MEMORANDUM

State of Alaska

Department of Transportation & Public Facilities
Northern Region Preconstruction

TO: Chris Johnston, P.E.
Engineering Manager
Northern Region

DATE: September 4, 2013

FILE NO: P:\working\Airports\ambler\airport\report\obstruction area memo.doc

THRU: Kevin Maxwell JSC for KFM
Regional Engineering Geologist
Northern Region

TELEPHONE NO: 458-6883

FAX NO: 451-2353

FROM Tim Weiss TW
Engineering Geologist
Northern Region

SUBJECT: **Ambler Airport Rehabilitation Geotechnical Investigation Addendum AKSAS 60262**

SUMMARY
This memorandum is based on the Northern Regions Material Section (NRMS) Geotechnical Report, "Ambler Airport Rehabilitation and Ambler Sewage Lagoon Road" Report dated June 2013, and at your request. This memo is an addendum to the above referenced report and provides additional geotechnical information pertaining to the planned terrain obstruction removal area of the Ambler Airport project.

As part of the Airport Rehabilitation project, the terrain obstruction area at the southwest corner of the main and crosswind runways is planned to be lowered in elevation to provide aircraft visibility between the two runways (Figure 1). The obstruction area is approximately 10 feet higher in elevation than the runways. It is planned to use the material from the lowering of the obstruction area as borrow material and placed at the main runway expansion area.

We estimate approximately 20 percent of the terrain obstruction area material could have high organic contents and/or natural moisture, additionally we estimate a soil shrinkage factor of approximately 10 to 25 percent after compaction and before excavation for the area.

GEOTECHNICAL INVESTIGATION AND SUBSURFACE FINDINGS
The terrain obstruction area has an undulating surface with spruce trees up to 6 inches in diameter and overall gradually slopes to the south and southwest. The geotechnical investigation was performed in February 2013, with seven test holes drilled in the area. The obstruction area was snow covered at the time of our investigation with up to 3 feet of snow and some drifting. A small trail was plowed to provide drill rig access. Two of the

seven test hole locations (TH13-049 and 13-011) were drilled slightly outside the approximate boundary. TH13-011 was mainly drilled to provide subsurface information at the toe of the crosswind runway, this test hole is not included. TH13-048 is located in a disturbed area and lower in elevation than areas to the north, this area could have disturbance related to a nearby weather station and antennas.

All test holes were drilled using a solid stem auger method, with 4.5-inch O.D. augers and samples collected from auger cuttings. These six test holes encountered the following subsurface conditions:

- 1 foot thick organic mat.
- Frozen material was encountered from the surface to 12 feet in depth. TH3-048 was frozen to the depth explored at 15 feet.
- Moisture contents in the frozen material ranged from 7.5 to 16.7 percent. Higher moisture contents were encountered in TH13-048 with 28.4 and 31.8 percent collected in silt material, and a highly organic layer from 2 to 5 feet in depth yielded a moisture content of 115.5 percent.
- Thawed material was encountered in all test holes except TH13-048, and from a consistent depth from 12 to 12.5 and continued to depths explored at 15 feet. Thawed material consisted of silt and fine silty sand.
- Organic contents in frozen material were slight and ranged from 0.2 to 1.1 percent. At TH13-048 the highly organic material encountered from 2 to 5 feet indicated 44.0 percent organics.
- Asbestos sample results ranged from less than 0.1 percent by weight and 12 asbestos structures to less than 0.1 percent by weight and zero asbestos structures.

Visible Ice was not encountered in any test holes in the terrain obstruction area to the depths explored. Frozen material encountered was classified as nonvisible bonded with no excess ice (Nbn), nonvisible bonded with excess ice (Nbe), and poorly bonded or friable (Nf).

EXPECTED PHYSICAL SITE CONDITIONS

- Expect frozen ground, either seasonally or perennially frozen within the terrain obstruction area at any time of the year.
- Expect perched groundwater on top of frozen layers.
- Expect pumping of silt soils at the bottom of excavations
- Expect ice-rich soils to be present in low areas.
- Expect organic soils in low areas.
- Expect difficulty handling moist or wet thawed silty soils.

COMMENTS AND RECOMMENDATIONS

Our investigation took place during the winter and surface conditions were not observed in the terrain obstruction area.

- Two different materials were encountered during drilling:
    1. A material with low drill resistance that was marginally frozen, poorly bonded and friable. The material was sandy in nature and probably

related to mapped surface dune deposits. This was generally associated with lower natural moistures and higher elevations.

2. A material with higher drilling resistance that was frozen and well bonded (TH13-048 only). This material was silty in nature, high moistures, high organics, and generally associated with lower elevations.

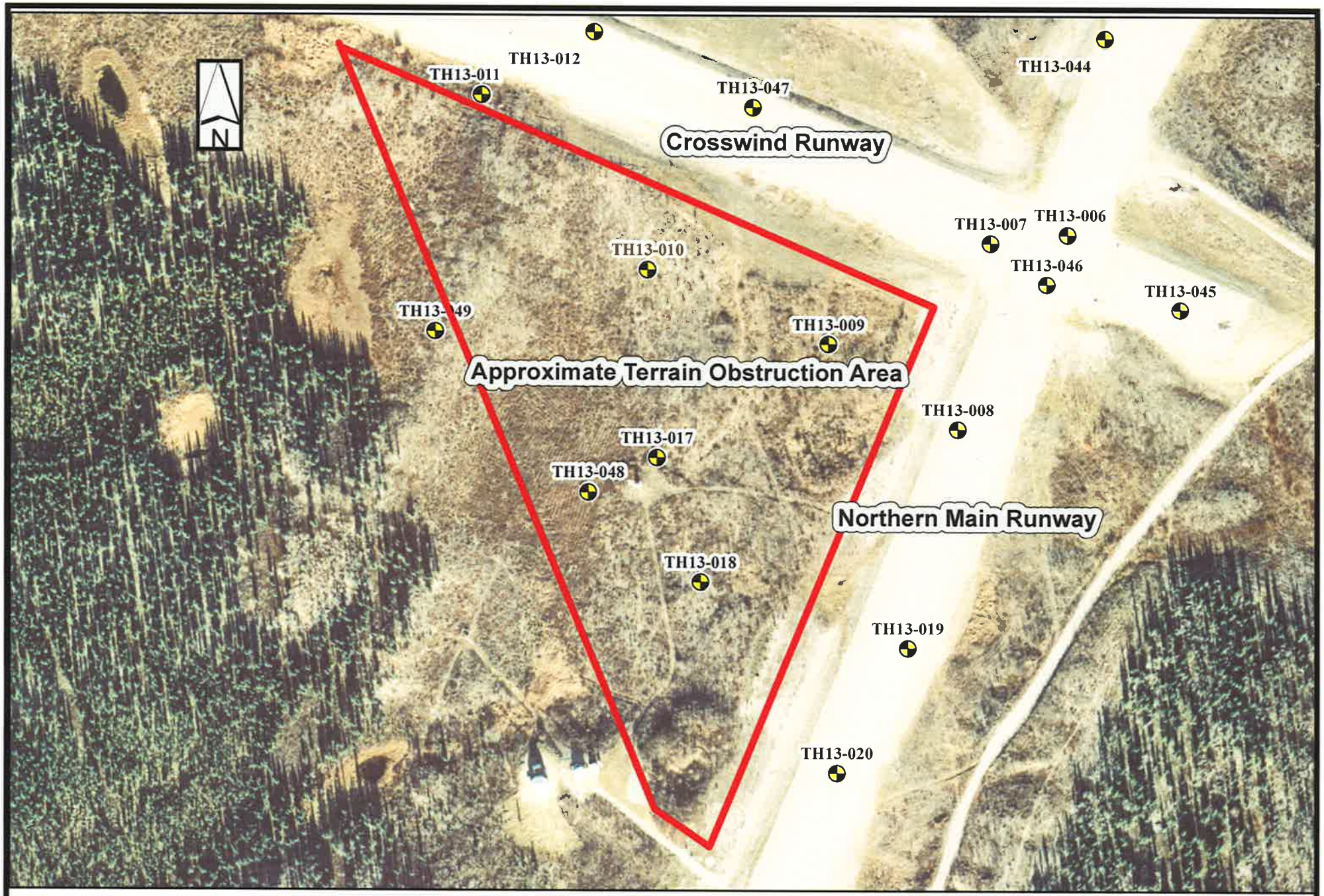
- The limits of the two materials are not clearly defined, but in general, the silty material with organics and higher moistures are related to lower areas of the terrain obstruction area.
- Most of the terrain obstruction area drilling encountered marginally frozen, poorly bonded and friable silty sand or sandy silty material.
- This material fails to meet standard specifications for Select Material Type A and B and is frost susceptible with 50.2 to 85 percent passing the #200 sieve. This material can be used where frost susceptible borrow material is acceptable. We estimate approximately 20 percent of the terrain obstruction area material could have excessive organic contents and\or natural moisture.
- Naturally Occurring Asbestos (NOA) testing in the area indicated values below 0.25 percent. Additional Asbestos testing results can be found in the referenced geotechnical report.
- One Proctor value indicated optimum moisture content of 14.6 percent and 103.0 pounds per cubic foot maximum dry density. Samples collected in the area indicated most natural moisture contents in the area are at or near optimum moisture.
- Some material may be above optimum moisture, requiring draining and drying to achieve optimum compaction.
- Optimum compaction is necessary to avoid differential settlement beneath the runway extension areas.
- Based on the results of laboratory testing, the natural state of the subsurface soils in the terrain obstruction area, and the attached letter from 1988, we estimate a soil shrinkage factor of approximately 10 to 25 percent after compaction and before excavation.

Attached are a complete set of test hole logs, laboratory test results for the terrain obstruction area, and a DOT&PF letter dated 1988 and pertaining to the original construction of Ambler Airport.

Jeff Currey, P.E.
Materials Engineer

9-4-13
Date

cc: Scott Maybrier, Airport Design
Attachments: Figure 1, test hole logs, lab results, 1988 Ambler letter.



AMBLER AIRPORT REHIBILITATION PROJECT
TERRAIN OBSTRUCTION AREA

Feet
0 250 500

Legend
Test Hole Locations

FIGURE 1, PAGE 4

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-009
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Station, Offset	
Equipment Type	Mobile B-24	Latitude, Longitude	N67.1066°, W157.8558°
Weather	cloudy and cold	Elevation	
TH Finalized By	T. Weiss	Vegetation	Tundra

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

GENERAL COMMENTS:
Obstruction area. Located on orginal ground.

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1									Tn Silty SAND Nbn
	2		AUGER	13-2214						SAMPLE 13-2214 (1.8-2.2):
	3									
	4									Nf
	5		AUGER	13-2215						SAMPLE 13-2215 (4.8-5.2): NM 11.7%, ORG 1.0% Nbn, Interlayered Silt
	6									
	7									Nf
	8		AUGER	13-2216						SAMPLE 13-2216 (7.8-8.2): 31.8 degrees F
	9									Tn SILT Nf
	10									SAMPLE 13-2217 (9.0-15.0): ML, 85% -200, NV, NP
	11									
	12		AUGER	13-2217						moist, loose, 33.5 degrees F
	13		AUGER	13-2218						SAMPLE 13-2218 (12.8-13.2): NM 8.9%
	14									
	15									BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-010
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Station, Offset	
Equipment Type	Mobile B-24	Latitude, Longitude	N67.10695°, W157.85796°
Weather	cloudy and cold	Elevation	
TH Finalized By	T. Weiss	Vegetation	Tundra

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

GENERAL COMMENTS:
Obstruction area. Located on orginal ground.

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1		AUGER	13-2219						SAMPLE 13-2219 (0.8-1.2):
	2									Tn Sandy SILT *sl Org*, Nbn SAMPLE 13-2221 (1.5-10.0): ML, 50.2% -200, NV, NP, Max. Density 103 pcf, Opt. Moisture 14.6%
	3									
	4		AUGER	13-2220						Interlayered silt SAMPLE 13-2220 (3.8-4.2):
	5									
	6		AUGER	13-2221						Nf
	7		AUGER	13-2222						SAMPLE 13-2222 (6.8-7.2): NM 7.5%
	8									31.7 degrees F
	9									
	10									Tn Silty SAND Nf
	11									SAMPLE 13-2223 (10.0-15.0): 33.2 degrees F
	12		AUGER	13-2223 13-2224						SAMPLE 13-2224 (12.3-12.7):
	13									dry, 33.6 degrees F
	14									
	15									BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-017
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Equipment Type	Mobile B-24
Station, Offset		Weather	cloudy and cold
Latitude, Longitude	N67.10607°, W157.85785°	TH Finalized By	T. Weiss
Vegetation	Tundra	Elevation	

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

GENERAL COMMENTS:
Obstruction area. On orginal ground.

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1									Bn Silty SAND *sl Org*, Nbn
	2		AUGER	13-2237						SAMPLE 13-2237 (2.3-2.7):
	3									Tn Nf, 30.2 degrees F
	4									
	5		AUGER	13-2238						SAMPLE 13-2238 (4.8-5.2): NM 10.9%, ORG 0.2%
	6									
	7									
	8		AUGER	13-2239						SAMPLE 13-2239 (7.8-8.2):
	9									31.7 degrees F
	10									
	11									
	12									dry to moist, 33.1 degrees F
	13		AUGER	13-2240						SAMPLE 13-2240 (12.8-13.2): NM 14.9%
	14									
	15									BOH
				13-2107						SAMPLE 13-2107 (16.8-17.2):

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR_AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-018
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Station, Offset	
Equipment Type	Mobile B-24	Latitude, Longitude	N67.10549°, W157.85733°
Weather	cloudy and cold	Elevation	
TH Finalized By	T. Weiss	Vegetation	Tundra

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

GENERAL COMMENTS:
Obstruction area. On orginal ground.

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1		AUGER	13-2241						Bn Sandy SILT *sl Org*, Nf
	2									SAMPLE 13-2242 (1.0-7.0): ML, 62.9% -200, ORG 1.1%, NV, NP SAMPLE 13-2241 (1.8-2.2): Tn
	3		AUGER	13-2242						
	4									
	5									
	6									
	7									30.8 degrees F
	8		AUGER	13-2243						SAMPLE 13-2243 (8.2-8.7):
	9									Tn Silty SAND Nf
	10									
	11									
	12									moist, 33.6 degrees F
	13									
	14		AUGER	13-2244						SAMPLE 13-2244 (13.8-14.2):
	15									BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-048
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Station, Offset	
Equipment Type	Mobile B-24	Latitude, Longitude	N67.10591°, W157.85867°
Weather	cloudy and cold	Elevation	
TH Finalized By	T. Weiss	Vegetation	Tundra

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

GENERAL COMMENTS:
Obstruction area

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1									Bn SILT w/ Sand *hi Org*, Nbn
	2									Bn PEAT *hi Org*
	3		AUGER	13-2234						SAMPLE 13-2234 (2.8-3.2): NM 115.5%, ORG 44.0%
	4									
	5									Gy SILT w/ Sand Nbe
	6									
	7		AUGER	13-2235						SAMPLE 13-2235 (6.8-7.2): NM 31.8%, NV, NP
	8									
	9									
	10									
	11									
	12									
	13		AUGER	13-2236						SAMPLE 13-2236 (12.8-13.2): NM 28.4%
	14									
	15									BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

FINAL TEST HOLE LOG

STATE OF ALASKA DOT/PF
Northern Region Materials
Geology Section

Project	Ambler Airport Rehibilation	Test Hole Number	TH13-049
Project Number	AKSAS 61303	Total Depth	15 feet
Field Geologist	T. WEISS	Dates Drilled	3/1/2013
Field Crew	S. Parker and P. Lanihan	Station, Offset	
Equipment Type	Mobile B-24	Latitude, Longitude	N67.10666°, W157.8605°
Weather	cloudy and cold	Elevation	
TH Finalized By	T. Weiss	Vegetation	Tundra

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

GENERAL COMMENTS:
Obstruction area

Drilling Method	Depth in (Feet)	Casing Blows / ft	Sample Data: Method	Number	Blow Count	Sample Interval	N-Value	Frozen	Graphic Log	SUBSURFACE MATERIAL
S-S Auger	0									Bn ORG MAT *hi Org*
	1									Bn-Tn Sandy SILT *sl Org*, Nbn
	2									SAMPLE 13-2232 (2.0-10.0): ML, 51.4% -200, ORG 0.8%, NV, NP
	3		AUGER	13-2230						SAMPLE 13-2230 (2.8-3.2): Tn Nf
	4									
	5		AUGER	13-2231						SAMPLE 13-2231 (4.8-5.2): Consistent
	6		AUGER	13-2232						
	7									
	8									31.2 degrees F
	9									
	10									Tn Silty SAND Nf
	11									
	12									
	13									dry to moist, 34.2 degrees F
	14		AUGER	13-2233						SAMPLE 13-2233 (14.2-14.8): NM 9.4%
	15									BOH

Note: Unless otherwise noted, all samples are taken with 1-3/8-in. ID Standard Penetration Sampler driven with 140 lb. hammer with 30-in. drop. ☐ CME Auto Hammer ☐ Cathead Rope Method

NR AKDOT TEST HOLE LOG - USCS LOGS LATEST.GPJ NR_AKDOT_PRECON_USCS_06_28_07.GDT 9/4/13

STATE OF ALASKA DEPARTMENT OF TRANSPORTATION
NORTHERN REGION
LABORATORY TESTING REPORT

PROJECT NAME:	Ambler Airport Rehibilation
PROJECT NUMBER:	
AKSAS NUMBER:	61303
SAMPLED BY:	T. Weiss
MATERIAL SOURCE:	Terrain Obstruction Area

TEST HOLE NUMBER		TH13-009	TH13-009	TH13-009	TH13-010	TH13-010	TH13-017	TH13-017
DEPTH (feet)		4.8-5.2	9.0-15.0	12.8-13.2	1.5-10.0	6.8-7.2	4.8-5.2	12.8-13.2
LATITUDE		N67.1066°	N67.1066°	N67.1066°	N67.10695°	N67.10695°	N67.10607°	N67.10607°
LONGITUDE		W157.8558°	W157.8558°	W157.8558°	W157.85796°	W157.85796°	W157.85785°	W157.85785°
LAB NUMBER		**13-2215**	**13-2217**	**13-2218**	**13-2221**	**13-2222**	**13-2238**	**13-2240**
DATE SAMPLED		1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13
% Passing	**3"**							
	2"							
	1.5"							
Gravel	**1.0"**							
	0.75"							
	0.5"							
	0.375"							
	#4							
	#8							
	#10							
	#16							
	#30							
Sand	**#40**				100			
	#50		100		99			
	#60		99		99			
	#80		99		98			
	#100		98		97			
Silt/Clay	**#200**		85.0		50.2			
	0.02							
Hydro	**0.005**							
	0.002							
	0.001							
LIQUID LIMIT			NV		NV			
PLASTIC INDEX			NP		NP			
USCS CLASSIFICATION			ML		ML			
USCS SOIL DESCRIPTION		(SiSa)	Si	(SiSa)	SaSi	SaSi	(SiSa)	(SiSa)
NATURAL MOISTURE		11.7		8.9		7.5	10.9	14.9
ORGANICS		1.0					0.2	
SP. GR. (FINE)					2.66			
SP. GR. (COARSE)								
MAX. DRY DENSITY					103.0			
OPTIMUM MOISTURE					14.6			
L.A. ABRASION								
DEGRAD. FACTOR								
SODIUM SULF. (CRSE)								
SODIUM SULF. (FINE)								
NORDIC ABRASION								
REMARKS					T-99 was used			

GENERAL COMMENTS

Gradation is based on material passing the 3" sieve, according to Alaska Test Method T-7.

[1] Organic content determination is based on the results of the ATM T-6 test method.

(Soil descriptions shown in parentheses are based on field determinations.)

USCS Soil Description Abbreviations: WG = Well-graded; PG = Poorly-graded; E = Elastic; L = Lean; F = Fat

STATE OF ALASKA DEPARTMENT OF TRANSPORTATION
NORTHERN REGION
LABORATORY TESTING REPORT

PROJECT NAME:	Ambler Airport Rehibilation
PROJECT NUMBER:	
AKSAS NUMBER:	61303
SAMPLED BY:	T. Weiss
MATERIAL SOURCE:	Terrain Obstruction Area

TEST HOLE NUMBER		TH13-049	TH13-049	TH13-048	TH13-048	TH13-048	TH13-018	
DEPTH (feet)		2.0-10.0	14.2-14.8	2.8-3.2	6.8-7.2	12.8-13.2	1.0-7.0	
LATITUDE		N67.10666°	N67.10666°	N67.10591°	N67.10591°	N67.10591°	N67.10549°	
LONGITUDE		W157.8605°	W157.8605°	W157.85867°	W157.85867°	W157.85867°	W157.85733°	
LAB NUMBER		**13-2232**	**13-2233**	**13-2234**	**13-2235**	**13-2236**	**13-2242**	
DATE SAMPLED		1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	1-Mar-13	
% Passing	**3"**							
	2"							
	1.5"							
Gravel	**1.0"**							
	0.75"							
	0.5"							
	0.375"							
	#4							
	#8							
	#10							
	#16							
	#30							
Sand	**#40**	100					100	
	#50	98					99	
	#60	96					99	
	#80	89					97	
	#100	83					96	
Silt/Clay	**#200**	51.4					62.9	
	0.02							
Hydro	**0.005**							
	0.002							
	0.001							
LIQUID LIMIT		NV			NV		NV	
PLASTIC INDEX		NP			NP		NP	
USCS CLASSIFICATION		ML					ML	
USCS SOIL DESCRIPTION		SaSi	(SiSa)	(Pt)	(Si w/Sa)	(Si w/Sa)	SaSi	
NATURAL MOISTURE			9.4	115.5	31.8	28.4		
ORGANICS		0.8		44.0			1.1	
SP. GR. (FINE)								
SP. GR. (COARSE)								
MAX. DRY DENSITY								
OPTIMUM MOISTURE								
L.A. ABRASION								
DEGRAD. FACTOR								
SODIUM SULF. (CRSE)								
SODIUM SULF. (FINE)								
NORDIC ABRASION								
REMARKS				hi Org[1]				

GENERAL COMMENTS

Gradation is based on material passing the 3" sieve, according to Alaska Test Method T-7.

[1] Organic content determination is based on the results of the ATM T-6 test method.

(Soil descriptions shown in parentheses are based on field determinations.)

USCS Soil Description Abbreviations: WG = Well-graded; PG = Poorly-graded; E = Elastic; L = Lean; F = Fat

Mitl Gravel

MEMORANDUM

State of Alaska
Department of Transportation & Public Facilities

TO: Rod Platzke
Design Group Chief
Northern Region

DATE: November 28, 1988

FILE NO: 244N:

TELEPHONE NO: 451-2230

FROM: Hal Livingston HL
Sr. Engineering Geologist
Northern Region

SUBJECT: Shrinkage in silt soils used in embankments

The wind-blown silt at Ambler was used in constructing the runway embankment in 1977. Several in-place densities of the silt borrow (primarily in the ditch areas) were taken during construction and compared with the densities of the compacted embankment. As would be expected, the first lifts of silt placed on uncompacted soil did not achieve 95 percent compaction. Later lifts gradually achieved higher rates of compaction until a 96 percent compaction was reached. Comparison of the in-place density with that achieved in construction shows that the in-place volume of the wind-blown silt ranged from 9.2 to 15.4 percent higher than when compacted into the runway embankment. The average indicated shrink was 11.7 percent for the wind-blown silt at Ambler. These figures are based on the construction data attached.

Additional tests with the Nuclear densometer and the Washington densometer were taken at Ambler on October 13, 1988. These tests were run in three locations along the proposed cross-wind runway where cuts will be made to supply material for the embankment. Knowledge of the expected decrease in volume from in-place yards to embankment yards will help the designers set grades and backslopes. Contractors will also know more closely how many yards they will have to excavate in order to construct the embankment.

The shrinkage percentage between tests ranged from 11.5 to 23.0 and averaged 15.6 percent. If 200,000 cubic yards of material is to be placed in the embankment, then approximately 237,000 cubic yards will have to be excavated to supply this quantity. It is probable that there is natural variation in the in-place density of wind-blown silt at Ambler and the actual number of yards required for the embankment may be above or below that estimated based on these tests. This small number of tests cannot guarantee precise quantities, because there is some variation in the shrinkage factors between test locations, but the tests should aid considerably in reducing the unknown factors.

At Chalkyitsik much less data is available but it indicates that shrink of the in-place alluvial silt and silty sand is 34.5 percent when compacted into the runway embankment. This large shrinkage may result from several processes acting on the soil but the chief cause is probably fluffing of

the material by the action of seasonal freezing; in other words, the formation of taber ice in successive cycles over a very long time (thousands of years). The presence of volcanic ash in the surface layer of wind-blown silt probably has helped this fluffing process.

The conditions for taber ice formation are ideal in that the materials are composed of silt containing a high percentage of .02 and .005 sizes (from the volcanic ash). The presence of permafrost 7 to 8 feet below the surface results in retention of moisture within the zone of seasonal freezing and provides a resevoir of water needed to form abundant taber ice lenses.

Successive freeze-thaw cycles would move larger particles to the surface and position them in sorted stone rings or even sand rings. Several examples of both features were observed in the exposures in the side borrow areas at the Chalkyitsik Airport.

There is evidence in the area (burned trees and stumps) that recent forest fires could have resulted in the removal of shading trees and complete destruction of the insulating moss layer. Subsequent melting of perennially frozen soils only a few years ago could have left the soils less compacted than they would be after several tens of years.

CONCLUSION

The very loose soils at Chalkyitsik are probably the result of fluffing of the soil resulting from successive freeze and thaw and the accumulation of taber ice within the fine-grained soils. Forest fires, that later removed the insulating trees and moss, resulted in melting of the ice. Drainage of much of the moisture from the thawed soils left them with a very low density.

Geologists with the Department need to be aware of these potential problems in fine-grained soils so that adequate sampling can be done to alert Designers, Bidders, and construction personnel to the presence of material with unusually high shrinkage.

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Attachments: Lab tests.

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