GEOTECHNICAL REPORT

For

Fire Station 6-2 Facility
Wasilla, Alaska

Prepared By:
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Reviewed By:
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November 23, 2016

GEOTECHNICAL REPORT

For

Fire House 6-2 Facility

Wasilla, Alaska

Prepared for:

Matanuska Susitna Borough

HDL Project Number 16-115

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AELS831

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WASILLA, ALASKA

1.0 INTRODUCTION

This report presents the results of subsurface explorations and laboratory testing for the proposed expansion at the existing Matanuska-Susitna Borough (MSB) Fire Station 6-2 facility at 4568 South Knik Goose Bay Road near Wasilla, Alaska (Site). Included in this report is a description of the project, description and results of the subsurface explorations and laboratory testing, and geotechnical recommendations for the proposed buildings and driveways.

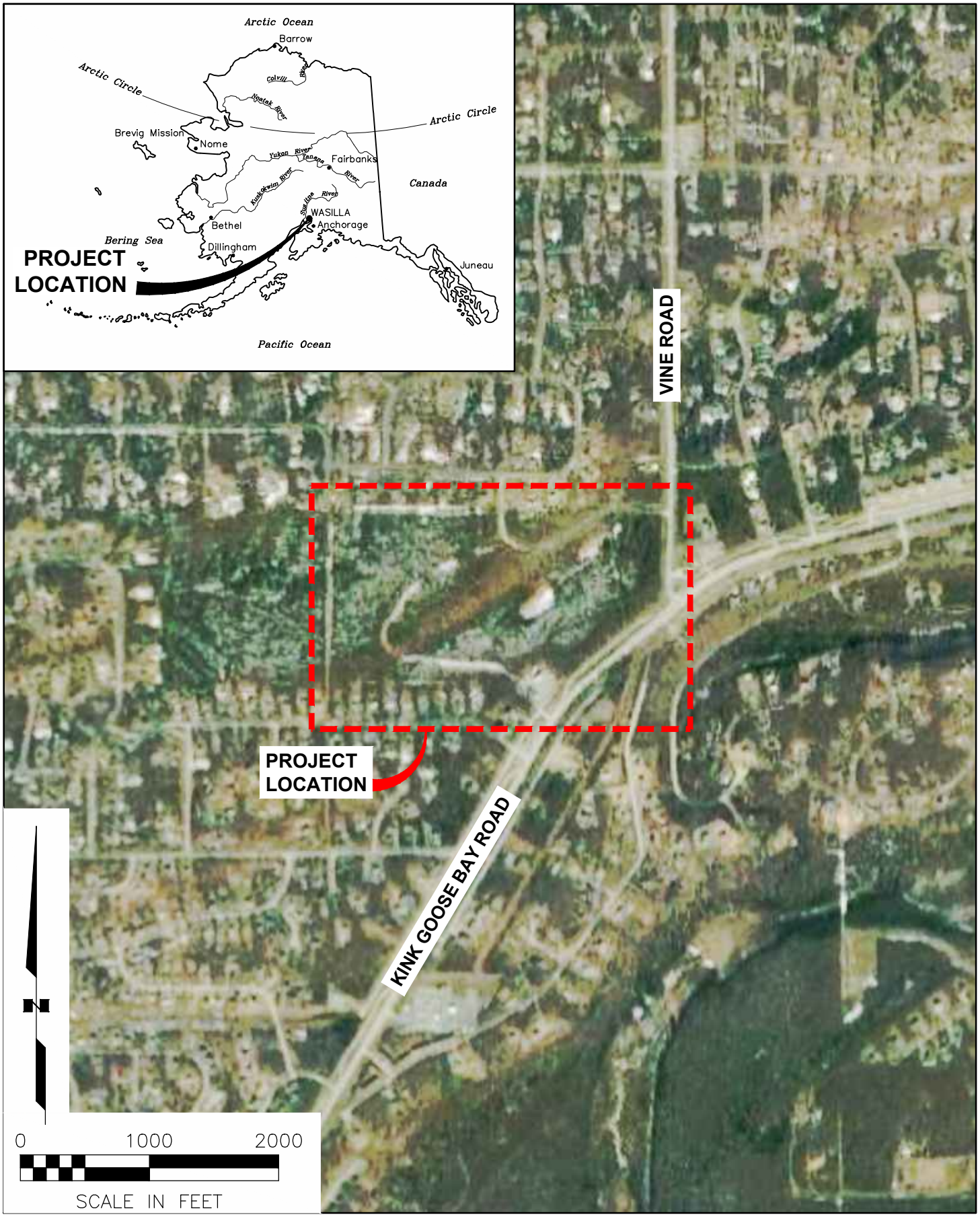
The purpose of the subsurface exploration and laboratory tests were to evaluate the soil and groundwater conditions. Soil samples were recovered from the borings and classified in the field by an experienced engineering assistant with HDL Engineering Consultants, LLC (HDL), and returned to our laboratory for testing. The subsurface evaluation was performed in general accordance with the procedures outlined in the Alaska Department of Transportation and Public Facilities (AKDOT&PF) "Alaska Geotechnical Procedures Manual" dated 2007.

2.0 SITE AND PROJECT DESCRIPTION

The site is a partially developed lot that includes some paved access roads, some cleared areas, and some wooded areas near the existing Fire Station 6-2. The approximate location of the proposed expansion is shown on the Vicinity Map provided as Figure 1. Based on the information provided by the MSB, the project consists of constructing multiple buildings, driveways, parking areas, a training tower, a well house, and a septic system.

The details of the proposed project have not been provided at the time of this report. For the purposes of this report, HDL has assumed that all structures will be supported by shallow, spread footing foundations and will be heated.

The project and subsurface descriptions presented herein are based on our current understanding of the project as of the date of this document. Modifications to the proposed expansion may require further evaluation of the subsurface conditions.



H:\jobs\16-115 KGB Fire Station 6-2 (MSB)\CAD\DRAWINGS\16-115_00_FIG-1-VINICTY, 1=1, 11-23-16 at 08:24 by jkk
LAYOUT: vicinity

MATANUSKA - SUSITNA BOROUGH
WASILLA, AK

Figure 1
VICINITY MAP
FIRE STATION 6-2 FACILITY
WASILLA, AK

3.0 SITE CONDITIONS

The following sections describe the general geology and climate of the region.

3.1 General Geology

The project area is located within the Cook Inlet-Susitna Lowland Section of the Coastal Trough physiographic province of Alaska. The Talkeetna Mountains border the province on the northeast, the Alaska Range lies to the north and west and the Cook Inlet lies to the south. Glacial features including ground moraines, drumlins, eskers, and outwash plains characterize the entire Cook Inlet-Susitna Lowlands. Kame and kettle topography, indicative of glacial outwash plains, is common and forms many of the hills and small rounded lakes that exist in the project area. Five major glacial advances of the Quaternary Period can be recognized throughout the vicinity ending approximately 12,000 years ago.

Soils in the area are typically glacial derived sands and gravels with varying fines content. Peat bogs have developed in many of the low-lying areas subsequent to the last glaciations. As the glaciers receded towards the mountains, the Susitna and Knik River drainages were established, as well as others in the project area. These drainages deposited sands and gravels in channel areas and fine grain sediment in floodplains.

3.2 Climatology

The project area is located in a transitional climatic zone varying between continental and maritime climates. The zone is characterized by pronounced diurnal and annual temperature variations, moderate annual precipitation, and moderate surface winds[1]. Climatology data presented in this report was collected in Willow by the Alaska Climate Research Center. The average January temperatures in the area range between -1.3°F and 15.6°F, while average July temperatures range between 51.4°F and 68.3°F. The mean annual temperature in the area is 32.9°F with an average of 26.4 inches of precipitation per year.

4.0 FIELD EXPLORATIONS

HDL observed the drilling of five (5) soil borings, designated B-01 through B-05, and attempted two (2) percolation tests on November 2, 2016 and November 3, 2016. The soil borings were drilled in the locations specified by the MSB. The percolation tests were performed near borings B-04 and B-05. Soil samples were collected the borings to evaluate the soils encountered. The borings were drilled to depths ranging from 16.5 feet to 26.5 feet below existing ground surface (bgs). The percolation tests were performed at depths of approximately 4 feet bgs. Borings were located using tape measurements from known features. Refer to Figure 2, Boring Location Map for the approximate location of the soil borings.

The soil borings were drilled by Geotek Alaska, Inc., of Anchorage, Alaska, working as a subcontractor to HDL. The borings were advanced using a track mounted Geoprobe® 6620DT

[1] Shulski, Martha, and Gerd Wendler. *The Climate of Alaska*. Fairbanks, AK: University of Alaska, 2007. Print.

H:\jobs\16-115 KGB Fire Station 6-2 (MSB)\CAD\DRAWINGS\16-115_00_fig-2-site, 1=1, 11-23-16 at 08:31 by jkk
LAYOUT: FIRE STA 6-2

MATANUSKA - SUSITNA BOROUGH
WASILLA, AK

Figure 2
BORING LOCATION MAP
FIRE STATION 6-2 FACILITY
WASILLA, AK

drill rig with 3¼" inside diameter (I.D.) hollow stem augers and a 3.0-inch outside diameter (O.D.) split-spoon sampler. Split-spoon sampling was conducted in accordance with the Standard Penetration Test (SPT) Procedure. Split-spoons were advanced into the bottom of the boring with blows from a 340-pound hammer free-falling 30 inches onto the drill rod in borings. The number of blows required to advance the sampler the last 12 inches of an 18-inch sample is termed the Penetration Resistance, designated as the "N-value", and was recorded for each sample depth. The values give a measure of the relative density (compactness) or consistency (stiffness) of unfrozen cohesionless and cohesive soils, respectively.

An experienced HDL engineering assistant was present during field explorations to locate the borings, collect samples, log subsurface conditions, perform percolation tests, and observe groundwater depths where encountered. Recovered soils were described in the field in general accordance with ASTM International Standard (ASTM) D2488. Samples were collected and delivered to HDL's laboratory for further testing.

Based on the laboratory test results, soil descriptions were confirmed or modified according to the Unified Soil Classification System (USCS), as summarized on Figure A1. As appropriate, samples were given a frost design classification in accordance with a modified United States Army Corps of Engineers (USACE) system as presented as Figure A2, Frost Design Soil Classification. The boring logs are included in Appendix A.

5.0 LABORATORY TESTING

Laboratory testing of the soil samples was conducted at HDL's American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL) accredited and USACE validated laboratory. Select laboratory tests were performed on samples recovered from the borings to confirm and/or modify field classifications and evaluate the properties of the soil.

Twenty three (23) moisture content tests were performed in accordance with ASTM D2216. Five (5) P_{200} tests, which quantifies the amount of material finer than the #200 sieve, were performed in accordance with ASTM D1140, and four (4) grain size distribution tests were performed in accordance with ASTM D422. The results of the laboratory tests are depicted on the boring logs in Appendix A.

6.0 SUBSURFACE CONDITIONS

Borings were drilled to evaluate the site subsurface soil and groundwater conditions. Boring B-01 was performed near the proposed well house/controls building. Borings B-02 and B-03 were performed near the proposed training center and fire station, respectively. Boring B-04 was performed near the center of the proposed parking area and boring B-05 was performed near the proposed training tower.

In general, vegetation and organic topsoil were encountered at the ground surface. Boring B-02 was performed in an existing parking area and encountered asphalt and a gravel base course at

the surface. Granular material, consisting of sand, gravel, and cobbles with varying amounts of silt, was encountered beneath the organic topsoil and continued to depth. The subsurface conditions are summarized below, and detailed information may be found on the boring logs in Appendix A.

6.1 Topsoil

Organic topsoil was encountered at the surface in four (4) of the five (5) borings. The organic topsoil ranged from 3 inches to 7 inches in thickness, with the thickest layer encountered at B-05.

6.2 Granular Material

Granular material consisting primarily of sand and gravel with varying amounts of cobbles and fines was encountered beneath the layer of topsoil and was present to the depth explored. N-values ranged from 5 to refusal within the granular layer, generally indicating loose to very dense soils. The majority of the granular material encountered was observed to be dense to very dense.

The moisture contents of the granular soil ranged from 2.2% to 21.0%. The fines content of the cobbles varied from 20.3% to 39.0%, indicating moderately frost susceptible (F3) material.

6.3 Groundwater

The borings and test pits did not encounter groundwater during the subsurface evaluation. Groundwater levels at the site will fluctuate depending on the season, temperature, and precipitation. Groundwater levels during construction may be higher than those observed.

6.4 Percolation Tests

Percolation testing was performed in a 4-inch diameter standpipe located 15 feet east of B-05. The standpipe was placed approximately 4 feet bgs in thawed soils and percolation testing was performed on November 3, 2016. The measured percolation rate was approximately 19 minutes/inch. A second percolation test was attempted near B-04 but the soils at the base of the standpipe frozen overnight and the test could not be conducted.

7.0 ENGINEERING ANALYSIS & RECOMMENDATIONS

Design of any structure's foundation must consider the bearing support capabilities of the supporting soils as well as the expected settlements and effects of seasonal frost action. A summary of the geotechnical considerations and recommendations are provided below.

7.1 Site Work

The following sections provide a summary of geotechnical considerations for the site development.

7.1.1 Site Preparation

Topsoil should be stripped prior to construction. Stripped surface soils should not be utilized for structural fill, but may be used as topsoil in areas to be seeded.

Sands encountered onsite are expected to be moderate to highly frost susceptible (F3), some seasonal movement due to frost action would be expected if the sands are left in place and subject to freeze/thaw cycles. If soft or unstable soils or other deleterious materials are encountered during construction, the materials should be removed and replaced with compacted structural fill. We recommend that the exposed subgrade soils be proof-rolled to provide a level, firm, uniform surface prior to the placement of fill. An experienced geotechnical engineer should observe the exposed subgrade conditions and the compacted structural fill.

7.1.2 Structural Fill and Compaction

Structural fill placed to grade the site or backfill areas of over-excavation should be granular and consist of well graded mixture of clean sands and gravels to provide drainage and frost protection. Structural Fill placed within the footprint of the building should consist of 24 inches of non-frost susceptible soils (NFS), followed by 24 inches of low frost susceptible soils (F1). Structural fill placed within the parking area and driveway areas should consist of 24 inches of low frost susceptible soils (F1). The on-site soils beneath the organic layer do not meet the requirement for non-frost susceptible (NFS) or low frost susceptible soils (F1).

Structural fills should be placed in lifts not to exceed 10 to 12 inches loose thickness, and compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate. During fill placement, we also recommend that large cobbles or boulders with dimensions in excess of 2/3 the lift thickness be removed.

The bottom of all footing excavations should be compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.1.3 Paved Driveways and Parking Areas

Based on our understanding of the project, the driving surface of the proposed improvements, which includes the proposed driveways and parking area, will be paved with asphalt. Typically, a minimum of 2 inches of asphalt pavement is used but thicker pavement may be needed if heavy loads are anticipated. The pavement should underlain by a minimum of six (6) inches of base course over a minimum of 24 inches of Structural Fill. The base course material should meet the Alaska Department of Transportation & Public Facilities Standard Specifications requirements for Aggregate Base Course, Gradation D-1. Gradation requirements are detailed in Table 1, Aggregate Material Specifications.

The base course should be compacted to a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction procedure (ASTM D1557) or vibratory table (ASTM D4253) as appropriate.

7.2 Seismic Analysis

The site characterization criteria found in the 2009 International Building Code (Code) should be used for design. The seismic design criteria are found in Chapter 16, Section 1613 of the Code. The Code requires that the site characterization be determined by soil and rock parameters. Based on the subsurface conditions encountered, we recommend the site be considered Seismic Site Class "D". The maximum considered earthquake ground motion spectral response accelerations for short period and for one-second peaks were calculated utilizing the United States Geological Survey's (USGS's) Earthquake Hazards Program; results of which are summarized in the table below.

Table 1 – Seismic Design Criteria

IBC 2009 Seismic Design Criteria	Value
Spectral Response at Short Periods, S_S	1.463
Spectral Response at 1-Second Period, S_1	0.543
Site Class	D
Site Coefficient F_a	1.000
Site Coefficient F_v	1.500
Site Adjusted Spectral Response at Short Periods, S_{MS}	1.463
Site Adjusted Spectral Response at 1-second Periods, S_{M1}	0.814

7.3 Foundation Analyses

Design of any structure's foundation must consider the bearing support capabilities of the supporting soils, the effects of seasonal frost action, and the expected total and differential settlements. The foundation system must also consider the risk of failure and the cost of construction.

Depending on the anticipated loads, the proposed structures can likely be supported by a shallow, spread footing foundation system. Foundations should be embedded to the appropriate depth for frost protection and be a minimum of 1.5 feet wide to avoid punching shear.

Unsuitable bearing soil at the foundation bearing grade, or within the foundation influence zone, as evaluated by the geotechnical engineer should be replaced with suitable, compacted structural fill.

Foundations should be constructed immediately after subgrade preparation to protect the soil bearing surface. In addition, foundation excavations should be backfilled as soon as possible

after foundation construction. Excavations along foundation walls should be filled such that the fill at the interior and exterior sides of the walls are at about the same height for lateral pressure considerations whenever possible.

7.3.1 Allowable Bearing Pressures

HDL assumes the proposed buildings will be constructed on structural fill overlying in situ sand and gravel. If the soils beneath the proposed foundations are consistent with those encountered during the subsurface evaluation and are prepared as recommended, a typical allowable soil bearing capacity of 3,500 pounds per square foot (psf) could be used for design of foundations. The actual bearing capacity of the soils is a function of the depth and dimensions of the foundation and should be further evaluated once the proposed foundations are further understood.

7.3.2 Settlement

The total settlements that will develop are dependent upon the actual loads that are applied, the dimensions of the foundations, the density of the supporting soil, and the care with which structural fills are placed and compacted. For shallow foundations designed as recommended above, we estimate that total settlements of about ¾-inch will occur and that differential settlements will be about one-half the total. Due to the nature of the soils, we anticipate that these settlements will develop almost elastically as the load is applied if the subgrade is prepared in accordance with our recommendations.

7.4 Frost Susceptibility

Wasilla is in a region of mild to moderate freeze and thaw cycles. Soils throughout the project were found to be moderately frost susceptible (F3). The foundations must be designed to protect the underlying soil from frost. The depth of the foundations will depend on whether the structure will be heated and whether insulation will be used and should be evaluated once the proposed project is better understood.

7.5 Drainage and Dewatering

Groundwater was not encountered in the borings. HDL recommends the site be graded to promote positive drainage away from the structures and compaction of the near surface soils to reduce the permeability.

7.6 Excavations and Shoring

It is assumed that temporary excavations will be needed to support the foundation construction. We estimate that existing subsurface granular material will stand at an approximate relationship of 2-horizontal to 1-vertical on a temporary basis so long as they are protected from degradation from surface water and dessication. Shoring may be required if unstable soils are encountered. Additional loads from adjacent equipment, hydrostatic pressure, and structures must also be accounted for in the pressure distribution for shoring design.

Dewatering is not anticipated to be necessary based on groundwater conditions encountered during drilling. However, groundwater levels are variable and can fluctuate. The need for

dewatering will depend on the time of year for construction and the depth of the trench. Heavy precipitation may cause soils to become saturated and less stable. Surface water should be directed away from the excavations.

It is recommended that the trench side slopes, trench bottom conditions, and dewatering efforts be made the responsibility of the contractor as he is present on a day to day basis and can adjust his efforts to obtain the needed stability, trench conditions, and meet the applicable Alaska and Federal Occupational Safety and Health Administration (OSHA) safety regulations. Deviation from the OSHA stipulations requires the approval of a licensed Professional Geotechnical Engineer.

8.0 CLOSURE AND LIMITATIONS

The analysis and conclusions included in this report are based on site conditions as they exist in the borings observed by HDL. The analysis and conclusions assume that the exploratory borings are representative of the subsurface conditions throughout the site, that is, that the subsurface conditions everywhere are not significantly different from those disclosed in the borings. If, during construction, subsurface conditions are different from those encountered, advise us at once so we can review these conditions.

If substantial time has elapsed between submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of the conclusions considering the time lapse or changed conditions.

Unanticipated soil conditions are commonly encountered and cannot be fully determined by merely taking soil samples or advancing borings. Such unexpected conditions frequently require additional expenditure to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

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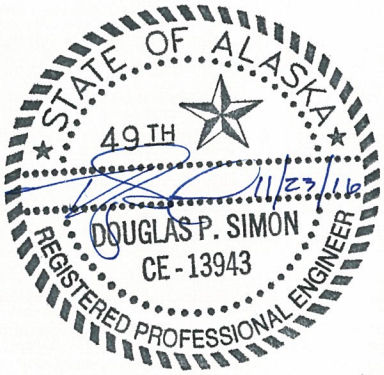
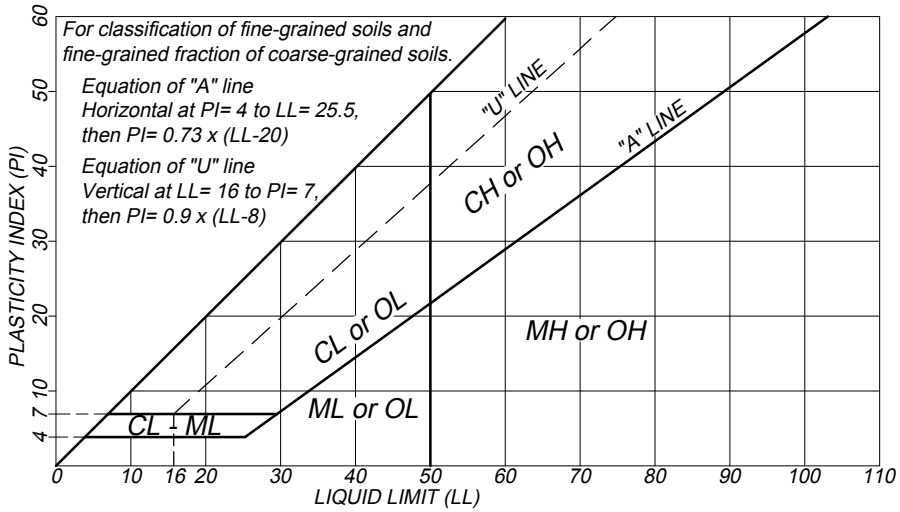


APPENDIX A

Figure A1	Unified Soil Classification System
Figure A2	Frost Design Soil Classification
Figure A3-A7	Boring Logs
Figures A8	Grain Size Distribution Curves

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Names			Soil Classification Generalized Group Descriptions	
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS Less than 5% fines	GW	Well-graded Gravels
			GP	Poorly-graded Gravels
		GRAVELS with fines More than 12% fines	GM	Gravel & Silt Mixtures
			GC	Gravel & Clay Mixtures
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS Less than 5% fines	SW	Well-graded Sands
			SP	Poorly Graded Sands
		SANDS with FINES More than 12% fines	SM	Sand & Silt Mixtures
			SC	Sand & Clay Mixtures
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid limit 50% or less	INORGANIC	ML	Non-plastic & Low Plasticity Silts
			CL	Low-plasticity Clays
		ORGANIC	OL	Non-plastic and Low Plasticity Organic Clays Non-plastic and Low Plasticity Organic Silts
	SILTS AND CLAYS Liquid limit greater than 50%	INORGANIC	CH	High-plasticity Clays
			MH	High-plasticity Silts
		ORGANIC	OH	High plasticity Organic Clays High Plasticity Organic Silts
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT	Peat



MATANUSKA - SUSITNA BOROUGH
WASILLA, AK

Figure A1
UNIFIED SOIL CLASSIFICATION SYSTEM
FIRE STATION 6-2 FACILITY
WASILLA, AK

FROST DESIGN SOIL CLASSIFICATION
(Modeled after U.S. Army Corps of Engineers Standards)

GROUP	KIND OF SOIL	P200	TYPICAL SOILS
NFS	Sand or Gravel	0 to 6	SW, SP GW, GP
F1	Gravelly Soils	6 to 10	GM, GW-GM, GP-GM
F2	Gravelly Soils Sands	10-20 6-15	GM, GW-GM, GP-GM SW, SP, SM, SW-SM, SP-SM
F3	Gravelly Soils Sands, except very fine silty sands Clays PI > 12	Over 20 Over 15	GM, GC SM, SC CL, CH CL, CH
F4	All Silts Very fine silty sands Clays, PI < 12 Varved clays and other fine-grained, banded sediments	Over 15	ML, MH SM CL, CL-ML CL and ML CL, ML, and SM; CL, CH, and ML; CL, CH, ML, and SM

P200 = percent passing the number 200 sieve

MATANUSKA - SUSITNA BOROUGH
WASILLA, AK

Figure A2
FROST DESIGN SOIL CLASSIFICATION
FIRE STATION 6-2 FACILITY
WASILLA, AK

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # B-01

PROJECT NUMBER : *16-115*
PROJECT : *Fire Station 6-2 Facility*
CLIENT : *Matanuska Susitna Borough*

Station / Location:
Lat/Long:
Elevation:

Equipment Type: *Geoprobe 6620DT*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek Alaska*

Total Depth: *23.0 feet*
Date: *11/3/2016*
Geologist: *W.Pence*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0								Organics — 0.0
0.3								Poorly-graded SAND, fine to coarse; with gravel, fine to coarse; some silt; brown, moist, dense to very dense, F3
3	SS	S1	7 18 19		37			
5	SS	S2	5 29 50					S2 Spoon Refusal: 50/5", P200 =24.7%, Sa =40.3%, Gr =35.0%, Moisture =6.2%
7.5								Poorly-graded SAND, fine to medium; some silt; little gravel, fine; brown, moist, very dense
8	SS	S3	15 35 38		73			S3 Moisture =6.8%
10	SS	S4	14 50					S4 Spoon Refusal: 50/3", Moisture =6.8%
15	SS	S5	8 44 50					S5 Spoon Refusal: 50/5", Moisture =6.4%
20	SS	S6	26 50					Poorly-graded SAND, fine to medium; some gravel, fine to coarse; some silt; brown, moist, very dense — 20.0
								S6 Spoon Refusal: 50/4", Moisture =4.5%
23							BOH 23	23.0

Notes:
Auger refusal at 23 feet bgs. No Free groundwater encountered.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 1

A USCS LOG OF TEST HOLE 16-115_BORING LOGS_VP.GPJ HDL MODIFIED.GDT 11/23/16

Figure A3

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # B-02

PROJECT NUMBER : *16-115*
PROJECT : *Fire Station 6-2 Facility*
CLIENT : *Matanuska Susitna Borough*

Station / Location:
Lat/Long:
Elevation:

Equipment Type: *Geoprobe 6620DT*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek Alaska*

Total Depth: *26.5 feet*
Date: *11/2/2016*
Geologist: *D. Simon*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0								Asphalt — 0.0
1	SS	S1	5 45					0.3 Poorly-graded SAND, coarse; with gravel, fine; trace silt; brown, moist, very dense S1 Spoon Refusal: 45/0", Moisture =2.2%
2								
3	SS	S2	40					S2 Spoon Refusal: 40/1", No Recovery. Description based on cuttings.
4								
5	SS	S3	40					5.0 Poorly-graded GRAVEL, coarse; with sand, medium to coarse; trace silt; brown, moist, very dense S3 Spoon Refusal: 40/0", No Recovery. Description based on cuttings.
6								
7								7.5
8	SS	S4	10 50					Poorly-graded SAND, fine to coarse; with gravel, fine to coarse; trace silt; brown, moist, very dense, F3 S4 Spoon Refusal: 50/3", P200 =21.6%, Sa =41.4%, Gr =37.0%, Moisture =10.0%
9								
10								10.0
11	SS	S5	45 10 5		15			Poorly-graded SAND, fine to medium; with silt, little gravel, fine; brown, moist, medium dense to very dense, F3 S5 Moisture =8.2%
12								
13								
14								
15	SS	S6	1 18 37		55			S6 P200 =36.2%, Moisture =7.5%
16								
17								
18								
19								
20	SS	S7	9 16 50					20.0 SILT, with sand, fine to medium; little gravel, fine; brown, moist, dense to very dense S7 Spoon Refusal: 50/5", Moisture =6.0%
21								
22								
23								
24								
25	SS	S8	27 18 17		35			S8 Moisture =7.8%
26								26.5
							BOH 26.5	Notes: No free groundwater encountered.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 1

A USCS LOG OF TEST HOLE 16-115_BORING LOGS_VP.GPJ HDL MODIFIED.GDT 11/23/16

Figure A4

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # B-03

PROJECT NUMBER : *16-115*
PROJECT : *Fire Station 6-2 Facility*
CLIENT : *Matanuska Susitna Borough*

Station / Location:
Lat/Long:
Elevation:

Equipment Type: *Geoprobe 6620DT*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek Alaska*

Total Depth: *26.5 feet*
Date: *11/2/2016*
Geologist: *W.Pence*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0								Organics — 0.0
1								Poorly-graded SAND, fine to medium; with silt; trace gravel, fine; brown, moist, loose to very dense, F3 — 0.3
2								
3	SS	S1	1 1 4		5			S1 P200 =34.7%, Moisture =21.0%
4								
5			5					
6	SS	S2	14 26		40			S2 Moisture =9.8%
7								
8	SS	S3	40					S3 Spoon Refusal: 54/1", Moisture =10.8%
9								
10	SS	S4	50					S4 Spoon Refusal: 40/1"
11								
12								
13								
14								
15	SS	S5	52 50					Poorly-graded SAND, fine to coarse; with silt; some gravel, fine to coarse; grey, moist, very dense, F3 — 15.0
16								S5 Spoon Refusal: 50/6", P200 =39.0%, Sa =45.0%, Gr =16.0%, Moisture =9.1%
17								
18								
19								
20	SS	S6	50					Poorly-graded SAND, fine to coarse; little gravel, fine; brown, moist, very dense — 20.0
21								S6 Spoon Refusal: 50/6", Moisture =3.6%
22								
23								
24								
25	SS	S7	22 54 31		85			Poorly-graded SAND, fine to coarse; some gravel, fine; grey, moist, very dense — 25.0
26								S7 Moisture =7.8%
							BOH 26.5	26.5

Notes:
No free groundwater encountered.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 1

A USCS LOG OF TEST HOLE 16-115_BORING LOGS_VP.GPJ HDL MODIFIED.GDT 11/23/16

Figure A5

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # B-04

PROJECT NUMBER : *16-115*
PROJECT : *Fire Station 6-2 Facility*
CLIENT : *Matanuska Susitna Borough*

Station / Location:
Lat/Long:
Elevation:

Equipment Type: *Geoprobe 6620DT*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek Alaska*

Total Depth: *16.5 feet*
Date: *11/2/2016*
Geologist: *W.Pence*

Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0								Organics — 0.0
1								Poorly-graded SAND, fine to coarse; with gravel, fine to coarse; little silt; brown, moist, dense to very dense, F3 — 0.3
2								
3	SS	S1	7 15 30		45			S1 P200 =20.3%, Moisture =6.9%
4								
5								
6	SS	S2	9 19 30		49			S2 P200 =28.9%, Moisture =7.2%
7								
8	SS	S3	5 26 36					S3 Spoon Refusal: 36/5", Moisture =7.2%
9								
10	SS	S4	32		10			Poorly-graded SAND, fine to coarse; with silt; some gravel, fine; brown/grey, moist, very dense — 10.0 S4 Split spoon sample terminated due to mechanical problems, Moisture =8.3%
11								
12								
13								
14								
15								
16	SS	S5	8 23 33		56			S5 Moisture =5.9%
							BOH 16.5	16.5

Notes:
No free groundwater encountered.

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 1

A USCS LOG OF TEST HOLE 16-115_BORING LOGS_VP.GPJ HDL MODIFIED.GDT 11/23/16

Figure A6

HDL ENGINEERING Consultants

LOG OF BORING

HOLE # B-05

PROJECT NUMBER : *16-115*
PROJECT : *Fire Station 6-2 Facility*
CLIENT : *Matanuska Susitna Borough*

Station / Location:
Lat/Long:
Elevation:

Equipment Type: *Geoprobe 6620DT*
Drilling Method: *Hollow-Stem Auger*
Field Crew: *Geotek Alaska*

Total Depth: *24.5 feet*
Date: *11/3/2016*
Geologist: *W.Pence*

Ground Water Data		
Depth in (ft.)		
Time		
Date		
Symbol		

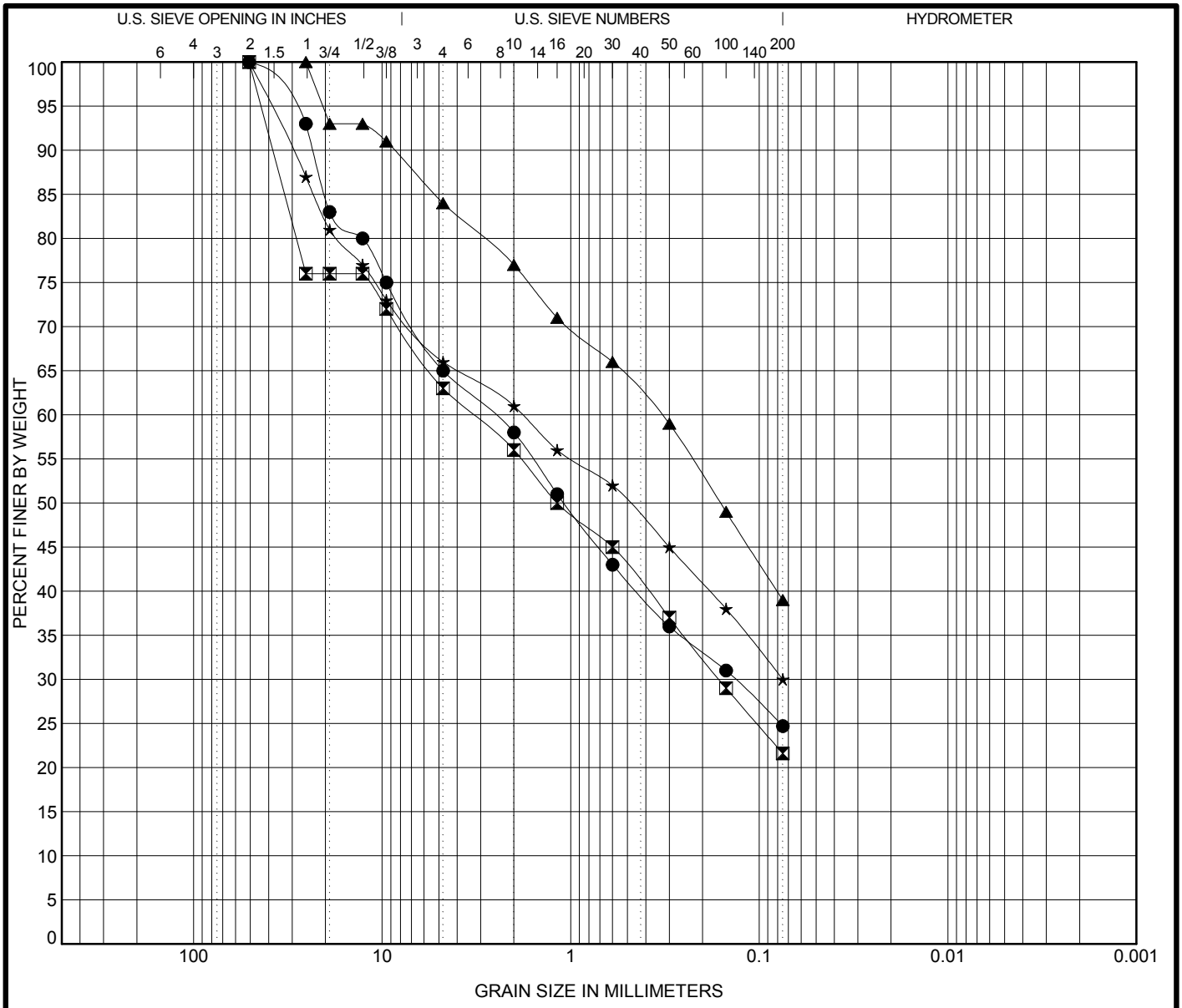
Depth (Feet)	Sample Type	Number	Blow Count	Sample Recovery	N-Value	USCS Classification Frozen Zone	Soil Graphic	SUBSURFACE MATERIAL
0								Organics — 0.0
1								Poorly-graded SAND, fine to coarse; some gravel, fine to coarse; trace silt; brown, moist, dense — 0.6
2								
3	SS	S1	5 19 28		47			S1 P200 =21.5%, Moisture =6.8%
4								
5								5.0
6	SS	S2	12 17 16		33			Poorly-graded SAND, fine to coarse; with silt; with gravel, fine; brown, moist, dense S2 P200 =30.0%, Sa =36.0%, Gr =34.0%, Moisture =6.6%
7								
8	SS	S3	35 50					7.5 Poorly-graded SAND, fine to medium; some silt; little gravel, fine; brow, moist, very dense S3 Sample Refusal: 50/2", Moisture =7.8%
9								
10	SS	S4	22 51					S4 Sample Refusal: 51/5", Moisture =5.1%
11								
12								
13								
14								
15	SS	S5	46 51					15.0 Poorly-graded SAND, fine to coarse; some silt; some gravel, fine to coarse; brown, moist, dense S5 Sample Refusal: 51/4", Moisture =4.7%
16								
17								
18								
19								
20	SS	S6	50					S6 Sample Refusal: 50/4", Moisture =6.2%
21								
22								
23								
24							BOH 24.5	24.5 Notes: Auger refusal at 24.5 feet bgs. No free gound water encoutered.

☒ Auto Hammer ☐ Cathead Rope Method ☐ 140 lb. hammer with 30 in. drop ☒ 340 lb. hammer with 30 in. drop

Sheet Number 1 of 1

A USCS LOG OF TEST HOLE 16-115_BORING LOGS_VP.GPJ HDL MODIFIED.GDT 11/23/16

Figure A7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-01	DEPTH 5.0						
⊠	B-02	DEPTH 7.5						
▲	B-03	DEPTH 15.0						
★	B-05	DEPTH 5.0						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	DEPTH 5.0	50.8	2.561	0.134		35.0	40.3	24.7	
⊠	B-02	DEPTH 7.5	50.8	3.279	0.164		37.0	41.4	21.6	
▲	B-03	DEPTH 15.0	25.4	0.331			16.0	45.0	39.0	
★	B-05	DEPTH 5.0	50.8	1.8	0.075		34.0	36.0	30.0	

HDL ENGINEERING Consultants
3335 Arctic Blvd Ste 100
Anchorage, AK 99503
Telephone: 907-564-2120
Fax: 907-564-2122

GRAIN SIZE DISTRIBUTION

Project: Fire Station 6-2 Facility

Client: Matanuska Susitna Borough

Project Number: 16-115

US GRAIN SIZE 16-115 BORING LOGS.GPJ HDL MODIFIED.GDT 11/22/16

Figure 8A

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STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER

WATER WELL LOG

Drilling Started: ___/___/_____ Completed: 11 /19 /1983

City/Borough:	Subdivision:	Block	Lot	Property Owner Name & Address:
Wasilla	SETTLER`S BAY 1	B3	L01	MATANUSKA-SUSITNA BOROUGH ,

Latitude _____ **Longitude** _____

Meridian S Township 017N Range 002W Section 27 , NE 1/4 of NW 1/4 of SE 1/4 of SE 1/4

BOREHOLE DATA: (from ground surface)

Suggest T.M. Hanna's hydrogeologic classification system *
https://info.ngwa.org/servicecenter/shopper/ProductDetail.cfm?ProdCompanyPassed=ngw&ProdCdPassed=ngw-t1030

	Depth From	Depth To

Drilling method: ☐ Air rotary, ☐ Cable tool, ☐ Other _____

Well use: ☐ Public supply, ☐ Domestic, ☐ Reinjection, ☐ Hydrofracking

Fluids used: _____

☐ Other _____

Depth of hole: 174 ft, Casing stickup: _____ ft

Casing type: _____ Thickness _____ inches

Casing diameter: _____ inches Casing depth _____ ft

Liner type: _____ Diameter: _____ inches Depth: _____ ft

Static water (from top of casing): _____ ft on ___/___/_____

Pumping level & yield: _____ feet after _____ hours at _____ gpm

Recovery rate: _____ gpm, Method of testing: _____

Development method: _____ Duration: _____

Well intake opening type: ☐ Open end, ☐ Open hole , ☐ Other

☐ Screened; Start: _____ ft, Stopped _____ ft

Screen type: _____ Slot/mesh size _____

☐ Perforated; Start: _____ ft, Stopped _____ ft

Start: _____ ft, Stopped _____ ft

Gravel packed ☐ Yes ☐ No From _____ ft , To _____ ft

Note: .....

Grout type: _____ Volume _____

Depth: From _____ ft, To _____ ft

Pump intake depth: _____ ft

Pump size _____ hp Brand name _____

Was well disinfected upon completion? ☐ Yes ☐ No

Method of disinfection: .....

Was water quality tested? ☐ Yes ☐ No

Water quality parameters tested: .....

.....

Well driller name: WAYNE E WESTBERG .....

Company name: M-W DRILLING .....

Mailing address: PO BOX 110378 .....

City: ANCHORAGE State: AK Zip 99511

Phone number : (907) 945 - 3287

Driller's signature: _____

Date: ___/___/_____

AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be forwarded to the Department of Natural Resources within 45 days of well completion. Please email well logs to:

dnr.water.reports@alaska.gov OR send to

Alaska DNR, MLW, Alaska Hydrologic Survey
550 West 7th Avenue, Suite 1020
Anchorage, AK 99501

Anchorage Municipal Code 15.55.060(I) requires that a copy of this well log be forwarded to the Development Services Department within 30 days of well completion.

City Permit Number: _____

Date of Issue: ___/___/_____

Parcel Identification Number: _____-_____-_____

Is well located at approved permit location? ☐ Yes ☐ No

* Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press

M-W DRILLING, Inc.
P.O. Box 10-378 • 10300 Old Seward Highway
(907) 349-8535
ANCHORAGE, ALASKA 99511

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DRILLING LOG

Well Owner MATANUSKA SUSITNA BOROUGH Use of Well Industrial/Public

Location (address of: Township, Range, Section, if known; or distance main road
Lot 1 Block 3 Setller's Bay #1

Size of casing 6" Depth of Hole 176 feet Cased to 158.94 feet

Static water level 132.75 ft. (~~above~~) (below) land surface. Finish of well (check one) open end ( ); Screen (XX); Perforated ( ).

Describe screen or perforation 0.100" slot Johnson Stainless Steel; 175-159.2'; 5" blank riser with K packer 159.2 - 153.6'

Well pumping test at 235 gallons per (~~hour~~) (minute) for 15.3 hours with 6.35 ft. of drawdown from static level.

Date of completion October 19, 1983

WELL LOG

Depth in feet from ground surface			Give details of formations penetrated, size of material, color and hardness
0	TO	2	Casing stickup
2	TO	85	Silty gravel
85	TO	109	Silty hardpan till
109	TO	137	Silty loose gravel
137	TO	150	Sandy gravel; damp, tan
150	TO	175	Water gravel; sandy, tan
175	TO	176	Hardpan
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		
	TO		

Wayne E. Watling

NWWA Certified Contractor
Certificate No's. 814 & 973

[redacted]

2 — STATE

SP 17-2-27 DDBA