GEOTECHNICAL REPORT

MERTARVIK AIRPORT
LOCATION STUDY- PHASE III
RECONNAISSANCE INVESTIGATION

AKSAS No. 57405
AIP No. 3-02-0000-008-2007

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6 May 2009

GEOTECHNICAL REPORT

MERTARVIK AIRPORT LOCATION STUDY – PHASE III RECONNAISSANCE INVESTIGATION

The following reports the results of R&M Consultants' reconnaissance geotechnical investigation for the *Mertarvik Airport Location Study*, on Nelson Island in southwestern Alaska; authorized by DOT&PF NTP No. 8 of *Foundations & Geotechnical Services Term Agreement* No. P62152. This report is intended for use by the project planning staff to support their evaluations and selection of a preferred airport location at Mertarvik. It is understood that additional, site-specific geotechnical investigations will be required to support the design and construction phase, once the actual airport site is determined.

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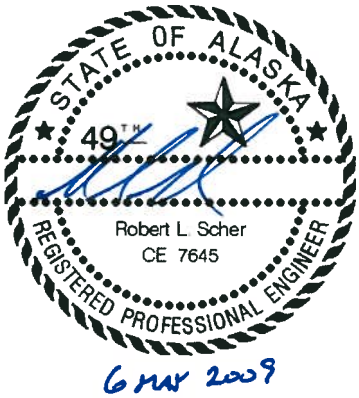

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GEOTECHNICAL REPORT

MERTARVIK AIRPORT LOCATION STUDY RECONNAISSANCE INVESTIGATION

1: INTRODUCTION

The village of Newtok is located on the north bank of the Ninglick River, about 12 miles upstream from the Bering Sea in southwest Alaska (Figure 1). In the mid-1990s, the Newtok Traditional Council initiated planning to relocate the village, due to ongoing erosion of the river bank which threatens the present village; ultimately selecting a preferred site, designated Mertarvik, approximately nine miles to the southeast of Newtok, on the north side of Nelson Island (Figure 1).

In association with the efforts to relocate Newtok, the Alaska Department of Transportation and Public Facilities (DOT&PF) sponsored an office study that identified six conceptual sites for an airport at Mertarvik (Figure 2) (PDC, 2008). Subsequently, the DOT&PF selected two of these sites for further study (designated hereafter Airport Sites 3 and 4); and contracted R&M Consultants, Inc. (R&M) to perform reconnaissance-level geotechnical explorations at each site, and at a potential material source (designated hereafter as Hill 460; Figure 2).

For preliminary planning, the new airport would consist of a 4,000-foot runway, 400-foot taxiway and 100,000 square-foot apron; all completed with an aggregate surfacing. Figure 3 illustrates the general location of the subject airport sites, Hill 460, and assumed access routes (corridors), as well as the proposed townsite and new barge landing. This figure was used as the basis for determining the number and location of the reconnaissance test holes.

The general elements of R&M's geotechnical reconnaissance investigation included (i) drilling a small number of test holes to qualify the general subsurface conditions (e.g. soil column, groundwater, and permafrost) at Airport Sites 3 and 4, along assumed access routes between the proposed new townsite and the airport sites, and at Hill 460[1]; and (ii) laboratory testing on some of the recovered samples to measure key soil indexing properties, and rock quality.

The following report describes the findings of R&M's reconnaissance investigation, including background information (i.e. regional geology, climate, and past geotechnical investigations in the area); descriptions of our field exploration and laboratory testing methods and procedures; and summaries of the factual field and laboratory test results, and our interpretations of the site conditions (e.g. surface, soil characteristics, permafrost, groundwater, and bedrock) at the two airport sites, along the assumed access routes, and at Hill 460.

[1] The DOT&PF had intended for R&M to also complete two 30-foot deep cores at Hill 460 to assess the weathering and quality of the rock with depth. However, that task was deleted (deferred to a later date) due to freezing temperatures and absence of a local unfrozen water supply at the time of the field work.

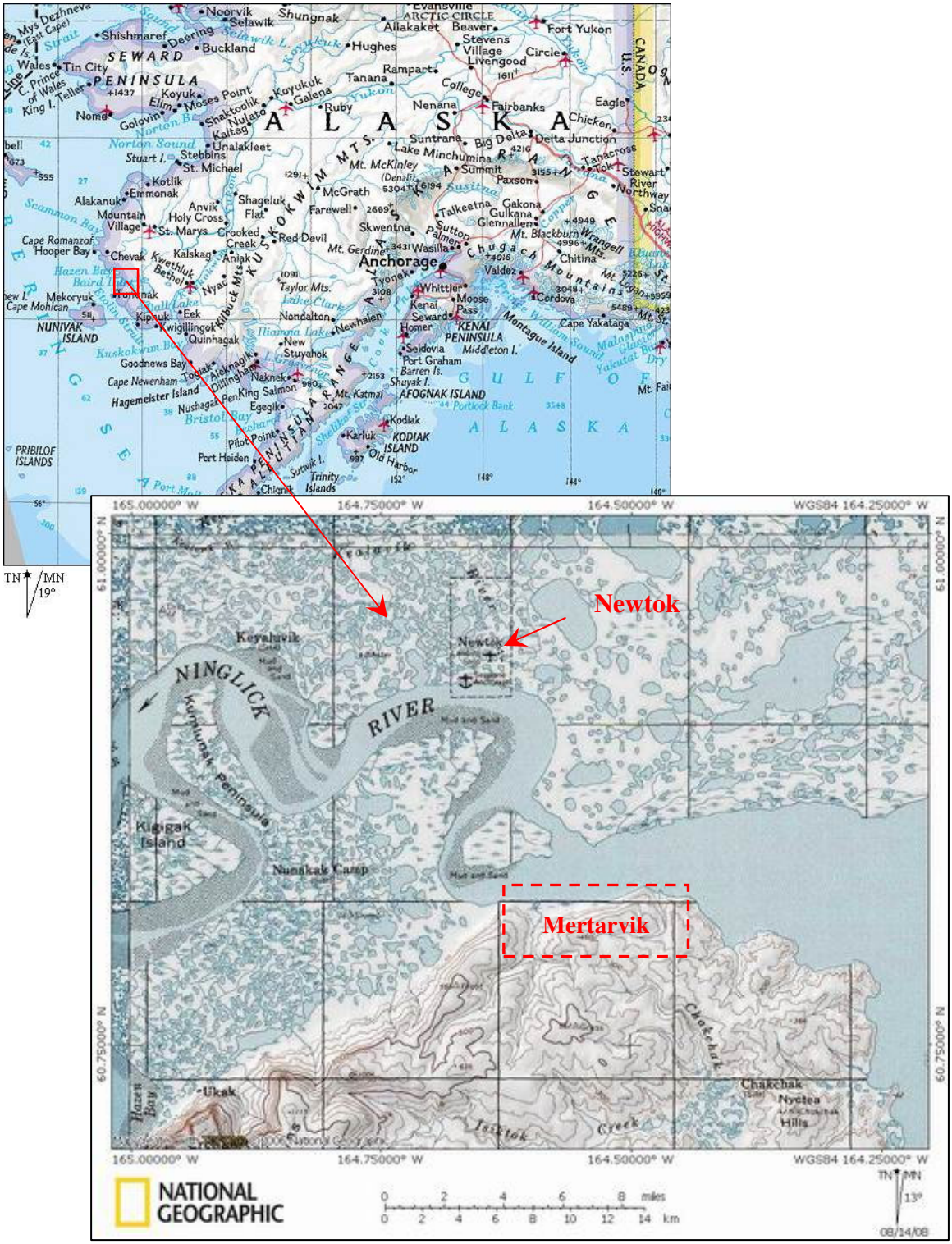

FIGURE 1: LOCATION MAP

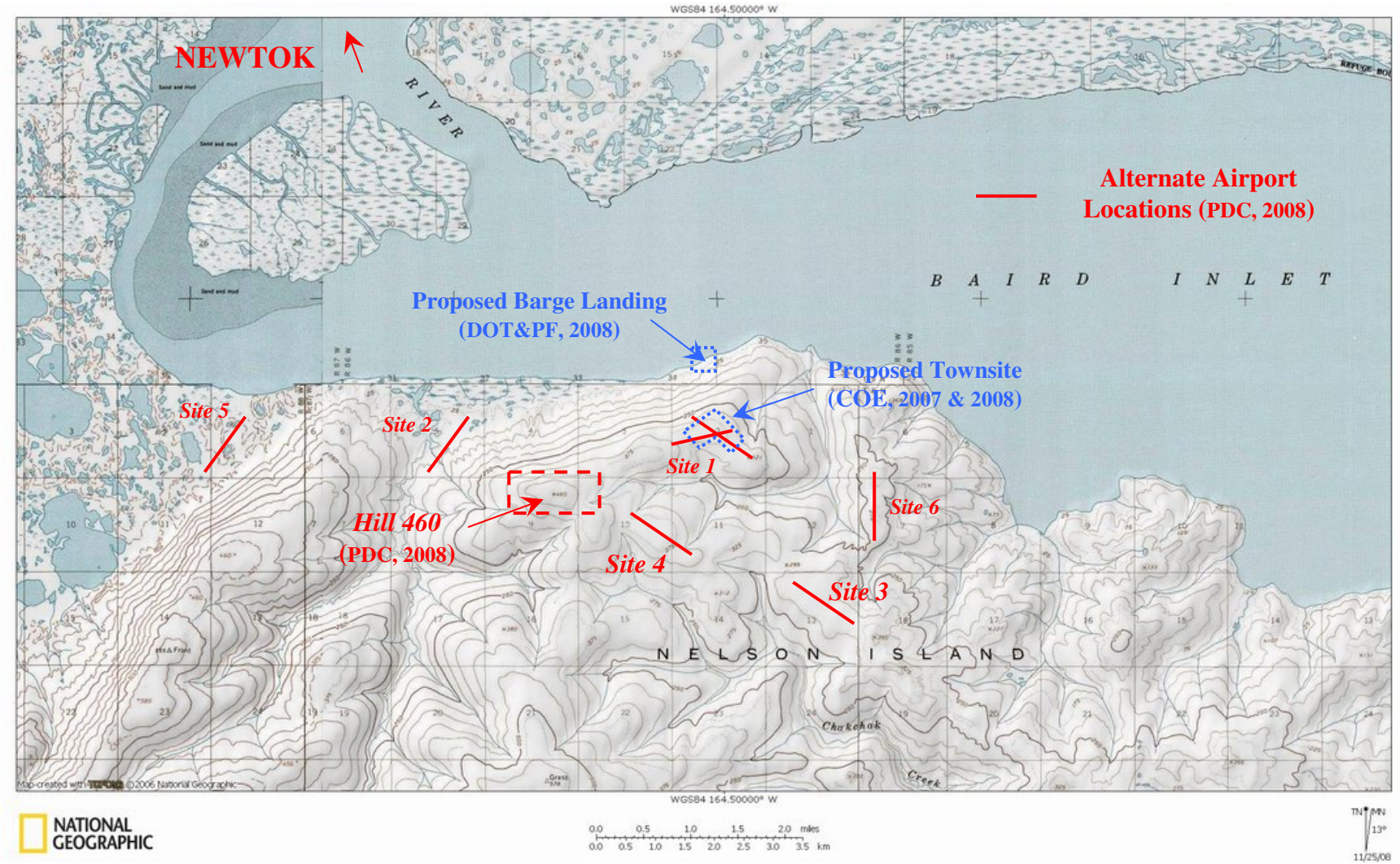

FIGURE 2: NORTH NELSON ISLAND

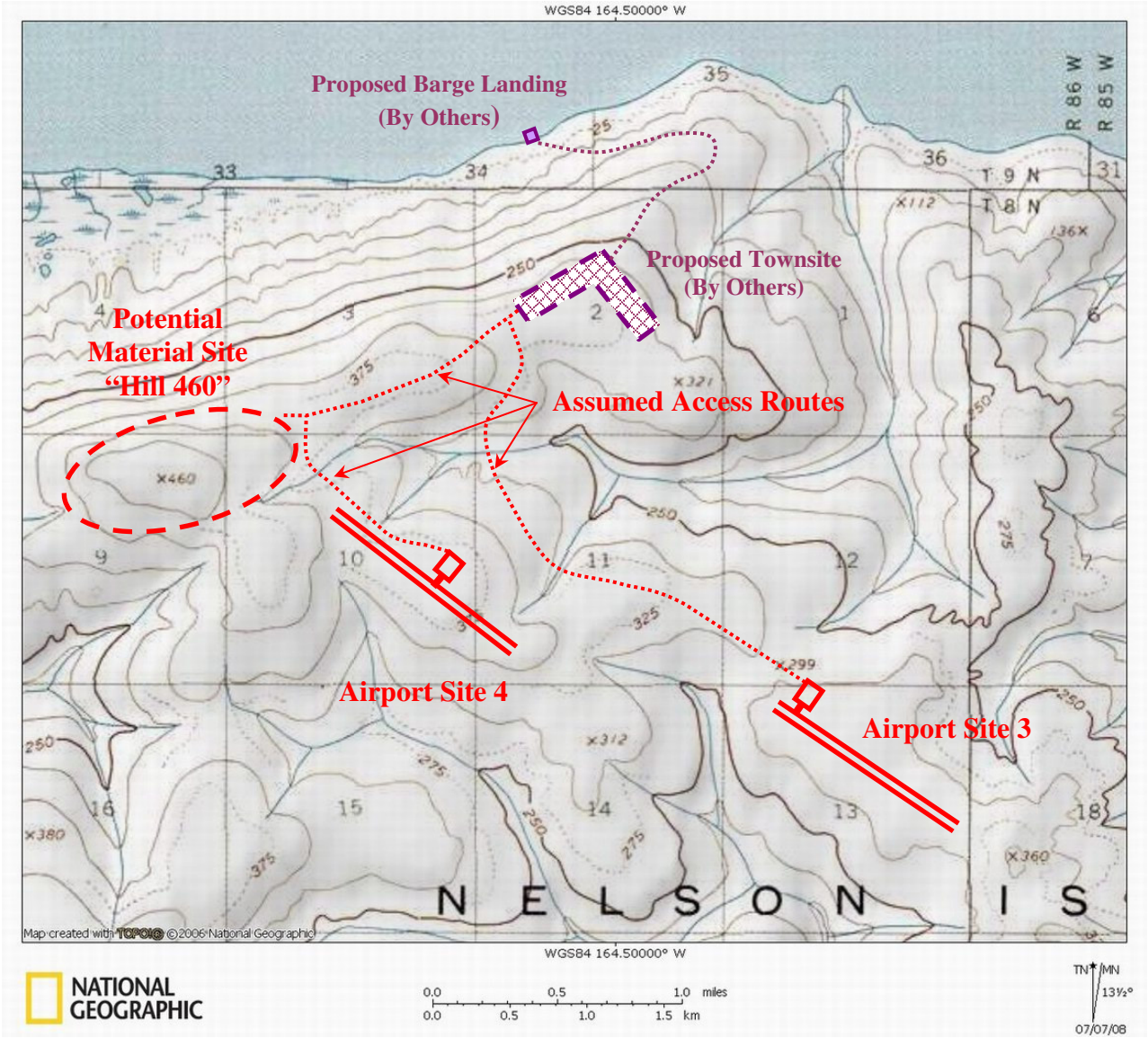

FIGURE 3: PROJECT AREA LAYOUT MAP

2: BACKGROUND

2.1 REGIONAL GEOLOGY

Nelson Island is situated within an unnamed highland subdivision of the *Yukon-Kuskokwim Coastal Lowland* physiographic province (Wahrhaftig, 1965). The terrain on Nelson Island is characterized by rolling, low hills with gentle slopes; generally covered with undifferentiated alluvium and slope deposits comprised mostly of volcanic rock particles, ash and pumice (Karlstrom, et al., 1964). The coastal lowlands surrounding Nelson Island are characterized by relatively flat, poorly draining terrain dotted with numerous lakes, marshes, and meandering streams with extremely low gradients; and covered with generally interstratified, Holocene, Quaternary and Pleistocene age fine-grain eolian, alluvial, estuarine, beach, and re-worked deposits (Biekman, 1974). The region is underlain by continuous permafrost (Brown, et al., 1997).

The bedrock on Nelson Island consists of Quaternary basalt overlying Cretaceous sedimentary rocks of the Kuskokwim Group (Biekman, 1974); although only the basalt has been mapped to outcrop on the north end of Nelson Island. Coonrad (1957) reported there are eight to 20 basalt flows on Nelson Island, each with a columnar structure and dipping gently to the east, and a combined total thickness of more than 200 feet.

Much of Nelson Island is mantled with loess and recent deposits of organic materials. Previous reconnaissance visits to the northern end of Nelson Island (see section 3, below) have also observed beach deposits containing sand and gravel along the coast, and minor coarse-grained soil deposits along established drainages.

Southwestern Alaska is characterized by low seismicity. No faults with interpreted displacements more recent than Pre-Neogene age are known within about 150 to 200 miles of Newtok (Plafker, et al., 1993). The Alaska Earthquake Information Center database[2] lists three seismic events with magnitudes greater than or equal to a local magnitude (M_L) of 5.0 that have occurred within about 200 miles of Newtok between 1898 and 2008; the largest being an earthquake of M_L5.2 (19 August 1971) located roughly 80 to 90 miles to the northeast of Newtok.

2.2 CLIMATE

The Nelson Island-Newtok area experiences a transitional climate (AEIDC, 1975?); characterized in summer by relatively maritime conditions (e.g. moderate annual temperature variations with higher winds and precipitation), and in winter by more continental conditions (e.g. greater annual temperature variations, with more moderate winds and precipitation). We are not aware of any climate records from Newtok. Table 1 summarizes some of the long-term climate data[3] recorded at Bethel, Cape Romanzof, and Mekoryuk, each respectively located about 100 miles east, 80 miles north, and 60 miles southwest of Newtok.

[2] http://www.giseis.alaska.edu/Seis/

[3] http://www.wrcc.dri.edu/summary/climsmak.html

TABLE 1: NELSON ISLAND-NEWTOK AREA CLIMATE DATA

PARAMETER	Bethel (1949–2008)	C. Romanzof (1953-1985)	Mekoryuk (1949-1973)
Air Temperature, °F:			
Mean Annual	29.6	28.9	29.2
Mean Winter (Dec-Feb) / Summer (Jun-Aug)	7.2 / 53.4	12.2 / 47.3	11.8 / 46.8
Historic Extreme Daily Low / High	-48 / 87	-26 / 79	-39 / 76
Precipitation, in:			
Mean Annual	17.2	25.5	15.0
Min / Max Mean Monthly	0.7 / 3.4	1.0 / 5.0	0.6 / 2.2
Max Single Day	2.3 (Aug)	2.8 (Aug)	1.7 (Jul)
Mean Annual Snowfall	54.9	68.2	46.0
Extreme Monthly High Snowfall	47.0 (Dec)	34.1 (Dec)	14.4 (Nov)

2.3 PREVIOUS GEOTECHNICAL INVESTIGATIONS

Between 1977 and 2005, we are aware of at least five site visits by geologists and/or geotechnical engineers to the north end of Nelson Island, for the purpose to visually reconnoiter potential sources of gravel or rock, and/or to inspect surface conditions for a site for relocating Newtok. No subsurface explorations were completed during any of these five site visits; although a few grab samples of soil and rock were collected. A summary of the geotechnical site visits performed between 1977 and 2005, including the areas inspected and findings, is included in PDC (2008).

During 2007 and 2008, three geotechnical investigations were completed at Mertarvik (not including the subject airport investigation). Two of these investigations pertained to the new townsite and an access road from the shoreline (COE 2007 and 2009); and the third was for a barge landing facility (DOT&PF, 2008) (Figure 3). None of these past investigations included explorations within the subject two alternate airport sites, or at the proposed Hill 460 material site.

3: METHODS

The following describes the field explorations (drilling and ground temperature measurements), and laboratory testing (soil and rock) completed during the reconnaissance investigation. The results of these elements are discussed in following sections of this report.

3.1 GEOTECHNICAL TEST HOLES

R&M drilled 29 test holes (designated TH08-05[4] through TH08-33) between 10 October and 1 November 2008. The depths of these test holes ranged from about 1.5 to 21.5 feet below existing ground. All of the field work was performed under the direct supervision of R&M engineering geologist Aaron Banks.

Maps illustrating the location of each test hole are provide in Appendices A, B and C. The drilling locations were determined in the field using a recreational Garmin Etrex Vista GPS unit, and are shown on the logs. Note that this unit has a manufacturer's reported accuracy of about 50 feet.

R&M's geologist maintained a field log throughout the drilling of each test hole which documented the drilling method, progress, and samples attempted and recovered; visual-manual descriptions of the recovered soils (following ASTM D 2488 and D 4083); and an interpretation of the geotechnical conditions between the recovered soil samples. Subsequently, the field logs were modified and/or supplemented with additional interpretations of the subsurface conditions based on further visual inspection of the recovered soil samples, and the factual results of our laboratory testing. The final logs for each boring are provided in Appendices A (Airport Site 3), B (Airport Site 4), and C (Hill 460). Keys pertaining to the general format, symbols and terminology contained on the test hole logs are provided in Appendix D.

The test holes were drilled by Denali Drilling, Inc., of Anchorage, using equipment they already had at Mertarvik, including a Mobil B-61 drill mounted on a 240 Nodwell tracked carrier (Figure 4), a hydraulic crane and air compressor mounted on a 160 Nodwell tracked carrier, and continuous-flight hollow-stem auger and air rotary tooling.

While drilling, disturbed soil samples were collected from each test hole, generally at depths of roughly 2.5 and five feet, and then at intervals of about five feet until the boring was terminated. The soil samples collected from all of the assumed access routes and Hill 460 borings were obtained by grabbing cuttings off the auger. The samples from all of the airport site borings were collected following the *Standard Penetration Test* (SPT; ASTM D 1586). The number of hammer blows required to advance the SPT sampler the final 12 inches of each 18-inch interval (*N*-value) can be used to judge the relative density or consistency of unfrozen soils, and are provided on the logs in Appendices A and B.

[4] The test hole designation format (year-test hole number) follows that used by the DOT&PF; we started with TH08-05 to avoid confusion with the four test holes drilled by the DOT&PF earlier in 2008 that were designated TH08-01 through TH08-04 (DOT&PF, 2008).

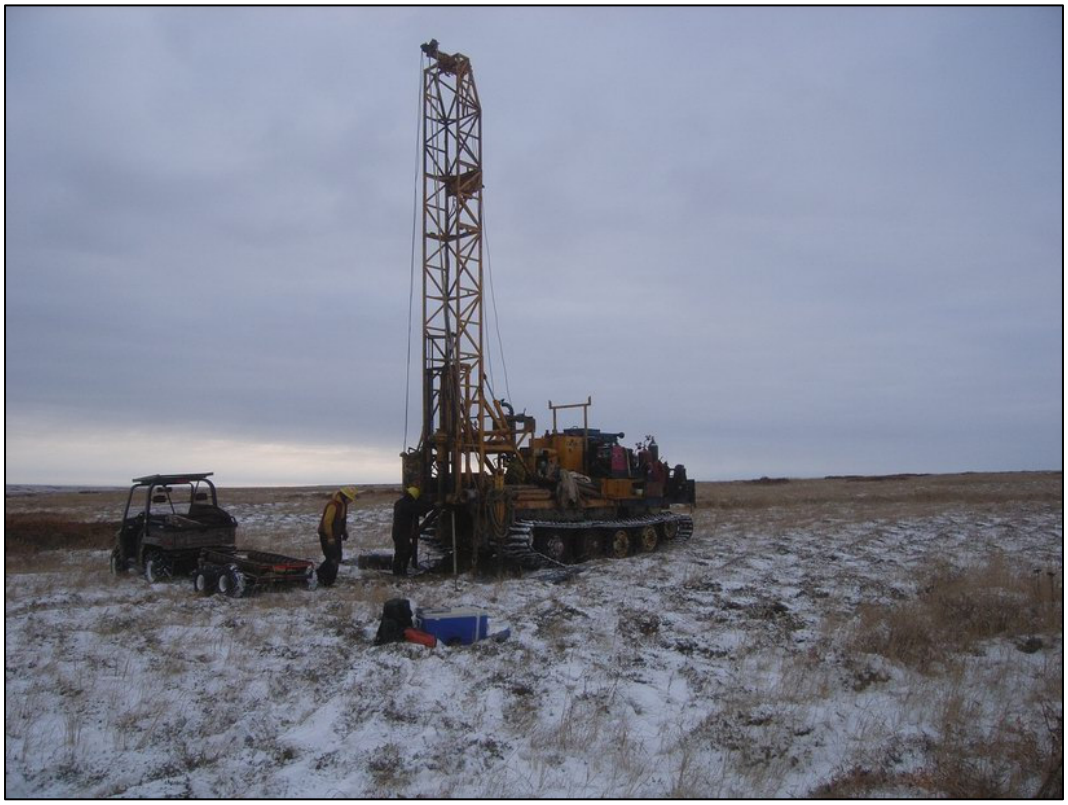

FIGURE 4: MOBIL B-61 DRILL (OCTOBER 2008)

After logging, all of the recovered soil samples were double packaged in sealed plastic bags and shipped to R&M's laboratory in Anchorage. After drilling, each test hole was backfilled with cuttings.

3.2 GROUND TEMPERATURE MEASUREMENTS

Three test holes at each airport site were completed with one inch PVC casing (TH08-13, 14 and 15 at Site 3; TH08-18, 20 and 21 at Site 4). After drilling, a multi-wire cable with *Yellow Springs Instrument Co.* YSI 44007 thermistors spaced at 2.5 to 5-foot intervals (fabricated by Dryden Instrumentation of Anchorage, Alaska), was set in each PVC casing.

On November 2nd, Mr. Banks measured the resistance of each thermistor using a *Fluke Model 87 True RMS* multimeter. The ground temperatures were then determined using an empirical equation as a function of the measured resistance, which is provided in Appendices A and B. These thermistor strings were then left in the PVC casing for future reading, with the top connectors protected with a plastic covering.

3.3 LABORATORY TESTING

All of the soil samples returned to R&M's laboratory in Anchorage were visually inspected. Most of these samples were also tested to measure key index properties for the purpose of classification, and grouping the soils into general units sharing similar physical and mechanical characteristics, following ASTM (2007) procedures:

- D 422 - Particle Size Analysis of Soils;
- D 1140 - Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve;
- D 2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass;
- D 2974 - Moisture. Ash, and Organic Matter of Peat and Other Organic Soils; and,
- D 4318 - Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

Select samples of the rock collected at Hill 460 were also tested to measure physical and quality (durability) properties, following AASHTO (2007) procedures:

- T85 – Specific Gravity and Absorption of Coarse Aggregate;
- T96 – Resistance to Degradation of Small-Size Aggregate by Abrasion and Impact in the Los Angeles Machine;
- T104 – Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate; and,
- ATM-313 - Degradation Value of Aggregate (DOT&PF, 2005).

The results of the soil tests are shown on the boring logs and tabulated in Appendices A, B and C. A summary of the rock quality test results is provided in Appendix C. When reviewing the test hole logs and laboratory test results note:

(a) The mineral constituents of individual soil samples were assigned *group names* and *symbols* following the *Unified Soil Classification System*, as defined in ASTM D 2487 (see Drawing D-04); although, group symbols annotated with an asterisk (e.g. SM*) indicate that the classification was estimated, in part, based on visual-manual indicators (ASTM D 2488. And,

(b) Soils containing organic matter were assigned group names and symbols following DOT&PF (2007), with two modifications. First, a dual group symbol was used for "coarse or fine-grained soil with organics" where the dry preparation/wet preparation liquid limit ratio was greater than 0.75 (e.g. SM-O or ML-O). Second, the group symbols were annotated with an asterisk (e.g. ML-0* or OL*) where the dry preparation/wet preparation liquid limit ratio was assumed considering the results of plasticity testing on other, but similar samples.

Finally, we have chosen for this project to report the results of ASTM D 2974 in terms of the measured ash content (AC), versus as an apparent organic content (=1-AC). The reason for this is that we believed a portion, if not all of the mass lost during ignition of some samples tested was associated with dehydration and/or decomposition of clay minerals versus loss of organic matter, a known consideration with this test (ASTM, 1983); especially in the deeper samples we interpreted to be residual soil or completely weathered bedrock.

4: AIRPORT SITES – GEOTECHNICAL CONDITIONS

The following summarizes the factual findings from our field explorations and laboratory testing, and our interpretations of the general geotechnical conditions (e.g. surface, soil profile and characteristics, groundwater, permafrost, bedrock, etc) at Airport Sites 3 and 4, and along the assumed access routes. More detailed descriptions of the subsurface conditions are contained on the test hole logs in Appendices A and B.

4.1 GENERAL

In general, the terrain across both airport sites and along assumed access routes appeared to be fairly well drained, and covered with grassy tussock tundra comprised predominantly of grasses and crowberry with patches of short willow along the drainages and in depressions (COE, 2005). No bedrock exposures were observed at either airport site or along the assumed access routes. Permafrost was observed in many of the test holes, although no significant thermokarst features were noted at the surface over those areas.

Based on the reconnaissance borings, the project area is mantled with an organic mat typically six to 10 inches thick. The underlying soil profile was generally comprised of non to moderately plastic silt, with trace amounts of organic matter (roots), and intervals containing variable sand, gravel, and/or scattered cobbles/boulders; over highly to moderately weathered bedrock. Based on color, structure, and texture, we interpreted this general soil profile to represent colluvium and/or eolian deposits overlying residual soil transitioning with depth to completely weathered bedrock; however, visual distinction of and between these designations in any one test hole was very subjective.

Finally, groundwater was observed in only one of the test holes drilled during the entire reconnaissance investigation (TH08-10, along the assumed access route to Airport Site 3). However, no groundwater monitoring wells were established, and given the fine-grained texture it is possible that groundwater was missed while drilling. Therefore, we believe it is likely that discontinuous zones of groundwater may exist in the areas explored, especially seasonally perched over permafrost and more dense soils.

4.2 AIRPORT SITE 3

Airport Site 3 is situated along a northwest-southeast trending ridge, about two miles south-southeast of the proposed new townsite (Figure 3). Based on aerial topographic mapping, ground elevations across the site appear to vary less than about 25 feet, with grades typically less than two to four percent. Table 2 summarizes the general subsurface conditions interpreted in the five reconnaissance test holes drilled at Airport Site 3; a map of the boring locations, the test hole logs, measured ground temperature data, and laboratory test results are provided in Appendix A.

The soils underlying the surface organic mat were generally fine-grained, and described as gray to gray-brown (in some holes grading to red-brown with depth), non to slightly plastic, and medium dense where unfrozen; with intervals containing trace to small amounts of very fine-sized sand, scattered weak gravel, cobbles and/or boulders, and trace amounts of fine organic

matter. Based on visual-manual inspection (ASTM D 2488) and laboratory testing (see Appendix A), most of the soil samples were classified as silt with organics or silt with sand and organics (ML*-O); and silt or silt with sand (ML*). Moisture contents in these soils ranged from 30 to 184% in the frozen samples (number of tests, n=9), and generally decreased with depth; and 19 to 44% in the unfrozen samples (n=6), with no apparent correlation with depth or other index property. The percent of soil particles, by mass, passing the No. 200 sieve (P200) ranged from 46 to 98% (n=8), and marginally decreased with depth. The liquid limits (LL) and plastic indices (PI) were less than 42 and 9, respectively (n=9). Ash contents ranged from 91.1 to 97.7%, by mass (n=9); and dry preparation/wet preparation liquid limit ratios of 0.92 and 1.01 were measured in two of those samples.

TABLE 2: AIRPORT SITE 3 TEST HOLE SUMMARY

TEST HOLE TH08-#	TOTAL DEPTH, ft	DEPTH BELOW EXISTING GROUND, ft		
		Groundwater	Permafrost(1)	Bedrock(2)
12	10.3	n.o.	n.o.	9.5
13	11.8	n.o.	1.5	11.8
14	21.5	n.o.	1.5	n.o.
15	21.5	n.o.	2	n.o.
16	21.5	n.o	n.o.	n.o.

n.o. Not observed
(1) Permafrost extended to the total depth drilled, unless otherwise listed.
(2) Top of interpreted moderately to highly weathered rock.

Some soils exhibiting more plasticity were also recovered from the deeper portions of TH08-14 and TH08-15; classified as elastic silt (MH). Based on limited laboratory testing, moisture contents ranged from 54 to 73% (n=4, all frozen samples); P200 values ranged from 71 to 76% (n=2); and two samples had LL-PI pairings of 60-19 and 66-20. An ash content of 89.6% was also measured in the one sample tested (collected from a depth of about 16 feet in TH08-14); however, we considered that value was more a reflection of the clay content versus organic matter (see 3.3, above).

Permafrost was observed in three of the borings (Table 2). The frozen samples collected from these borings were generally described (see Drawing D-03) as containing about five to 15%, by volume, visible segregated ice in the form of individual ice crystals or inclusions (Vu), or random or irregularly oriented lenses (Vr) up to about one to two inches thick. Ground temperatures measured in these three borings ranged from 31.0 to 31.8 ºF (see data in Appendix A).

4.3 AIRPORT SITE 4

Airport Site 4 is situated along a northwest-southeast trending ridge, about 1.5 miles south-southwest of the proposed new townsite (Figure 3). Based on aerial topographic mapping, ground elevations across the site appear to vary about 50 to 75 feet, with grades typically less than about four to seven percent. Table 3 summarizes the general subsurface conditions

interpreted in the five reconnaissance test holes drilled at Airport Site 4; a map of the boring locations, the test hole logs, measured ground temperature data, and laboratory test results are provided in Appendix B.

TABLE 3: AIRPORT SITE 4 TEST HOLE SUMMARY

TEST HOLE TH08-#	TOTAL DEPTH, ft	DEPTH BELOW EXISTING GROUND, ft		
		Groundwater	Permafrost(1)	Bedrock(2)
17	19.1	n.o.	n.o.	19
18	15.4	n.o.	5	13
19	13.2	n.o.	n.o.	15
20	20.8	n.o.	n.o.	20.8
21	15.2	n.o	n.o.	15

n.o. Not observed
(1) Permafrost extended to the total depth drilled, unless otherwise noted.
(2) Top of interpreted moderately to highly weathered rock.

The soils underlying the surface organic mat were generally fine-grained, and described as gray to gray-brown (in some holes grading to red-brown with depth), non to slightly plastic, and medium dense to dense; with intervals containing variable amounts of very fine-sized sand, scattered weak gravel, cobbles and/or boulders (i.e. TH08-20 and TH08-21), and trace amounts of fine organic matter. Based on visual-manual inspection (ASTM D 2488) and laboratory testing (see Appendix B), the soil samples were classified as silt with organics or silt with sand and organics (ML*-O); silt, silt with sand, or sandy silt (ML*); silty clay (CL-ML*); elastic silt with sand and gravel (MH*); and silty sand or silty sand with gravel (SM*). Moisture contents in these soils ranged from 16 to 45% in the unfrozen samples (n=14), and 53 to 55% in frozen samples (n=2), with no apparent correlation with depth or other index property. The P200 values ranged from 39 to 99% (n=7), and generally decreased with depth. The LL and PI values were generally less than 50 and 7, respectively (n=6); excluding one sample with a LL-PI pairing of 55-16. Ash contents ranged from 93.4 to 97.0% (n=5); and dry preparation/wet preparation liquid limit ratios of 0.98 and 1.06 were measured in three of those samples.

Permafrost was observed in one boring at the airport site (TH08-18), with the frozen samples generally described as containing about 10% visible segregated ice in the form of random or irregularly oriented lenses (Vr) up to about two inches thick. Ground temperatures measured in TH08-13 ranged from 31.0 to 31.8 ºF; while the temperatures measured in two borings without permafrost, TH08-20 and TH08-21, ranged from about 33.9 to 37.4 ºF (see data in Appendix B).

4.4 ACCESS ROUTES

Figure 3 illustrates the access routes, between the proposed new townsite and the alternate airport sites, we assumed for the purpose of the reconnaissance investigation. Based on aerial topographic mapping, surface grades along these routes are typically less than about four to seven percent. Table 4 summarizes the general characteristics of the reconnaissance test holes

drilled along the assumed access routes; a map of the boring locations, the test hole logs, and the laboratory test results are provided in Appendices A and B.

TABLE 4: ACCESS ROUTE TEST HOLE SUMMARY

PROPOSED TOWNSITETO:	TEST HOLE TH08-#	TOTAL DEPTH, ft	DEPTH BELOW EXISTING GROUND, ft		
			Groundwater	Permafrost(1)	Bedrock(2)
Airport Site 3	6	20	n.o.	7-13	n.o.
	7	20	n.o.	19	n.o.
	8	20	n.o.	n.o.	n.o.
	9	20	n.o.	n.o.	n.o.
	10	10	5	n.o.	10
	11	15	n.o.	6.5-12	n.o.
Airport Site 4	5	20	n.o.	12	n.o.
	22	15	n.o.	n.o.	n.o.
	23	15	n.o.	n.o.	n.o.
	24	15	n.o.	8.5	n.o.
	25	7.5	n.o.	3	7.5 (*cobble?*)

n.o. Not observed
(1) Permafrost extended to the total depth drilled, unless otherwise noted.
(2) Top of interpreted moderately to highly weathered rock.

The descriptions and estimated classifications of the soils underlying the surface organic mat along the assumed access routes were the same as discussed above at the two alternate airport sites. Based on laboratory testing of samples collected at the surface from the auger cutting, moisture contents ranged from 28 to 112% in the unfrozen samples (n=38), and 26 to 60% in frozen samples (n=9), which generally correlated with the ash content; P200 values ranged from 44 to 92% (n=15), with no apparent correlation to depth; and ash contents ranged from 81.1 to 96.7% (n=9).

Permafrost was observed sporadically in six of the borings. Based on the sampling method (i.e. cuttings collected from the auger) it was not possible to describe the concentration or form of the ground ice; however, no massive ice was suspected.

5: HILL 460 - GEOTECHNICAL CONDITIONS

The following summarizes the factual findings from our field explorations and laboratory testing, and our interpretations of the general geotechnical conditions at Hill 460. More detailed descriptions of the subsurface conditions are contained on the test hole logs in Appendix C.

The proposed material site, Hill 460, encompasses an outcrop of massive bedrock exposed (Figure 5) along the northern flank of the east-west trending ridge located about two miles west of the proposed new townsite (Figure 3). The terrain across the top of Hill 460 is well drained; sloping gently to the south and east (<5-10%), but more steeply to the north and west (≈ 15-20%). The ground surface is covered with grassy tussock tundra, comprised predominantly of short grasses, mosses and lichen (COE, 2005).

FIGURE 5: HILL 460 – NORTH BEDROCK EXPOSURE (OCTOBER 2008)

5.1 OVERBURDEN SOILS

R&M completed eight test holes across the top of Hill 460 for the purpose of qualifying the composition and depth of soil overlying the bedrock (overburden). Table 5 summarizes the general subsurface conditions encountered in each of the test holes; a map of the boring locations, the logs, and laboratory test results (soil and rock) are provided in Appendix C.

The area explored was mostly covered with an organic mat typically six to 10 inches thick, but absent along portions of the ridge top. The underlying soils were generally comprised of reddish to dark brown or dark gray, moist to dry, non to slightly plastic silt with variable sand and weak, gravel, and scattered cobbles. Trace amounts of fibrous organic matter (fine roots) were also observed at shallow depths in several of the borings. These soils were interpreted, based on

color, visible structure, and texture, to be a residual soil grading with depth to completely weathered bedrock.

TABLE 5: HILL 460 TEST HOLE SUMMARY

TEST HOLE TH08-#	TOTAL DEPTH, ft	DEPTH BELOW EXISTING GROUND, ft		
		Groundwater	Permafrost(1)	Bedrock(2)
26	15	n.o.	3	10
27	9	n.o.	n.o.	6
28	1.5	n.o.	n.o.	0
29	9.5	n.o.	n.o.	7
30	20	n.o.	6.5-11	n.o.
31	20	n.o.	n.o.	n.o.
32	11.5	n.o.	6.5-12	10.5
33	7	n.o	3(-5.5?)	6

n.o. Not observed
(3) Permafrost extended to the total depth drilled, unless otherwise noted.
(2) Top of interpreted moderately to highly weathered rock.

Moisture contents in these soils ranged from 4.5 to 117% in the unfrozen samples (n=23), and 36 to 64% in frozen samples (n=4), which generally decreased relative to depth and/or fines content. The P200 values ranged from 19 to 88% (n=14), and generally decreased with depth. The LL and PI values were generally less than 34 and 11, respectively (n=6). And ash contents ranged from about 76 to 98% (n=6), and generally decreased with depth.

5.2 BEDROCK

The bedrock exposed along the northern flank of Hill 460 (Figure 5) ranged from approximately 30 to 100 feet high (highest exposure at the western end of the ridge); however, minimal rock was exposure along the top and southern flank of the hill. Based on visual-inspection, the bedrock, as well as the tabular boulders (up to five feet long) and rubble covering the northern slope of the hill, were described as hard, massive, dark gray to black vesicular basalt, with about 10 percent voids (Figure 6).

This exposure was interpreted to be a hard cap rock, more resisted to the geologic processes that have eroded and shaped the surrounding land. It should be noted that basalt is often formed in flows (layers). Each of these flows may have different composition, structure and weathering characteristics. Thus, the rock may transition from hard and unweathered to softer and more highly weathered with depth.

FIGURE 6: VESICULAR BASALT RUBBLE (OCTOBER 2008)

Laboratory tests performed on four samples of rock obtained from the rubble covering the north flank of Hill 460 measured degradation values ranging from 17 to 67, LA abrasion losses of 15 to 33%, sodium sulfate losses of 1 to 4%, and bulk specific gravities of 2.759 to 2.822.

6: CLOSURE

The discussions of regional, local and project site conditions presented in this report have been based on the proposed improvements and development information listed herein. Alteration or deviation from any of these elements could substantially affect the foregoing geologic and geotechnical interpretations.

Additionally, because subsurface conditions can change significantly within a given area, and/or with the passing of time, the possibility exists that important subsurface conditions not disclosed by the subject reconnaissance explorations described herein may be discovered during further investigations or construction.

R&M Consultants, Inc. has 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.

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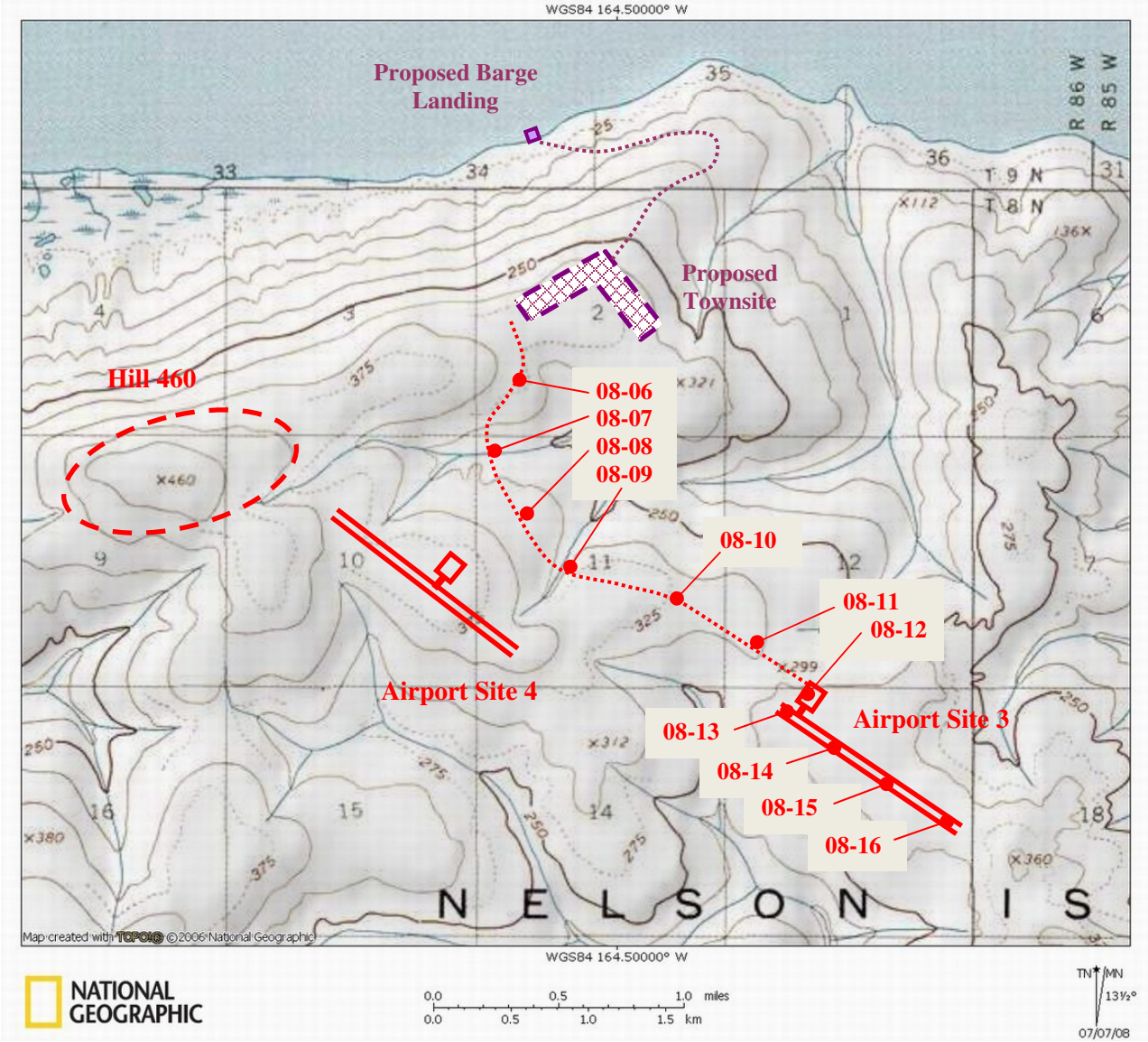
APPENDIX A

AIRPORT SITE 3 EXPLORATIONS



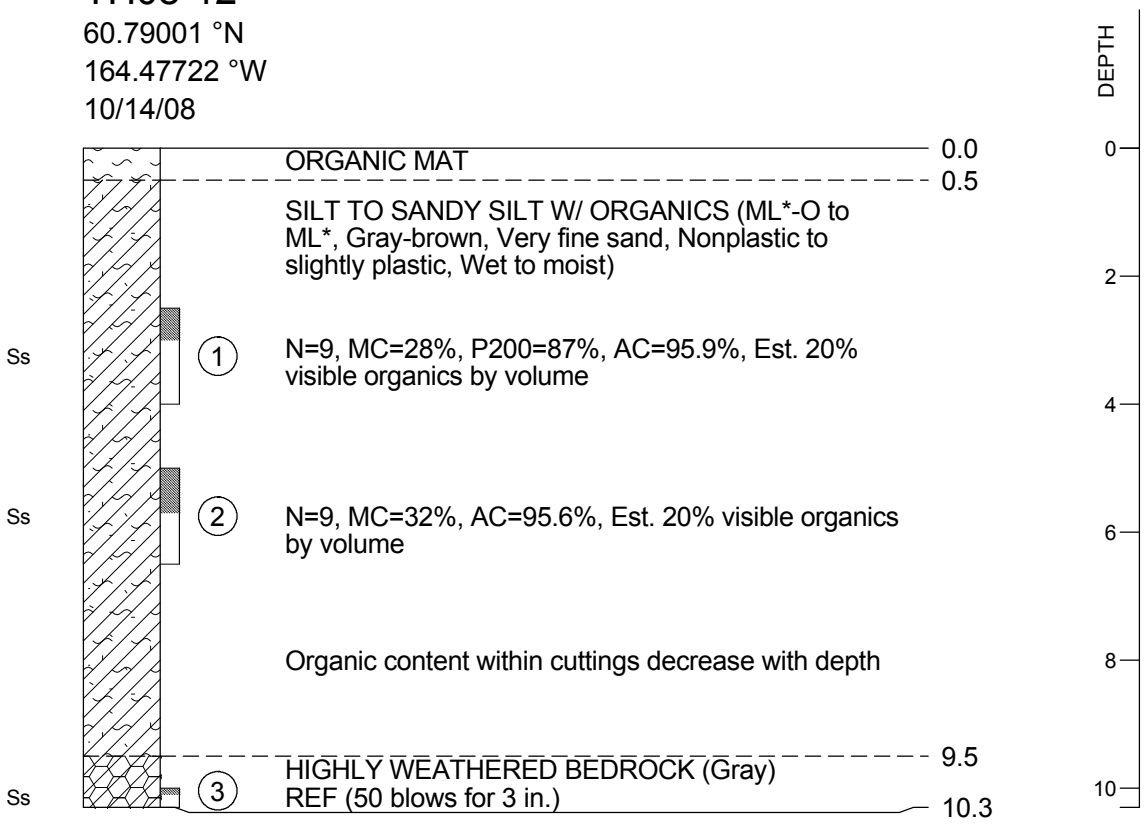
1429.03

AIRPORT SITE 3 TEST HOLE LOCATION MAP
MERTARVIK AIRPORT RECONNAISSANCE STUDY

DRAWING A-01

TH08-12

60.79001 °N
164.47722 °W
10/14/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

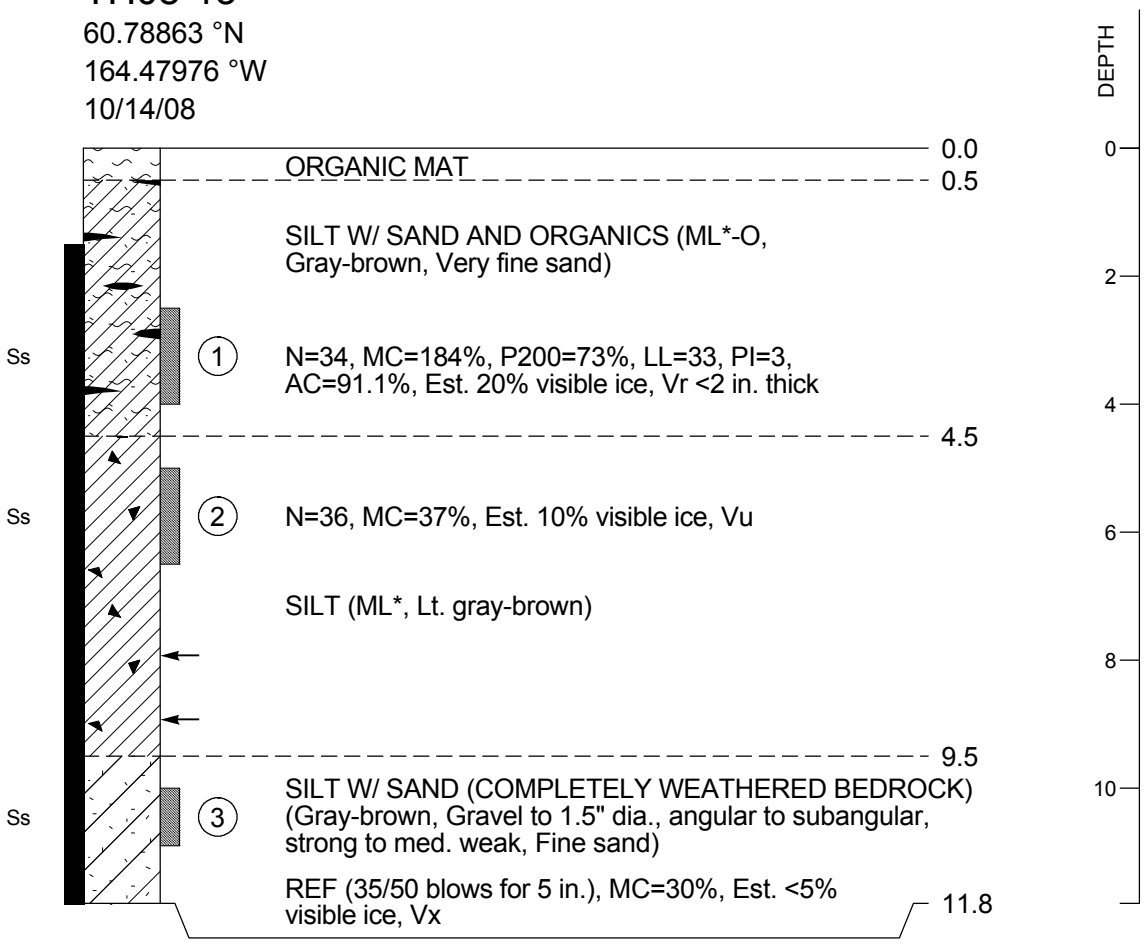
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 3
TH08-12

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-02

TH08-13

60.78863 °N
164.47976 °W
10/14/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below 7.5 ft.
Auger refusal at 11.8 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/25/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

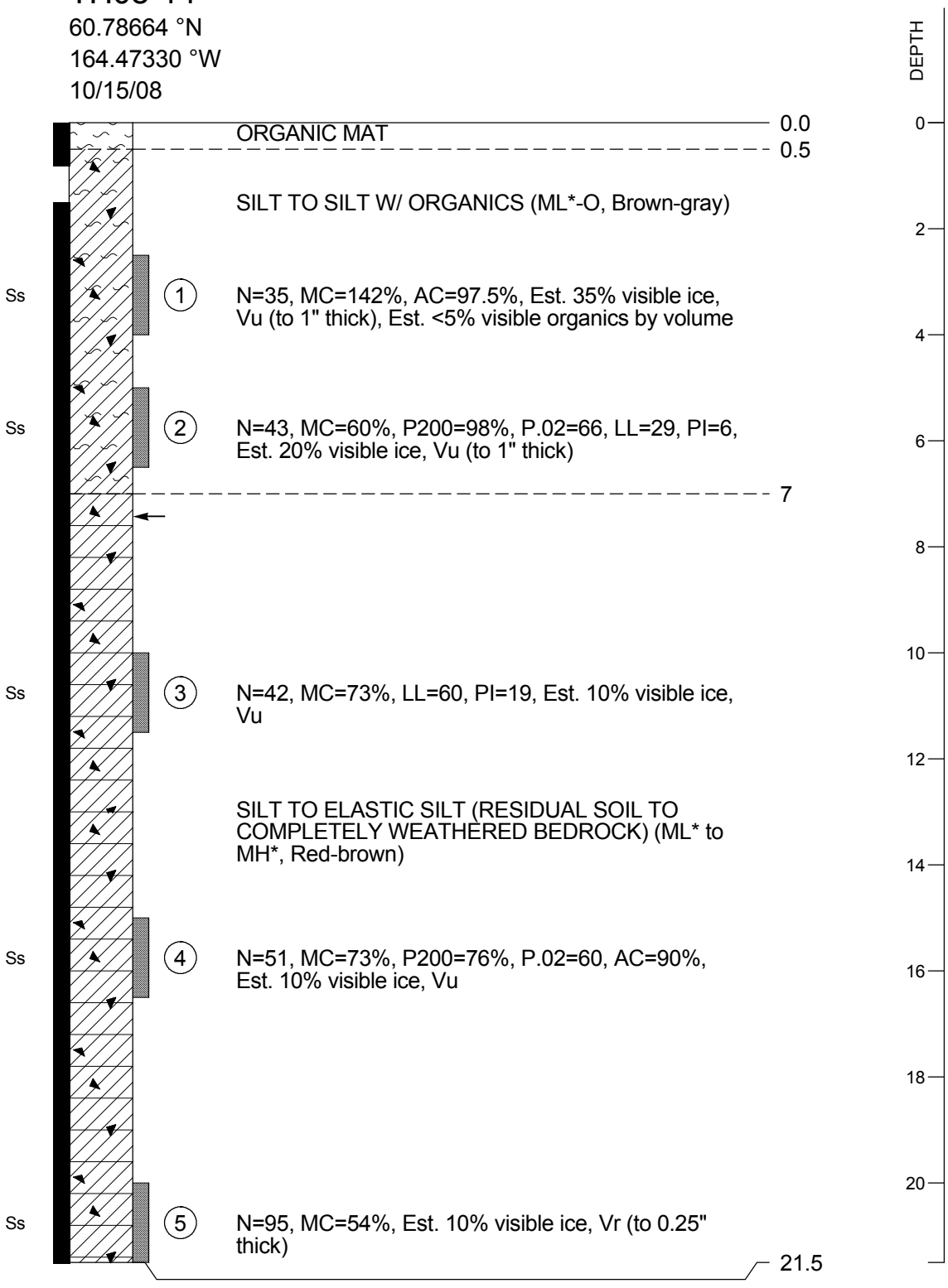
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 3
TH08-13

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-03

TH08-14

60.78664 °N
164.47330 °W
10/15/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Cobble/boulder interpreted at 7.5 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

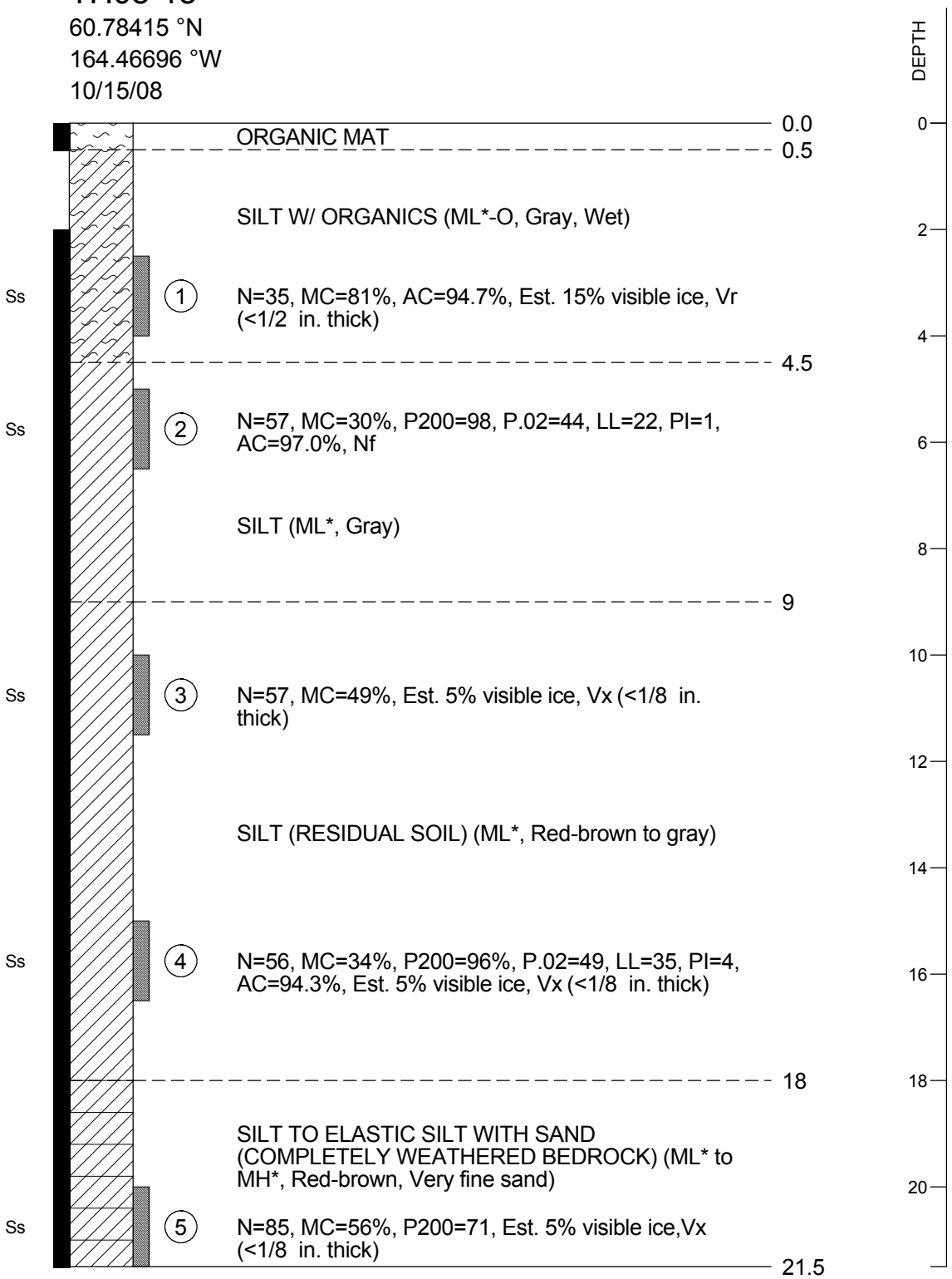
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 3
TH08-14

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-04

TH08-15

60.78415 °N
164.46696 °W
10/15/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

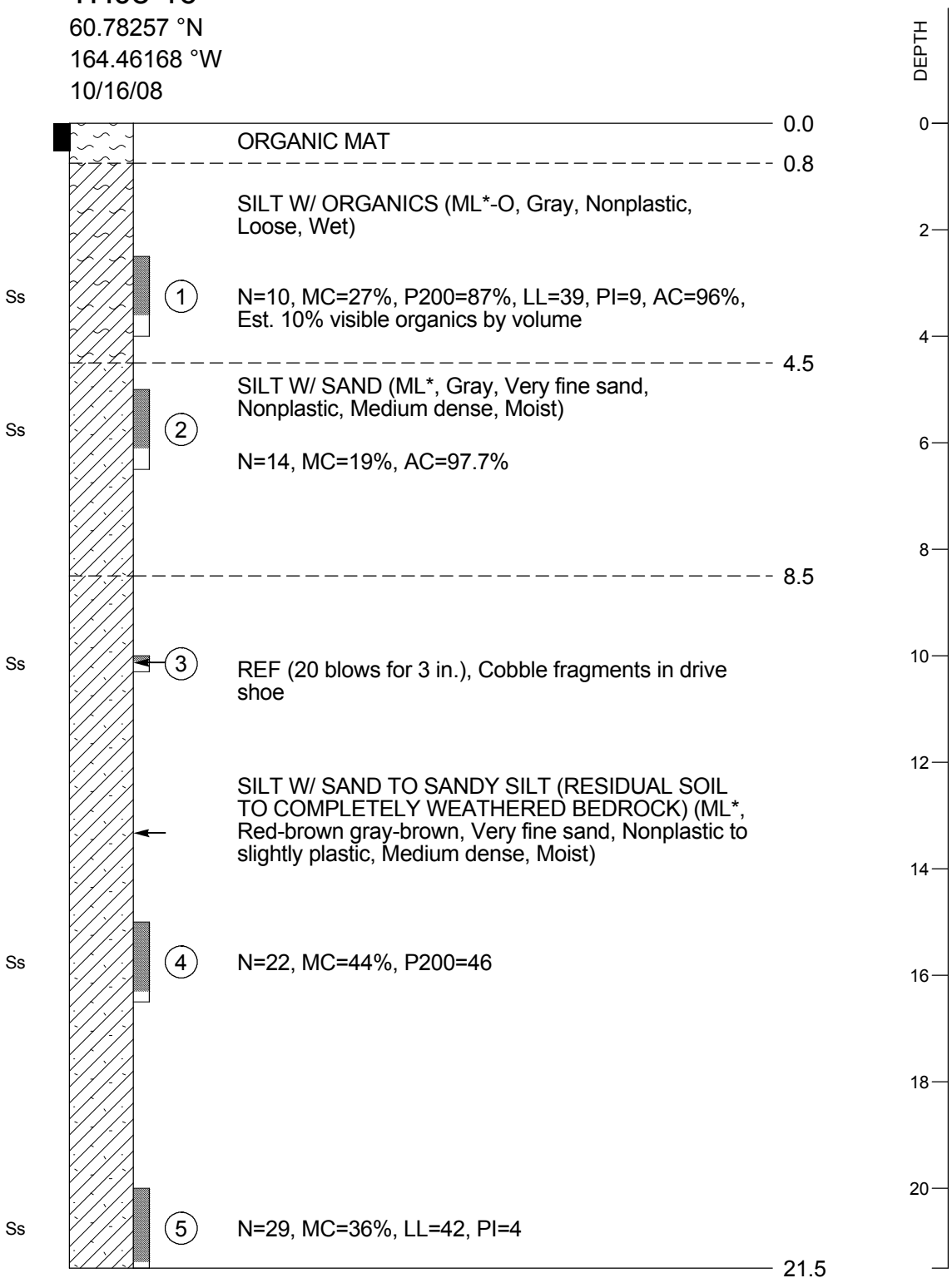
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 3
TH08-15

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-05

TH08-16

60.78257 °N
164.46168 °W
10/16/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below 8.5 to 14 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

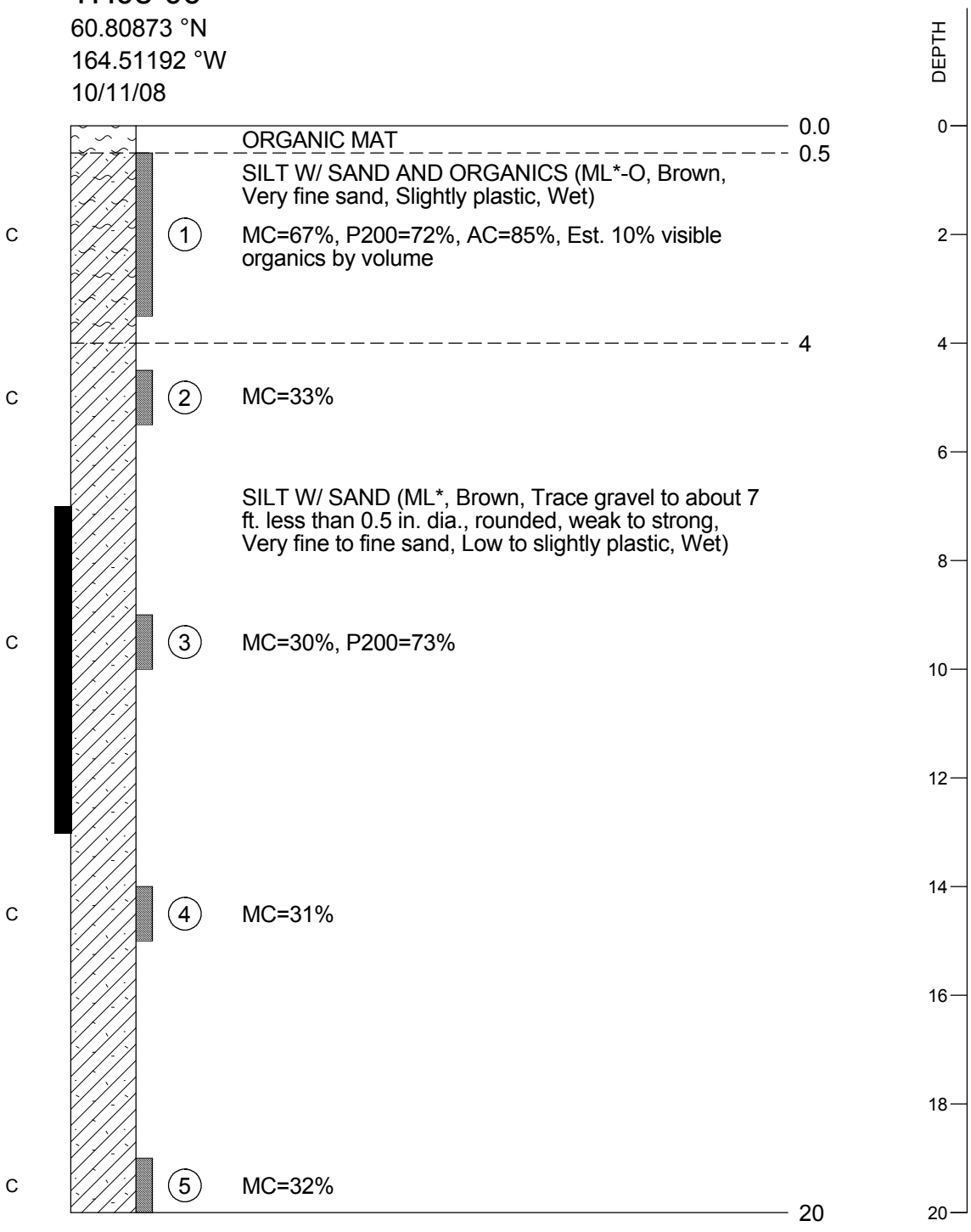
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 3
TH08-16

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-06

TH08-06

60.80873 °N
164.51192 °W
10/11/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

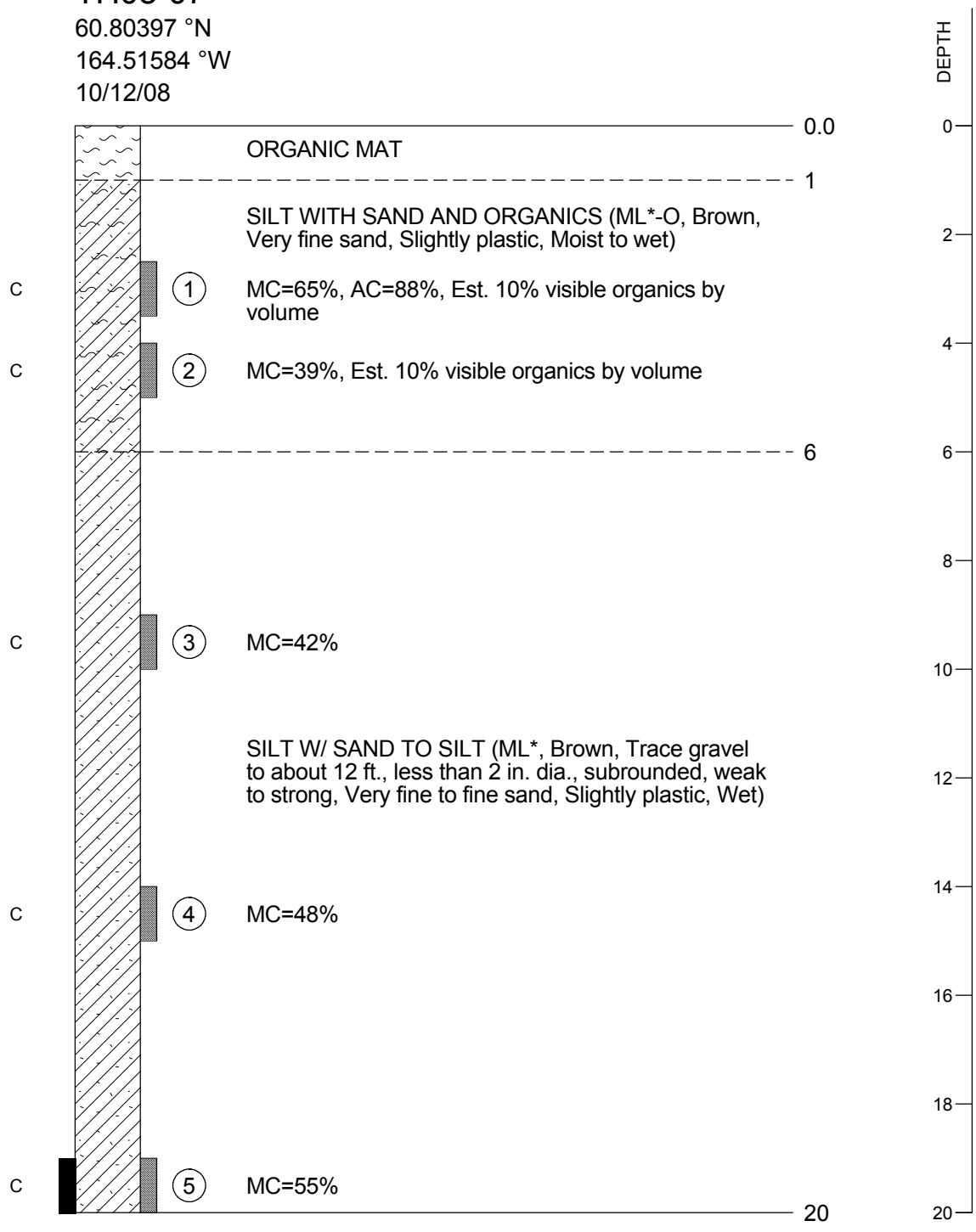
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-06

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-07

TH08-07

60.80397 °N
164.51584 °W
10/12/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

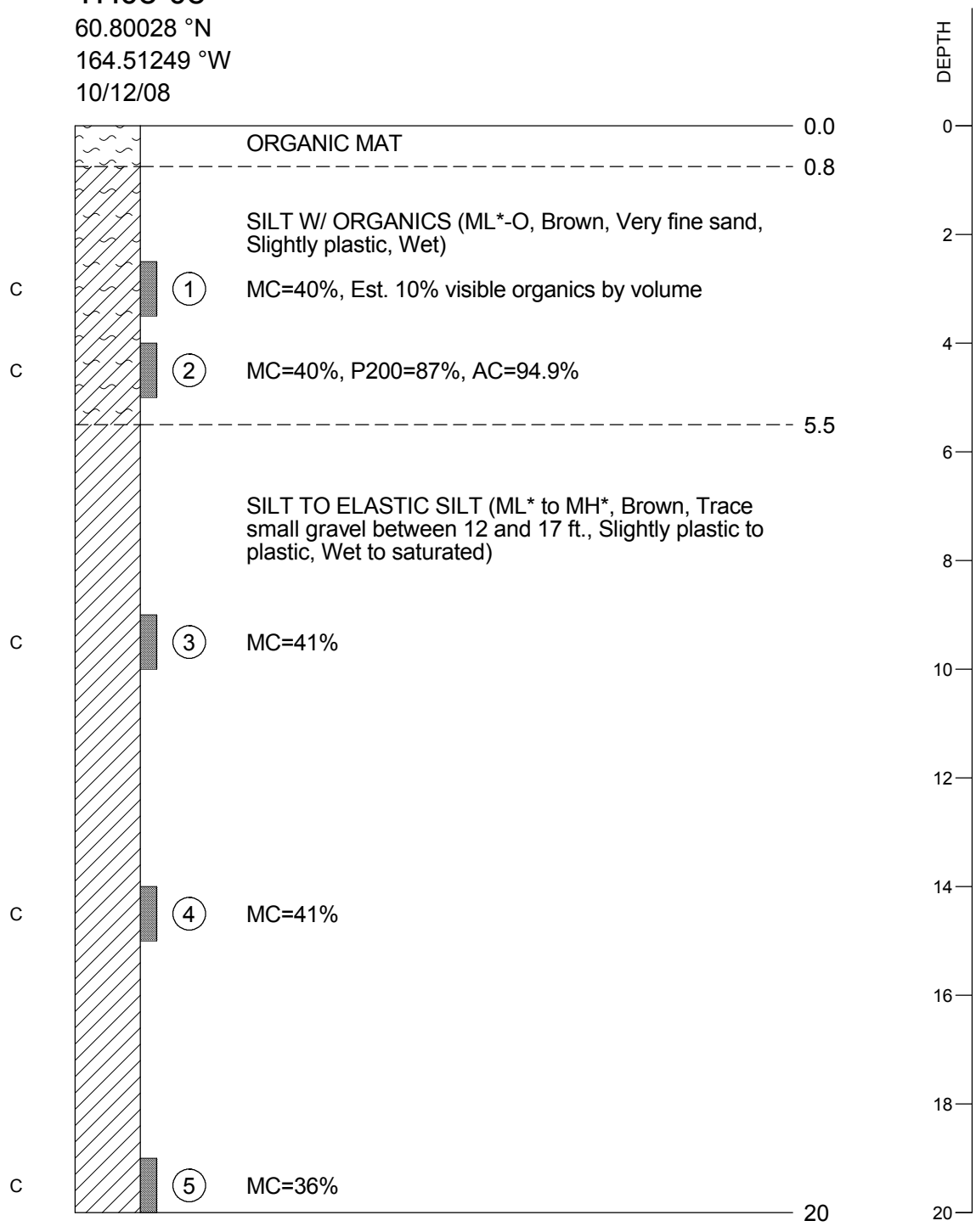
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-07

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-08

TH08-08

60.80028 °N
164.51249 °W
10/12/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

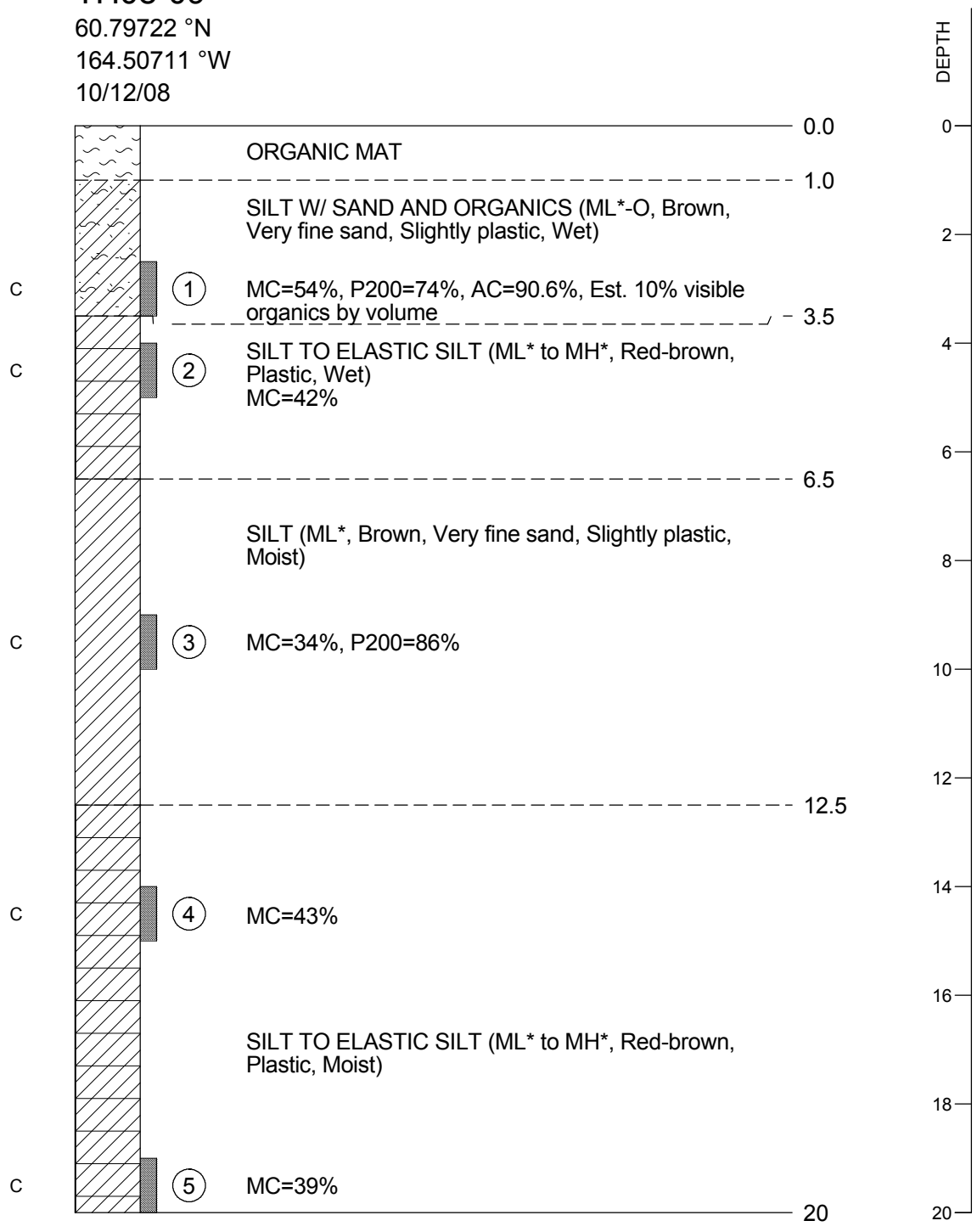
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-08

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-09

TH08-09

60.79722 °N
164.50711 °W
10/12/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

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MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/25/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

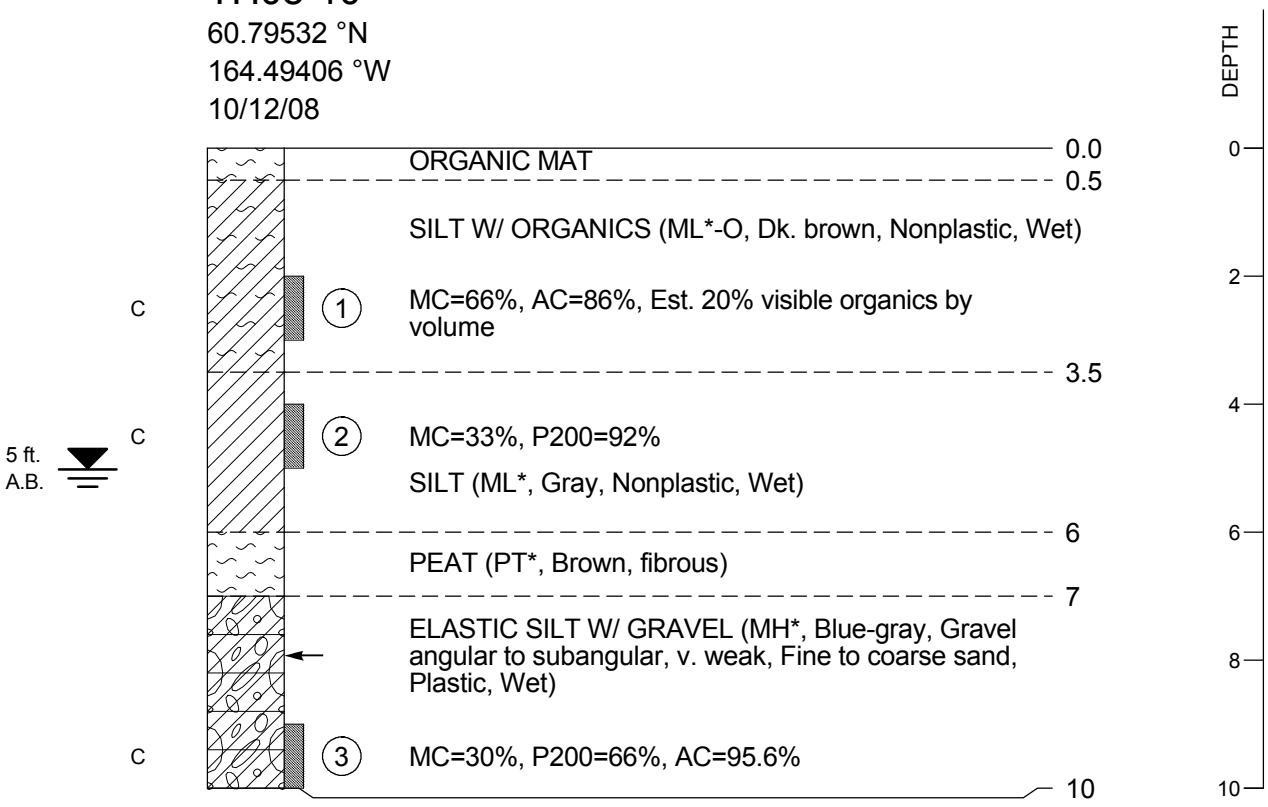
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-09

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-10

TH08-10

60.79532 °N
164.49406 °W
10/12/08



* Estimated group symbol (ASTM D 2488)
Cobble/boulder interpreted at 8 ft.
Auger refusal at 10 ft. Bedrock fragments taken from bit

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

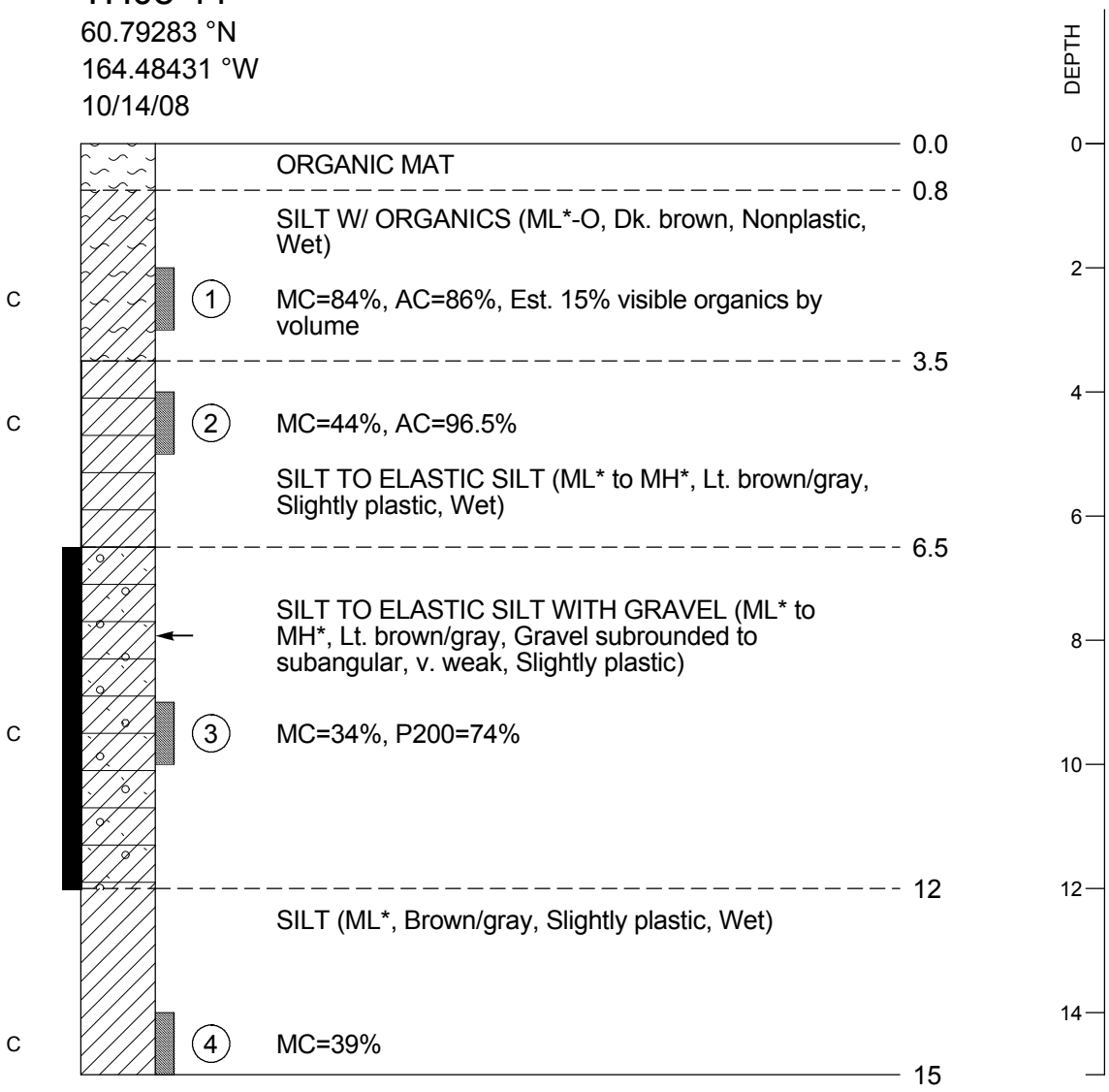
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-10

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-11

TH08-11

60.79283 °N
164.48431 °W
10/14/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Cobble/boulder interpreted at 8 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 3 ACCESS ROUTE
TH08-11

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	A-12

SUMMARY OF LABORATORY SOIL TEST RESULTS
Geotechnical Reconnaissance Investigation
Mertarvik Airport Location Study - Phase 3

Airport Site 3

SAMPLE IDENTIFICATION			PARTICLE SIZE ANALYSIS, % Finer (by mass)						ATTERBERG LIMITS Wet Prep (Dry Prep)			Moisture Content	Ash Content	USC
			Standard U.S. Sieve			Hydrometer (mm)								
Test Hole	No.	Depth, ft	#10	#40	#200	0.02	0.005	0.002	LL	PL	PI	%	%	
TH08-12	1	2.5 - 4			87							28	95.9	ML*-O
	2	5 - 6.5										32	95.6	ML*-O
TH08-13	1	2.5 - 4	100	87	73				33 (33)	(30)	(3)	184	91.1	ML
	2	5 - 6.5										37		
	3	10 - 10.9										30		
TH08-14	1	2.5 - 4										142	97.5	ML*
	2	5 - 6.5		100	98	66	27	16	29	23	6	60		ML
	3	10 - 11.5							60	41	19	73		MH*
	4	15 - 16.5	100	95	76	60	31	22	66	46	20	73	89.6	MH
	5	20 - 21.5										54		
TH08-15	1	2.5 - 4										81	94.7	ML*-O
	2	5 - 6.5	100		98	44	14	7.7	22	21	1	30	97.0	ML
	3	10 - 11.5										49		
	4	15 - 16.5	100		96	49	21	15	35	31	4	34	94.3	ML
	5	20 - 21.5			71							56		ML*/MH*
TH08-16	1	2.5 - 4	100	96	87				35 (39)	(30)	(9)	27	96.0	ML
	2	5 - 6.5										19	97.7	ML*
	4	15 - 16.5			46							44		
	5	20 - 21.5							42	38	4	36		ML*

* Estimated soil group following ASTM D 2488

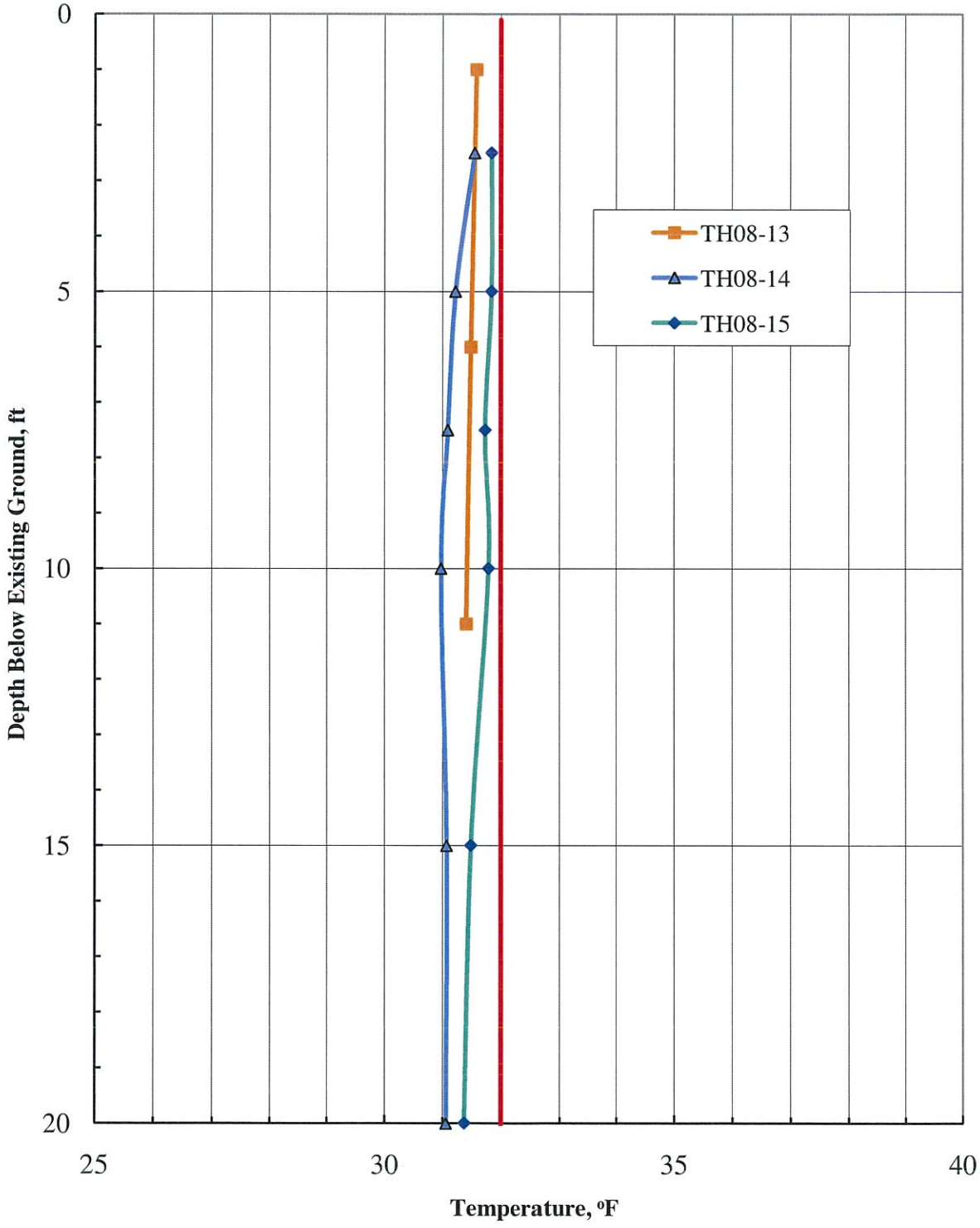
SUMMARY OF LABORATORY SOIL TEST RESULTS
Geotechnical Reconnaissance Investigation
Mertarvik Airport Location Study - Phase 3

Access Route to Site 3

SAMPLE IDENTIFICATION			PARTICLE SIZE ANALYSIS, % Finer (by mass)						ATTERBERG LIMITS Wet Prep (Dry Prep)			Moisture Content	Ash Content	USC
			Standard U.S. Sieve			Hydrometer (mm)								
Test Hole	No.	Depth, ft	#10	#40	#200	0.02	0.005	0.002	LL	PL	PI	%	%	
TH08-06	1	0.5 - 3.5			72							67	85.1	ML*-O
	2	4.5 - 5.5										33		
	3	9 - 10			73							30		ML*
	4	14 - 15										31		
	5	19 - 20										32		
TH08-07	1	2.5 - 3.5										65	88.3	ML*-O
	2	4 - 5										39		
	3	9 - 10										42		
	4	14 - 15										48		
	5	19 - 20										55		
TH08-08	1	2.5 - 3.5										40		
	2	4 - 5			87							40	94.9	ML*-O
	3	9 - 10										41		
	4	14 - 15										41		
	5	19 - 20										36		
TH08-09	1	2.5 - 3.5			74							54	90.6	ML*-O
	2	4 - 5										42		
	3	9 - 10			86							34		ML*
	4	14 - 15										43		
	5	19 - 20										39		
TH08-10	1	2 - 3										66	86.1	ML*-O
	2	4 - 5			92							33		ML*
	3	9 - 10			66							30	95.6	MH*
TH08-11	1	2 - 3										84	85.7	ML*-O
	2	4 - 5										44	96.5	ML*
	3	9 - 10			74							34		ML*
	4	14 - 15										39		

* Estimated soil group following ASTM D 2488

Mertarvik Airport Location Study, Phase 3
Geotechnical Reconnaissance Investigation
Ground Temperature Plots - Airport Site 3



Mertarvik Airport Location Study, Phase 3

Geotechnical Reconnaissance Investigation

Ground Temperature Measurements - Airport Site 3

TH08-13

String Installed

Date	Thermistor			R	Temperature	
(String)	No.	BS1, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1		0.02			
(RM8-1)	2		0.1			
	3		0.07			
	4	1.0	0.1	16,440	-0.2	31.6
	5	6.0	0.07	16,510	-0.3	31.5
	6	11.0	0.09	16,530	-0.3	31.4

TH08-14

String Installed

Date	Thermistor			R	Temperature	
(String)	No.	BS1, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1	2.5	0.06	16,490	-0.3	31.5
(RM8-2)	2	5.0	0.04	16,660	-0.4	31.2
	3	7.5	0.09	16,680	-0.5	31.1
	4	10.0	0.05	16,770	-0.6	31.0
	5	15.0	0.02	16,750	-0.5	31.1
	6	20.0	0.05	16,730	-0.5	31.1

TH08-15

String Installed

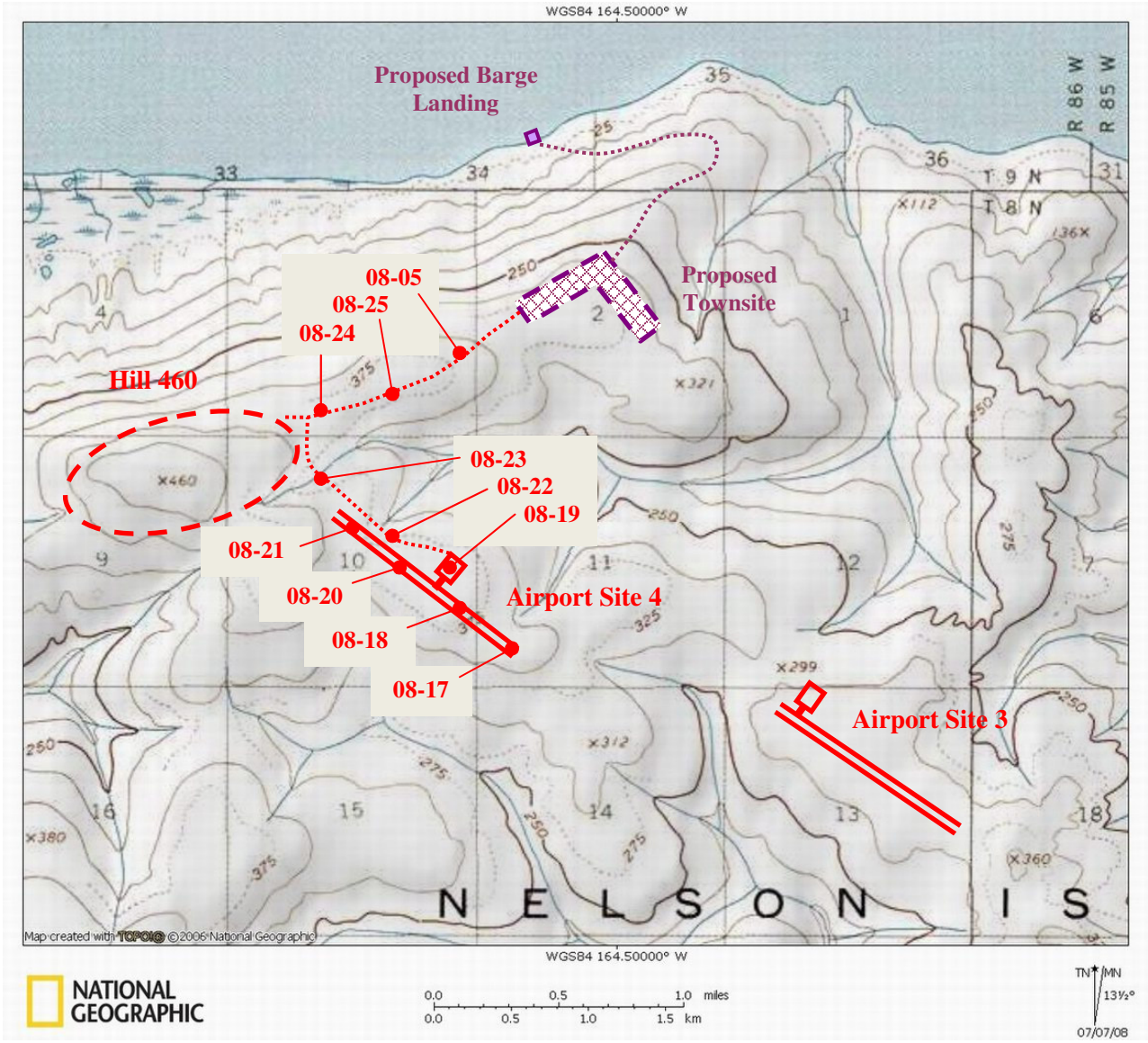
Date	Thermistor			R	Temperature	
(String)	No.	BG, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1	2.5	0.09	16,330	-0.1	31.8
(RM8-3)	2	5.0	0.09	16,330	-0.1	31.8
	3	7.5	0.02	16,440	-0.2	31.7
	4	10.0	0.01	16,420	-0.1	31.8
	5	15.0	0.06	16,520	-0.3	31.5
	6	20.0	0.04	16,590	-0.3	31.4

$$\text{Temp, } ^{\circ}C = [a+b*\ln R+c*(\ln R)^3]^{-1}-273.15-CF$$

	YSI 44034
a =	0.0012818350
b =	0.0002366900
c =	0.0000000910

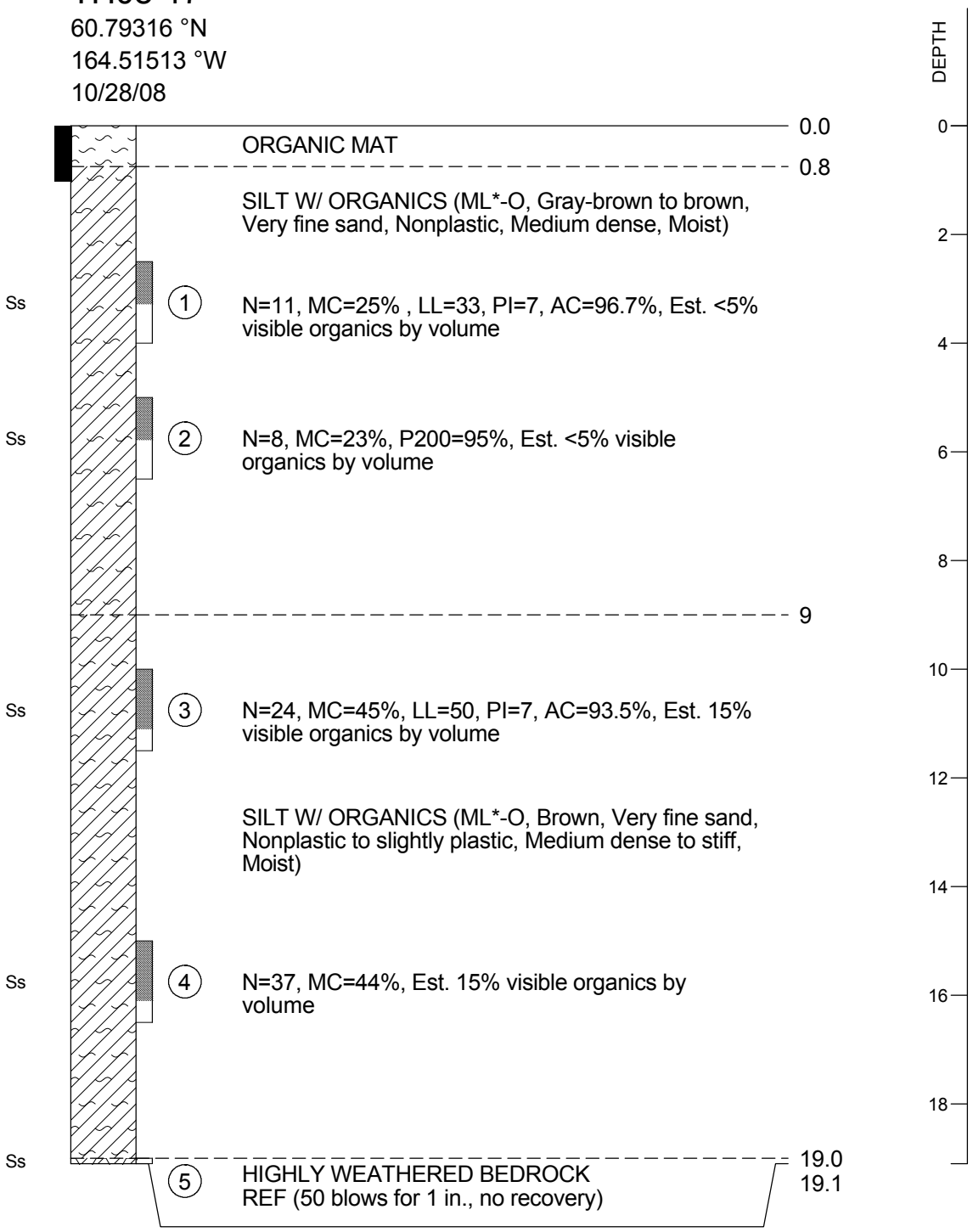
APPENDIX B

AIRPORT SITE 4 EXPLORATIONS


WGS84 164.50000° W
Proposed Barge Landing
Proposed Townsite
08-05
08-25
08-24
Hill 460
08-23
08-22
08-19
08-21
08-20
08-18
08-17
Airport Site 4
Airport Site 3
R 86 W
R 85 W
T 9 N
T 8 N
N E L S O N I S
Map created with TOPO! ©2006 National Geographic
WGS84 164.50000° W
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
TN MN
13½°
07/07/08

TH08-17

60.79316 °N
164.51513 °W
10/28/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 19 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/25/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

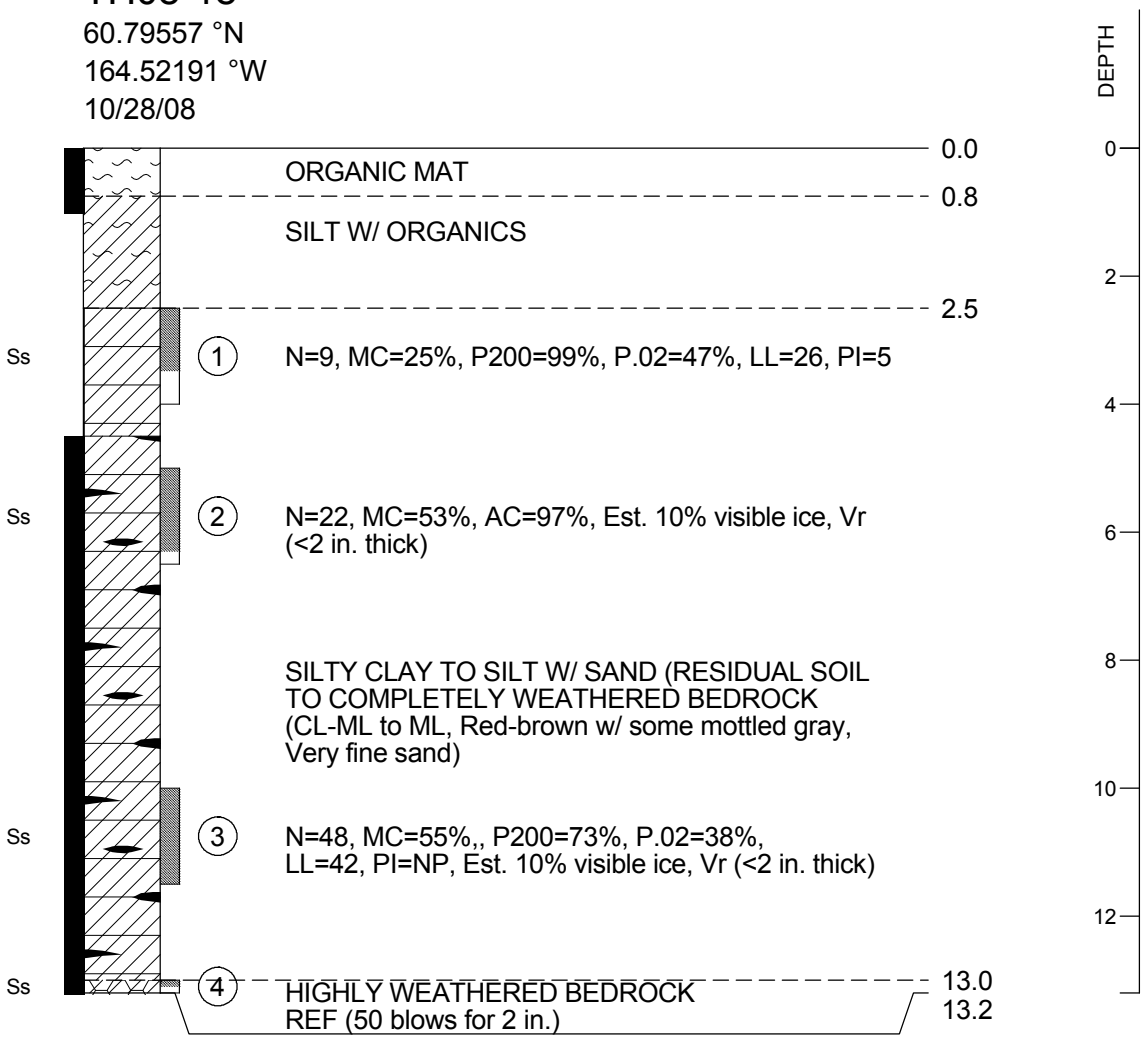
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 4
TH08-17

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-02

TH08-18

60.79557 °N
164.52191 °W
10/28/08



No groundwater observed
Auger refusal at 13 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/25/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

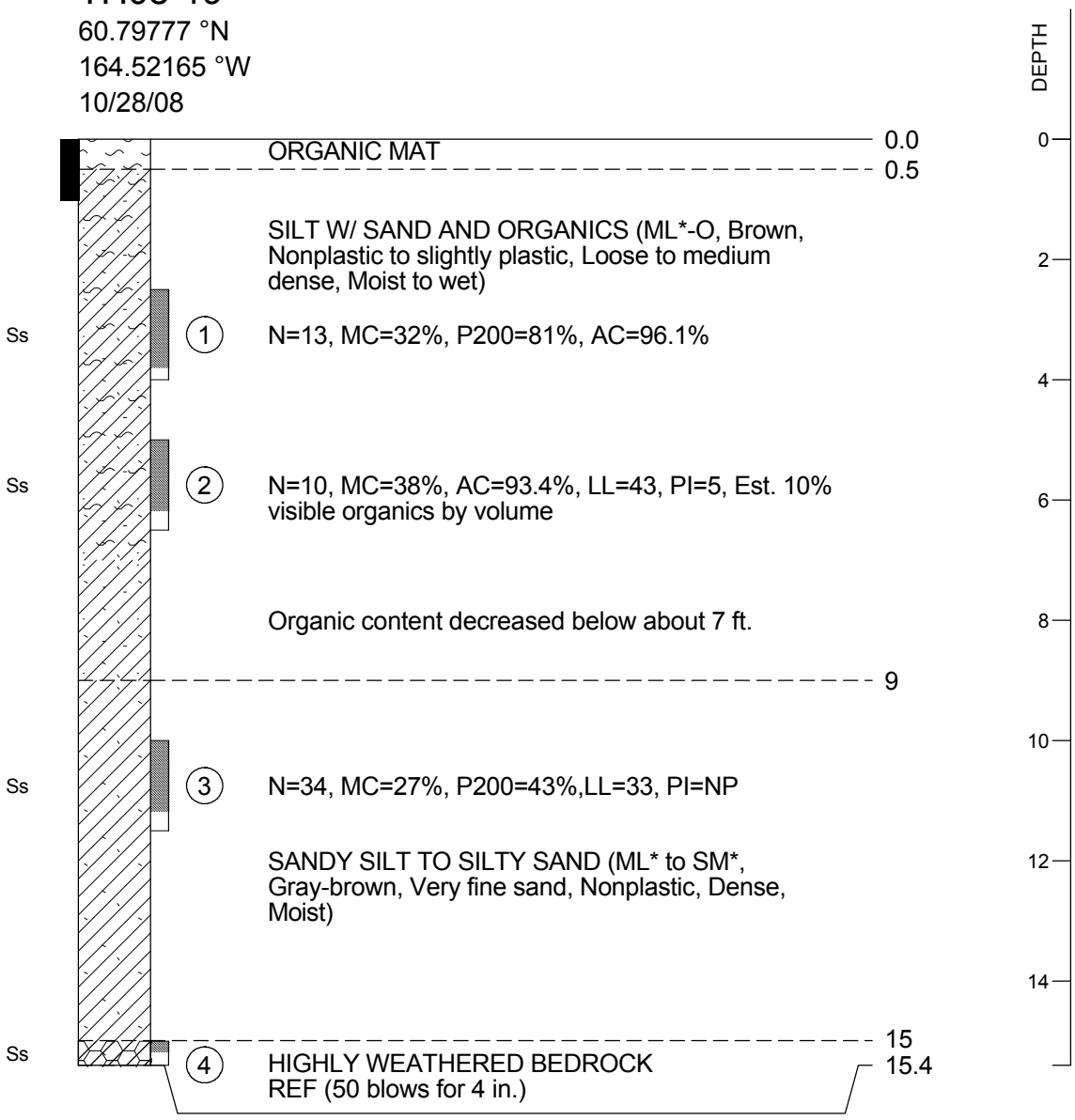
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 4
TH08-18

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-03

TH08-19

60.79777 °N
164.52165 °W
10/28/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 15.4 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

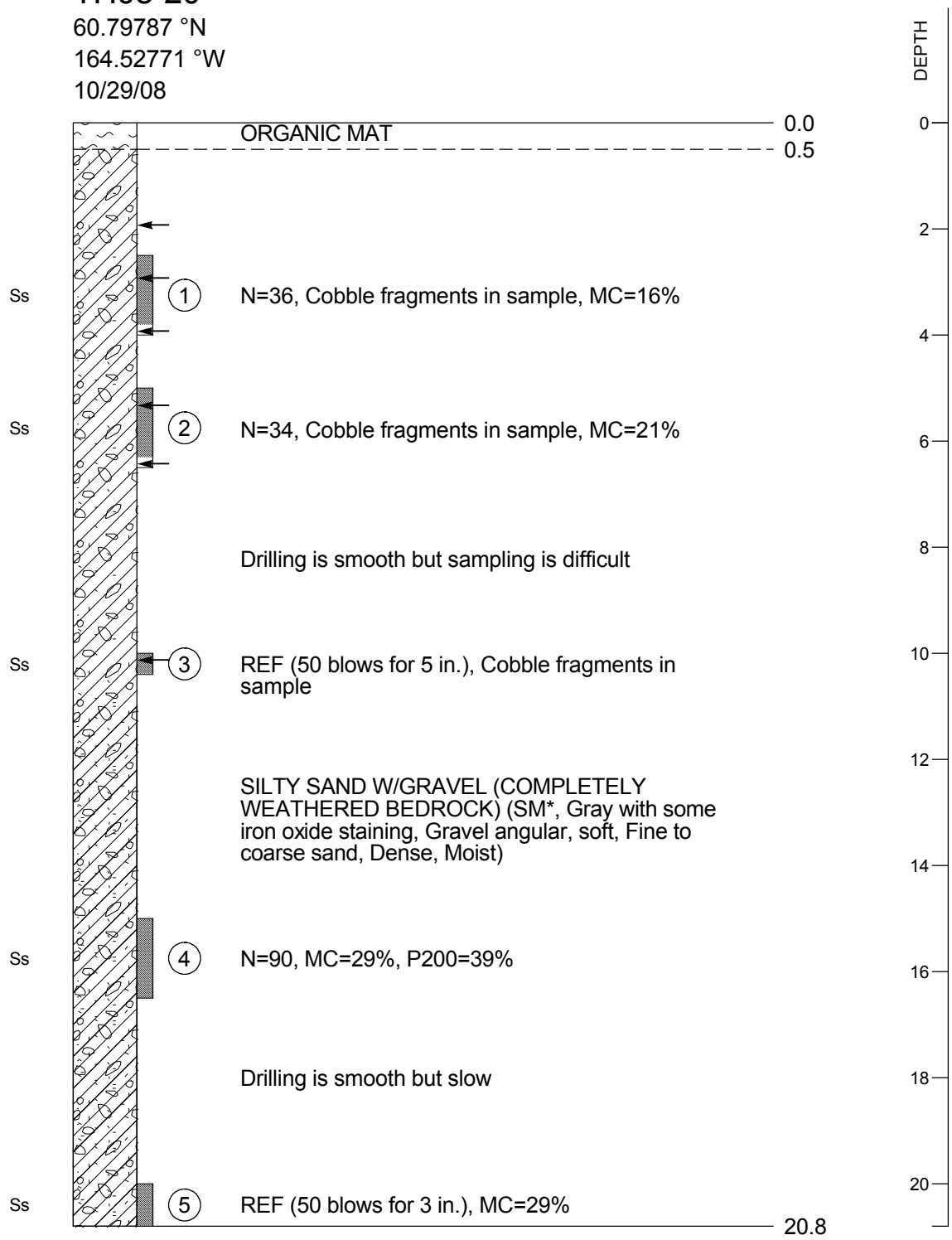
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 4
TH08-19

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-04

TH08-20

60.79787 °N
164.52771 °W
10/29/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below 2 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

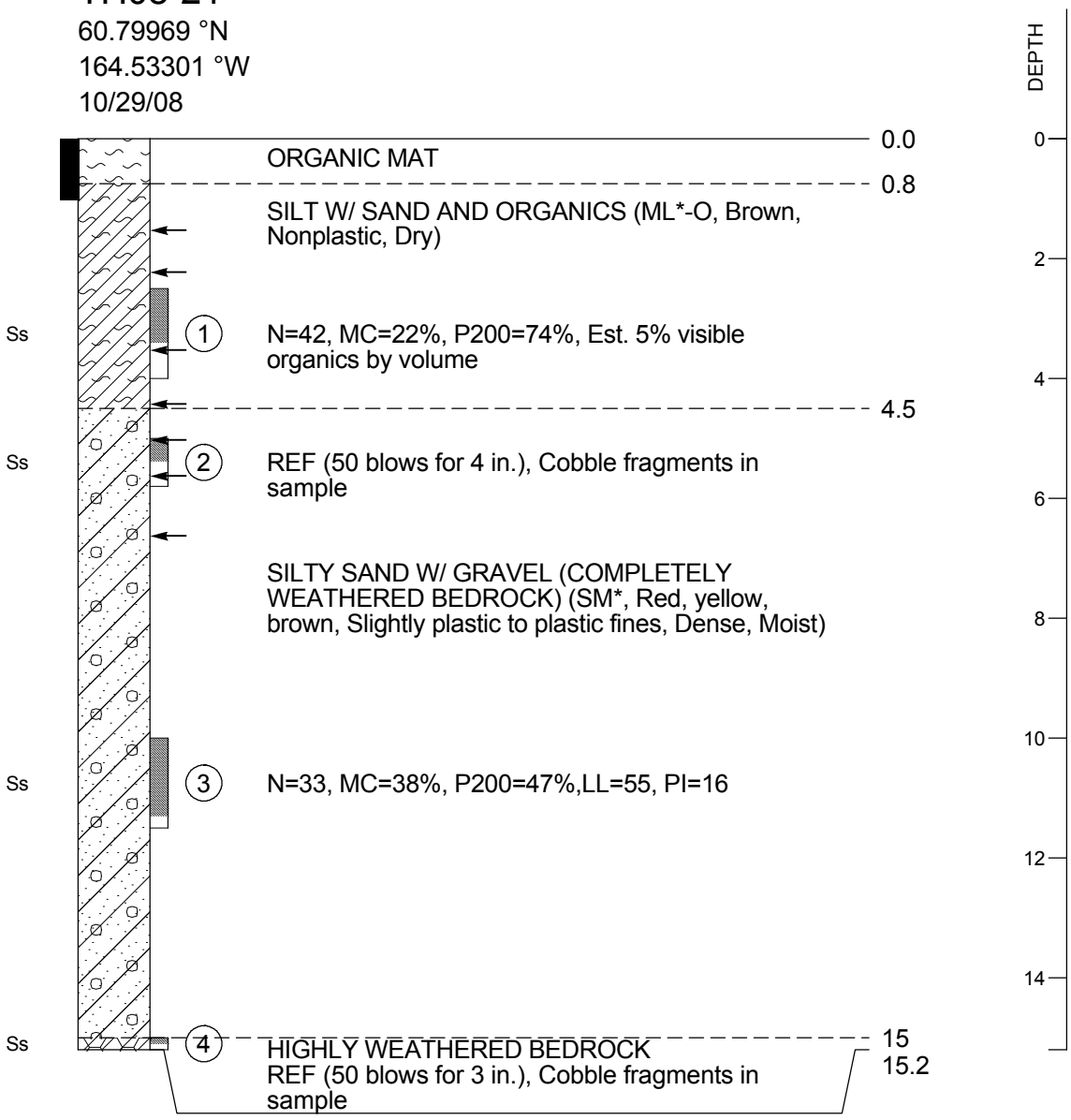
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 4
TH08-20

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-05

TH08-21

60.79969 °N
164.53301 °W
10/29/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Cobbles and boulders interpreted from surface to about 7 ft.
Auger refusal at 15.2 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

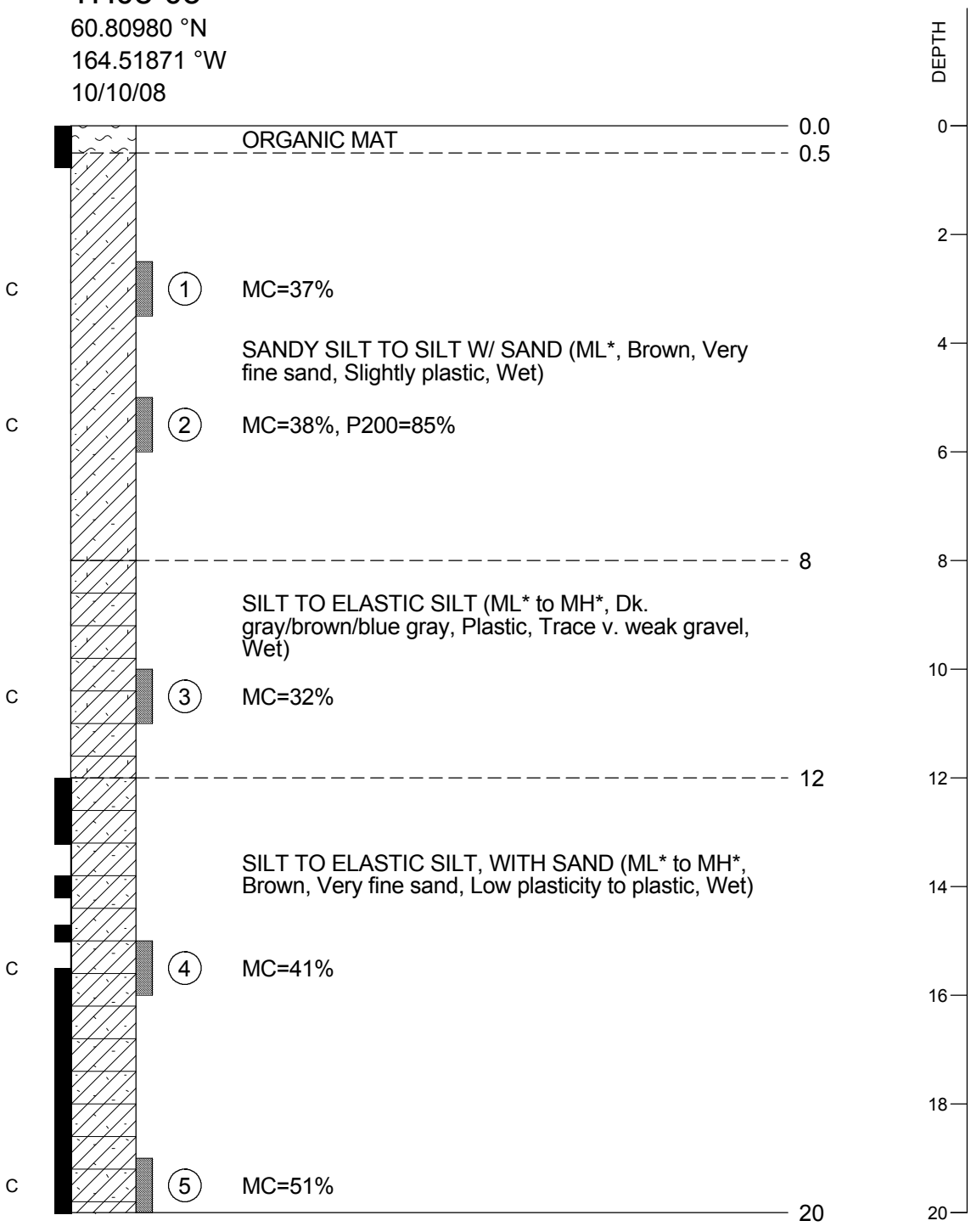
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
AIRPORT SITE 4
TH08-21

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-06

TH08-05

60.80980 °N
164.51871 °W
10/10/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Drilling action indicated discontinuous permafrost from 12 ft. to approx. 15.5 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/24/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

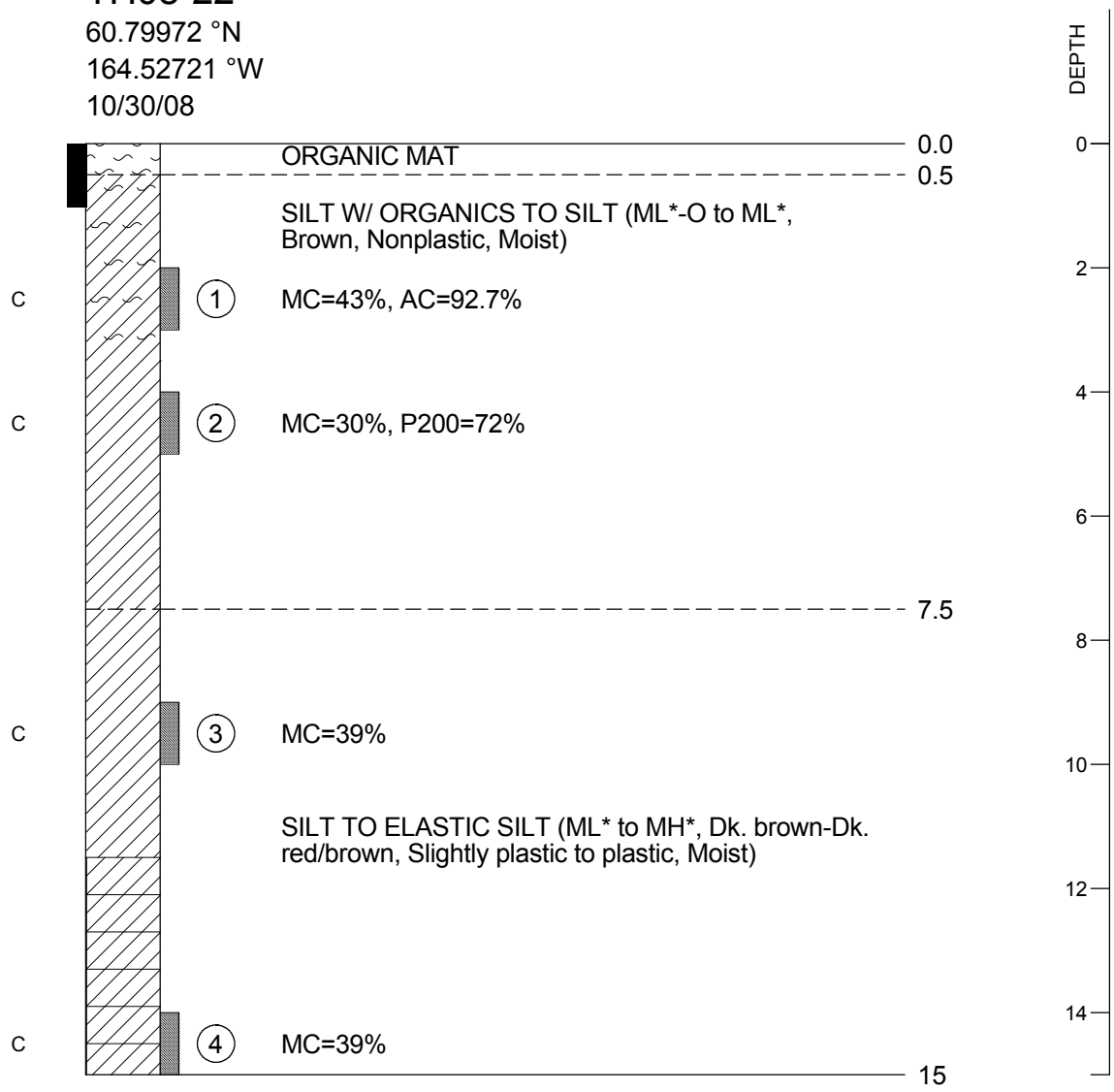
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 4 ACCESS ROUTE
TH08-05

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-07

TH08-22

60.79972 °N
164.52721 °W
10/30/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/26/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

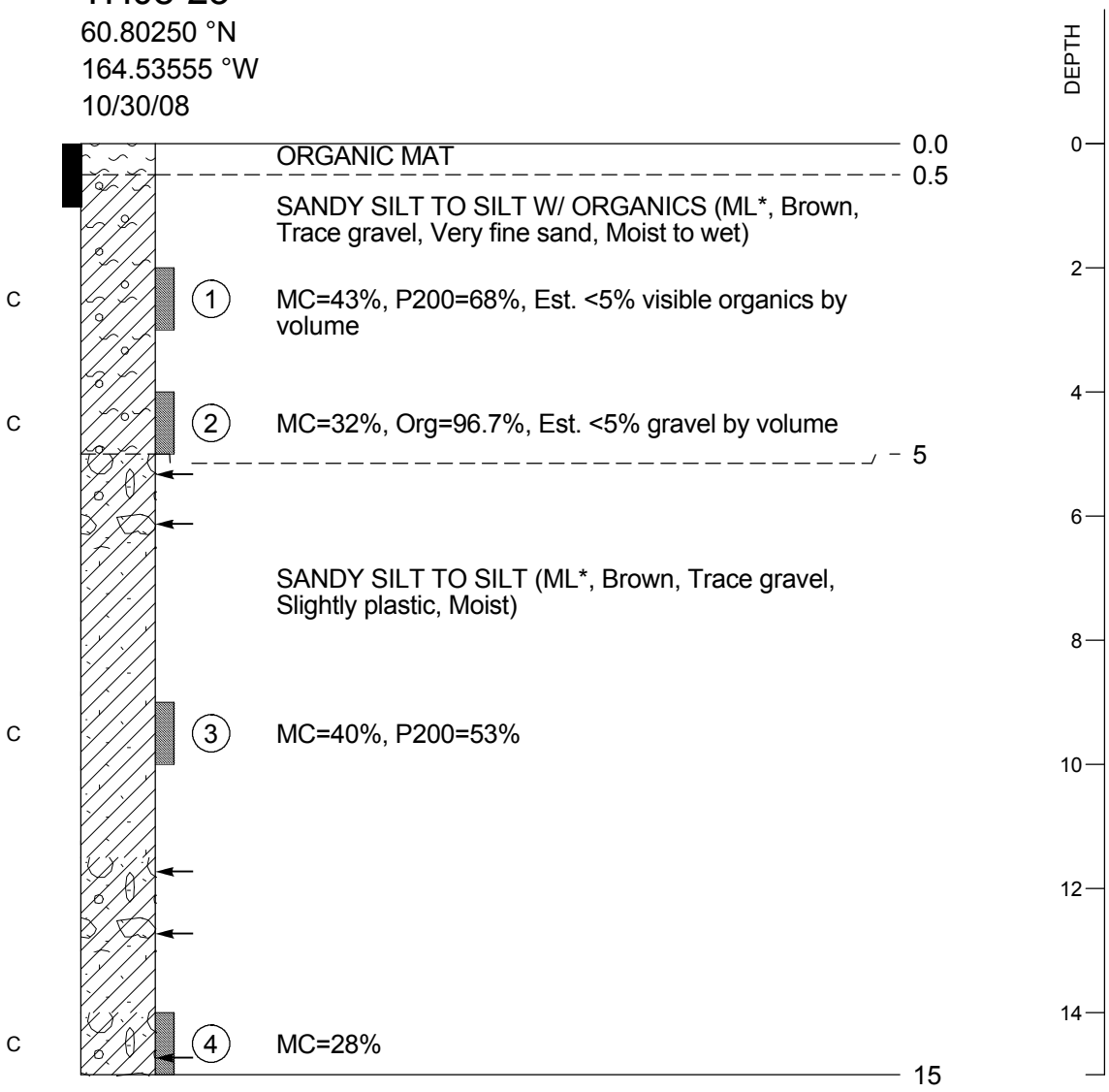
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 4 ACCESS ROUTE
TH08-22

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-08

TH08-23

60.80250 °N
164.53555 °W
10/30/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below about 5 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/26/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

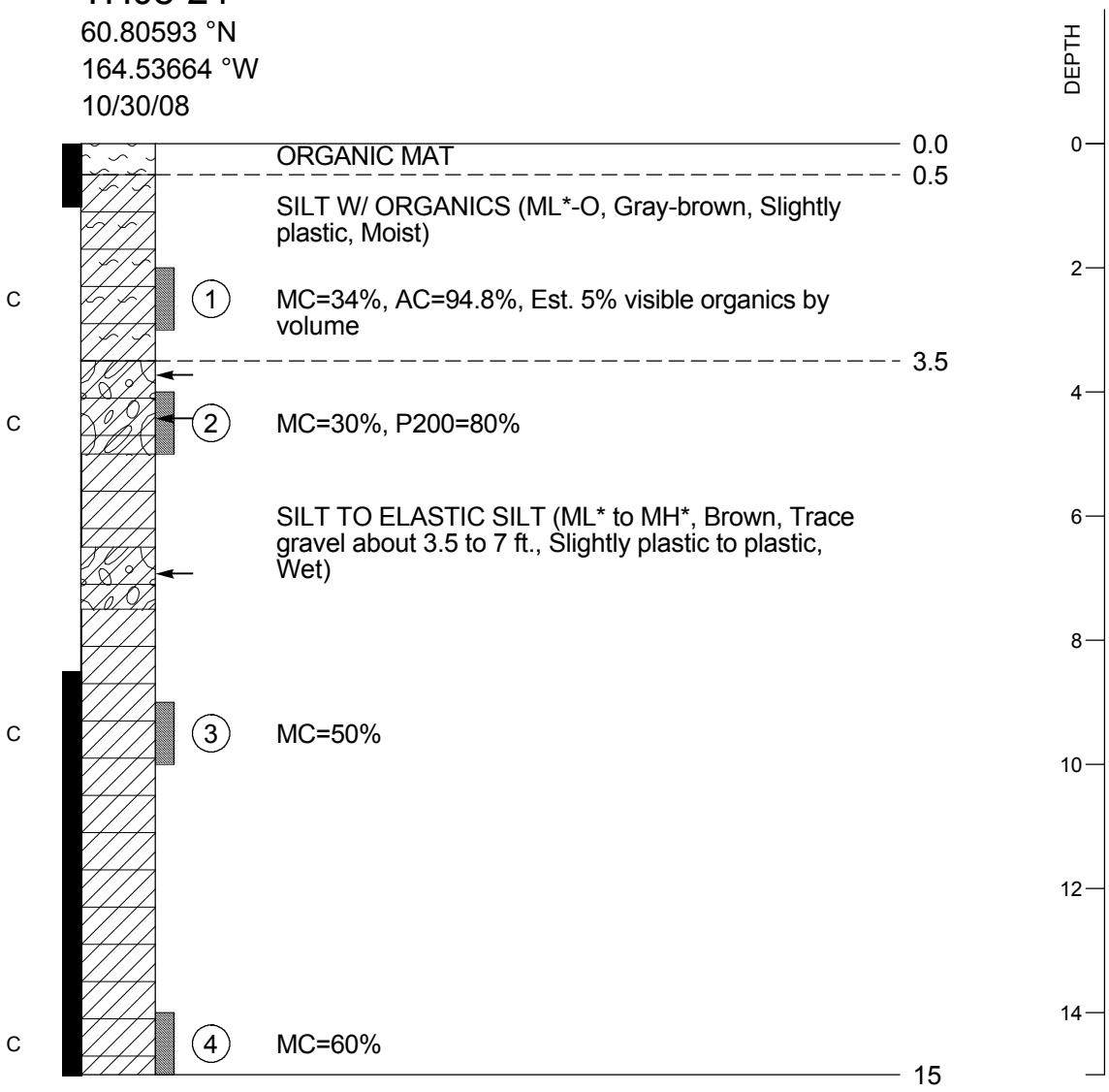
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 4 ACCESS ROUTE
TH08-23

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-09

TH08-24

60.80593 °N
164.53664 °W
10/30/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below about 5 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK AIRPORT AND ROADS.GPJ

MASTER ONE COL/PAGE MERTARVIK AIRPORT AND ROADS.GPJ MASTER2.GDT 3/26/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

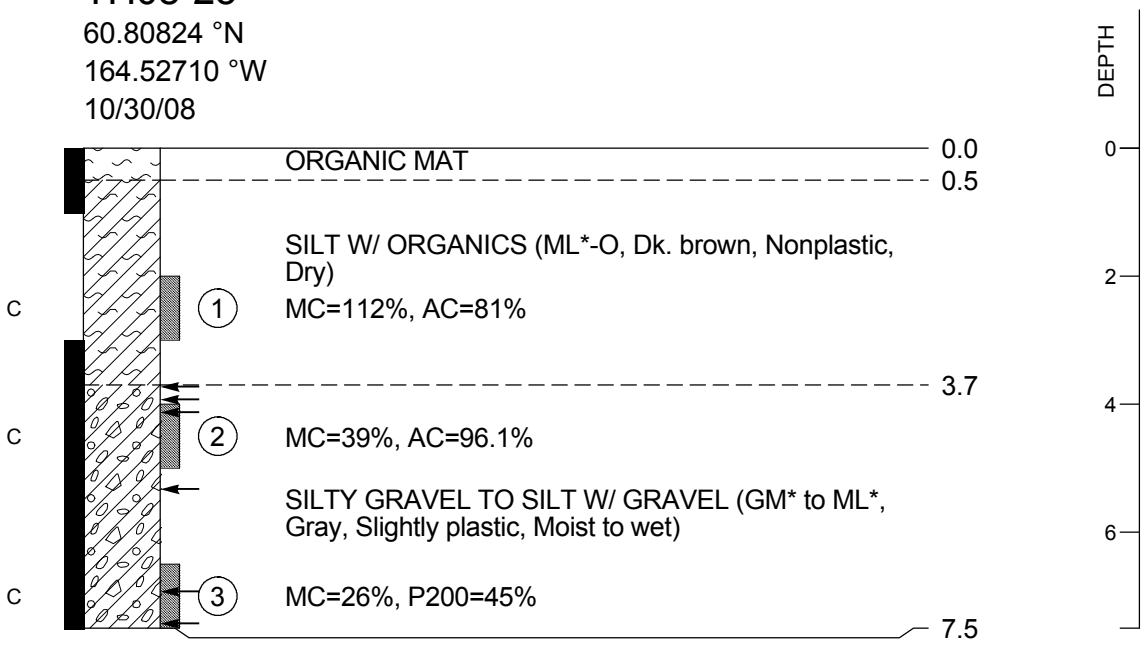
PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 4 ACCESS ROUTE
TH08-24

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-10

TH08-25

60.80824 °N
164.52710 °W
10/30/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Scattered cobbles and boulders interpreted below about 4 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

PREPARED BY: R&M CONSULTANTS, INC.

AIRPORT RECONNAISSANCE STUDY
MERTARVIK, ALASKA
SITE 4 ACCESS ROUTE
TH08-25

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	B-11

SUMMARY OF LABORATORY SOIL TEST RESULTS
Geotechnical Reconnaissance Investigation
Mertarvik Airport Location Study - Phase 3

Airport Site 4

SAMPLE IDENTIFICATION			PARTICLE SIZE ANALYSIS, % Finer (by mass)						ATTERBERG LIMITS Wet Prep (Dry Prep)			Moisture Content	Ash Content	USC
			Standard U.S. Sieve			Hydrometer (mm)								
Test Hole	No.	Depth, ft	#10	#40	#200	0.02	0.005	0.002	LL	PL	PI	%	%	
TH08-17	1	2.5 - 4							32 (33)	(26)	(7)	25	96.7	ML*-O
	2	5 - 6.5			95							23		
	3	10 - 11.5							49 (50)	(43)	(7)	45	93.5	ML*-O
	4	15 - 16.5										44		
TH08-18	1	2.5 - 4	100		99	47	16	9.8	26	21	5	25		CL-ML
	2	5 - 6.5										53	97.0	
	3	10 - 11.5	100		73	38	15	4.2	42	nv	np	55		ML
TH08-19	1	2.5 - 4			81							32	96.1	ML*-O
	2	5 - 6.5							46 (43)	(38)	(5)	38	93.4	ML*-O
	3	10 - 11.5			43				33	nv	np	27		SM*
TH08-20	1	2.5 - 4										16		
	2	5 - 6.5										21		
	4	15 - 16.5			39							29		SM*
	5	20 - 20.8										29		
TH08-21	1	2.5 - 4			74							22		
	3	10 - 11.5			47				55	39	16	38		MH*

* Estimated soil group following ASTM D 2488

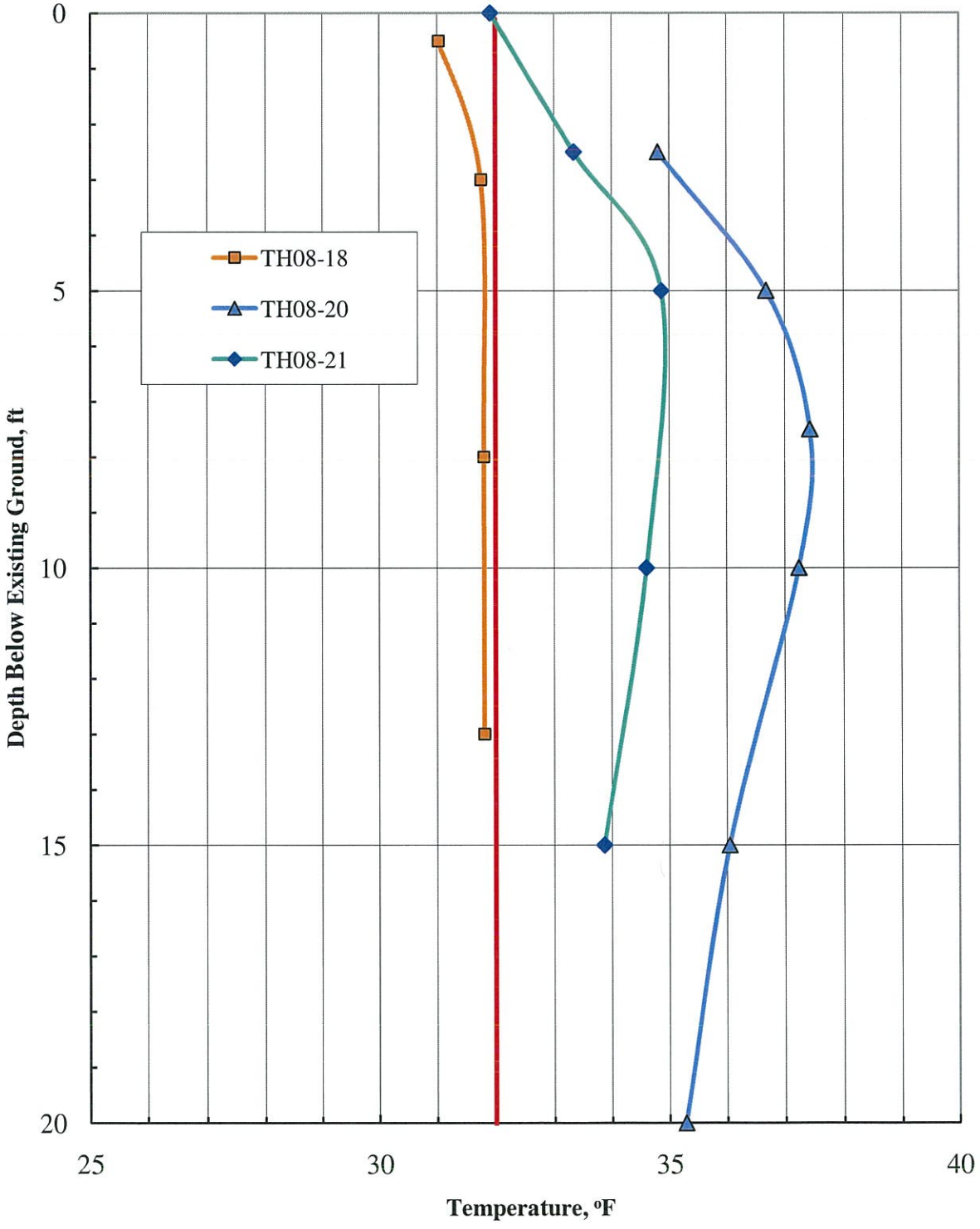
SUMMARY OF LABORATORY SOIL TEST RESULTS
Geotechnical Reconnaissance Investigation
Mertarvik Airport Location Study - Phase 3

Access Route to Airport Site 4

SAMPLE IDENTIFICATION			PARTICLE SIZE ANALYSIS, % Finer (by mass)						ATTERBERG LIMITS			Moisture Content	Organic Content	USC
			Standard U.S. Sieve			Hydrometer (mm)			Wet Prep (Dry Prep)					
Test Hole	No.	Depth, ft	#10	#40	#200	0.02	0.005	0.002	LL	PL	PI	%	%	
TH08-05	1	2.5 - 3.5										37		
	2	5 - 6			85							38		ML*
	3	10 - 11										32		
	4	15 - 16										41		
	5	19 - 20										51		
TH08-22	1	2 - 3										43	92.7	ML*-O
	2	4 - 5			72							30		ML*
	3	9 - 10										39		
	4	14 - 15										39		
TH08-23	1	2 - 3			68							43		
	2	4 - 5										32	96.7	ML*-O
	3	9 - 10			53							40		ML*
	4	14 - 15										28		
TH08-24	1	2 - 3										34	94.8	ML*-O
	2	4 - 5			80							30		ML*
	3	9 - 10										50		
	4	14 - 15										60		
TH08-25	1	2 - 3										112	81.1	ML*-O
	2	4 - 5										39	96.1	
	3	6.5 - 7.5			45							26		

* Estimated soil group following ASTM D 2488

Mertarvik Airport Location Study, Phase 3
Geotechnical Reconnaissance Investigation
Ground Temperature Plots - Airport Site 4



Mertarvik Airport Location Study, Phase 3

Geotechnical Reconnaissance Investigation

Ground Temperature Measurements - Airport Site 4

RM 08-18

String Installed

Date	Thermistor			R	Temperature	
(String)	No.	BG, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1					
(RM8-6)	2					
	3	0.5	0.08	16,720	-0.5	31.0
	4	3.0	0.1	16,360	-0.1	31.8
	5	8.0	0.05	16,380	-0.1	31.8
	6	13.0	0.07	16,360	-0.1	31.8

RM 08-20

String Installed

Date	Thermistor			R	Temperature	
(String)	No.	BS1, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1	2.5	0.05	15,050	1.6	34.8
(RM8-5)	2	5.0	0.09	14,250	2.6	36.7
	3	7.5	0.1	13,950	3.0	37.4
	4	10.0	0.09	14,030	2.9	37.2
	5	15.0	0.07	14,520	2.2	36.0
	6	20.0	0.02	14,870	1.8	35.3

RM 08-21

String Installed

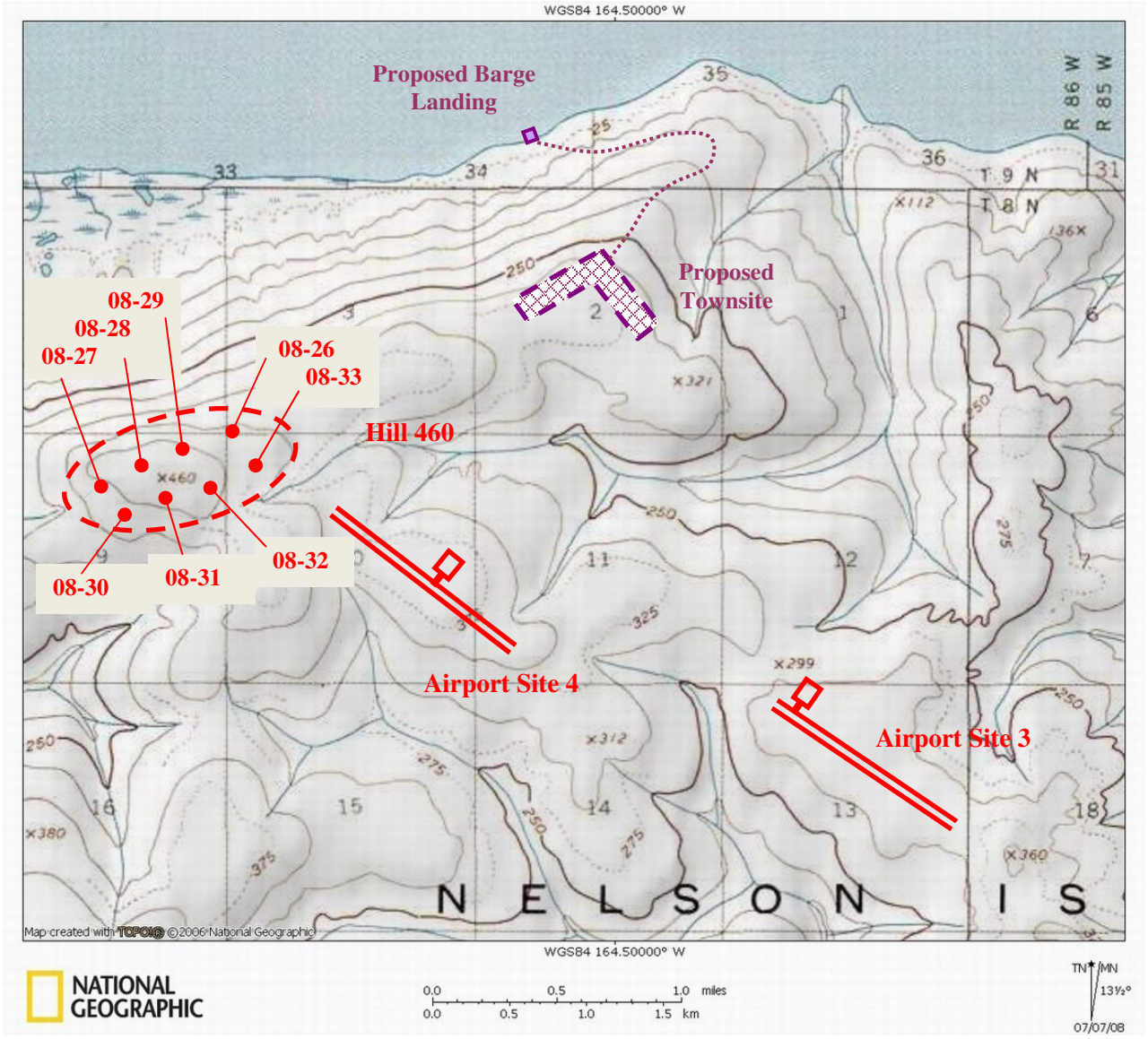
Date	Thermistor			R	Temperature	
(String)	No.	BS1, ft	CF, °C	Ohms	°C	°F
2 Nov '08	1					
(RM8-4)	2	0.0		16,370	0.0	31.9
	3	2.5		15,720	0.7	33.3
	4	5.0		15,060	1.6	34.9
	5	10.0		15,170	1.4	34.6
	6	15.0		15,490	1.0	33.9

Temp, $°C = [a+b*\ln R+c*(\ln R)^3]^{-1}-273.15-CF$

	YSI 44034
a =	0.0012818350
b =	0.0002366900
c =	0.0000000910

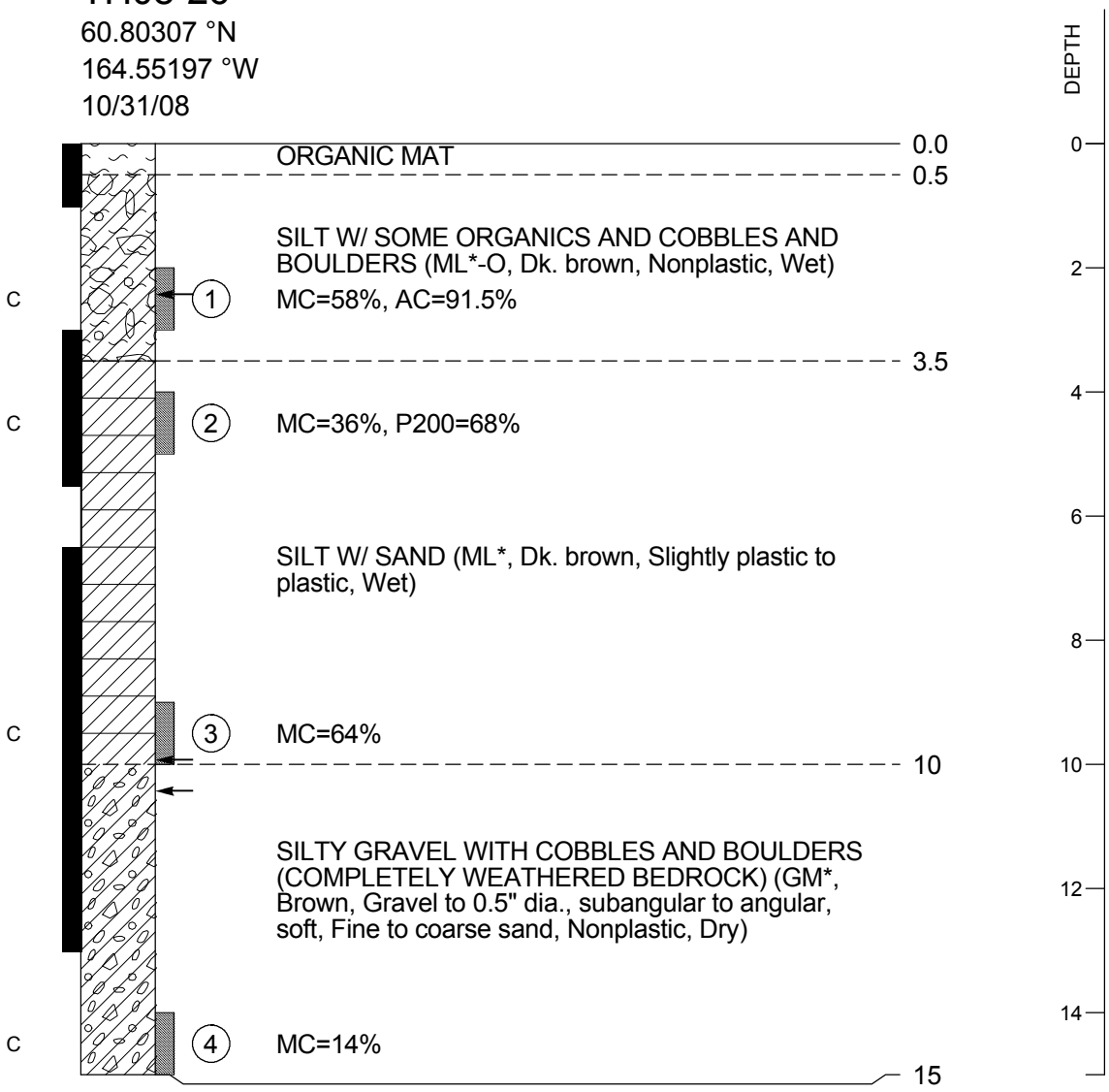
APPENDIX C

HILL 460 EXPLORATIONS


WGS84 164.50000° W
Proposed Barge Landing
Proposed Townsite
08-29
08-28
08-27
08-26
08-33
Hill 460
08-32
08-31
08-30
Airport Site 4
Airport Site 3
R 86 W
R 85 W
T 9 N
T 8 N
N E L S O N I S
Map created with TOPO! ©2006 National Geographic
WGS84 164.50000° W
NATIONAL GEOGRAPHIC
0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km
TN MN
13½°
07/07/08

TH08-26

60.80307 °N
164.55197 °W
10/31/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 15 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK QUARRY.GPJ

MASTER ONE COL/PAGE MERTARVIK QUARRY.GPJ MASTER2.GDT 4/1/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

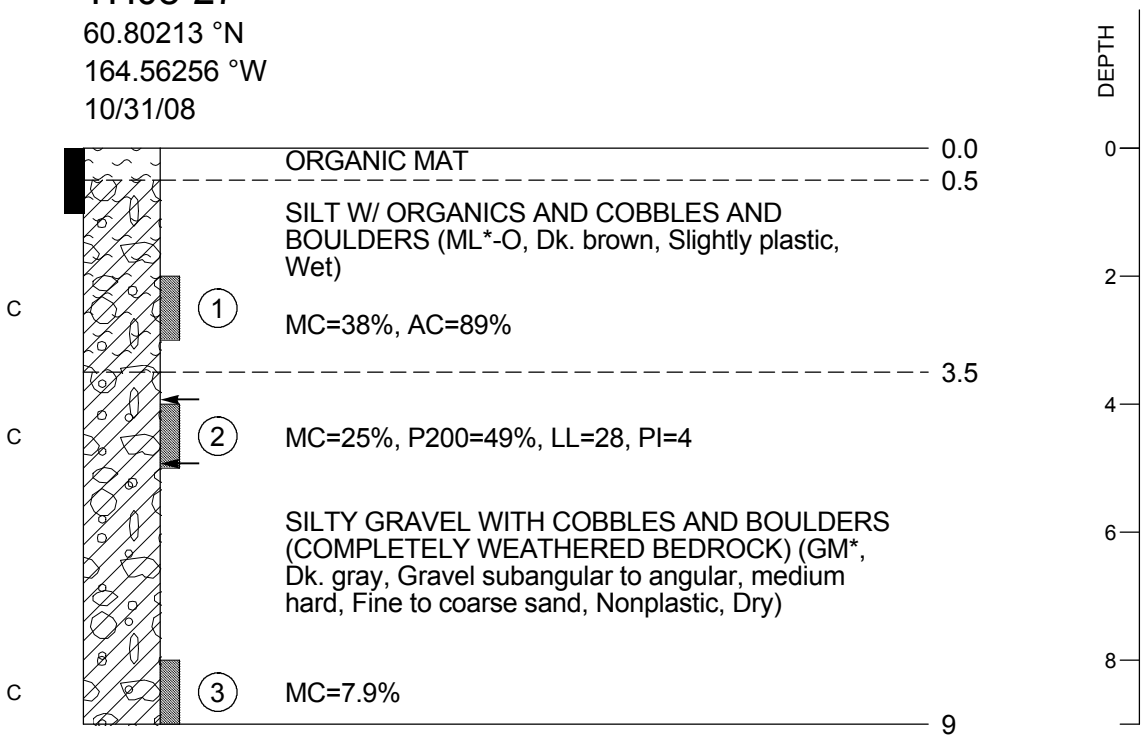
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-26

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-02

TH08-27

60.80213 °N
164.56256 °W
10/31/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 9 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK QUARRY.GPJ

MASTER ONE COL/PAGE MERTARVIK QUARRY.GPJ MASTER2.GDT 4/1/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

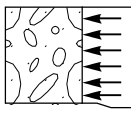
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-27

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-03

TH08-28

60.80234 °N
164.55901 °W
10/31/08



0.0

COBBLES AND BOULDERS, Sparse oganic overburden and numerous cobbles and boulders on the surface.

1.5

DEPTH
0

No groundwater observed
Auger refusal at 1.5 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK QUARRY.GPJ

MASTER ONE COL/PAGE MERTARVIK QUARRY.GPJ MASTER2.GDT 4/1/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

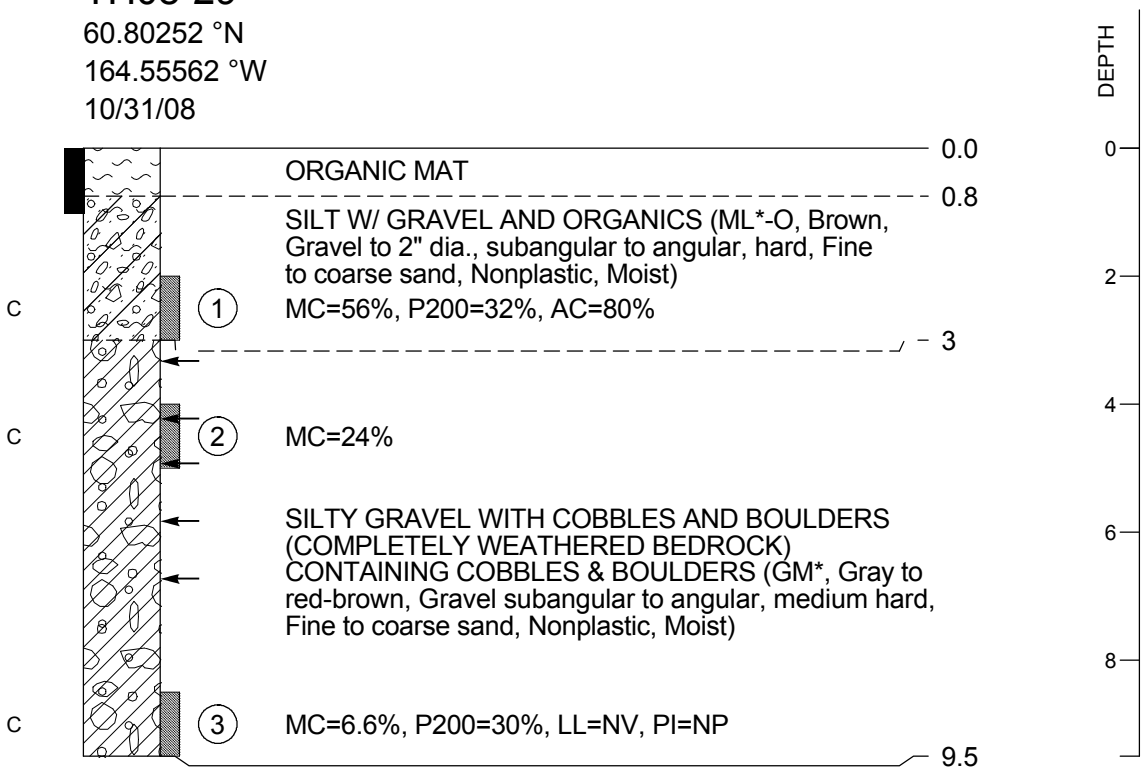
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-28

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-04

TH08-29

60.80252 °N
164.55562 °W
10/31/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 9.5 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

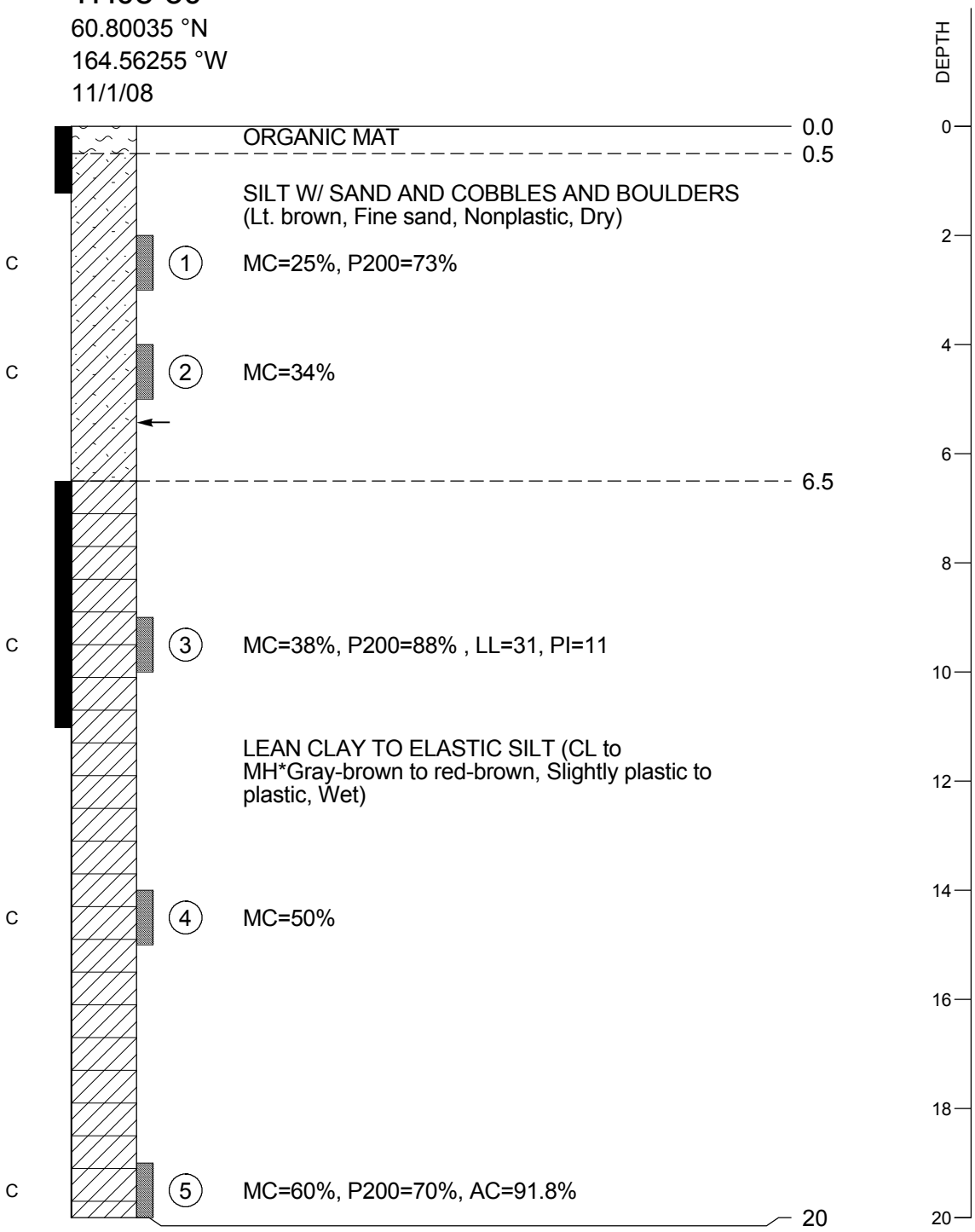
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-29

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-05

TH08-30

60.80035 °N
164.56255 °W
11/1/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

Z:\PROJECT\1429.03\LOGS\MERTARVIK QUARRY.GPJ

MASTER ONE COL/PAGE MERTARVIK QUARRY.GPJ MASTER2.GDT 4/1/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

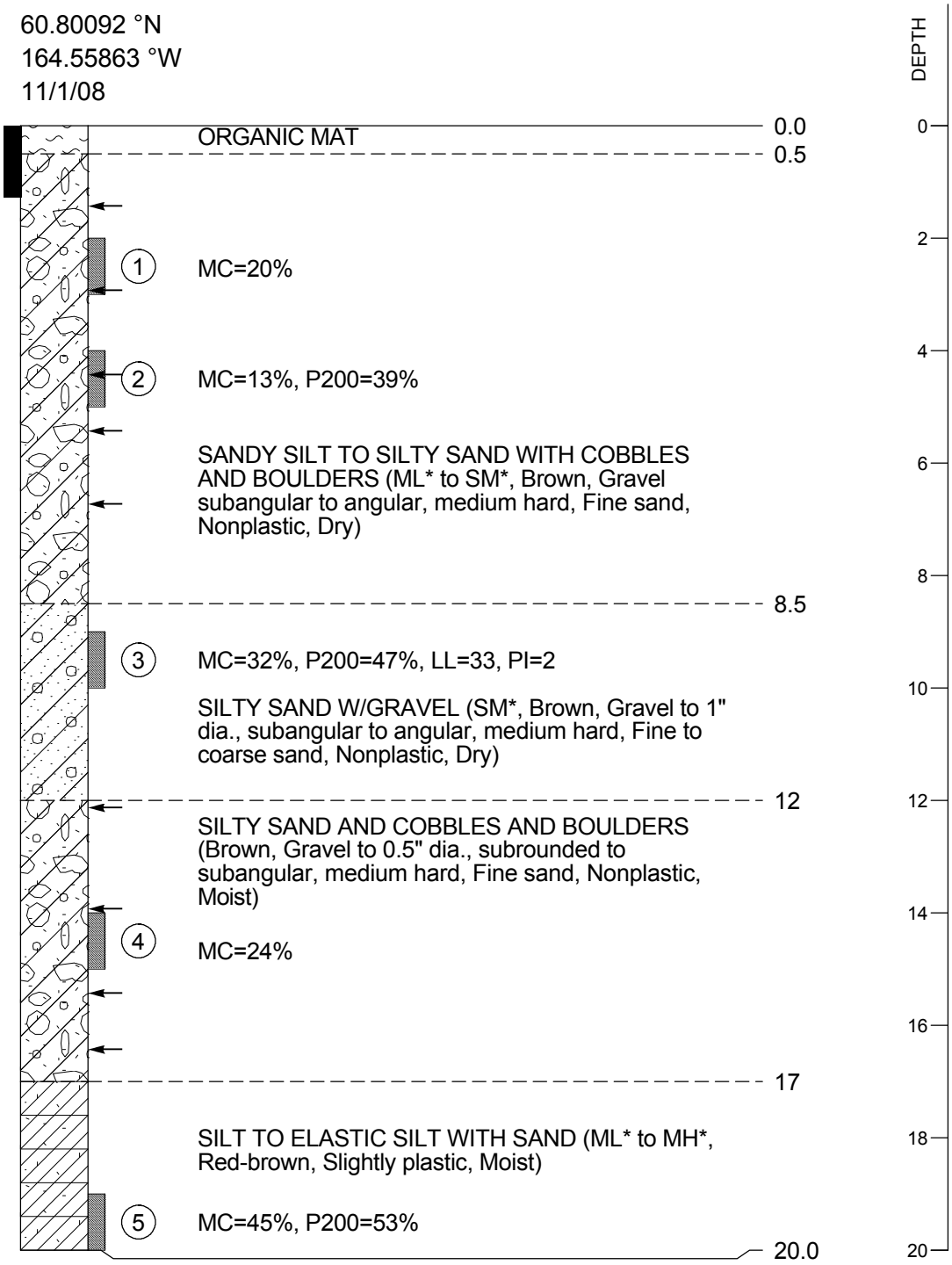
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-30

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-06

TH08-31

60.80092 °N
164.55863 °W
11/1/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

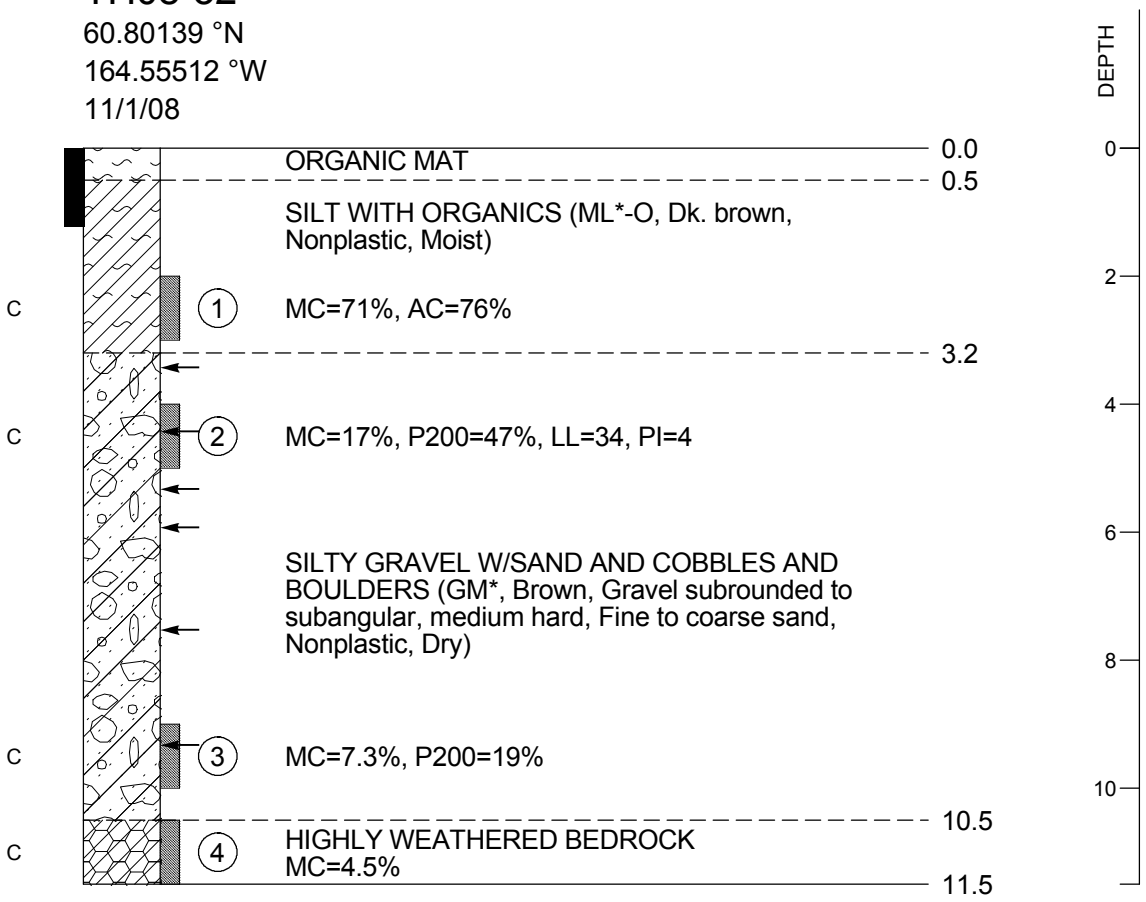
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-31

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-07

TH08-32

60.80139 °N
164.55512 °W
11/1/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 11.5 ft.

Z:\PROJECT\1429.03\LOGS\MERTARVIK QUARRY.GPJ

MASTER ONE COL/PAGE MERTARVIK QUARRY.GPJ MASTER2.GDT 4/1/09

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

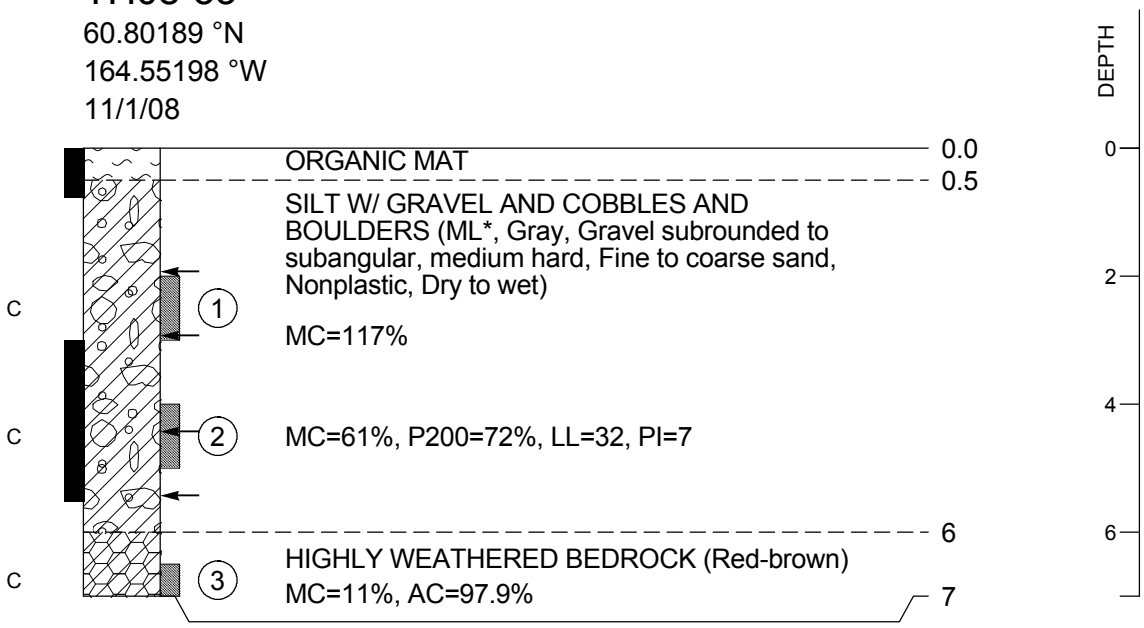
PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-32

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-08

TH08-33

60.80189 °N
164.55198 °W
11/1/08



* Estimated group symbol (ASTM D 2488)
No groundwater observed
Auger refusal at 7 ft.

DWN:	A.T.B.
CKD:	R.L.S.
DATE:	NOV. 08
SCALE:	1"=3'

PREPARED BY: R&M CONSULTANTS, INC.

NEWTOK AIRPORT RELOCATION
MERTARVIK, ALASKA
HILL 460
TH08-33

FB:	NA
GRID:	BAIRD INL.
PROJ.NO:	1429.03
DWG.NO:	C-09

SUMMARY OF LABORATORY SOIL TEST RESULTS
Geotechnical Reconnaissance Investigation
Mertarvik Airport Location Study - Phase 3

Hill 460

SAMPLE IDENTIFICATION			PARTICLE SIZE ANALYSIS, % Finer (by mass)					ATTERBERG LIMITS			Moisture Content	Ash Content	USC
			Standard U.S. Sieve			Hydrometer (mm)		Wet Prep (Dry Prep)					
Test Hole	No.	Depth, ft	#10	#40	#200	0.02	0.005	LL	PL	PI	%	%	
TH08-26	1	2 - 3									58	91.5	ML*-O
	2	4 - 5			68						36		
	3	9 - 10									64		
	4	14 - 15									14		
TH08-27	1	2 - 3									38	88.9	ML*-O
	2	4 - 5			49			28	24	4	25		GM*
	3	9 - 10									7.9		
TH08-29	1	2 - 3			32						56	79.7	ML*-O
	2	4 - 5									24		
	3	8.5 - 9.5			30			nv	nv	np	6.6		SM*
TH08-30	1	2 - 3			73						25		
	2	4 - 5									34		
	3	9 - 10			88			31	20	11	38		CL*
	4	14 - 15									50		
	5	19 - 20			70						60	91.8	
TH08-31	1	2 - 3									20		
	2	4 - 5			39						13		
	3	9 - 10			47			33	31	2	32		SM*/ML*
	4	14 - 15									24		
	5	19 - 20			53						45		
TH08-32	1	2 - 3									71	75.8	
	2	4 - 5			47			34	30	4	17		
	3	9 - 10			19						7.3		
	4	10.5 - 11.5									4.5		
TH08-33	1	2 - 3									117		
	2	4 - 5			72			32	25	7	61		
	3	6.5 - 7									11	97.9	

* Estimated soil group following ASTM D 2487, ASTM D 2488, and Drawing A-29 (for soil with organic matter)

SUMMARY OF LABORATORY ROCK QUALITY TEST RESULTS

TEST	ROCK HAND SAMPLE (HS)			
	HS-1	HS-2	HS-3	HS-4
Degradation Value (*Reading*)	54 (*3.6*)	67 (*2.3*)	38 (*5.6*)	17 (*9.7*)
LA Abrasion, % Loss (*Grading*)	33 (*B*)	29 (*B*)	26 (*B*)	15 (*B*)
Sodium Sulfate, % Loss - Coarse Particles	1	1	1	4
Specific Gravity Bulk Apparent (*Absorption, %*)	 2.766 2.935 (*2.084*)	 2.786 2.924 (*1.696*)	 2.822 2.997 (*2.058*)	 2.759 2.938 (*2.208*)

APPENDIX D

GENERAL DRAWINGS

SOILS
CONSISTENCY AND SYMBOLS

SOIL DENSITY/CONSISTENCY - CRITERIA: Soil density/consistency as defined below and determined by normal field 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.

GRANULAR/NON-COHESIVE

Consistency	N * (blows/ft.) Manual 140 lb. hammer	N** (blows/ft.) Automatic 340 lb. hammer
Very Loose	0 - 4	0 - 2
Loose	5 - 10	3 - 4
Medium Dense	11 - 30	5 - 14
Dense	31 - 50	14 - 23
Very Dense	>50	>23

CLAYEY/COHESIVE

Consistency	N * (blows/ft.) Manual 140 lb. hammer	N ** (blows/ft.) Automatic 340 lb. hammer
Very Soft	<2	0
Soft	2 - 4	1 - 2
Medium	5 - 8	3 - 4
Stiff	9 - 15	5 - 6
Very Stiff	16 - 30	7 - 13
Hard	>30	>13

* Standard Penetration "N": Blows per 6 inches of a 140-pound manual hammer (lifted with rope & cathead) falling 30 inches on a 2 in O.D. split-spoon sampler except where noted.

From State of Alaska Department of Transportation and Public Facilities "Alaska Geotechnical Exploration Procedures Manual" dated October 1, 2003.

** Equivalent "N": Blows per 6 inches of a 340 lb automatic hammer (CME) falling 30 inches on a 3 in O.D. split-spoon sampler.

KEY TO TEST RESULTS

DD - Dry Density
LL - Liquid Limit
MC - Moisture Content
Org - Organic Content
PI - Plastic Index
PL - Plastic Limit
PP - Pocket Penetrometer
P200 - % Passing #200 Screen
P.02 - % Passing 0.02 mm
SG - Specific Gravity
TV - Torvane

DWN:	P.K.H.
CKD:	C.H.R.
DATE:	GENERAL
SCALE:	NONE

PREPARED BY: R&M CONSULTANTS, INC.

GENERAL NOTES

FB:	N/A
GRID:	N/A
PROJ.NO:	GENERAL
DWG.NO:	D-01

Z:\EARTHSCI\GINT FORMS\B01&B02.GDW (DRAWING I - 8-01 ENGLISH 2-HAMMER (DOT&PF-AIA)) 4/3/09 11:04 AM

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

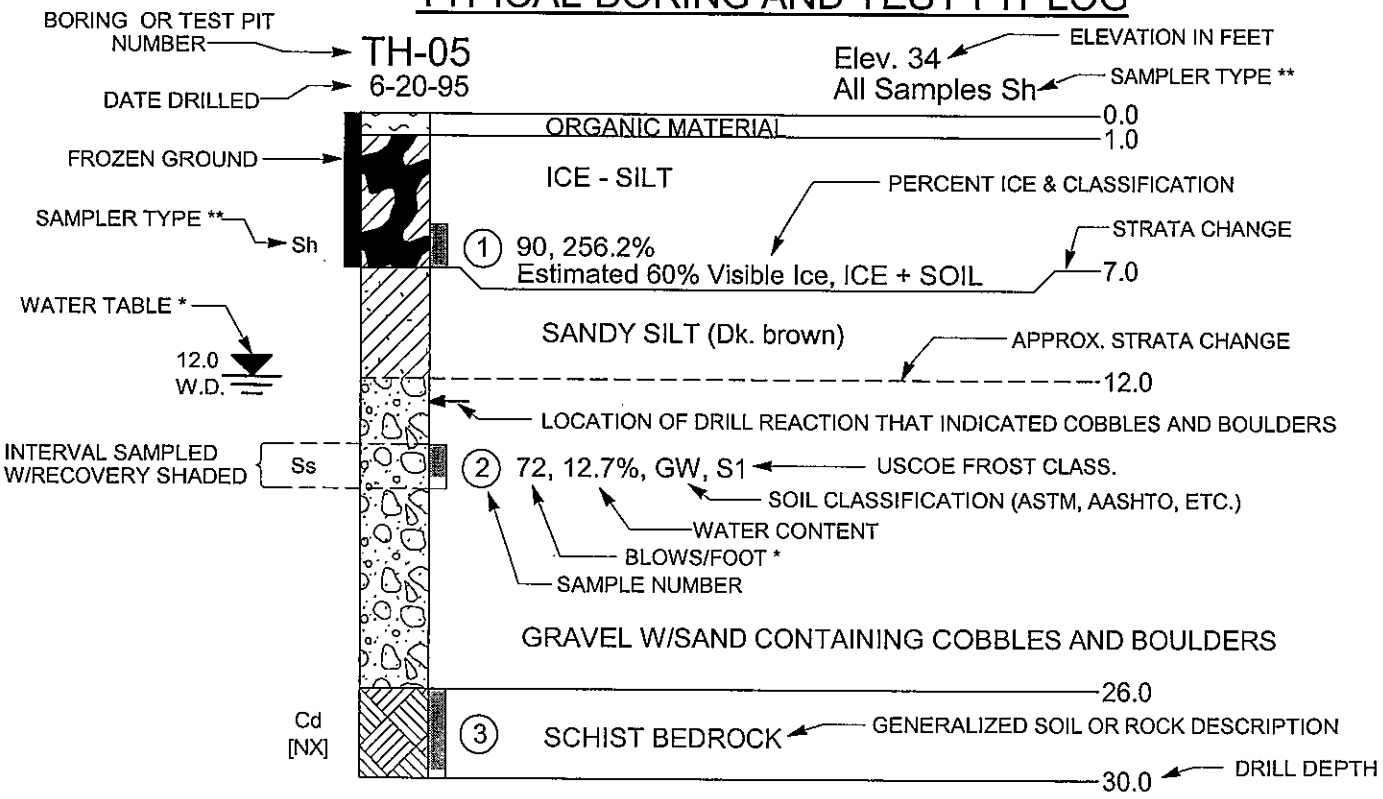
(The symbols shown above are frequently used in combinations, e. g. GRAVEL W/SILT AND SAND)

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.

Z:\EARTHSCI\GINT FORMS\B01&B02.GDW (DRAWING W - B-02 DOT ASTM (ENG)) 4/3/09 11:05 AM

DWN:	P.K.H.
CKD:	C.H.R.
DATE:	GENERAL
SCALE:	NONE

PREPARED BY: R&M CONSULTANTS, INC.

EXPLANATION OF SELECTED SYMBOLS

FB:	N/A
GRID:	N/A
PROJ.NO:	GENERAL
DWG.NO:	D-02

EXPLANATION OF ICE SYMBOLS

The ice description system follows the Standard Practice for Description of Frozen Soils (Visual-Manual Procedure), ASTM D 4083. In this system, which is an extension of the Unified Soil Classification System, the amount and physical characteristics of the soil ice are accounted for. The following table is a summary of the salient points of the classification system:

ICE DESCRIPTIONS

GROUP SYMBOL	ICE VISIBILITY & CONTENT	SUBGROUP	
		DESCRIPTION	SYMBOL
N	Ice not visible to the unaided eye	Poorly Bonded or Friable	Nf
		Well bonded — No excess ice	Nb — Nbn
		Well bonded — Excess Ice	Nb — Nbe
V	Significant segregated ice is visible to the unaided eye, but individual ice masses or layers are less than 1 inch thick	Individual ice crystals or inclusions	V x
		Ice coatings on particles	V c
		Random or irregularly oriented ice formations	V r
		Stratified or distinctly oriented ice formations	V s
		Uniformly distributed ice	V u
ICE	Strata are greater than 1 inch thick *	Ice with soil inclusions	ICE + SOIL TYPE
		Ice without soil inclusions	ICE

* In some special cases where the soil is ice poor a thin layer may be called out by special notation on the log, i.e. 2 inch ice lense at 6 feet.

Z:\EARTHSCI\GINT FORMS\ICE.GDW (DRAWING ICE SYMBOLS DOT) 4/3/09 11:05 AM

DWN:	P.K.H.
CKD:	C.H.R.
DATE:	GENERAL
SCALE:	NONE

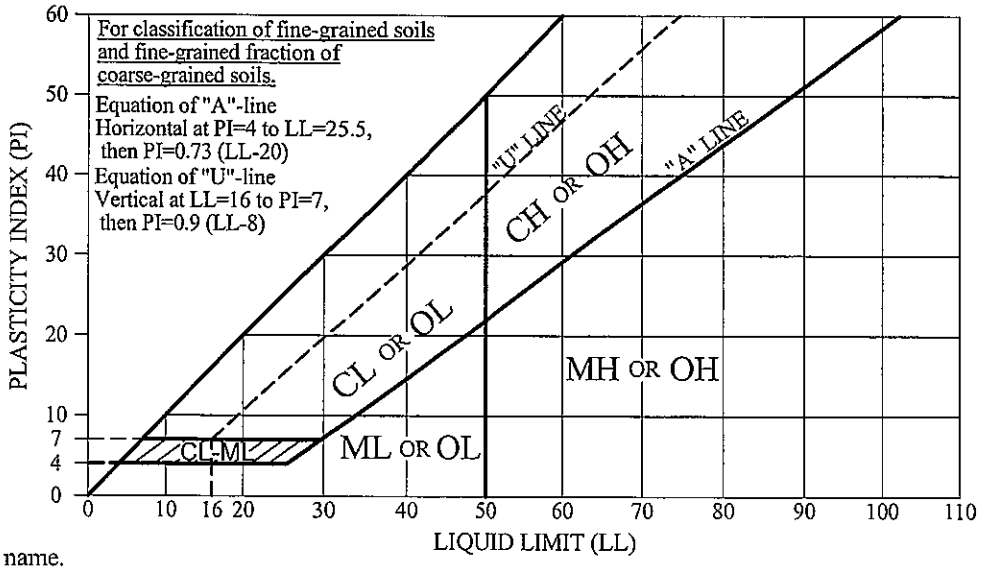
PREPARED BY: R&M CONSULTANTS, INC.

EXPLANATION OF ICE SYMBOLS

FB:	N/A
GRID:	N/A
PROJ.NO:	GENERAL
DWG.NO:	D-03

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-grained Soils More than 50% retained on the No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly-graded gravel [F]
		Gravels with Fines More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly-graded sand [I]
		Sands with Fines More than 12 % fines [D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey sand [G,H,I]
Fine-grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	inorganic	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 and plots below "A" line [J]	ML	Silt [K, L, M]
		organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic Clay [K, L, M,N] / Organic Silt [K, L, M,O]
	Silts and Clays Liquid Limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic Clay [K, L, M,P] / Organic Silt [K, L, M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravel with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly-graded gravel with silt
GP-GC poorly-graded gravel with clay
[D] Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly-graded sand with silt
SP-SC poorly-graded sand with clay
[E] $Cu = D_{60} / D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand " to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 and plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Z:\EARTHSCI\GINT FORMS\ASTM.GDW (DRAWING ASTM CLASS DOT BORDER) 4/3/09 11:06 AM

DWN:	P.K.H.
CKD:	C.H.R.
DATE:	GENERAL
SCALE:	NONE

PREPARED BY: R&M CONSULTANTS, INC.

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES ASTM D 2487

FB:	N/A
GRID:	N/A
PROJ.NO:	GENERAL
DWG.NO:	D-04