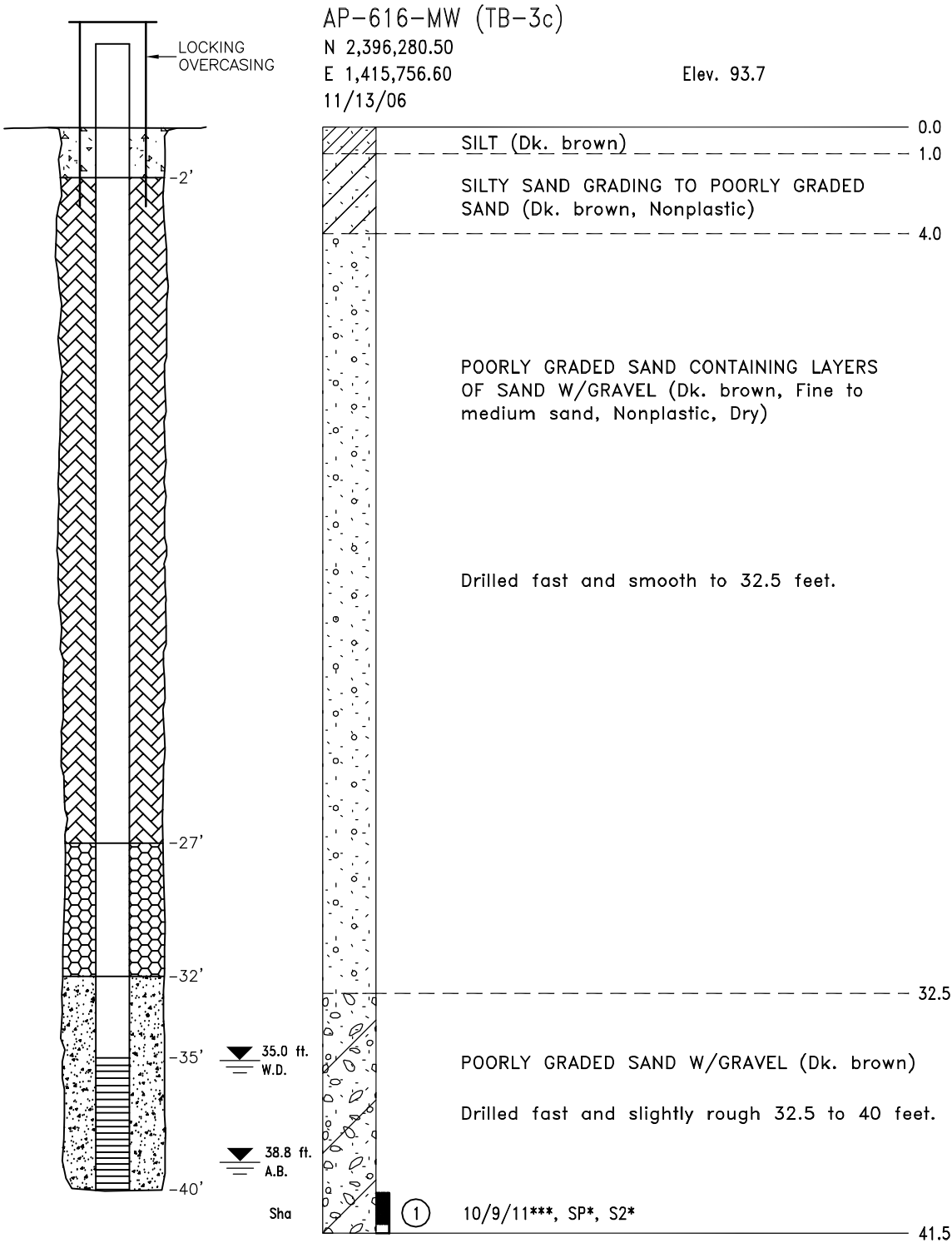


CONTRACT NO. W911KB-05-D-0004
CONTRACTOR R&M CONSULTANTS, INC.
CITY ANCHORAGE STATE ALASKA
ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

DESIGNED: P.K.H.
DRAWN: P.K.H.
CHECKED: C.H.R.
SUBMITTED: C.H.R.
KENAI RIVER BLUFF EROSION
KENAI, ALASKA
TEST BORING LOG
AP-615-MW

DATE: JAN. 2007
R&M NO. 1209.10
SCALE: AS SHOWN
DWG. NO. B-10

project\1209.10\geo\KENAI AP-616-MW (3c), 1=1, 01/17/07 at 09:51 by pkh



* Estimated Classification
*** Sampler driven with plastic liners.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger Drill
Crew: Gary Cormier and Darin Vandehey



MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

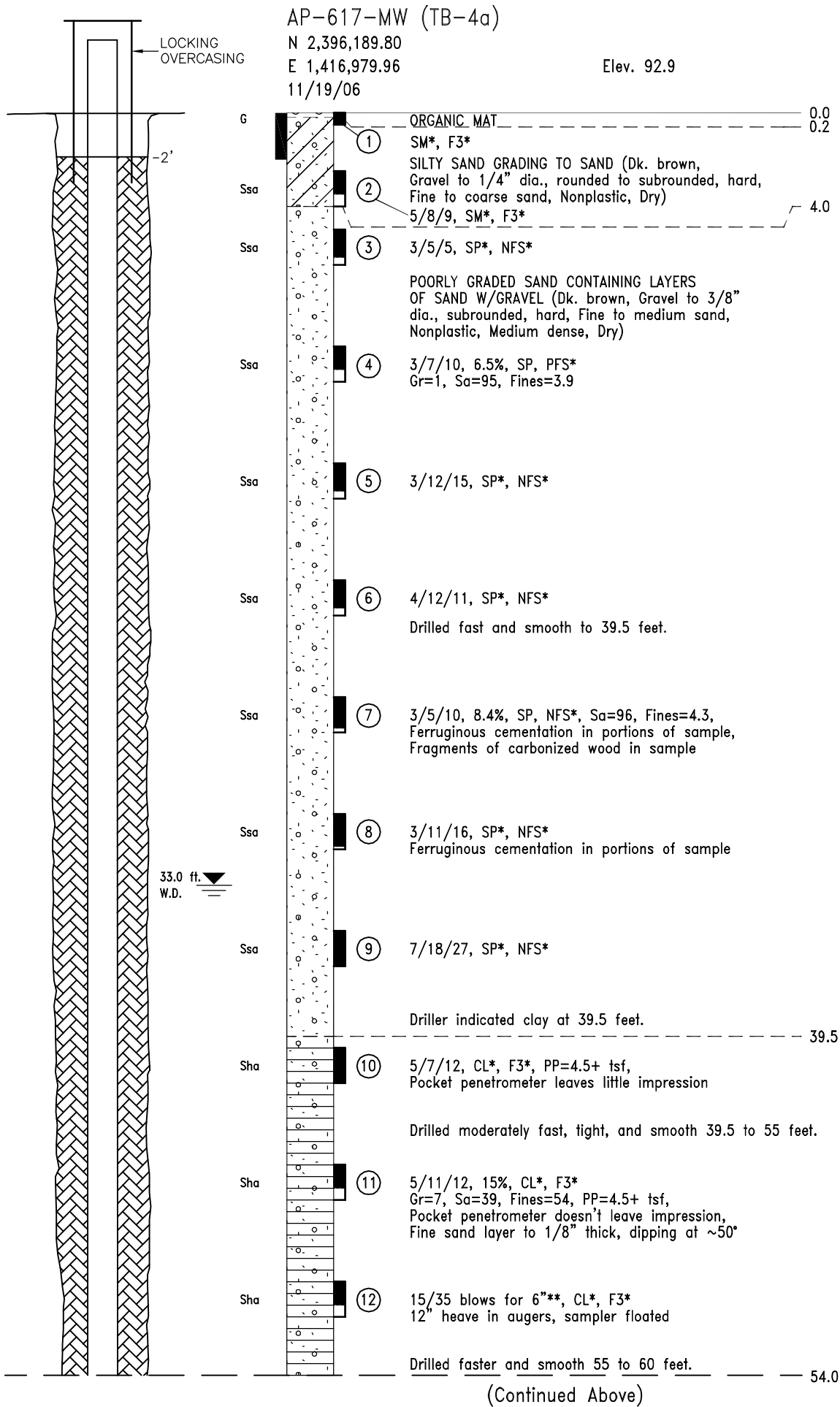
MONITORING WELL NOTES :

- 1. Screen w/prepacked sand was installed between 35 and 40 ft.
- 2. Installation was uneventful.

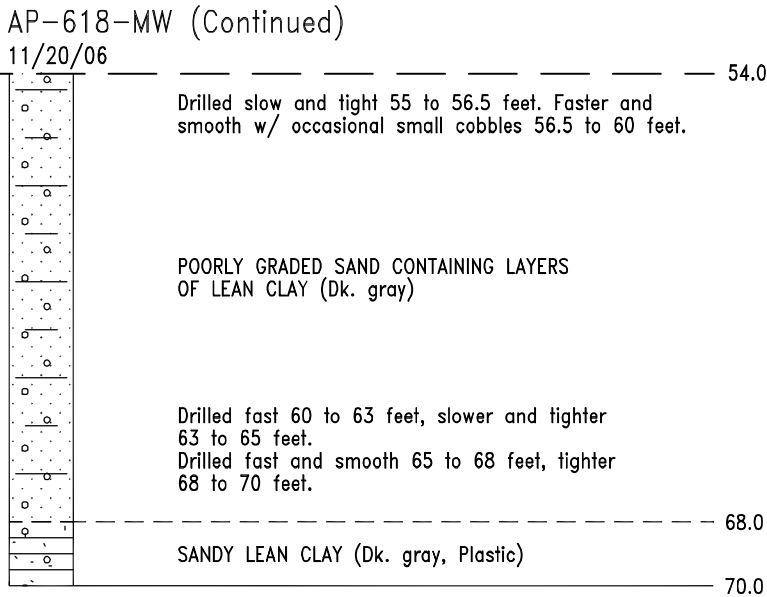
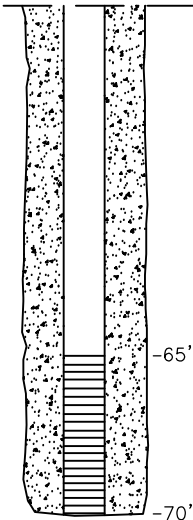
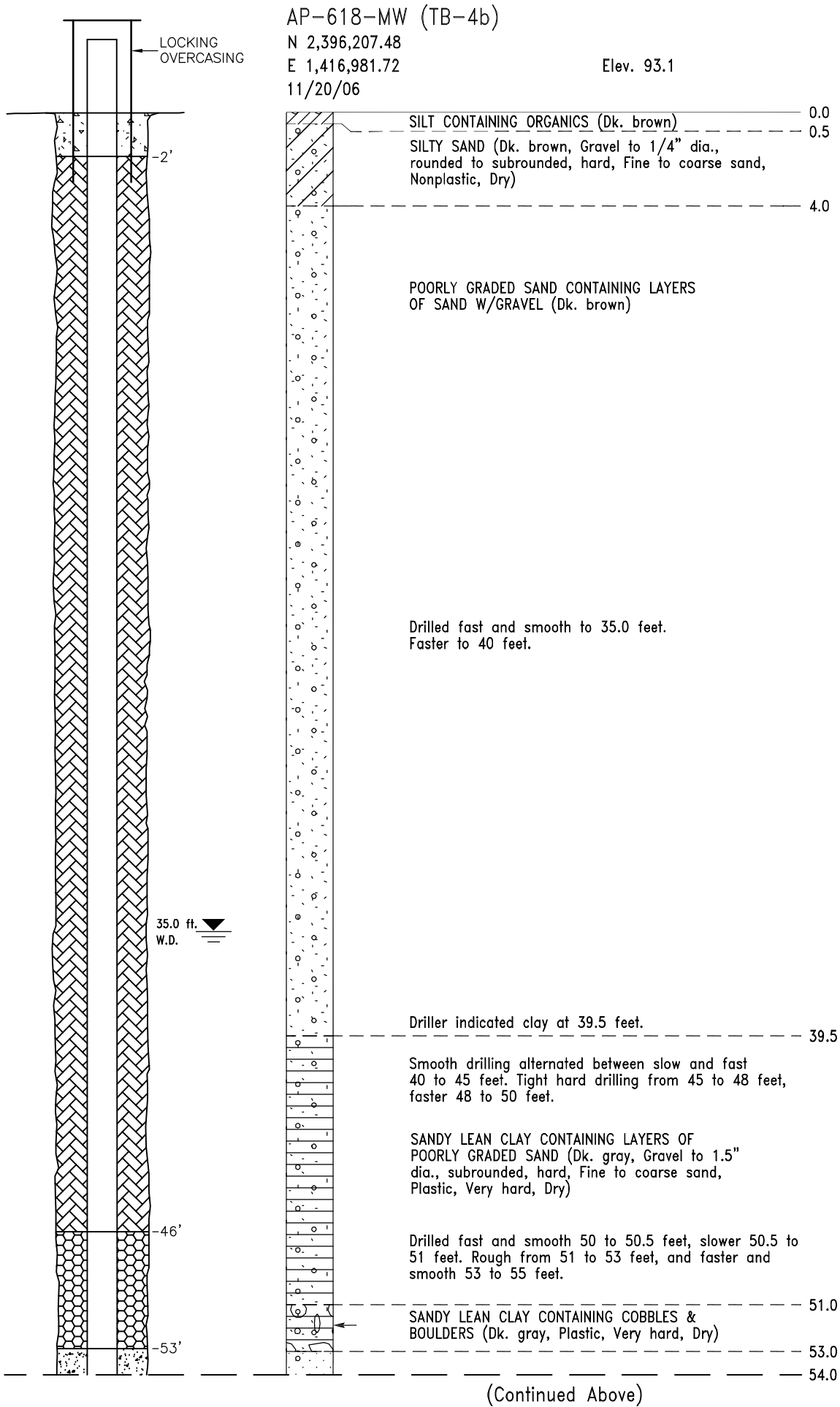
See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

R&M CONSULTANTS, INC.			
CONTRACT NO. W911KB-05-D-0004		ALASKA DISTRICT	
CONTRACTOR R&M CONSULTANTS, INC.		CORPS OF ENGINEERS	
CITY ANCHORAGE STATE ALASKA		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG AP-616-MW		
SUBMITTED: C.H.R.			
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-11

project\1209.10\geo\KENAI AP-617-MW (4a), 1=1, 02/13/07 at 09:41 by kjp



project\1209.10\geo\KENAI AP-618-MW (4b), 1=1, 01/17/07 at 09:50 by pkh



Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

MONITORING
WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

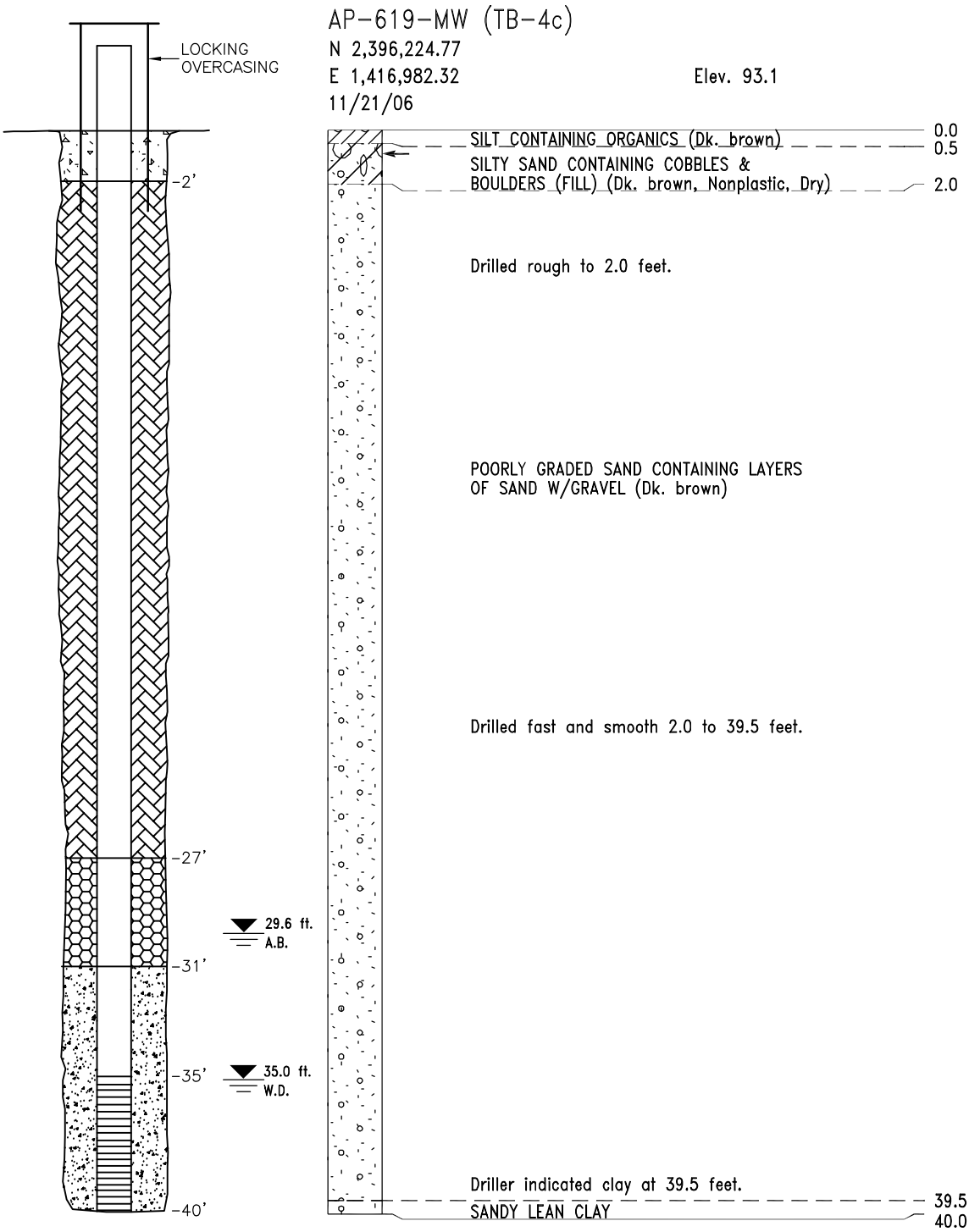
MONITORING WELL NOTES :

1. Hole was drilled with wooden plug in end of augers.
2. Screen w/prepacked sand was installed between 65 and 70 ft.
3. Installation was uneventful.

See Drawings B-01 and B-02 for
Explanation of Boring Log Symbols.

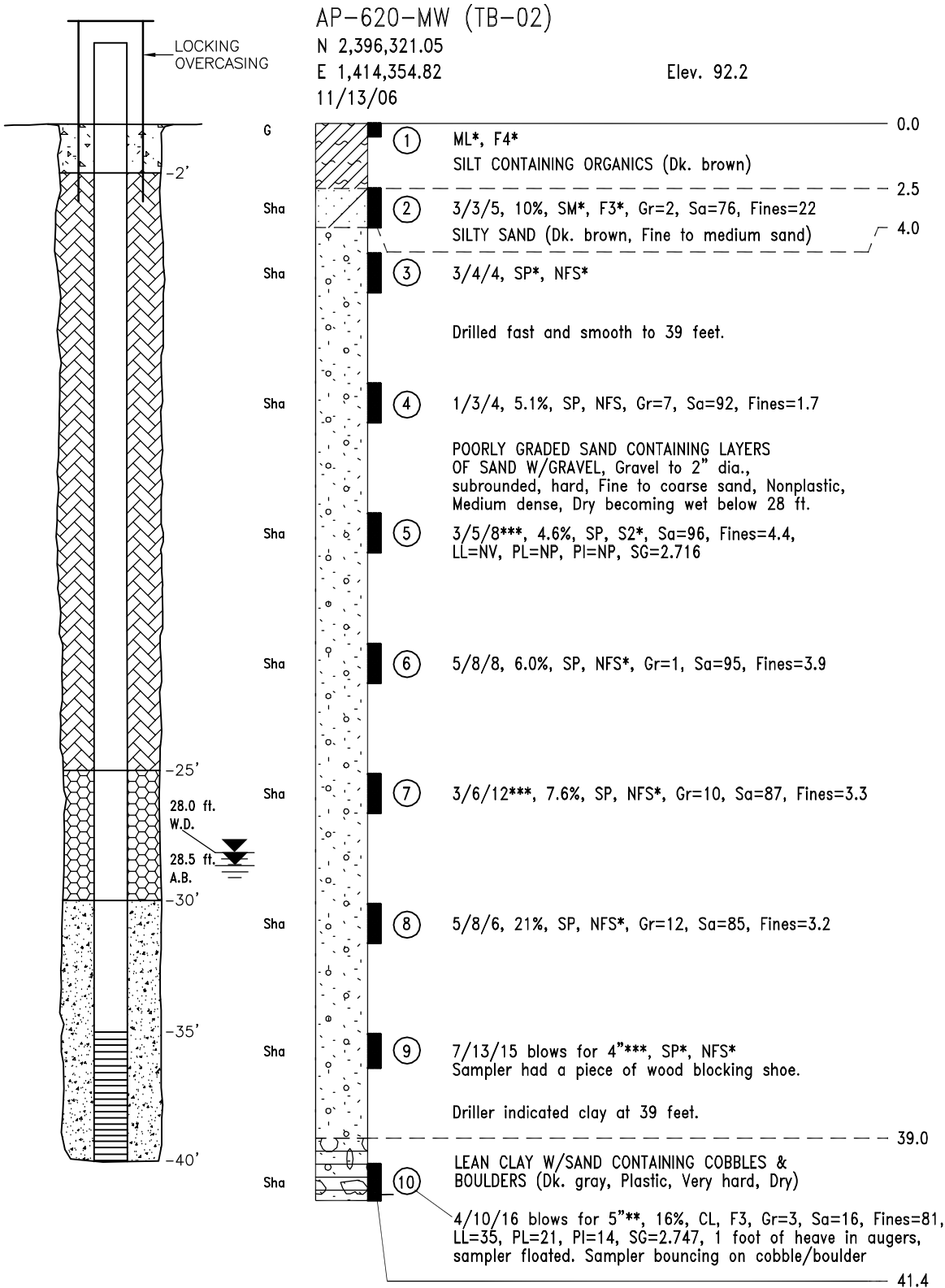
<div>R&M R&M CONSULTANTS, INC.</div>			
CONTRACT NO. W911KB-05-D-0004		ALASKA DISTRICT	
CONTRACTOR R&M CONSULTANTS, INC.		CORPS OF ENGINEERS	
CITY ANCHORAGE STATE ALASKA		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG AP-618-MW		
SUBMITTED: C.H.R.			
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-13

project\1209.10\geo\KENAI AP-619-MW (4c), 1=1, 01/17/07 at 08:38 by pkh



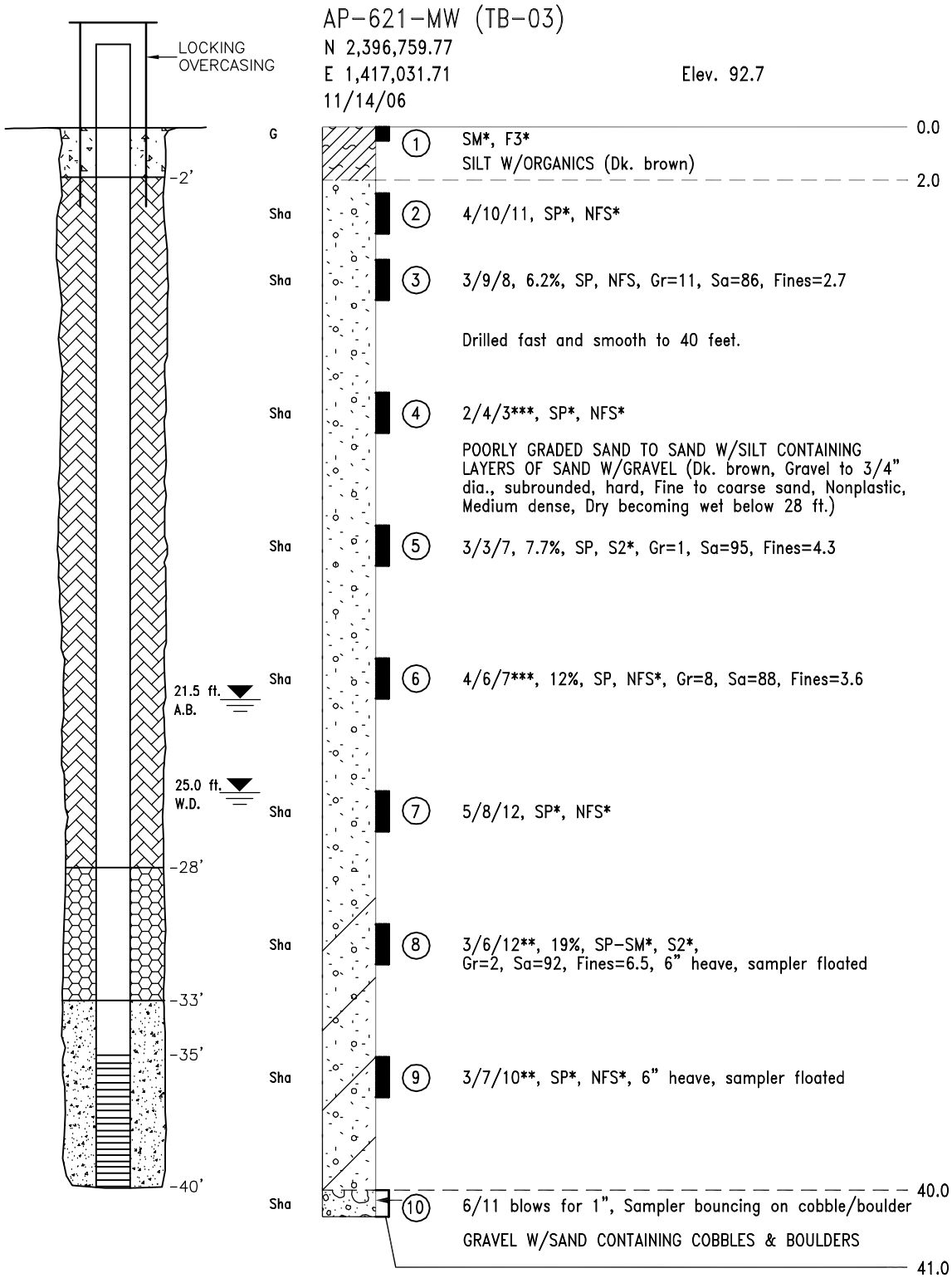


project\1209.10\geo\KENAI AP-620-MW & 621-MW, 1=1, 01/17/07 at 09:50 by pkh



* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.
*** Sampler driven with brass liners.
One-dimensional consolidation performed on sample #10.
Constant head permeability test performed on sample #5.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey



* Estimated Classification
** Designates that blow counts may not be representative due to sand heaving into the augers.
*** Sampler driven with brass liners.
Constant head permeability test performed on samples #4 and #6.

Geologist: Peter Hardcastle
Drill Company/Rig: Discovery Drilling/CME 75
Drilling Method: 8-inch Hollow Stem Auger
Drill Crew: Gary Cormier and Darin Vandehey

MONITORING WELL LEGEND

- SCREEN - 0.010" SLOT
- 20/40 SILICA SAND
- BENTONITE (CHIPS)
- VOLCLAY GROUT
- CONCRETE

MONITORING WELL NOTES :

- Screens w/prepacked sand were installed between 35 and 40 ft.
- Caving sand prevented placement of silica sand through the augers until they had been pulled back 10 feet in AP-620-MW. Sand backfill was a mixture of silica sand and sand cave in.
- Installation of AP-621-MW was uneventful.

See Drawings B-01 and B-02 for Explanation of Boring Log Symbols.

R&M CONSULTANTS, INC.			
CONTRACT NO. W911KB-05-D-0004		ALASKA DISTRICT	
CONTRACTOR R&M CONSULTANTS, INC.		CORPS OF ENGINEERS	
CITY ANCHORAGE STATE ALASKA		ANCHORAGE, ALASKA	
DESIGNED: P.K.H.	KENAI RIVER BLUFF EROSION KENAI, ALASKA		
DRAWN: P.K.H.			
CHECKED: C.H.R.	TEST BORING LOG		
SUBMITTED: C.H.R.	AP-620-MW & AP-621-MW		
DATE: JAN. 2007	R&M NO. 1209.10	SCALE: AS SHOWN	DWG. NO. B-15

WELL LOG DATA

American Environmental

PROJECT: Daubenspeck Property		WELL NO. MW-1
LOCATION: Grid 337.7, 315.1		DATE DRILLED: 6/14/2000
DRILLING METHOD: Hollow Stem Auger \ Split Spoon Sample		CASING TYPE/DIA. PVC 2"
DEPTH DRILLED: 28 feet		TOTAL CASING: 20 feet
GROUND ELEVATION:		T.O.C. ELEVATION:
GROUT TYPE/QUANTITY: Bentonite Chips ½ bag \ Bentonite slurry 20 gallons		SCREEN TYPE/ LENGTH: 0.20 slot PVC \ 10 feet
GROUT INTERVAL: Chips 12 to 14.11' Slurry 1 to 12'		SCREENED INTERVAL:
SAND PACK TYPE/INTERVAL: 14.11 to 28 feet		STATIC WATER LEVEL/DATE:
DEPTH TO WATER WHILE DRILLING: 21.5' bgl		LOGGED BY: PETE CAMPBELL
WATER LEVEL ELEVATION:		DRILLER: Hughes Drilling

DEPTH	H2O/SOIL SAMPLE	FORMATION DESCRIPTION
0-5'		Sand, brown, clean
5-7	SSS #1 BC: 3-5-5-5	5-6' Sand, medium, brown with minor gravel, moist 6-7' Sand, fine brown, moist PID 8.1
7-9'	SSS#2 BC: 3-3-4-5	7-8' Sand, fine brown, moist 8-9' Sand, fine, gray PID 0.0
9-11	SSS#3 BC: 3-4-6-8	Sand, fine, gray PID 0.0
11-13	SSS#4 BC: 4-8-8-4	Sand, fine, gray PID 0.0
13-15	SSS#5 BC: 6-7-8-9	Sand, fine, gray to 13.8 13.8-15 Sand, very fine, gray, moist PID 0.0
15-17	SSS#6 BC: 4-7-9-8	Sand, medium, brown salt & pepper. PID 0.0 Drill to 20
20-28	SSS#7 BC: 5-10-13-15	20-21' Sand fine, brown, wet 21-22' Sand with minor silt, wet, approximately 6" of water in augers PID 5.1 Sample Collected: MW-1-20-22 @09:34 Drill to 24', water at 21.5 Drill to 28' EOB

WELL LOG DATA

American Environmental

PROJECT: Daubenspeck Property		WELL NO. MW-2
LOCATION: Grid 889.3, 198.9		DATE DRILLED: 6/14/2000
DRILLING METHOD: Hollow Stem Auger \ Split Spoon Sample		CASING TYPE/DIA: PVC 2"
DEPTH DRILLED: 25 feet		TOTAL CASING: 13'
GROUND ELEVATION:		T.O.C. ELEVATION:
GROUT TYPE/QUANTITY: Bentonite Chips ½ bag \ Bentonite slurry 20 gallons		SCREEN TYPE/ LENGTH: 0.20 slot PVC \ 10 feet
GROUT INTERVAL: Chips 8 to 10' Slurry 1 to 8'		SCREENED INTERVAL: 15 to 25'
SAND PACK TYPE/INTERVAL: 10 to 25 feet		STATIC WATER LEVEL/DATE:
DEPTH TO WATER WHILE DRILLING: 18.8' bgl		LOGGED BY: PETE CAMPBELL
WATER LEVEL ELEVATION:		DRILLER: Hughes Drilling
DEPTH	H2O\SOIL SAMPLE	FORMATION DESCRIPTION
0-4'		Drill, no cuttings
4-6	SSS #1 BC: 1-1	Sand, brown with some surface litter, (wood) 50% recovery PID 4.5
6-8'	SSS#2 BC: 1-1-1-0	Sand, brown, dry 30% recovery PID 6.6
8-10	SSS#3 BC: 3-3-2-2	0% recovery, Spoon bounced as if on a log. Bailing wire on tip of bit
10-12	SSS#4 BC: 2-1-1-1	Sand, brown with some organics PID 7.5 20% recovery
12-14	SSS#5 BC: 3-5-5-6	Sand, brown dry to moist PID 4.5
14-16	SSS#6 BC: 4-7-7-8	Sand, brown dry to moist PID 1.3 Drill to 20
20-22	SSS#7 BC: 4-4-4-7	Sand, brown wet PID 2.5 Water at 18.8 Sample Collected: MW-2-20-22 @ 12:14 Drill to 25', water at 18.8 EOB As the augers were removed from the hole a large chunk of metal came up the augers with several pieces of copper wire.

WELL LOG DATA

American Environmental

PROJECT: Daubenspeck Property		WELL NO. MW-3
LOCATION: Ghd 238.7, 54.1		DATE DRILLED: 6/14/2000
DRILLING METHOD: Hollow Stem Auger \ Split Spoon Sample		CASING TYPE/DIA: PVC 2"
DEPTH DRILLED: 30 feet		TOTAL CASING: 22.9'
GROUND ELEVATION: 100.3		T.O.C. ELEVATION: 103.41
GROUT TYPE/QUANTITY: Bentonite Chips 1 bag \ Bentonite slurry 20 gallons		SCREEN TYPE/ LENGTH: 0.20 slot PVC \ 10 feet
GROUT INTERVAL: Chips 12.5 to 17' Slurry 4.5 to 12.5'		SCREENED INTERVAL: 20 to 30'
SAND PACK TYPE/INTERVAL: 17 to 30 feet		STATIC WATER LEVEL/DATE:
DEPTH TO WATER WHILE DRILLING: 24' bgl		LOGGED BY: PETE CAMPBELL
WATER LEVEL ELEVATION:		DRILLER: Hughes Drilling

DEPTH	H2O\SOIL SAMPLE	FORMATION DESCRIPTION
0-5'		Sand, brown
5-7	SSS #1 BC: 1-1-1-1	Sand, brown, moist, fine PID 0.0
7-9'	SSS#2 BC: 1-1-1-1	7-8 Sand, medium, brown, moist 8-8.3 Sand, fine, brown 8.3-9 Sand, medlum, brown, some organics PID 0.0
9-11	SSS#3 BC: 1-1-1-1	Sand, medium, brown, with minor gravel. PID 0.0
11-13	SSS#4 BC: 1-1-1-1	Sand, medium, brown. PID 0.0
13-15	SSS#5 BC: 1-1-1-1	Sand, medlum, brown. PID 0.0
15-17	SSS#6 BC: 1-1-1-1	Sand, medlum, brown. PID 0.0
17-19	SSS#7 BC: 1-1-1-1	Sand, medium, brown, with minor gravel. PID 5.0
19-21	SSS#8 BC: 1-1-1-1	Sand, medium, brown, with minor gravel. PID 8.5
21-23	SSS#9 BC: 2-7-23	21-22 Sand, fine, brown. 22-23 Pea Gravel with concrete in tip, refusal. PID 8.6
		The augers apparently hit the suspected lip of the cistern that was rumored to be in the area. The rig was moved east 10 feet and re-drilled to 23'
23-25	SSS#10 BC: 3-7-7-10	Sand, brown with minor gravel, wet. PID 8.2 Sample Collected MW-3-23-25 @17:57



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Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 15 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,502 ft.
Easting: 1,415,363 ft.

Top of Hole
Elevation: 90.0 ft.

Hole Number, Field: Permanent:
TB-1 AP-604-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other _____
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.0 ft. WD

Depth Drilled:
100.0 ft.

Total Depth:
101.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class: TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
1		1		NFS	Grab	SP	Poorly graded SAND					- 0.0		Surface: Second growth willows
2														
3		2		NFS	1	SP	Poorly graded SAND	8	87	5		- 0.0	3	Brown, moist, fine to medium sand
4					2									
5		3		NFS	1	SP	Poorly graded SAND					- 0.0		Brown, moist, fine to medium sand
6					1									
7					1									
8					1									
9					1									
10														
11		4		NFS	2	SP	Poorly graded SAND	4	93	3		- 0.0	5	Gray, moist, fine to medium sand
12					3									
13					5									
14														
15														
16		5		NFS	2	SP	Poorly graded SAND					- 0.0		Gray, moist, fine to medium sand
17					5									
18														
19														
20														
21		6			3	SP	Poorly graded SAND					- 0.0		Gray, moist, fine to medium sand
22					5									
23														
24														
25		7a			3	SP	Poorly graded SAND							
26		7b			5	SM	Silty SAND	1	75	24			22	Dark gray, moist, fine sand, nonplastic (NP)
27		7c			5	SP	Poorly graded SAND							fines
28														
29														
30		8			7	SP	Poorly graded SAND							Gray, wet, medium sand
31					11									
32					15									
33														
34														
35														
36		9			5	SP	Poorly graded SAND							Gray, wet, fine to medium sand
37					8									

EXPLORATION LOG KENAI BLUFFS.GPJ ACE, ANC.GDT 9/3/04

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-604-P



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Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 15 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,502 ft.
Easting: 1,415,363 ft.

Top of Hole
Elevation: 90.0 ft.

Hole Number, Field: Permanent:
TB-1 AP-604-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.0 ft. WD

Depth Drilled:
100.0 ft.

Total Depth:
101.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frost Class. ASTM D 4083 TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
							%Gravel	%Sand	%Fines				
38				13									
40		10		6 11 14	CL	Lean CLAY with Sand	0	22	78				Dark gray, moist, fine sand, plastic fines. LL=30.8, PI=15.5
42													
44													
46		11		7 7 10	CL	Lean CLAY with Sand							Dark gray, moist, rounded gravel, fine sand, plastic fines, very stiff
48													
50		12		6 8 13	CL	Lean CLAY with Sand							Dark gray, moist, plastic fines, very stiff
52													
54													
56		13		8 20 12	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff
58													
60		14		5 9 8	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff
62													
64													
66		15		4 9 12	CL	Lean CLAY with Sand	7	18	75	0.25		15	Dark gray, moist, fine sand, plastic fines, very stiff
68													
70		16		4 6 9	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff
72													

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-604-P

DWG. NO. B-19



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Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 15 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,502 ft.
Easting: 1,415,363 ft.

Top of Hole
Elevation: 90.0 ft.

Hole Number, Field: TB-1
Permanent: AP-604-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.0 ft. WD

Depth Drilled:
100.0 ft.

Total Depth:
101.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class. TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
74														Surface: Second growth willows
76		17			6 14 21	CL SP- SM	Lean CLAY with Sand Poorly graded SAND with Silt							Dark gray, moist, fine sand, plastic fines, very stiff Gray, wet, fine to medium sand
80		18			10 14 18	SP- SM	Poorly graded SAND with Silt	1	92	7				Gray, wet, medium sand
90		19a			4 12 11	SP- SM	Poorly graded SAND with Silt							Gray, wet, medium sand
92		19b				CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines
94														
96														
98														
100					7 15 18	SP	Poorly graded SAND							Gray, wet, fine to medium sand
102														Bottom of Hole 101.5 ft. Groundwater Encountered While Drilling: at an elevation of 63.0 ft. PID = (Cold/Hot) Photo Ionization Detector
104														
106														Survey datum is Alaska State Plane, Zone 4, NAD83. Elevation datum MLLW.
108														

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Hole Number:
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Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 16 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,309 ft.
Easting: 1,415,302 ft.

Top of Hole
Elevation: 89.8 ft.

Hole Number, Field: Permanent:
TB-2 AP-605-MW

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☒ Monitoring Well ☐ Piezometer

Depth to Groundwater:
29.9 ft. WD

Depth Drilled:
37.5 ft.

Total Depth:
38.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class: TM-5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
0		1a			Grab	ML	SILT				1	-		Surface: Lawn
1		1b				SP	Poorly graded SAND				1	1.0		Brown, moist, nonplastic (NP) fines, organics (sixty percent by volume)
2					2						0.5	-		Brown, moist, rounded gravel, fine to medium sand
3		2			2		Poorly graded SAND				0.5	1.0		Brown, moist, fine to medium sand
4					4							-		
5		3			2		Poorly graded SAND					1.0		Brown, moist, fine to medium sand
6					3							-		
7					4							1.0		Brown, moist, fine to medium sand
8					5							-		
9		4			5		Poorly graded SAND				0.75	0.0		Gray, moist, fine to medium sand
10					4							-		
11					6							0.0		
12					6							-		
13					7							1.0		
14					7							-		
15		5			6		Poorly graded SAND	4	92	4	0.75	-	5	Gray, moist, fine to medium sand
16					7							1.0		
17												-		
18												1.0		
19												-		
20		6			3		Poorly graded SAND					1.0		Brown, moist, fine to medium sand
21					3							-		
22					5							1.0		
23												-		
24												1.0		
25												-		
26		7			3		Poorly graded SAND					1.0		Brown, moist, fine to medium sand, localized evidence of mottling, one small area (one inch thick) of 30% slit
27					4							-		
28					8							1.0		
29												-		
30		8			2		Poorly graded SAND with Gravel	24	74	2	1			Brown, wet, rounded gravel, fine to coarse sand
31					6									
32					10									
33														
34														
35														
36		9			2		Poorly graded SAND							Twelve inches of heaving sand Gray, wet, fine to medium sand
37					3									

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Hole Number:
AP-605-MW



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Soils and Geology Section EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 16 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,309 ft.
Easting: 1,415,302 ft.

Top of Hole
Elevation: 89.8 ft.

Hole Number, Field: Permanent:
TB-2 AP-605-MW

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☒ Monitoring Well ☐ Piezometer

Depth to Groundwater:
29.9 ft. WD

Depth Drilled:
37.5 ft.

Total Depth:
38.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class, TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
38		10			4 3 7	CL	Lean CLAY with Sand	4	14	82			17	Dark gray, moist, fine sand, plastic fines, very stiff
40														Bottom of Hole 38.5 ft.
42														Groundwater Encountered While Drilling: at an elevation of 59.9 ft.
44														PID = (Cold/Hot) Photo Ionization Detector
46														Survey datum is Alaska State Plane, Zone 4, NAD83. Elevation datum MLLW.
48														
50														
52														
54														
56														
58														
60														
62														
64														
66														
68														
70														
72														

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-605-MW

DWG. NO. B-22



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EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 17 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,225 ft.
Easting: 1,415,366 ft.

Top of Hole
Elevation: 88.7 ft.

Hole Number, Field: Permanent:
TB-3 AP-606-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.9 ft. WD

Depth Drilled:
99.5 ft.

Total Depth:
101.0 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frost ASTM D 4083	Frost Class. TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
38														Surface: Dirt parking lot
40		10a			4	CL	Lean CLAY with Sand					-1		Gray, moist, plastic fines, very stiff
41		10b			8	GP	Poorly graded GRAVEL					1.0		Gray, moist, rounded gravel, coarse sand, 1.5 inches thick
42		10c			15	CL	Lean CLAY with Sand							
44		11a			7	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff
45		11b			17	SP	Poorly graded SAND							Dark gray, moist, medium sand
46		11c			24	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff
48														
50		12			7	CL	Lean CLAY with Sand					-1		Dark gray, moist, fine sand, plastic fines, very stiff
51					13							1.0		
52					16									
54						SP	Poorly graded SAND							Estimated by drill action
56		13			6	CL	Lean CLAY with Sand					-1		Dark gray, moist, fine sand, plastic fines, very stiff, marbled with clean gray medium sand to one and one sixteen inches thick
57					13							0.0		
58					15									
60		14			9	CL	Lean CLAY with Sand	0	23	77		-1	17	Dark gray, moist, fine sand, plastic fines. LL=29, PI=15
61					13							0.0		
62					38									
64														
66		15			7	CL	Lean CLAY with Sand					-1		Dark gray, moist, fine sand, plastic fines
67					11							0.0		
68					15									
70		16			4	CL	Lean CLAY with Sand					-1		Dark gray, moist, fine sand, plastic fines
71					8							0.0		
72					12									

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-606-P

DWG. NO. B-24



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ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 17 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,225 ft.
Easting: 1,415,366 ft.

Top of Hole
Elevation: 88.7 ft.

Hole Number, Field: TB-3
Permanent: AP-606-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.9 ft. WD

Depth Drilled:
99.5 ft.

Total Depth:
101.0 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frost Class. ASTM D 4083 TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
							%Gravel	%Sand	%Fines				
74		17		4 9	CL	Lean CLAY with Sand	1	26	73	- 0.0	- 0.0	17	Dark gray, moist, fine sand, plastic fines, very stiff
76				11									
78													
80		18		5 9	CL	Lean CLAY with Sand					- 0.0		Dark gray, fine sand, plastic fines, 1.25-inch thick seam of fine gray sand in sample
82				12									
84													
86		19		5 13	SP- SM	Poorly graded SAND with Silt					- 0.0		Dark gray, moist, fine to medium sand, NP fines
88				21									
90		20		3 7	SP- SM	Poorly graded SAND with Silt	0	89	11		- 0.0	20	Dark gray, moist, fine to medium sand, NP fines
92				17									
94													
96		21		7 12	SP- SM	Poorly graded SAND with Silt					- 1.0		Dark gray, moist, medium sand, NP fines
98				12									
100		22		6 17	SP- SM	Poorly graded SAND with Silt					- 0.0		Dark gray, moist, fine to medium sand, NP fines
102													Bottom of Hole 101.0 ft. Groundwater Encountered While Drilling: at an elevation of 60.8 ft. PID = (Cold/Hot) Photo Ionization Detector
104													
106													Survey datum is Alaska State Plane, Zone 4, NAD83. Elevation datum MLLW.
108													

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-606-P



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Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

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Date: 18 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,206 ft.
Easting: 1,414,825 ft.

Top of Hole
Elevation: 89.6 ft.

Hole Number, Field: Permanent:
TB-4 AP-607-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.9 ft. WD

Depth Drilled:
100.0 ft.

Total Depth:
101.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class. TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
2		1		F2	Grab	SM	Silty SAND with Gravel				2	- 0.0		Surface: Second growth willows and spruce Brown, moist, rounded gravel, fine to medium sand, nonplastic (NP) fines
4				NFS	5	SP	Poorly graded SAND				0.25	- 1.0		Brown, moist, fine sand
6		2												
8														
10														
12														
14														
16		3		NFS	3	SP	Poorly graded SAND				1.25	- 0.0		Brown, moist, rounded gravel, fine sand
18														
20														
22														
24														
26		4a			5	SP	Poorly graded SAND					- 0.0		Brown, moist, fine sand
26		4b			4	SM	Silty SAND	0	65	35			23	Brown, moist, fine sand, NP fines
26		4c			4	SP	Poorly graded SAND							Brown, moist, fine sand
28														
30		5			4	SP	Poorly graded SAND	7	92	1				Brown, wet, medium to coarse sand
32					7									
34														
36		6			2	GP	Poorly graded GRAVEL with Sand	50	48	2				Twelve inches of heaving sand Dark gray, wet, rounded gravel, fine to coarse sand

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-607-P



ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

Page 2 of 3

Date: 18 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,206 ft.
Easting: 1,414,825 ft.

Top of Hole
Elevation: 89.6 ft.

Hole Number, Field: Permanent:
TB-4 AP-607-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

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2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frozen ASTM D 4083	Frost Class, TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
38					13									Surface: Second growth willows and spruce
40														
42														
44														
46		7			5 15 18	CL	Lean CLAY with Sand					0.0		Dark gray, moist, fine sand, plastic fines, very stiff
48														
50														
52														
54														
56		8			3 6 10	CL	Lean CLAY with Sand					1.0		Dark gray, moist, rounded gravel, fine sand, plastic fines, very stiff
58														
60														
62														
64														
66		9a 9b			2 6 8	CL SP	Lean CLAY with Sand Poorly graded SAND					1.0		Dark gray, moist, fine sand, plastic fines, very stiff Dark gray, moist, fine to medium sand
68														
70		10			6 11 14	CL	Lean CLAY with Sand							Dark gray, moist, fine sand, plastic fines, very stiff, 1.25-inch layer of gray fine sand
72														

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-607-P



ALASKA DISTRICT
CORPS OF ENGINEERS
ENGINEERING SERVICES

Soils and Geology Section
EXPLORATION LOG

Project: Kenai River Bluff Erosion Study
Kenai, Alaska

Page 3 of 3

Date: 18 Sep 2003

Drilling Agency: ☐ Alaska District
☒ Other Hughes Drilling

Elevation Datum: MLLW
☐ MSL ☒ other

Location: Northing: 2,396,206 ft.
Easting: 1,414,825 ft.

Top of Hole
Elevation: 89.6 ft.

Hole Number, Field: Permanent:
TB-4 AP-607-P

Operator:
Pat Kelley

Inspector:
Steven Henslee

Type of Hole: ☐ other
☐ Test Pit ☐ Auger Hole ☐ Monitoring Well ☒ Piezometer

Depth to Groundwater:
27.9 ft. WD

Depth Drilled:
100.0 ft.

Total Depth:
101.5 ft.

Hammer Weight:
340 lbs

Split Spoon I.D.:
2.5 in.

Size and Type of Bit:
8 in. HSA

Type of Equipment:
CME-75 with Autohammer

Type of Samples:
Grab and Drive

Depth (ft.)	Lithology	Sample	Frost ASTM D 4083	Frost Class. TM 5-822-5	Blow Count	Symbol	Classification ASTM: D 2487 or D 2488	Grain Size			Max Size (in.)	PID (ppm)	% Water	Description and Remarks
								%Gravel	%Sand	%Fines				
74														Surface: Second growth willows and spruce
76														
78														
80		11			5 6 9	CL	Lean CLAY with Sand					- 1.0		Dark gray, moist, fine sand, plastic fines
82														
84														
86		12a 12b			5 12 25	CL SP	Lean CLAY with Sand Poorly graded SAND							Dark gray, moist, fine sand, plastic fines Dark gray, moist, fine to medium sand
88														
90						CL	Lean CLAY with Sand							
92		13			3 9 12	SP	Poorly graded SAND					- 1.0		Dark gray, moist, fine to medium sand
94														
96		14			3 4 16	SP	Poorly graded SAND	0	98	2		- 1.0	20	Dark gray, moist, fine to medium sand
98														
100		15			.33	CL	Lean CLAY	0	8	92		- 0.0	27	Dark gray, moist, fine sand, plastic fines, very soft
102														Bottom of Hole 101.5 ft. Groundwater Encountered While Drilling: at an elevation of 61.6 ft. PID = (Cold/Hot) Photo Ionization Detector Survey datum is Alaska State Plane, Zone 4, NAD83. Elevation datum MLLW.
104														
106														
108														

EXPLORATION LOG KENAI BLUFFS.GPJ ACE ANV.GDT 9/3/04

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Project: Kenai River Bluff Erosion Study

Hole Number:
AP-607-P

APPENDIX C

GROUNDWATER MONITORING DATA

Groundwater Elevation Summary.....	C-01
Groundwater Elevation Trends	C-02 thru C-06

TABLE C-01
KENAI RIVER BLUFF EROSION STUDY
GROUNDWATER MONITORING PROGRAM
GROUNDWATER ELEVATION SUMMARY

Group ID	Monitoring Well ID	Test Hole ID	Total Depth (ft.)	Aquifer	Groundwater Elevations ^a																											
					Reading No. 1 20/21-Nov-2006		Reading No. 2 27-Dec-2006		Reading No. 3 24-Jan-2007		Reading No. 4 28-Feb-2007		Reading No. 5 23-Mar-2007		Reading No. 6 28-Apr-2007		Reading No. 7 24-May-2007		Reading No. 8 26-Jun-2007		Reading No. 9 26-Jul-2007		Reading No. 10 24-Aug-2007		Reading No. 11 25-Sep-2007		Reading No. 12 24-Oct-2007		Reading No. 13 3-Dec-2007			
					Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.	Time	Elev.
GROUP-1	AP-608-MW	TB-1A	100	LOWER	NA	21.1	14:45	22.0	14:15	22.0	12:13	21.9	10:55	22.6	9:00	22.1	12:15	22.0	12:10	21.6	12:25	21.9	9:33	22.1	12:25	22.1	11:35	21.7	14:35	22.2		
	AP-609-MW	TB-1B	75	LOWER	NA	21.4	14:45	21.8	14:12	21.6	12:08	21.7	10:59	21.8	9:05	21.8	12:12	21.5	12:07	21.2	12:23	21.1	9:30	21.1	12:22	21.2	11:32	21.2	14:34	21.4		
	AP-610-MW	TB-1C	40	UPPER	NA	54.4	14:40	54.5	14:10	54.4	12:16	54.3	11:02	54.3	8:55	54.3	12:10	54.3	12:05	54.2	12:20	54.2	9:26	54.2	12:20	54.2	11:30	54.2	14:33	54.3		
GROUP-2	AP-611-MW	TB-2C	100	LOWER	NA	15.6	14:15	10.7	14:00	9.7	12:32	11.6	11:10	13.5	9:10	9.8	12:00	13.1	12:00	9.3	12:15	9.4	9:45	9.4	12:15	9.2	11:25	9.2	14:30	14.1		
	AP-612-MW	TB-2B	75	UPPER	NA	53.3	14:10	39.3	13:57	39.1	12:28	39.0	11:13	38.7	9:13	38.4	11:57	38.2	11:58	38.0	12:12	38.5	9:40	38.0	12:12	37.9	11:22	37.8	14:27	37.8		
	AP-613-MW	TB-2A	40	UPPER	NA	57.8	14:10	57.8	13:55	57.8	12:27	57.8	11:15	57.7	9:15	57.7	11:55	57.7	11:57	57.6	12:10	57.6	9:48	57.6	12:10	57.6	11:20	57.6	14:25	57.6		
GROUP-3	AP-614-MW	TB-3A	100	LOWER	NA	11.0	14:00	12.9	13:40	11.8	14:56	12.8	12:20	13.8	10:30	10.4	11:50	11.7	11:25	9.4	12:30	9.4	8:58	10.4	11:45	10.1	10:45	10.2	14:00	14.1		
	AP-615-MW	TB-3B	75	UPPER	NA	40.3	13:55	34.0	13:37	34.5	14:54	31.9	12:22	31.0	10:32	30.5	11:45	30.6	11:20	30.5	12:32	30.6	9:06	30.6	11:42	30.6	10:42	30.7	13:57	30.8		
	AP-616-MW	TB-3C	40	UPPER	NA	56.8	13:50	56.9	13:35	56.9	14:51	56.8	12:25	56.8	10:35	56.8	11:40	56.8	11:18	56.7	12:35	56.7	8:50	56.6	11:40	56.8	10:40	56.8	13:55	56.8		
GROUP-4	AP-617-MW	TB-4A	100	LOWER	NA	14.2	13:15	12.9	13:28	8.5	15:27	15.8	12:50	10.3	11:33	7.4	11:00	13.0	11:15	6.0	11:40	6.3	9:56	6.0	11:35	4.6	10:30	4.8	13:50	15.6		
	AP-618-MW	TB-4B	70	UPPER	NA	54.9	13:10	54.8	13:25	54.6	15:25	54.3	12:55	53.9	11:35	54.1	10:55	53.8	11:10	53.8	11:38	53.6	9:58	53.5	11:32	53.4	10:27	53.6	13:47	53.1		
	AP-619-MW	TB-4C	40	UPPER	NA	63.3	13:05	63.2	13:20	63.1	15:24	63.0	13:00	62.9	11:40	62.9	10:50	62.9	11:05	62.9	11:35	62.8	10:01	62.8	11:30	62.9	10:25	62.8	13:45	62.9		
SINGLE WELLS	AP-620-MW	TB-02	40	UPPER	NA	63.9	14:25	63.9	13:50	63.7	14:37	63.6	12:09	63.5	9:20	63.4	12:05	63.4	11:55	63.3	12:05	63.2	9:18	63.2	12:05	63.2	11:15	63.1	14:20	63.3		
	AP-621-MW	TB-03	40	UPPER	NA	71.0	12:10	70.7	13:00	70.5	15:06	70.2	12:34	70.1	10:40	70.0	10:35	69.9	10:50	69.9	11:15	69.9	10:10	69.8	11:05	70.0	10:05	69.9	13:25	70.0		
	MW-1 ^b	NA	25	UPPER	NA	69.0	12:25	69.1	13:10	68.9	15:17	68.7	12:38	68.6	10:55	68.6	10:45	68.5	10:58	68.4	11:25	68.3	10:22	68.3	11:20	68.4	10:15	68.3	13:35	68.4		
	MW-2 ^b	NA	25	UPPER	NA	72.0	12:20	71.7	13:05	71.5	15:11	71.3	12:40	71.2	10:51	71.1	10:40	71.0	10:55	70.9	11:20	70.9	10:15	70.8	11:15	71.0	10:10	71.0	13:30	71.1		
	MW-3 ^b	NA	30	UPPER	NA	67.0	12:00	66.8	12:50	66.6	15:20	66.5	12:45	66.4	11:30	66.3	10:30	66.3	11:00	66.2	11:30	66.2	10:06	66.2	11:25	66.2	10:20	66.2	13:40	66.3		
	AP-604 ^c	TB-1	101.5	UPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10:25	29.5	13:00	27.5	1145	27.4	11:45	27.4	11:25	27.5	11:55	27.3	11:00	27.6	14:10	27.3
	AP-605 ^c	TB-2	38.5	UPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10:15	29.8	13:05	29.8	1140	29.9	11:50	29.9	11:16	29.9	12:00	29.8	11:10	29.8	14:15	29.8
	AP-606 ^{c,d}	TB-3	101	UPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
	AP-607 ^{c,e}	TB-4	101.5	UPPER	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10:00	30.0	12:51	27.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Key:

a - The groundwater elevations shown are in feet above mean sea level.

b - MW-1 through MW-3 were installed by American Environmental, and have not been assigned an AP number.

c - AP-604 through AP-607 were installed by the USACE and were not scheduled for a complete 12 month reading cycle.

d - AP-606 was unable to be located.

e - Tooling became jammed in AP-607 and was not operable after Reading No. 6.

FIGURE C-02
GROUP ONE-GROUNDWATER ELEVATION TRENDS
KENAI RIVER BLUFF EROSION

GROUP-1

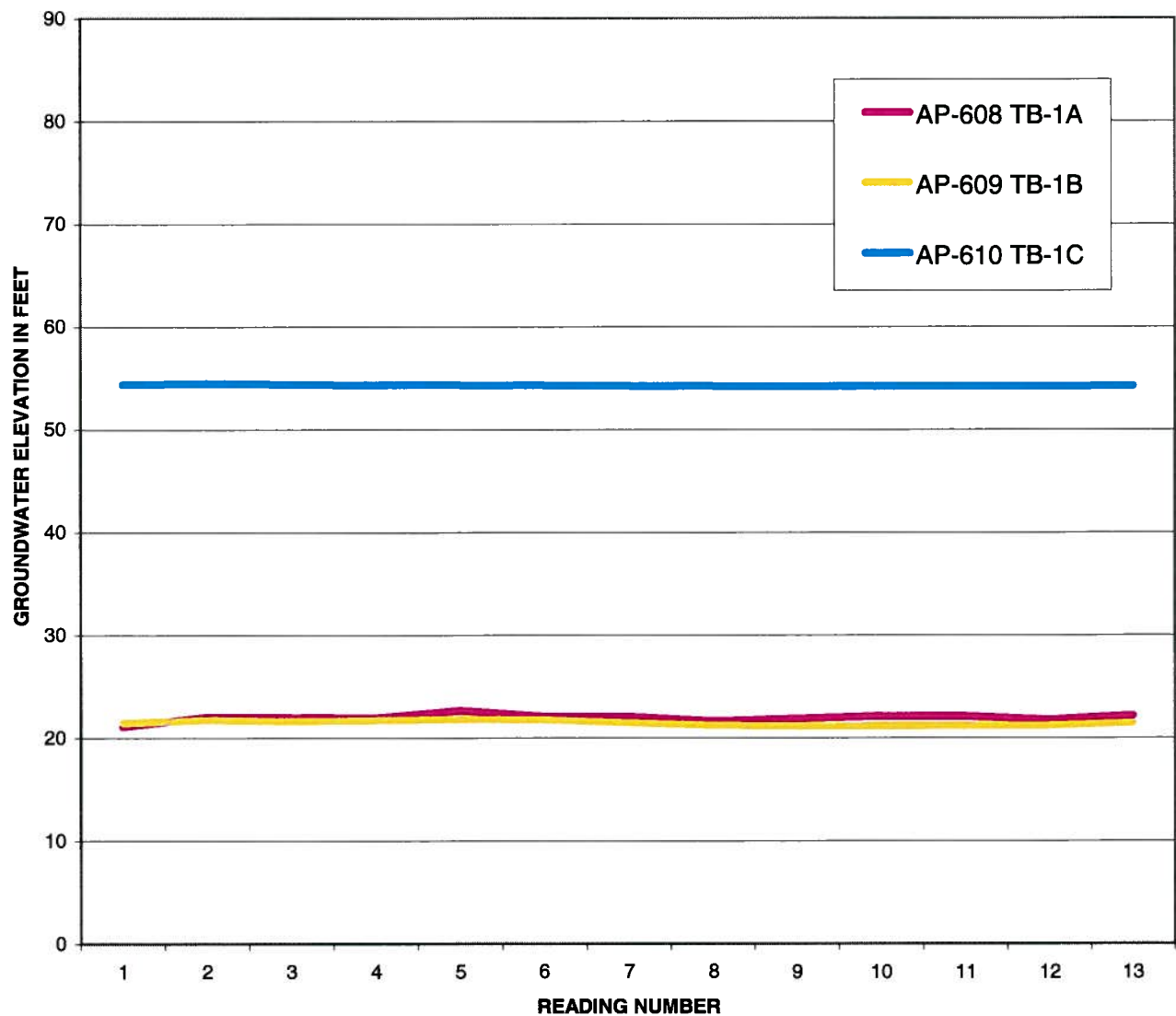


FIGURE C-03
GROUP TWO-GROUNDWATER ELEVATION TRENDS
KENAI RIVER BLUFF EROSION

GROUP-2

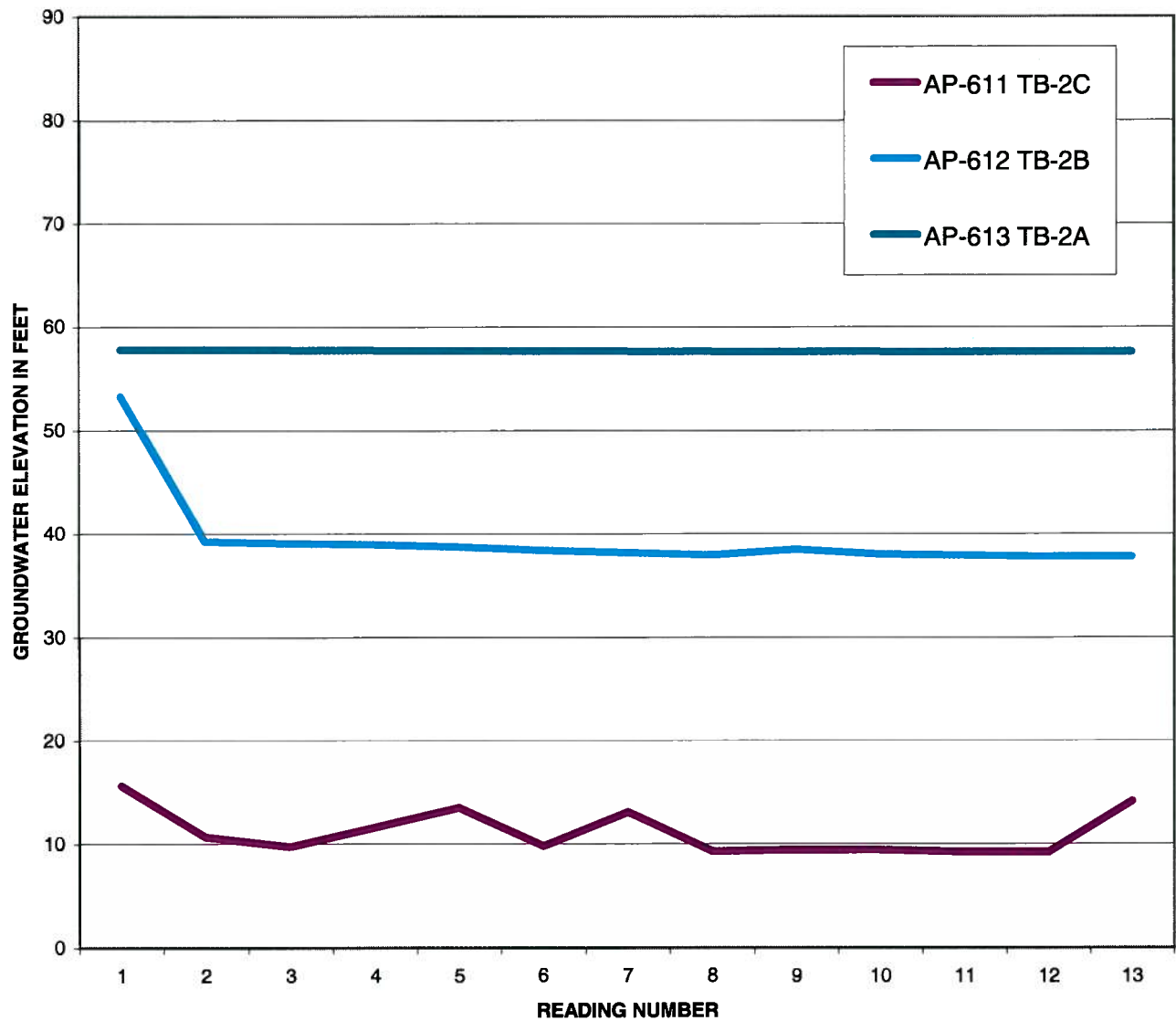


FIGURE C-04
GROUP THREE-GROUNDWATER ELEVATION TRENDS
KENAI RIVER BLUFF EROSION

GROUP-3

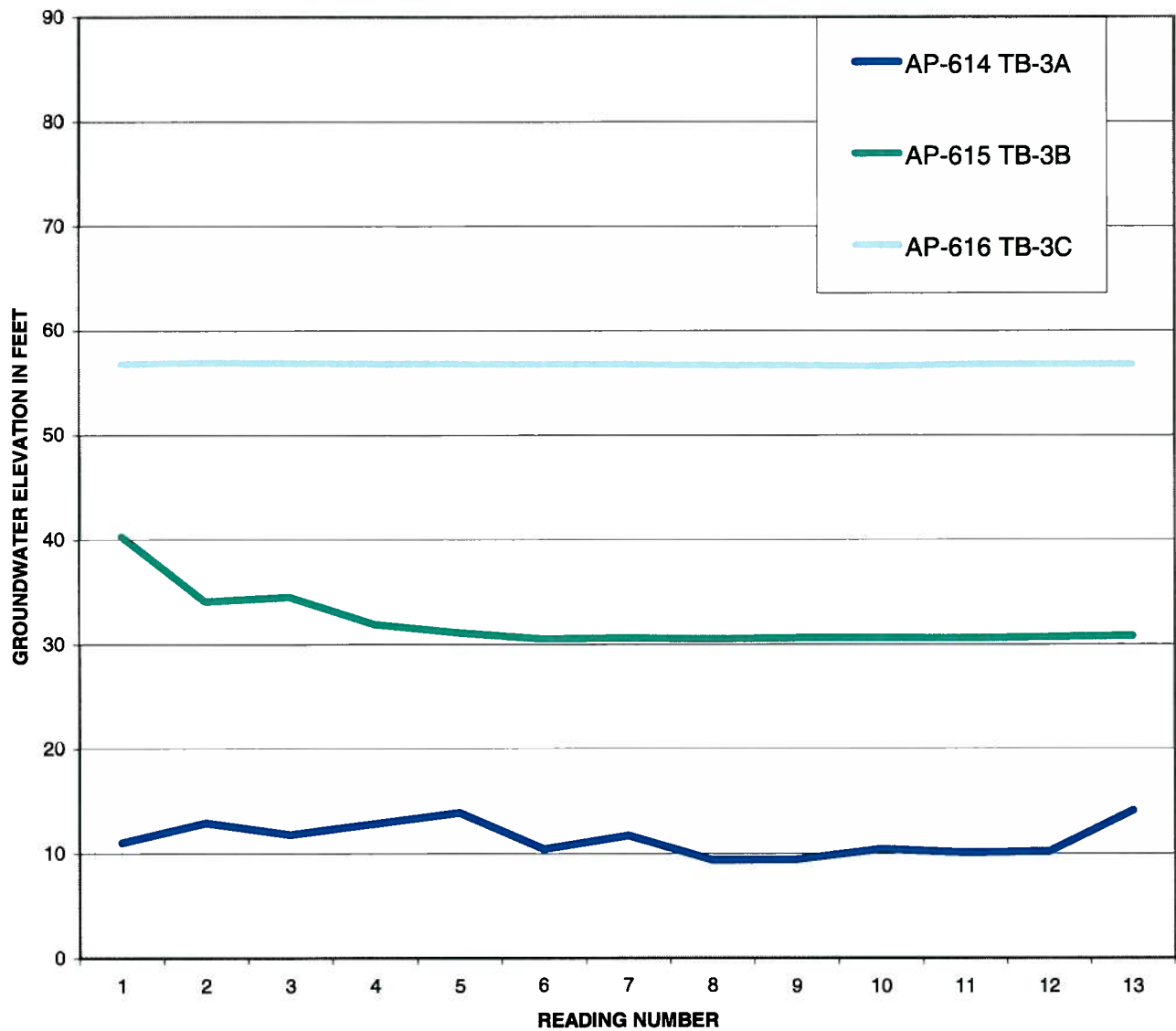


FIGURE C-05
GROUP FOUR-GROUNDWATER ELEVATIONS TRENDS
KENAI RIVER BLUFF EROSION

GROUP-4

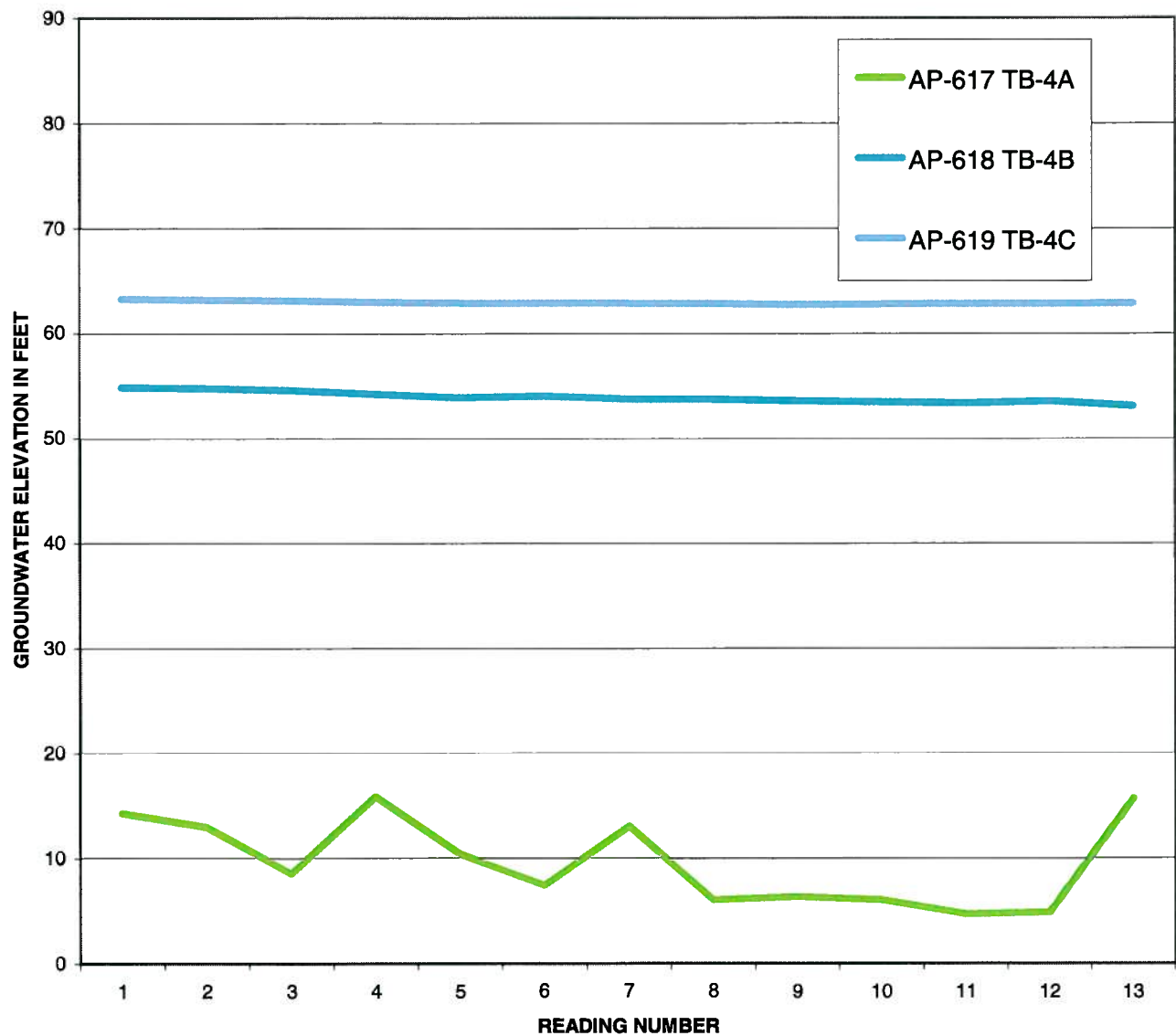


FIGURE C-06
SINGLE WELLS-GROUNDWATER ELEVATION TRENDS
KENAI RIVER BLUFF EROSION

SINGLE WELLS

