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Hydrologic and Geologic Study
of
proposed Lamont Road
Construction and Demolition Landfill Site,
Ft. Bragg, NC.

7 July 1996

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TO: Jim Bateson and Bobby Lutfy, NC DEHNR, Solid Waste Management Division

FROM: Richard R. Rust, PE, PhD, (919) 557-0444

SUBJECT: Hydrologic and Geologic Study of proposed Lamont Road Demolition Landfill Site, Ft. Bragg, NC.

REFERENCES:

Section .0504 (1) (c) NC DEHNR, Solid Waste Division, "15A NCAC 13B Solid Waste Management Rules"; as amended through January 4, 1994.

Heron, S.D. Jr.: The Stratigraphy of the Outcropping Basal Cretaceous Formations Between the Neuse River, North Carolina and the Lynches River, South Carolina (PhD dissertation), 1958, University of North Carolina-Chapel Hill.

Cabe, Suellen; Nickerson, J. G.; Hoffman, C. W.; and Farrel, K: Cretaceous and Tertiary Stratigraphy of the Northern Sandhills Area, North Carolina. Geologic Field Guides to North Carolina and Vicinity, Field Trip Number 10, 1992, Department of Geology, University of North Carolina at Chapel Hill.

PURPOSE:

The purpose of this study is twofold. First, the study will characterize the site's geology and hydrogeology so that DEHNR may evaluate the suitability of this site for development as a construction and demolition (C&D) landfill. Emphasis is placed on evaluation of properties which contribute to or inhibit the migration of leachate to groundwater (i.e.; ability to accurately predict the direction and rate of leachate migration and reliably detect this migration; permeability of cover soils, aquifers, and aquacludes; etc.). Second, the study will locate the groundwater surface and the direction of groundwater flow. If the site is found suitable, groundwater location will establish the limit of excavation to insure 4' separation of waste from seasonal high groundwater, and direction of groundwater flow will be used to site groundwater monitor wells for detection of leachate migration.

BACKGROUND:

The Lamont Road Construction and Demolition (C&D) Landfill site is located on the north side of Coolyconch Mountain, east of Lamont Road. The site has been excavated as a borrow site for sandy fill material. Just north of the site, petroleum contaminated soils are spread, dried, and stored for removal by contractor. Further north a borrow pit is currently being operated for sandy fill material. To the north west of the site, Ft. Bragg operates a landfill under NC DEHNR Permit No. 26C for inert debris. *- where is this soil spread.*

Ft. Bragg's continuing building program entails demolition of old structures. The Longstreet Road Sanitary Landfill (NC DEHNR Permit 26-02) is currently accepting demolition debris under permit to expedite reaching final contours for closure. When the Longstreet Road Sanitary Landfill is closed, Ft. Bragg will contract for disposal of municipal solid waste (MSW) at an off-post location to be determined. The Lamont Road Demolition Landfill site is the proposed location for disposal of debris from the continuing demolition of old structures. Ft. Bragg also intends to permit, construct, and operate a waste transfer station just to the west of the Demolition Landfill site in conjunction with the off-post disposal of MSW upon closure of the Longstreet Road Sanitary Landfill. The transfer station

will be operated under a separate permit and therefore must be buffered from the demolition landfill so that each may be monitored separately for groundwater contamination.

Three monitor wells are maintained and sampled in conjunction with the inert debris landfill. MW-1 was installed by USGS during May 1992 to a depth of 120 feet and screened from 109.5 to 119.5 feet. It is located 70 meters east and slightly south of the truck scales adjacent to Lamont Road and serves as the upgradient well for the inert debris landfill. MW-2 is located to the north of the inert debris landfill adjacent to the sediment pond and serves as the downgradient well for the inert debris. Midway between MW-1 and -2 is MW-3. Immediately adjacent to MW-3 is another well labeled "Dry Well". The construction specifications of MW-2, -3, and "Dry Well" are unknown. Sounding of MW-2 and -3 on 15 March 1996 revealed depths from top of casing to bottom of well of 46.75 and 46.96 feet respectively.

On 30 August 1995 Richard Rust talked to Jim Bateson, Hydrogeologist, Solid Waste Section, NC DEHNR, who will review the Geologic and Hydrogeologic Study for this Demolition Landfill site permit application. They discussed DEHNR requirements and Jim's observations during a recent visit to the site. Jim agreed that groundwater hydrology in resolution adequate for his purposes might be determined with 10 borings with piezometers installed in these borings, provided that the location of these piezometers is based upon current topographic map in a scale not smaller than 1 inch = 100 feet. On 5 September 1995 Richard Rust talked to Bobby Lutfy, Hydrogeologist, Solid Waste Section, NC DEHNR (Jim Bateson's boss). Bobby clarified that the requirements for the Geologic and Hydrogeologic Study were defined under 15A NCAC 13B .0504 (1) (c). Considering the geology as described by Jim Bateson from his site visit, Bobby feels that 2 undisturbed samples from each geologic unit (2 geologic units observed by Jim) and one or 2 remolded samples from whatever DPWE intends to use for cover soils.

On 14 March 1996 a site visit was conducted with the following: Bill Squire and George Whitley, DPWE; Jim Bateson and Jim Barber, DEHNR; Pat Jennings, RS&H; Ray Daniels, Geologist; and Richard Rust. During the visit, the initial boring locations were specified, the scope of work and work plan were confirmed, and the conditions for changes to the scope were specified.

SCOPE OF WORK:

The initial scope assumed that water would be encountered within 30 feet of the surface. This scope called for a 50' piezometer in the center of the site followed by 10 each piezometers at an average depth of 30', located so as to generate two sections (one running approximately north-south and one running approximately east-west intersecting in the center of the site).

During installation of piezometers, water was never encountered at less than 40', and in most borings, it was not encountered at 50'. One piezometer remained dry at 65'. This resulted in expanding the scope to include additional boring footage.

The borings were tested for standard penetration (SPT) every 5', sampled using split spoon, field classified, and logged. A one inch diameter slotted screen PVC piezometer was installed in each of these borings.

During drilling, 2 general geologic units were identified (tan/orange/brown bedded sand and grey plastic silty clay). 2 undisturbed samples were to be taken from each of the 2 geologic units with Shelby Tube. 2 Shelby Tubes were taken of the sand. Numerous attempts were made to recover 2 Shelby Tubes of the clay. These attempts were frustrated by collapse of the tube due to the hard nature of the clay, or by not being able to recover the tube due to the plastic nature of the clay. Only one useable Shelby Tube of clay was recovered. The laboratory determined that the required tests could be performed with this sample. The undisturbed samples were tested for saturated hydraulic

conductivity, volume percent water, porosity, particle size distribution and USCS classification.

Surface samples were taken from the intended source of cover soils. These were remolded as per Proctor and tested for saturated hydraulic conductivity, total porosity, and Atterberg limits.

GEOLOGY / HYDROGEOLOGY

The landfill site is located in the Sandhills region of the North Carolina Coastal Plain. The topography is moderately dissected by ephemeral and intermittent channels. The sediments exposed in the sand pit face surrounding the proposed demolition landfill are typical of fluvial Mittendorf Formation as mapped by Heron (1958) and discussed by Cabe and others (1992). The following is a description of the sediments exposed in the south face of the proposed pit and Bore Hole 1 in the pit bottom.

Within the pit area there are cross-bedded medium and coarse sands. It was suggested during the initial field conference that these sediments may be Eocene, but they do not have the interbedded sandstones, claystones, and fossils reported by Cabe et al. 1992. Within the sand pit area there are exposures of clay filled channels and clay balls of varying sizes in sandy beds. To facilitate the geologic log descriptions, the sections and bore holes are divided into four units (see geologic bore hole logs prepared by R. Daniels in the Appendix): the upper weathered soil unit is Bed 1; the sand unit is Bed 2; muddy sands (called sandy loam to sandy clay loam) are Bed 3; and clay, sandy clay, and clay loam are Bed 4. Bed 4 has the lowest permeability of the units described. Bed 1, the weathered soil, has little, if any, effect on lateral movement of ground water.

In 1995 R. Rust installed 15 landfill gas and 6 ground water monitoring wells in the Longstreet Road Sanitary Landfill, several miles to the east of the proposed C&D landfill site. Borings at the C&D landfill site were consistent with the units encountered at the Longstreet Road Sanitary Landfill: intermittent discontinuous clay lenses are bedded in sands and sandy silts. These near surface lenses perch local ground water above the permanent ground water table. The permanent ground water table is perched over continuous grey & olive grey clay layer several feet thick located during boring at approximately 260-280' MSL dipping slightly to the south east. At the C&D landfill site no borings were conducted to the expected depth of the Cape Fear formation. However, MW-1 installed in 1992 by USGS in the vicinity of the Lamont Road Scale House did encounter the above olive clays intermittently at depths from 335 to 283 MSL (bottom of boring). MW-1 has not been dry since it was installed.

The existence of thin (approximately 2 inches thick) intermittent discontinuous clay lenses is confirmed at the C&D landfill site by observation of the exposed faces in the sand pit excavations to the north. Seepage of water perched on these lenses is observed in the exposed faces with erosion of sandy soil under the clay lenses. Examination of the faces suggests this area was subjected to high energy fluvial deposition processes as evidenced by cross-bedded sands and clay rips, and low energy events which segregated the clay.

The excavation contractor working in the sand pit just north of and adjacent to the C&D landfill site confirmed in an interview that his practice is to excavate sand until a clay layer is encountered. He will excavate laterally until the sand is exhausted within his plan area boundary. Then he will excavate the clay lens to reach the suitable sand beneath the clay. Ponds exist in the excavation where rainwater is perched on exposed clay lenses. The clay layers are discontinuous and rarely exceed an acre in plan view area.

Geologic boring logs prepared by R. Daniels and engineering boring logs prepared by R. Rust are contained in the Appendix.

DIRECTION OF GROUNDWATER FLOW

Near surface ground water is believed to flow SW to the site with a divide on the escarpment to the east of the site and WSW from the site. Permanent water table is believed to flow to the south east at a deeper elevation of approximately 300' MSL.

Location	Full Depth Elevation	1 Day Elevation	> 7 day Elevation (4/26/96)
MW-1 (upgradient)	284.0	310.1 (3/15/96)	310.0
MW-3 (midgradient)	326.4	349.6 (3/15/96)	349.4
MW-2 (downgradient)	302.1	314.3 (3/15/96)	314.6
B-1	357.5	361.0	361.7
B-2	353.9	354.8	363.1
B-3	357.8	359.0	360.5
B-4	384.5	385.8	386.6
B-5	349.0	352.9	352.9
B-6	356.4	356.5	358.1
B-7	354.0	Dry (354.6)	355.1
B-8	361.0	363.7	364.4
B-9	363.0	Dry (363.5)	Dry (363.5)
B-10	350.0	351.0	352.7

FLUCTUATION IN GROUND WATER ELEVATION

Jamie Marlowe, USGS, Raleigh has installed numerous monitor wells on Ft. Bragg. On 10 May 1995 he indicated that Ft. Bragg sits on the Cape Fear Aquiclude (tight stiff green gray silty clay located at 180 - 200 ft MSL dipping slightly to the south and south east). Just above the Cape Fear is a 2 ft gray clay layer. 5 to 15 ft above the Cape Fear is a 2 ft thick discontinuous gray clay lens. None of the borings conducted for this report reached this depth.

Fluctuation in water table elevation between the wet and dry seasons is estimated at 4 ft based on data from USGS groundwater monitor wells on Ft. Bragg fitted with continuous water level recording devices. 2 of these wells are located approximately 9 miles west of the landfill and 3 are located 5 miles east of the landfill. The data is useful in estimating seasonal variations in water table elevation and water table elevation response to climatic events such as precipitation and evapotranspiration. Climatic data recorded at Pope AFB weather station, 5 miles east of the landfill is available from NOAA and the USAF. The USGS water table elevation data is maintained in their Raleigh office. The "print out" data should not be relied upon until the paper "tapes" are examined for errors in recalibration of the recording devices. Drastic jumps in elevation between consecutive readings on the print out indicate recalibration errors, which can often be resolved by examining the tapes and adjusting the print out accordingly.

we will need to see this groundwater data

LIMIT OF EXCAVATION:

The site may be excavated 40' and still maintain 4' buffer from seasonal high groundwater. This is based on the following assumptions: permanent groundwater is located at least 46' below existing excavated grade (as evidenced by stabilized water level in B-1, located in the center of the site); seasonal water table fluctuation is 4' (as evidenced by USGS data from proximate recording wells); and the level recorded in B-1 represents a median between seasonal high and low (B-1 stabilized water level was recorded midway between historical high and low months for the region of December and August).

SLOPE STABILITY:

The existing excavation in the pit is a free standing vertical wall approximately 40 feet high. The wall is subject to failure (i.e., landslide) and is a safety hazard for the following reasons: The soils in these walls are bedded sands with little or no cohesive properties. Their stability is adversely effected by changes in moisture content (i.e., cohesion decreases with saturation resulting in increased pore water pressure and cohesion decreases with drying). Additionally, sand loses stability with vibration, which is inherent in the operation of machinery in the pit or on top of the escarpment to the south and east of the pit. The road on top of the escarpment to the south poses additional threats to the stability of the escarpment (i.e., vibration and overburden pressure from traffic on the road). The escarpment walls surrounding the pit should be relaxed to a slope no steeper than 1:1 before further operations are conducted in the pit. The road on the escarpment to the south of the pit should be rerouted at least 100' south of the escarpment, and vehicle barriers should immediately be constructed to prevent vehicles/equipment from getting closer than 100 feet to the escarpment lip.

This information was conveyed to Bill Squire and R. Chisolm, DPWE, by phone, and COL Jim Hougnon, Director of DPWE, by fax on 30 April 1996.

PROPERTIES OF AQUIFER / AQUICLUDE SOILS, LABORATORY ANALYSIS

During installation of the piezometers 3 undisturbed soil samples were taken from the 2 general geologic units (clays and sands) for laboratory analysis by Special Testing Laboratories, Inc., Garner, NC.

A summary of laboratory results is as follows. The sands exhibited permeabilities ranging from 10^{-2} to 10^{-4} cm/sec. The clay (CL-ML), representing the thin discontinuous lenses perching near surface ground water, had a permeability of 1.58×10^{-7} .

The Laboratory Analysis in the Appendix contains:

Saturated hydraulic conductivity, volume percent water, porosity, particle size distribution and USCS classification of the undisturbed soil samples taken during boring for piezometer installation.

COVER SOILS

Abundant cover material is present in the borrow pit adjacent to the site. Surface samples were taken from the intended source of cover soils and analyzed by Special Testing Laboratories, Inc., Garner, NC. These were remolded as per Proctor and tested for saturated hydraulic conductivity, total

So, the soils are not suitable for cover?
porosity, Atterberg limits, and optimum moisture content for compaction. The results are in the Laboratory Analysis located in the Appendix. Remolded permeabilities ranged from 7.5×10^{-3} to 3.7×10^{-4} cm/sec. Tighter material is available (i.e., the CL-ML described above with 10^{-7} cm/sec permeability) located in abundance in the sand pit just north of the C&D landfill site. However, this material will be extremely difficult to spread and compact in homogeneous lifts due to the stiff nature of the clay. Additionally, desiccation cracking in this material is expected to negate any benefit resulting from its low permeability if it is used as cover.

CONCLUSIONS

The near surface ground water flow is from east to west with Coolyconch Mountain serving as the divide. The surrounding land use is controlled by the Department of Defense. There is no opportunity for a private landowner to install a potable water well between the C&D landfill site and surface water drainage features which might control or intercept near surface groundwater (Little Creek 1 mile northwest, Cypress Creek 1 mile north, Bones Creek 1 mile south) or between the C&D landfill site and monitor wells at the Longstreet Sanitary Landfill to the east (expected direction of flow of permanent water table perched on the Cape Fear aquiclude).

If it is desired to separate the detection of potential ground water contamination associated with the storage of petroleum contaminated soils just north of the C&D landfill site from groundwater contamination leaching from the C&D landfill, this may be accomplished since the direction of near surface ground water flow is to the west southwest.

C&D landfill site may be excavated to a depth of 40' without compromising a 4' separation of waste from seasonal high ground water elevation.

The cohesionless sands in the C&D landfill site pose slope stability problems. High walls in the excavation should therefore be laid back accordingly to prevent failures.

RECOMMENDATIONS

Locations of proposed ground water monitor wells is as follows: one upgradient well to be located on the escarpment southwest of B-4; a downgradient well to be located west northwest of B-1 in the buffer between the C&D landfill site and the proposed transfer station; and a downgradient well to be located 200' west southwest of B-1. These wells are intended to monitor near surface ground water perched on the discontinuous clay lens system prior to the ground water reaching the permanent water table. Assuming the Cape Fear unit is continuous under the C&D site and dips consistently with what was encountered in the installation of the Longstreet Road Sanitary Landfill monitor wells, monitoring of the permanent water table may be accomplished by using MW-1 as an upgradient well and installing a deep monitor well to approximately 300' MSL approximately 200' south of B-8 (200' east southeast of the C&D site).

APPENDIX

Contents:

Plan View of C&D Landfill Site showing:

Topography
Locations of Boring and Existing Monitor Wells (MW's 1, 2, and 3)
Phreatic Surface

Profiles of Topography and Phreatic Surface

Geologic Logs of Borings

Engineering Logs of Borings

Laboratory Analysis of Boring Samples and Cover Soils

Geology of the Proposed Lamont Road Demolition Landfill Site, Fort Bragg, NC

By. Raymond B. Daniels

The landfill site is located in the Sandhills region of the North Carolina Coastal Plain. The topography is moderately dissected by ephemeral and intermittent channels. The sediments exposed in the sand pit face surrounding the proposed demolition landfill are typical of the fluvial Middendorf Formation as mapped by Heron (1958) and discussed by Cabe and others (1992). The following is a description of the sediments exposed in the south face of the proposed pit and Bore Hole 1 in the pit bottom.

Within the pit area there are cross bedded medium and coarse sands. It was suggested during the initial field conference that these sediments may be Eocene, but they do not have the interbedded sandstones, claystones and fossils reported by Cabe et al. 1992. Within the sand pit area there are exposures of clay filled channels, clay balls of varying sizes in sandy beds. For our purposes we have divided the sections and bore holes into four units. The upper weathered soil unit is bed 1; the sand unit is bed 2; muddy sands (my sandy loam to sandy clay loam) are bed 3; and clay, sandy clay, clay loam and silty clay loam beds are bed 4. Textures in bed 4 range from clays, sandy clays, to clayey silts. Bed 4 has the lowest permeability of the various units described. Bed 1, the soil, probably has little if any effect on lateral movement of ground water.

Depth ft.	Description
0-3.5	Soil horizons. 2.5Yr3/6 medium loamy sand with common coarser grains, grades downward to (sand, bed 1)
3.57-7.5	2.5YR3/6 medium loamy sand to sandy loam; lower part has many medium to coarse white sand grains that disintegrate with pressure. Grades downward to (sand, bed 1)
7.5-10.5	Variogated 2.5YR5/6, 5YR5/6 and 7.5YR5/4 medium sand; base of soil; gradual to clear to (sand, bed 1)
10.5-14	10YR5/4 medium sand with few coarse and finer grains; gradual to (sand, bed 2)
14-24+	2.5YR5/6 loamy sand with common to abundant white weathered felspar grains; abundance of feldspar varies vertically and horizontally. Base of section covered by slump. (sand, bed 2)
	Bore Hole 1 (described from cores)
4.5-6.5	7.5YR 4/6 medium to coarse loamy sand to sandy loam. Common to abundant clayey bodies and weathered feldspars; grades to (sand, bed 2)
9.5-11.5	10YR7/6 and 7/1 fine sand with few fine mica flakes (sand, bed 2)

- 14.5-16.5 7.5YR 6/6 and 4/6 fine sandy loam with common to abundant mica; rare 10YR7/1 stringers of finer material about 1/16 inch thick
(muddy sand, bed 3)
- 19.5-21.5 2.5Y7/0 fine to coarse sandy clay.
(sandy clay, bed 4)
- 24.5-26.5 10YR8/1 medium sand with common to many streaks and bodies of 10YR6/8.
(sand, bed 2)
- 29-31 10Y7/1 clay loam with common fine mica; interbedded with 7.5YR6/6 and 5YR4/4 sand.
(clayey silt or silty clay, bed 4)
- 34-36 7.5YR6/6 medium sand with common coarse grains; common streaks and bodies of 10YR7.1 sandy clay loam.
(sand, bed 2)
- 39-41 2.5YR4/4 medium to coarse sand with common white clay balls and weathered feldspar grains; interbedded with few 10YR7i/1 fine sandy loam bodies and a few lenses of 10YR7/1 sandy clay loam.
(sand to muddy sand, bed 2 or 3)
- 41-46 Variegated 10YR7/1 and 4/6 fine to medium sand; abrupt to
(sand, bed 2)
- 49-51 2.5Y7/2 clay; difficult to work and has common fine mica. Base of bore hole 1
(clay, bed 4)

Approximately 550 feet of described section shows that sands are the most abundant unit followed by clays or sandy clays.

Bed	%	Thickness	
		Mean	Range
1	14		
2	60	18	1-32
3	5	3	2-7
4	21	7	1-21

The following is a classification of the bore holes into the four beds described above. The depths are approximate because the base of each unit is not known within 1 to 2 or 3 feet.

Bore Hole 2.

Depth in Feet Bed Classification

0-11.5	Soil Zone, bed 1
11.5-38	bed 2
38-39	bed 3
39-45	bed 2
45-48	bed 4
48-51.5	bed 2

Bore Hole 3

0-8	bed 1
8-29	bed 2
29-39	bed 4
39-40	bed 2

Bore Hole 4

0-12	bed 1
12-43	bed 2
43-46	bed 4
46-40.5	bed 3

Bore Hole 5

0-12	bed 4
12-51	bed 2

Bore Hole 6

0-21	bed 4	clay to sandy clay to clayey silt
21-50	bed 2	
50-51	bed 4	

Bore hole 7

0-11.5	Bed 1
11.5-27	bed 4
27-56.5	bed 2

Bore hole 8

0-9	Bed 1
9-12?	Bed 4
12-24	Bed 2
24-31	Bed 3
31-41	Bed 4
41-46	Bed 3
46-68	Bed 2
68-70	Bed 4

Bore Hole 9

0-7	Bed 1
7-38	Bed 2
38-43	Bed 3
43-53	Bed 4
53-60.5	bed 2

Bore Hole 10

0-5	No sample
5-11	Bed 4
11-15	Bed 3
15-21	Bed 4
21-53	bed 2

Literature Cited:

Heron, S.D. Junior, 1958. The stratigraphy of the outcropping basal Cretaceous formations between the Neuse River, North Carolina and the Lynches River, South Carolina (Ph. D. dissertation): Chapel Hill, University of North Carolina-Chapel Hill, 155 p.

Cabe, Suellen, J.G. Nickerson, C.W. Hoffman and K. Farrel, 1992. Cretaceous and Tertiary stratigraphy of the northern Sandhills area, North Carolina. Geologic Field Guides to North Carolina and Vicinity, field Trip Number 10. Department of Geology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina. Geologic Guidebook No. 1. pp. 177-178.

GEOTECHNICAL BORING LOG



SPECIAL TESTING LABORATORIES OF NORTH CAROLINA, INC.
 Post Office Box 37805 • Raleigh, North Carolina
 (919) 662-1234 • Fax (919) 662-9700

STL PROJECT NO.:
SITE DESCRIPTION: LAMONT C&D LANDFILL
COUNTY: FT BRAGG NC
BORING NO.: B-1
COLLAR ELEVATION:
TOTAL DEPTH: 51'
DRILL MACHINE: B61 MOBILE
DRILL METHOD: 3/4 HSA TD 15' → AIR ROTARY
DATE STARTED: 3/19/96
DATE COMPLETED: 3/20/96
BORING LOCATION: PIT CENTER

OFFSET:
GROUND WATER: @ 0 HR: DRY @ 24 HR:
GEOLOGIST/ENGINEER: R. RUST

94C-1822

ELEV. DEPTH	BLOW COUNT				BLOWS PER FOOT						W/GW	SAM NO.	LOG	DESCRIPTION	
	6'	6'	6'	0	20	40	60	80	100						
0															
2.5											M	S-1			
4.5-6.5	5	6	9	11							M	S-2			4.5-5.5 MOIST/WET TAN SC - SP
7.5											M	S-3			5.5 1" THICK GREY CH
9.5-11.5	10	5	5	6	6						M	S-4			5.5-6.5 MOIST BROWN RED BEDDED SANDS SW TRACES OF GREY CH
14.5-15.5	13	5	6	8	9						M	S-5			7.5-10.5 SAME AS 5.5-6.5
19.5-21.5	20	11	14	17	18										10.5-11.5 DRY LOOSE WHITE SAND (FINE) SOME RED GRAINS
24.5-27.5	25	11	11	9	10										14.5-14.8 SAME AS 4.5-5.5
29-31	30	6	8	17	21										14.8-16.2 MOIST LOOSE FINE SW BROWN WITH SOME WHITE GRAINS
34-36	35	11	13	13	11										16.2-16.5 MOIST HARD GREY CH
39-41	40	6	8	9	10										19.5-21.5 MOIST GREY SANDY CLAY CH WITH TRACE PURPLE STAIN
44-46	45	6	8	8	6										24.5-26.5 MOIST WHITE & TAN FINE SANDS SP LOOSE BEDDED W/IRON STAIN
49-51	50	15	30	39	50										29-30 TAN BEDDED SC
55															30-30.5 IRON STAINED SANDY CLAY
60															30.5-30.6 WHITE/PURPLE FINE SAND
65															30.6-30.7 MOIST GREY CLAY CH
															30.7-31.0 TAN/PURPLE SC GRADING TO COARSE LOOSE SP TAN/PURPLE
															34-36 WHITE/TAN/BROWN LOOSE COARSE BEDDED SANDS SP w/OCCASIONAL EXLS OF WHITE CLAY CH
															39-40 MOIST RED/BROWN COARSE SAND SW WITH GREY CH
															40-41 BEDDED TAN ORANGE FINE SAND SW WITH GREY CH
															44-45.5 TAN LOOSE FINE SAND SP w/SP MOIST AT TOP WET AT BOTTOM
															45.5-46.0 WET WHITE CLAYED SAND SC w/ BROWN IRON STAIN
															49.0-49.5 WET TAN COARSE SANDY CLAY SC 49.5-51 HARD MOIST GREY CLAY CH

BORING TERMINATED
 @ 51'

B-1
 10/5 HRS 3/21 47.50'
 3/27 47.4
 3/29 47.2
 4/16 47.1

FINAL EL ACS ?
 7 358'

GEOTECHNICAL BORING LOG

**SPECIAL TESTING LABORATORIES
OF NORTH CAROLINA, INC.**
Post Office Box 37805 • Raleigh, North Carolina
(919) 662-1234 • Fax (919) 662-9700

STL PROJECT NO.:
SITE DESCRIPTION: LAMONT C&D LANDFILL
COUNTY: FT BRAGG
BORING NO.: B-2
COLLAR ELEVATION:
TOTAL DEPTH: 51'
DRILL MACHINE: B61 MOBILE
DRILL METHOD: 3/4 HSA TO 15' → AIR ROTARY
DATE STARTED: 3/21/96
DATE COMPLETED: 3/21/96
BORING LOCATION: E OF PIT

OFFSET:
GROUND WATER: @ 0 HR: DRY @ 24 HR:
GEOLOGIST/ENGINEER: R. RUST / R. DANIELS

94C-1802

ELEV. DEPTH	BLOW COUNT			BLOWS PER FOOT						Wn/GW	SAM NO.	LOG	DESCRIPTION
	5'	6'	6'	0	20	40	60	80	100				
0													
2.5										M	S-1		
4.5-6.5	5	1	1	2						M	S-2	4.5-6.5 BROWN ORGANIC SANDY LOAM w/ ROOT FRAGMENTS	
7.5										M	S-3	9.5-11.5 BROWN LOAMY SAND w/ ROOT FRAGMENTS	
7.5-11.5	10	3	4	4	3					M	S-4	AT 11' HIT GREY SANDY CLAY CL	
14.5	15	9	13	15	13					M	S-5	14.5-16.5 MOIST STIFF GREY CLAYEY SAND SC SANDY CLAY CL (SEE B-1 19.5-21.5)	
16.5													
18.5-20.5	20	6	7	6	5							18.5-19.2 TAN LOOSE COARSE SAND SP MOIST	
20.5												19.2-20.1 WHITE CLAYEY SAND COARSE GRAINE MOIST	
28.5	25	11	12	12	15							20.1-20.5 TAN/PINK COARSE CLAYEY SAND MOIST	
30.5												20.5-35.0 TAN/ORANGE FINE COARSE SAND SP LIGHTER COLOR IS FINE BEDDED IRON STAIN OCCASIONAL THIN LAYERS OF WHITE CLAY	
33.5-35.5	30	6	7	7	9							35.0-35.4 GREY CLAY CH	
35.5												35.4-35.5 TAN/ORANGE LOOSE COARSE SAND GRM	
38.5	35	8	10	8	11							38.5-40.5 TAN COARSE SAND w/ CLAY CH LAYERS	
40.5												1/8" 40.1-40.3 GRM CLAY CH (SAND WET ABOVE)	
43.5	40	5	7	10	12							43.5-45.0 WET COARSE TAN SAND SIL w/ RED IRON STAIN	
45.5												45.0-45.5 WET GREY SANDY CLAY/SC COARSE GRAINS	
48.5	45	12	10	10	12							48.5-49.0 TAN BROWN MOIST SC	
51.5												49-51.5 GREY/TAN CS MOIST BEDDED	
50													
55													
60													
55													

BORING TERMINATED AT 51.5'

B-2	BELOW GND LEVEL	BASE EL 405?
1400	3/21	50.62'
	3/27	48.6
	3/29	46.7
	4/16	45.4
		357'-361'

STL PROJECT NO.:
SITE DESCRIPTION: (AMOUNT C & D LANDFILL
COUNTY: FT BRAGG
BORING NO.: B-3
COLLAR ELEVATION:
TOTAL DEPTH:
DRILL MACHINE: B61 MOBILE
DRILL METHOD: 3 1/4 HSA TO 15' -> AIR ROTARY
DATE STARTED: 3/21/46
DATE COMPLETED: 3/21/46
BORING LOCATION: S OF PIT



GEOTECHNICAL BORING LOG

SPECIAL TESTING LABORATORIES OF NORTH CAROLINA, INC.
 Post Office Box 37805 • Raleigh, North Carolina
 (919) 662-1234 • Fax (919) 662-9700

OFFSET:
GROUND WATER: @ 0 HR: DRY @ 24 HR:
GEOLOGIST/ENGINEER: R. RUST / E. DANIELS

940-1802

ELEV. DEPTH	BLOW COUNT			BLCWS PER FOOT						Wn / GW	SAM NO.	LOG	DESCRIPTION
	6'	6'	6'	0	20	40	60	80	100				
0													
2.5										M	S-1		
4.5-6.5	5	2	2	3						M	S-2		4.5-5.5 MOIST BROWN CLAY W/ROOTS
7.5										M	S-3		5-5-10.5 MOIST WET COARSE BROWN SAND
9.5-11.5	10	2	2	3	5					M	S-4		SW IRON OXIDIZED SAND 1/2" THICK THEN 16.5 TAN ORANGE COARSE SANDS MOIST
13.5-16.5	15	4	6	6	5					M	S-5		18-20 TAN COARSE SAND (VERY COARSE) W/ BROWN IRON STAIN 3 GRADING TO CLAY SAND 2" THICK LAYERS CLAY IS GREY CH
18-20	20	7	9	10	9								24-26 WHITE/TAN/ORANGE/BROWN BEDDED SANDS WITH OCCASIONAL TRAILS OF GREY SILTY CLAY
24-26	25	6	7	7	7								28-29 MOIST WHITE/TAN/ORANGE BEDDED FINE SANDS SW
28-30	30	4	3	3	5								29-29.8 WET CLAY SAND WHITE/TAN 29.8-30 MOIST HARD GREY CLAY CH
33-35	35	8	12	15	14								33-35 MOIST WET ACID CLAY W/ IRON MICA & SAND IN TOP FEET 3 GRADING
38-40	40	5	4	7	15								38-39 MOIST WET WHITE/TAN/ORANGE COARSE SC 39-40 GREY SILTY CLAY MOIST WITH IRON STAIN
45													
50													
55													
60													
65													

BORING TERMINATED 40'

B-3

▽ 3/27 38.8' BASE EL 410'
 3/29 38.6' ▽ 371 UP GRADIENT
 4/16 37.7'

STL PROJECT NO.:
SITE DESCRIPTION: LA MONT C/D LANDFILL
COUNTY: FT BRASS
BORING NO.: B-4
COLLAR ELEVATION:
TOTAL DEPTH:
DRILL MACHINE: B-61 Mobile
DRILL METHOD: 3 1/4 HSA TO 15' → AIR ROTARY
DATE STARTED: 3/22/96
DATE COMPLETED: 3/25/96
BORING LOCATION: ON CLIFF
NEAR SIGNAL SITE



GEOTECHNICAL BORING LOG

SPECIAL TESTING LABORATORIES OF NORTH CAROLINA, INC.
 Post Office Box J7805 • Raleigh, North Carolina
 (919) 662-1234 • Fax (919) 662-9700

SMC-2802

OFFSET:
GROUND WATER: @0 HR: DRY @24 HR:
GEOLOGIST/ENGINEER: R. RUST

ELEV.	DEPTH	BLOW COUNT			BLOWS PER FOOT					Wn / GW	SWM NO.	LOG	DESCRIPTION
		5'	6'	6'	0	20	40	60	80				
	0												
	2.5										M S-1		
4-6	5	1	1	1 2							M S-2		4-11 MOIST RED/BROWN SC FINE GRAINS
	7.5										M S-3		
9-11	10	3	2	2 3							M S-4		
14-16	15	3	3	3 3							M S-5		14-16 MOIST TAN/BROWN SW
18.5-20.5	20	5	5	5 6									18.5-20.5 MOIST RED/BROWN SC COARSER GRAINS THAN 4-11
23.5-25.5	25	4	6	10 11									23.5-25.5 TAN/ORANGE SC WITH THIN BEDS/BALLS OF GREY CLAY CH
28.5-30.5	30	11	12	12 12									28.5-30.5 TAN/ORANGE COARSE SAND SW WITH FLECKS OF GREY CLAY CH
33.5-35.5	35	9	10	11 12									33.5-35.5 RED/BROWN SC WITH GREY CLAY BEDS 1-2" THICK
38.5-40.5	40	8	10	12 13									38.5-40.5 TAN/ORANGE SC WITH GREY CLAY BEDS 1-2" THICK
43.5-45.5	45	16	20	22 22									43.5-50.5 GREY SANDY CLAY CH FINE GRAINS
48.5-50.5	50	8	12	14 16									BORING TERMINATED 50.5'
	55												
	60												
	65												

B-4

3/27 49.2

EL 446'

3/29 49.3

J 397 UPGRADE/ST

4/16 48.7



GEOTECHNICAL BORING LOG

SPECIAL TESTING LABORATORIES OF NORTH CAROLINA, INC.
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 (919) 662-1234 • Fax (919) 662-9700

94C-2802

STL PROJECT NO.:
 SITE DESCRIPTION: LAMONT C&D LANDFILL
 COUNTY: FT BRAGG
 BORING NO.: B-5
 COLLAR ELEVATION:
 TOTAL DEPTH:
 DRILL MACHINE: B-61 MOBILE
 DRILL METHOD: 3/4 HSA TO 15' -> AIR ROTARY
 DATE STARTED: 3/26
 DATE COMPLETED: 3/26
 BORING LOCATION: NW OF PIT
 1/2 WAY TO POND

OFFSET:
 GROUND WATER: @ 0 HR: DRY @ 24 HR:
 GEOLOGIST/ENGINEER: R. RUST

ELEV. DEPTH	BLOW COUNT			BLOWS PER FOOT						Wn / GW	SAM NO.	LOG	DESCRIPTION	
	6"	6"	6"	0	20	40	60	80	100					
0														
2.5											M	S-1		
4.5-6.5	9	19	25	31							M	S-2	4.5-11.5 MOIST GREY CH WITH OCCASIONAL PURPLE STAIN	
7.5											M	S-3		
9.5-11.5	12	28	35	37							M	S-4		
14.5-16.5	10	12	14	14							M	S-5	14.5-16.5 MOIST GREY/TAN FINE SAND SP DRY	
19-21	5	5	9	10									19-21 MOIST GREY CLAYEY SAND SC	
24-26	8	8	14	10									24-26 MOIST TAN/ORANGE CONCRE SAND SW WITH THIN BEDS OF GREY CLAY CH	
29-31	4	8	8	9									29-31 MOIST GREY CLAYEY SAND SC FINE GRAINED	
34-36	8	8	9	10									30.5' 1" THICK BED IRON STAINED CEMENTED SANDSTONE	
39-41	8	10	9	11									32-36 GREY/TAN CLAYEY SAND SC FINE GRAINED OCCASIONAL BED OF GREY SILTY CLAY	
44-46	10	13	12	14									39-41 WHITE/TAN FINE SAND SW	
49-51	4	6	8	8									44-46 WHITE/TAN CLAYEY SAND SC FINE TO CONCRE GRAINS BOTTOM 0.5' WET	
55													49-61 WET WHITE/TAN SAND SW w/ SOME SILT/CLAY	
60													BORING TERMINATED 61'	
55														

B-5

3/27 47.1

3/29 46.8

4/16 46.7

EL 400'

4 353'

STL PROJECT NO.:
 SITE DESCRIPTION: LAMONT C & D LANDFILL
 COUNTY: FT BRAGG
 BORING NO.: B-6
 COLLAR ELEVATION:
 TOTAL DEPTH:
 DRILL MACHINE: T-61 MITSUBISHI
 DRILL METHOD: 3/4 HSA TO 15' → AIR ROTARY
 DATE STARTED: 3/29
 DATE COMPLETED: 3/29
 BORING LOCATION: NW OF PIT
 (100' (1/4 OF WAY TO POND))



**GEOTECHNICAL
BORING LOG**

SPECIAL TESTING LABORATORIES
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 (919) 662-1234 • Fax (919) 662-9700

94C-1802

OFFSET:
 GROUND WATER: ☉ 0 HR: DRY ☉ 24 HR:
 GEOLOGIST/ENGINEER: R. RUST

ELEV.	DEPTH	BLOW COUNT			BLOWS PER FOOT						Wt / GW	SAM NO.	LOG	DESCRIPTION	
		6"	6"	6"	0	20	40	60	80	100					
	0														
	2.5											M	S-1		
45-4.5	5	9	18	25 33								M	S-2	4.5-6.5 MOIST GREY / ^{TRACE} IRON STAINED CLAY CH	
	7.5											M	S-3		
25-11.5	10	6	14	20 22								M	S-4	9.5-11.5 MOIST GREY CLAY CH WITH PURPLE STAIN	
4.5-16.5	15	9	18	26 35								M	S-5	14.5-16.5 MOIST GREY / ORANGE IRON STAINED CLAY CH	
9-21	20	11	14	13 16										19-21 MOIST GREY / TAN CLAYEY SAND / SANDY CLAY	
24-26	25	9	9	9 8										24-26 MOIST GREY / DRAB SAND SW WITH TRACE GREY SANDY CLAY	
29-31	30	9	9	8 10										29-31 MOIST GREY / TAN / DRAB SAND SW W TRACE GREY SANDY CLAY	
34-36	35	10	13	15 17										34-36 MOIST DRAB / TAN / ORANGE SANDY SW	
39-41	40	10	15	17 15										39-41 WET SANDY TAN SAND SW	
44-46	45	10	10	6 9										44-46 MOIST GREY / TAN COARSE CLAYEY SAND SW	
49-51	50	-	12	12 11										49-51 WET COARSE TAN SAND SW W/ GREY CLAY LENSES CH	
	55														
	60														
	65														

B-6

3/29 50.6 DRY
 4/16 49.7

EL 405?
 355

BORING TERMINATED
 AT 51'

STL PROJECT NO.:
SITE DESCRIPTION: LAMONT C&D LANDFILL
COUNTY: FT BRASS
BORING NO.: B-8
COLLAR ELEVATION:
TOTAL DEPTH:
DRILL MACHINE: B-61 MOBILE
DRILL METHOD: 3/4 HSA TO 15' -> AIR ROTARY
DATE STARTED: 4/4/96
DATE COMPLETED: 4/5/96
BORING LOCATION: EXHARDMENT
 E OF B-1



GEOTECHNICAL BORING LOG

SPECIAL TESTING LABORATORIES
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04C-1802

OFFSET:
GROUND WATER: @0 HR: DRY @24 HR:
GEOLOGIST/ENGINEER: R. RUST

ELEV. DEPTH	BLOW COUNT			BLOWS PER FOOT					Wn/GW	SAM NO.	LOG	DESCRIPTION
	5	6	6	0	20	40	60	80				
0												
2.5												
5-7	5	1	1	2	3					M S-1		5-7 MOIST COARSE RED/BROWN SAND SP
7.5										M S-2		
10-12	10	3	7	12	14					M S-3		10-12 MOIST RED/BROWN SAND SP OVER GREY/TAN SANDY CLAY CH W/ PURPLE STAIN
15-17	15									M S-4		
20-22	20	5	8	9	12					M S-5		15-17 RED/BROWN SAND
25-27	25	7	8	9	13							20-22 MOIST TAN/BROWN SAND SW
30-32	30	3	4	7	11							25-27 MOIST TAN/BROWN COARSE SAND SP WITH 0.5' THICK GREY CLAY LENSES CH
35-37	35	11	17	21	36							30-32 MOIST WET TAN BROWN SAND SW 31.5 MOIST GREY CLAY CH
40-42	40	15	27	22	31							35-37 MOIST GREY CLAY CH W/ PURPLE STAIN
45-47	45	5	3	3	10							40-42 MOIST GREY SANDY CLAY CH
50-52	50	4	5	9	12							45-47 MOIST WHITE/TAN SAND/SILT TRACE BALLS/THIN LENSES OF GREY CLAY
55-57	55	11	17	21	27							50-52 MOIST WHITE TAN BROWN COARSE SAND SW THIN LENSES OF GREY CLAY/SILT CLAY
60-62	60	4	5	7	11							55-57 MOIST TAN/BROWN COARSE SAND SW TRACE GREY CLAY/SILT CLAY
65-67	65	13	15	21	35							60-62 MOIST BROWN/TAN COARSE SAND SP W/THIN BEDS GREY CLAY/SANDY CLAY

← SHELBY TUBE TAKEN

65-70 11 17 25 31

B-8

4/6 67.3

ELEV 431?

7 364

WITH TRACE GREY CLAY/SILT.
 68-70 MOIST GREY CLAY WITH PURPLE STAIN CH
 BORING TERMINATED AT TD

STL PROJECT NO.:
SITE DESCRIPTION: LAURENT C&D LANDFILL
COUNTY: FT BRASS NC
BORING NO.: B-9
COLLAR ELEVATION:
TOTAL DEPTH:
DRILL MACHINE: 861 MOBILE
DRILL METHOD: 3/4 HSA TO 15' → AIR ROTARY
DATE STARTED: 4/18/95
DATE COMPLETED: 4/18/95
BORING LOCATION: 5 OF 61



GEOTECHNICAL BORING LOG

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OFFSET:
GROUND WATER: @ 0 HR: DRY @ 24 HR:
GEOLOGIST/ENGINEER: R. RUST

94C-1802

ELEV. DEPTH	BLOW COUNT			BLOWS PER FOOT						Wn/GW	SAM NO.	LOG	DESCRIPTION	
	5'	6'	6'	0	20	40	60	80	100					
0														
2.5													M S-1	
4.5-6.5	5	10	9 12										M S-2	4.5-11.5 MOIST BROWN SAND SW THICK CLAYEY SILT
7.5													M S-3	
9.5-11.5	10	6 8	2 9										M S-4	14.5-16.5 MOIST ORANGE/BROWN COARSE SAND SW
13	7	9	11 12										M S-5	19.5-21.5 MOIST TAN/BROWN COARSE SAND SW
15														24.5-26.5 MOIST TAN/ORANGE COARSE SAND SW W/THIN BEDS GREY SANDY SILT
20	4	5	5 6											29.5-31.5 MOIST BROWN COARSE SAND SW W/THIN BEDS/CLAYS OF GREY SAND SILT & SANDY CLAY
25	3	4	11 12											34.5-36.5 MOIST TAN SAND SW W/THIN BEDS GREY FINE SAND/ SILTY SILT
30	11	10	11 11											39.5-41.5 MOIST TAN/BROWN COARSE SAND W/GREY BEDDED SANDY CLAY AT 40.0' IRON STAIN
35	6	8	9 11											44.5-46.5 MOIST TAN/BROWN COARSE SAND W/GREY BEDDED SANDY CLAY AT 45.0' IRON STAIN
40	7	9	12 10											49.5-51.5 SAND AS HARD AS SAND TAN/BROWN COARSE SAND BELYN
45	9	12	16 17											54.5-56.5 MOIST TAN/ORANGE COARSE SAND W/THIN BEDS GREY CLAYEY SILT/SANDY CLAY
50	14	21	20 18											58.5-60.5 MOIST TAN/ORANGE COARSE SAND W/THIN BEDS BEDS OF GREY SILTY CLAY
55	15	14	21 23											
60	18	21	32 34											
65														
55														SECTION TERMINATED AT 65'

STL PROJECT NO.:
 SITE DESCRIPTION: LAMONT C&D LANDFILL
 COUNTY: FT. BRAGG
 BORING NO.: B-10
 COLLAR ELEVATION:
 TOTAL DEPTH:
 DRILL MACHINE:
 DRILL METHOD: 3/4 HSA TO 20' → AIR ROTARY
 DATE STARTED: 4/16/96
 DATE COMPLETED: 4/17/96
 BORING LOCATION:



**GEOTECHNICAL
BORING LOG**

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ENG-2802

OFFSET:
 GROUND WATER: @0 HR: DRY @24 HR:
 GEOLOGIST/ENGINEER: R. RUST

ELEV. DEPTH	BLOW COUNT			BLCWS PER FOOT						Wn / GW	SUN NO.	LOG	DESCRIPTION	
	6'	6'	6'	0	20	40	60	80	100					
0														
2.5														
5-7	5	4	5	10	15						M S-1		5-7 MOIST GREY CLAY CH WITH TAN & PURPLE STAIN	
7.5											M S-2			
10-12	10	12	20	19	29						M S-3		MOIST TAN/ORANGE CLAYEY SAND S. AND GREY CH → SANDY CLAY WITH TAN & PURPLE STAIN	
15											M S-4			
16-17	15	9	17	24	28						M S-5		15-17 SAME AS S-7	
20-22	20	10	12	12	16								20-22 WHITE SILTY SAND SW W/TAN STAIN 0.2' THICK GREY CH LENS	
24-26	25	11	10	8	9								24-26 MOIST GREY/TAN COARSE SANDS/CLAYEY SANDS SW ORANGE STAIN	
29-31	30	8	10	9	13								29-31 MOIST TAN/ORANGE/BROWN COARSE SANDS SW IRON STAIN BEDDED	
34-36	35	8	10	9	10								34-36 MOIST WHITE/TAN/BROWN COARSE SAND SP	
39-41	40	12	14	18	21								39-41 SAME AS ABOVE	
44-46	45	10	13	11	16								44-46 SAME AS ABOVE	
51-53	50	5	6	7	11								51-53 MOIST WHITE FINE SAND W/TAN ORANGE STAIN & THIN BEDS OF MICA	
55														
60														
65														

SPECIAL TESTING LABORATORIES OF NC, INC.

1510 Mechanical Blvd., Garner, NC 27529 (919) 662-1234 Fax No. (919) 662-9700

ENGINEERING - STEEL - WATER - CONCRETE - CHEMICAL ANALYSIS - SOILS - TEST BORINGS - CORE DRILLING - ASPHALT - ASBESTOS

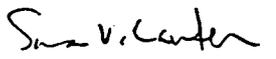
CLIENT: RS&H Architects
PROJECT: Fort Bragg #2
PROJECT NO: 96C-31
DATE: 5/30/96
LAB NO: 10

Laboratory Testing Report:

At the request of the client, the STL laboratory performed the following tests in general accordance with the applicable ASTM standards: Atterberg Limits (ASTM D4318); Bulk Density (ASTM D2937); Grain Size Distribution w/Hydrometer Analysis (ASTM D422); Moisture Content (ASTM D2216); Permeability (ASTM D2434 and ASTM D5084); and Standard Proctor (ASTM D698). Based on the results of the laboratory testing the soil porosity, void ratio, and saturation percentage were determined from the soil phase diagrams. See attached results.

We have appreciated being of service to you and are prepared to assist you on this or other projects. If you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact our office.

Respectfully Submitted,
SPECIAL TESTING LABORATORIES OF NC, INC.


Sara V. Lawter
Laboratory Manager

Laboratory Test Data Summary

REPORT ON SAMPLES OF Soils

Project Name: Pt. BRAGG
 Date Sampled: 4/96
 Sampled from: Various Borings

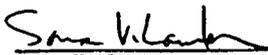
Project No.: 26C-11
 Date Received: 4/22/96
 By: Special, Inc.

Lab Sample No.: 10
 Date Reported: 5/31/96

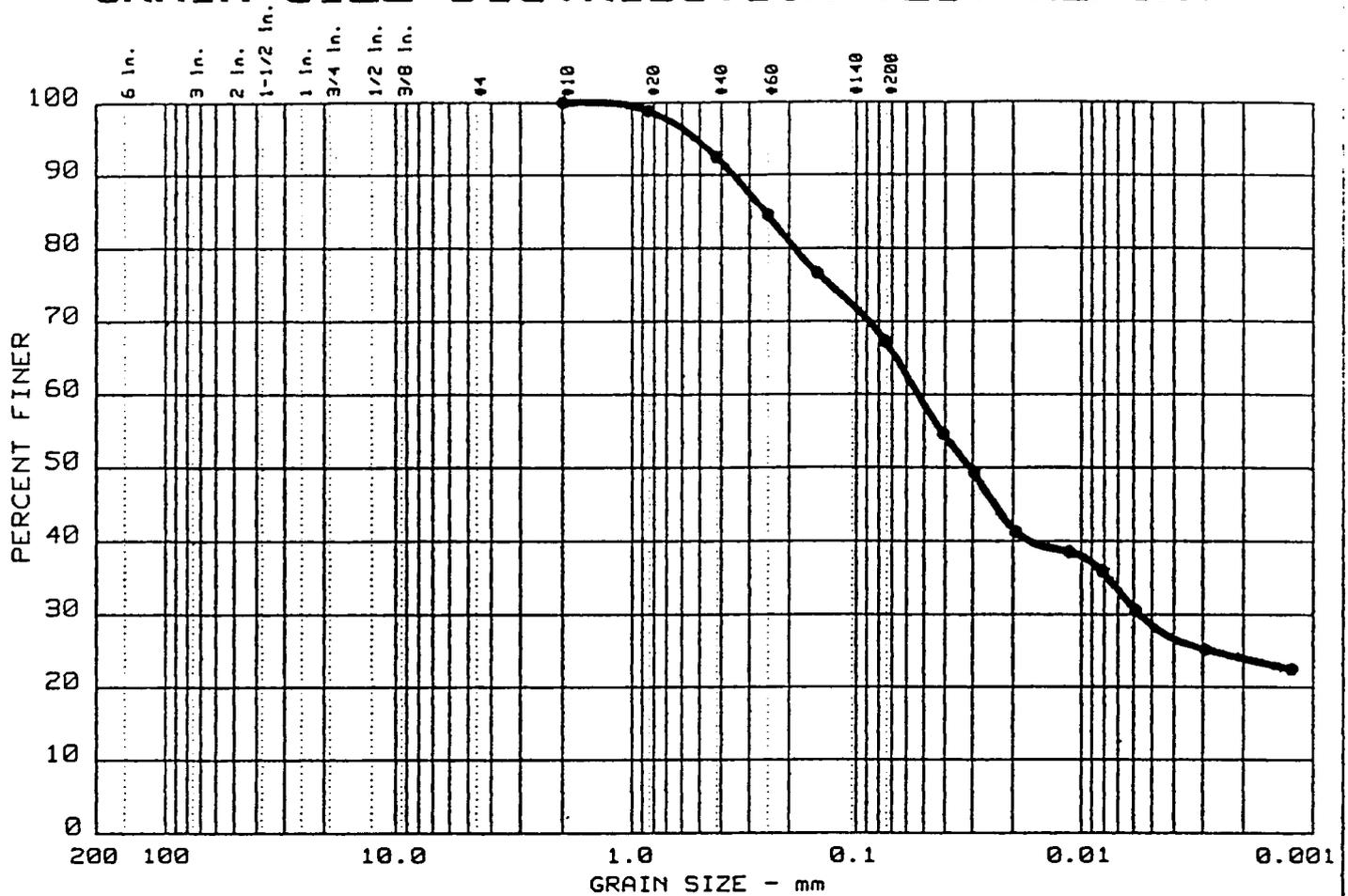
TEST RESULTS

Boring No.	B-7	B-8	B-9	Bulk #1	Bulk #2
Sample No.	ST-1	ST-1	ST-1		
Depth (ft)	13.0-15.0	15.0-17.0	13.0-15.0		
Retained #4 Sieve %	0.0	0.0			
Passing #10 Sieve %	100.0	100.0			
Passing #20 Sieve %	96.8	98.7			
Passing #40 Sieve %	92.5	92.0			
Passing #60 Sieve %	84.5	69.0			
Passing #100 Sieve %	76.7	29.8			
Passing #200 Sieve %	67.4	20.5			
Liquid Limit	20	19		21	32
Plastic Limit	15	NP		18	22
Plasticity Index	5	0		3	10
Color	Light Gray	Reddish Yellow		Reddish Tan	Brown to Red
Classification	CL-ML	SM			
Wet Density PCF	137.9	104.1	102.0	109.3	112.3
Dry Density PCF	122.7	89.9	92.5	101.2	101.9
Moisture Content	12.4	15.7	10.4	8.1	10.2
Void Ratio, e	0.348	0.838	0.788	0.634	0.623
Total Porosity, n	25.8	45.6	44.1	38.8	38.4
Saturation, S	94.6	49.7	36.1	33.8	43.4
Hydraulic Conductivity cm/sec	1.58E-7	7.54E-4	1.85E-2	3.71E-4	7.50E-3

Respectfully Submitted


 Sara V. Lawter
 Laboratory Manager

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● 8	0.0	0.0	32.7	38.9	28.4

LL	PI	D ₈₅	D ₆₀	D ₅₀	D ₃₀	D ₁₅	D ₁₀	C _c	C _u
● 20	5	0.257		0.0309	0.0057				

MATERIAL DESCRIPTION	USCS	AASHTO
● Light Gray Clayey Silt	CL-ML	

Project No.: 96C-31
 Project: Fort Bragg #2
 ● Location: B-7 (13.0 - 15.0 Feet)

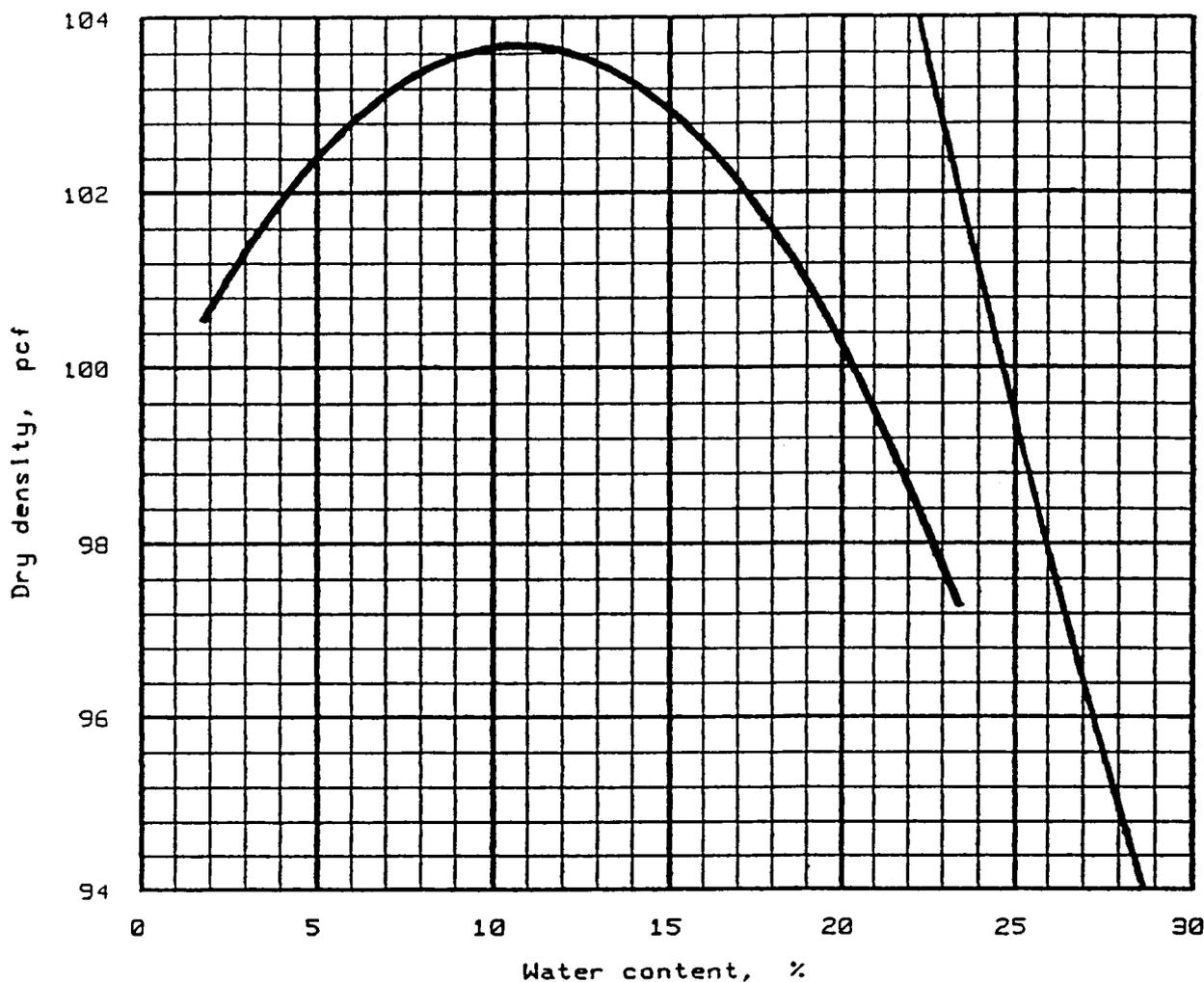
Date: 5-30-96

GRAIN SIZE DISTRIBUTION TEST REPORT

Remarks:

Figure No. _____

MOISTURE-DENSITY RELATIONSHIP TEST



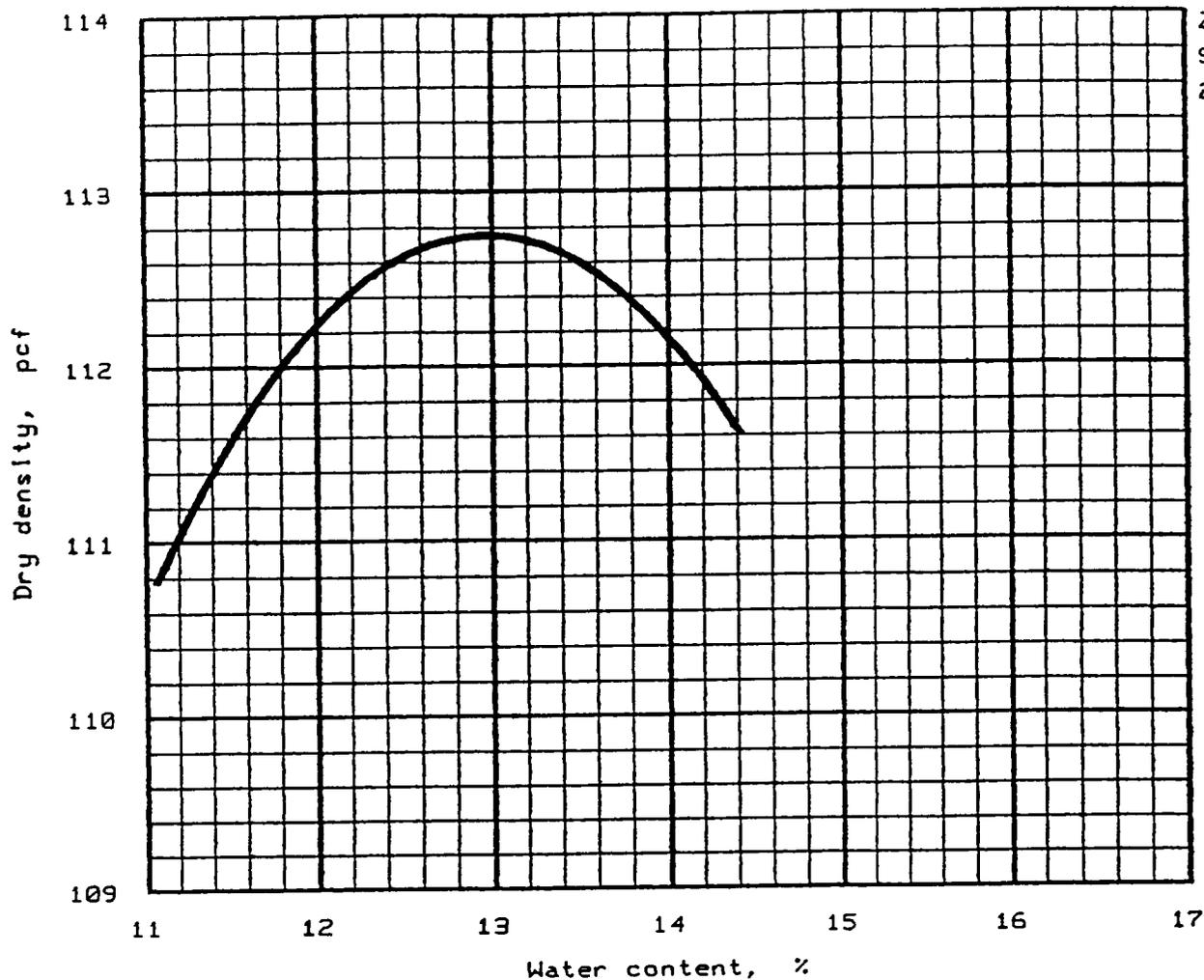
ZAV for
Sp.G. =
2.65

Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No. 4	% < No. 200
	USCS	AASHTO						
0-2 Ft			24.5 %					

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 103.7 pcf Optimum moisture = 10.7 %	Brown to Red Silty Sand (Visual)
Project No.: 96C-31 Project: Fort Bragg Location: Bulk Sample 1 Date: 5-06-1996	Remarks:
MOISTURE-DENSITY RELATIONSHIP TEST	Fig. No. _____

MOISTURE-DENSITY RELATIONSHIP TEST



ZAV for
Sp.G. =
2.65

Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No. 4	% < No. 200
	USCS	AASHTO						
0-2 Ft			7.1 %					

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.8 pcf Optimum moisture = 13.0 %	Reddish Tan Clayey Sand (Visual)
Project No.: 96C-31 Project: Fort Bragg Location: Bulk Sample 2 Date: 5-10-1996	Remarks:
MOISTURE-DENSITY RELATIONSHIP TEST	Fig. No. _____