McCALLUM
TESTING LABORATORIES, INC.
Geotechnical Engineering, Materials Testing & Environmental Services

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING

PROPOSED STORMWATER PUMP STATION

LANGLEY AIR FORCE BASE

HAMPTON, VIRGINIA

MTL PROJECT #02-3101

Prepared for:	Hayes, Seay, Mattern & Mattern, Inc. 448 Viking Drive, Suite 145 Virginia Beach, Virginia 23452
Attention:	James E. Spady, P.E.

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June 4, 2002

Hayes, Seay, Mattern & Mattern, Inc.
448 Viking Drive, Suite 145
Virginia Beach, Virginia 23452

Attention: **James E. Spady, P.E.**

Subject: **SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING**
Proposed Stormwater Pump Station – Andrew Street
Langley Air Force Base
Hampton, Virginia
MTL Project #02-3101

Dear **Mr. Spady**:

McCALLUM TESTING LABORATORIES, INC. is pleased to present this report of subsurface exploration and geotechnical engineering services for the above referenced project. Included in this report are:

1. A brief description of the project;
2. An outline of the services performed;
3. A tabulation of the subsurface conditions encountered; and
4. Our detailed recommendations for the design and construction of foundations and subgrade walls.

Should you have any questions concerning this report, please do not hesitate to contact this office at your earliest convenience.

Very truly yours,

McCALLUM TESTING LABORATORIES, INC.

COMMONWEALTH OF VIRGINIA
JON W. EBBERT
No. 034560
PROFESSIONAL ENGINEER
6/4/02

JON W. EBBERT, P.E.
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SUMMARY

The encountered subsurface conditions and the major geotechnical engineering recommendations have been summarized here for convenience. A detailed description of the soil conditions encountered and our detailed recommendations are provided in the report.

Beneath a surface veneer of topsoil, the borings encountered an 8 to 12 ft. thick fill layer, consisting of very compact to very loose, clayey and silty, fine sand, overlying Coastal Plain Sediments. The sediments consist of very loose to medium compact, silty and clayey sands. At the time of our exploration, water level measurements indicated groundwater to be 4 to 5 feet below existing grade.

- The pump station can be properly supported on a slab type foundation bearing on the silty sands encountered at the base of the required excavation. Maximum settlements should be on the order of ½ inch or less.
- If hydrostatic uplift pressures are excessive, a system of anchor piles can be utilized. Pile lengths and capacity information are presented in the report.
- The parameters to be utilized for design of the temporary sheet piles and the permanent reinforced concrete walls of the pump station are included in the text of the report.

PROJECT INFORMATION

The site for the proposed stormwater pump station is located on the east end of Andrew Street, just east of its intersection with Sijan Road at Langley Air Force Base in Hampton, Virginia. The relatively level site is a grass covered and paved parking area. Along the eastern end of the site, the property slopes moderately downward toward Back River with concrete debris along the eastern edge.

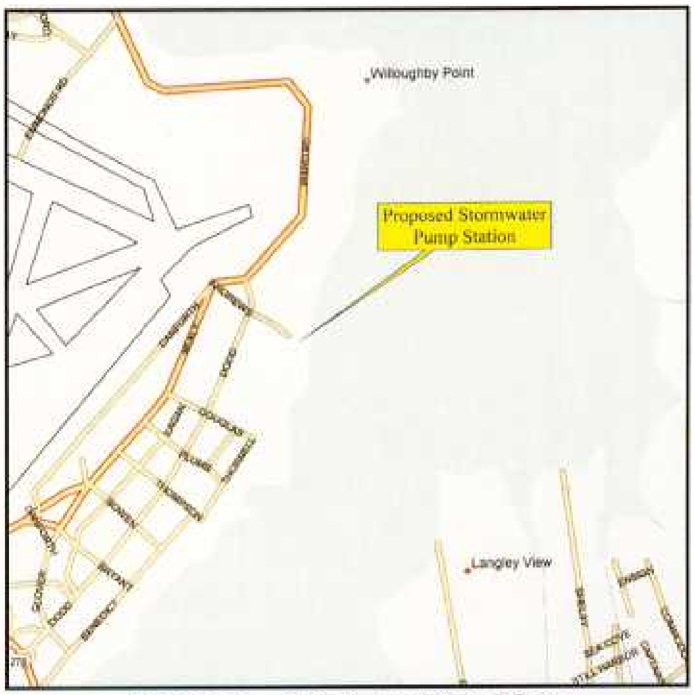

Figure 1. Site Location Plan

The planned pump station will consist of a one-story, pre-engineered modular control building above a wet well. The wet well will extend to a depth of approximately 20 ft. below existing grade. The well will have concrete walls and a base slab. The base slab of the wet well will have plan dimensions of 35 to 40 ft. by 40 to 45 ft. The maximum load exerted by the well base slab is expected to be on the order of 2500 psf.

SCOPE OF SERVICES

The evaluation of the site for the planned stormwater pump station required both the collection of subsurface data and the performance of various geotechnical analyses. These analyses were based on our experience with local conditions and available foundation types. All work was directed and supervised by a Professional Engineer specializing in geotechnical design and construction. This report which describes the exploration and provides our recommendations for the design and construction of foundations, ground slabs and subgrade walls was prepared after reviewing the project information provided to us and analyzing the subsurface data collected for the project.

McCallum Testing Laboratories, Inc. drilled two soil test borings extending to depths of 50.5 ft. each beneath the existing ground surface. Standard Penetration Tests (SPT's) were performed at 2 ft. intervals in the upper 10 ft. of boring and at 5 ft. intervals below 10 ft. All drilling, sampling, and testing was performed in accordance with applicable ASTM Standards or other widely accepted standards. At the completion of drilling, water level measurements were made within the completed bore holes. All samples obtained from the borings were visually examined by a Geotechnical Engineer and visually classified according to the Unified Soils Classification System.

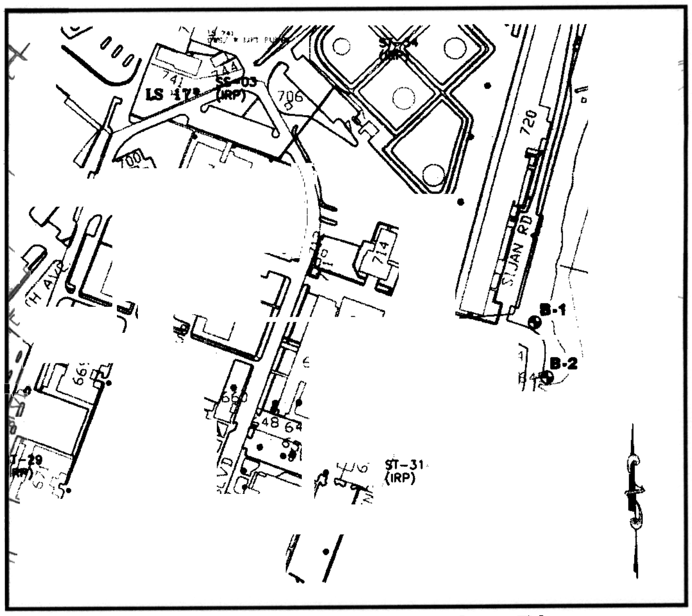

Figure 2. Boring Location Plan

A Site Location Plan, a Boring Location Plan, a Subsurface Profile, a Lateral Pressure vs. Depth diagram, and the detailed results of field sampling and testing are presented in the Appendix to this report.

SUBSURFACE CONDITIONS

Stratigraphy

Directly beneath a surface veneer of topsoil 1 inch thick, the borings encountered a thick layer of man-placed fill overlying Coastal Plain Sediments. A summarization of the subsurface conditions encountered is presented in the following tabulation:

STRATUM	AVERAGE DEPTH (FT)	DESCRIPTION	STANDARD PENETRATION RESISTANCE (BLOWS/FT)
A	0.1 - 10.0	**Fill** – Very compact to very loose, moist to wet, brown and gray, silty and clayey, fine sand (SM, SM-SC) with traces of gravel, brick and shell fragments	52 to 4, Decreasing With Depth
1	10.0 - 17.0	Very loose to loose, wet, brown and gray, silty, clayey, fine sand (SC) with traces of shell fragments	3 to 6
2	17.0 - 50.5*	Loose to medium compact, wet, gray, silty and clayey, fine sand (SM, SM-SC) with traces of shell fragments	9 to 17

* **Maximum Depth of Exploration.**

Groundwater

Our groundwater level measurements made at the completion of drilling operations indicated the level of groundwater to be approximately 4 to 5 ft. below the existing ground surface. Seasonal groundwater level fluctuations on the order of 2 to 3 feet are not uncommon in this area. Lowest groundwater levels normally occur in late summer and early fall while the highest levels generally occur in late winter and early spring. In addition, tidal fluctuations can effect the groundwater level at this site. At the time of our study, we believe groundwater levels were between their seasonal high and low elevations. However, due to the relatively dry conditions over the past year, we expect the average seasonal high elevation is as much as 2 ft. higher than the seasonal high elevation experienced this year.

RECOMMENDATIONS

Basis

The following recommendations are based on data obtained by this subsurface exploration program, the structural and site orientation data given previously and our past experience within the area. If the project information presented is incorrect or changed in the final design or if site or subsurface conditions encountered during construction differ appreciably from those indicated by this report, this office should be notified to determine the applicability of our recommendations in light of the changed conditions.

Wet Well Excavation

The construction of the wet well will require an excavation to a depth of approximately 22 ft. below existing grade. Based on our water level measurement, we expect the excavation will extend as much as 20 ft. below the level of groundwater. The excavation walls will therefore have to be properly supported by a system of braced sheet piles and the level of groundwater should be drawn down to below the excavation bottom with a system of well points. These procedures will permit work within the excavation to proceed unhampered by cave-ins and groundwater intrusion.

Foundation Discussion

The wet well can be properly supported on a slab type foundation bearing on the silty sands encountered at the base of the required excavation. However, it appears, based on our calculations, that the weight of the structure may be less than the anticipated hydrostatic uplift force. Should this be the case, to avoid potential damage to the structure and its associated piping, we recommend one of the following design alternatives be utilized:

(1) The bottom slab and walls can be thickened and/or the bottom slab can be extended outward beyond the wet well walls to provide resistance to buoyancy forces.

(2) The wet well base slab can be anchored with a pile foundation system.

(3) A combination of the first two alternatives can be utilized

These alternative foundation systems are discussed within the following sections of this report.

Slab Type Foundation

To provide uniform bearing and foundation soil stabilization, we recommend the foundation slab for the wet well bear on a 12 inch thick blanket of No. 57 crushed stone compacted to a non-yielding condition. Based on the plan dimensions and depth of the wet well, allowable soil pressure of over 10,000 psf are available. As such, the anticipated soil bearing pressures of 2,500 psf can be safely supported.

We expect maximum settlements should be ½ inch or less. Essentially all settlement is expected to occur with the application of the load with no long term settlements anticipated. The magnitude and rate of movement is not expected to adversely affect the structure. However, piping connections should be designed flexible enough to withstand the anticipated movement without causing pipe damage.

To develop additional resistances to the hydrostatic forces on the bottom of the slab, the plan dimensions of the base slab can be extended outward beyond the walls of the wet well. The increase uplift resistance will be equal to the buoyant weight of the soil directly above the extended base. Additional uplift resistance can be obtained by a system of anchor piles.

Pile Foundations

We have confined our pile analyses to 10 and 12 inch square, prestressed, precast concrete piles and helical piers due to their friction capacity and availability. The results of our calculations indicate the following recommended pile capacities for piles extending to the maximum depth of exploration, 50 ft.:

	Recommended Pile Capacities (tons)	
Pile Type	Compression	Uplift
10" square concrete	20	12
12" square concrete	25	15
10", 12" and 14" triple helical pier	8	8

Indicator Piles and Pile Load Tests – Precast Concrete Piles

Indicator piles and pile load tests are fundamental to a properly designed pile foundation system. We recommend a minimum of two indicator piles be installed across the wet well area at production pile locations. Indicator piles should be at least 5 ft. longer than the anticipated production pile length. The results of indicator pile driving should be evaluated by the Geotechnical Engineer to determine if a pile load test is required. If deemed necessary, an uplift load test should be run to failure, if at all possible, in accordance with ASTM D 3689, Section 7.7, Quick Load Test Method, no sooner than 48 hours after installation. The actual production pile lengths and capacities should then be determined based on the results of the indicator pile installations, the available subsurface data and the results of any required load tests.

Precast Concrete Pile Installation

Compatibility of the driving equipment and the pile type being driven is an essential element in achieving the required penetration and a satisfactory pile foundation. We recommend that a pile driving rig equipped with fixed leads and a pile hammer with a minimum energy of 8,000 to 15,000 ft-lbs be utilized.

The required driving resistance for production piles should be determined in accordance with a pile driving formula in conjunction with the results of indicator pile driving and any required load tests. However, the driving of piles in saturated sands can cause densification and an increase in porewater pressure at the tip, resulting in a temporary reduction of the driving resistance and pile capacity. Therefore, due to the effect of the excess porewater pressure, it may not be strictly possible to assign an initial minimum pile driving resistance for production piles. Where low driving resistances are encountered, piles should be retapped the following day to confirm that the final set of individual production piles does not vary significantly from that of successfully load tested piles or that indicated by pile driving formulae. Should such a variation occur, the matter should immediately be brought to the attention of the Geotechnical and Structural Engineers for their evaluation.

Helical Piers Installation and Inspection

The recommended helical piers consist of steel screw anchors with three circular helix shaped steel plates attached to a central steel shaft. The helical piers are installed by drilling the piles to their predetermined tip depth. Installation torque is monitored and averaged over the last three feet of embedment to help determine if the helical piers have achieved the design capacity. At least two indicator piles should be installed and the applied torque monitored. The indicator pile installation records should be provided to the Geotechnical Engineer to determine if an uplift load test is required. Where a load test is required, it should be performed in accordance with the procedures outlined in ASTM D 3689, Section 7.7, Quick Load Test Method. The actual production pile length and capacity should then be determined based on the indicator pile installation records, the available subsurface data and the results of any required load tests.

Pile Installation Inspection

Even the most knowledgeable contractor working with a well written set of specifications will not ordinarily be cognizant of detailed design assumptions. It is best to retain an independent inspector to observe the pile installation procedure and verify the compliance with the intent of the pile installation specifications. We recommend the Geotechnical Engineer be retained to approve each pile in the installation and to revise installation procedures should varying soil conditions be encountered.

Subgrade Walls

Based on the results of our field testing and visual classification of the on-site soils, we recommend the following parameters be utilized for design of the temporary sheet piles, the permanent reinforced concrete walls as well as an extended base slab for uplift resistance:

RECOMMENDED SOIL PARAMETERS FOR SUBGRADE WALL DESIGN

Depth (ft.)	0 - 6	6 - 17	17 - 50
Soil Unit Weight (pcf)	115	110	115
Buoyant Unit Weight (pcf)	55	50	55
Cohesion (psf)	0	0	0
Angle of Internal Friction	32	28	32
At Rest Earth Pressure Coefficient*	0.47	0.53	0.47
Active Earth Pressure Coefficient	0.31	0.36	0.31
Passive Earth Pressure Coefficient	3.25	2.77	3.25
Adhesion Against Steel (psf)	0	0	0
Friction Angle Against Steel	11	11	11
Adhesion Against Concrete (psf)	0	0	0
Friction Angle Against Concrete	17	17	17

* Please note that the "At-Rest" Earth Pressure Coefficient should be utilized for subgrade walls restrained against inward tilt.

All backfill around subgrade walls should be relatively clean sand (SW, SP, SP-SM, or SM) compacted to at least 95 percent of ASTM D 698.

Since the subgrade walls will be restrained against inward tilt, we recommend the lateral pressure used for the design of the subgrade walls be calculated using an "at-rest" condition. Therefore, the Lateral Pressure vs. Depth Diagram (Figure 3) was developed utilizing "at-rest" coefficients and includes the hydrostatic pressure from the groundwater.

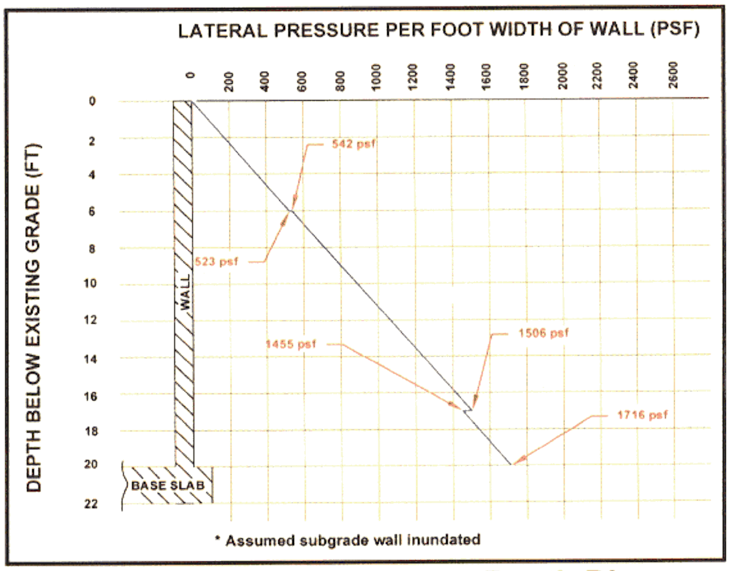

Figure 3. Lateral Pressure vs. Depth Diagram

APPENDIX

Site Location Plan

Boring Location Plan

Lateral Pressure vs. Depth Diagram

Subsurface Profile

Test Boring Records

Mag 15.00
Wed May 29 13:01 2002

Scale 1:15,625 (at center)
1000 Feet
500 Meters

Local Road
Major Connector
State Route
Airfield

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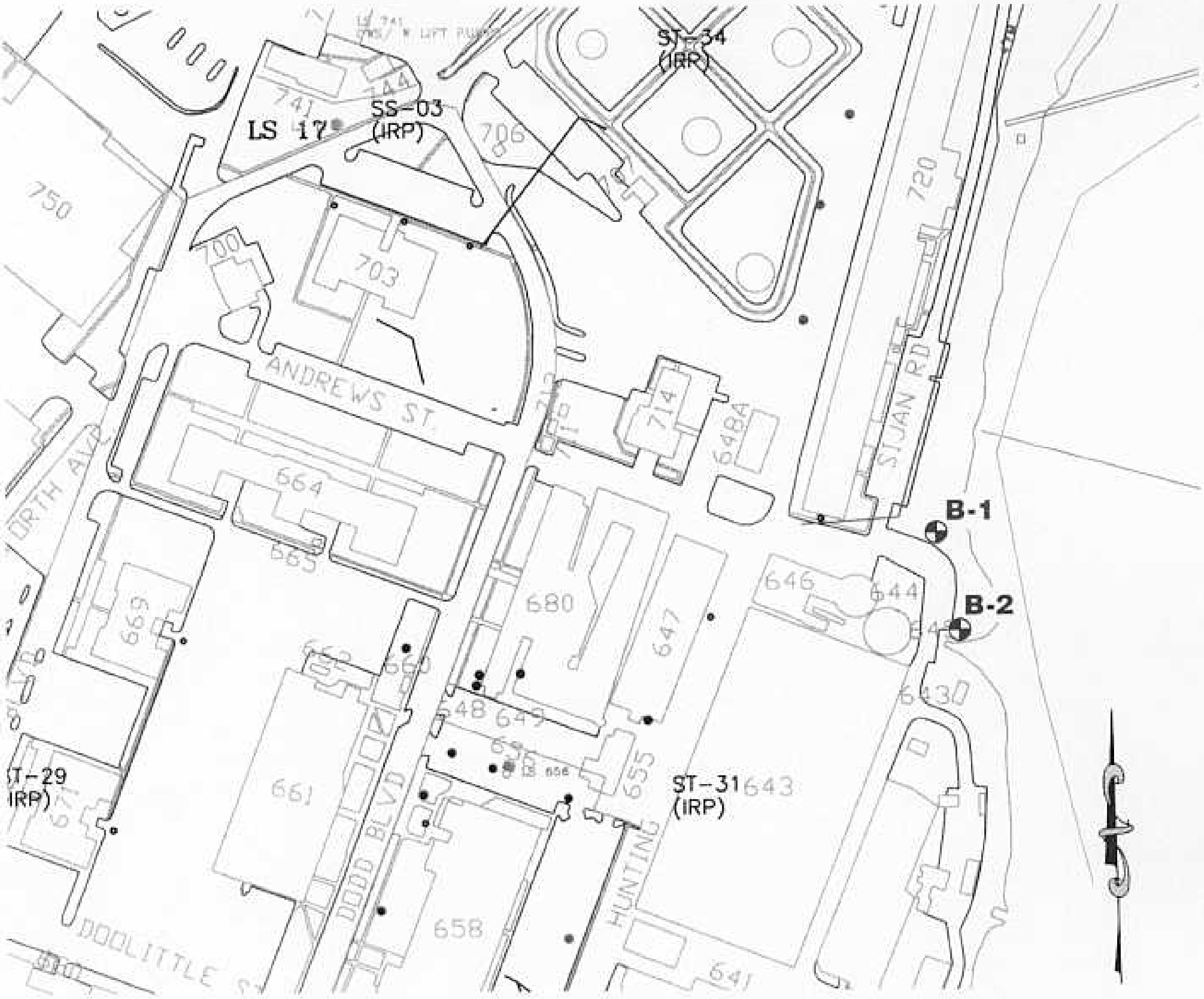
1808 Hayward Avenue
Chesapeake, Virginia 23325-0337

Scale:	As Shown	Approved By:	Jon W. Ebbert, P.E.	Date:	5/20/02
Project:	Proposed Stormwater Pump Station Langley Air Force Base Hampton, Virginia				
Drawing Title:	Site Location Plan			Drawing Number:	1



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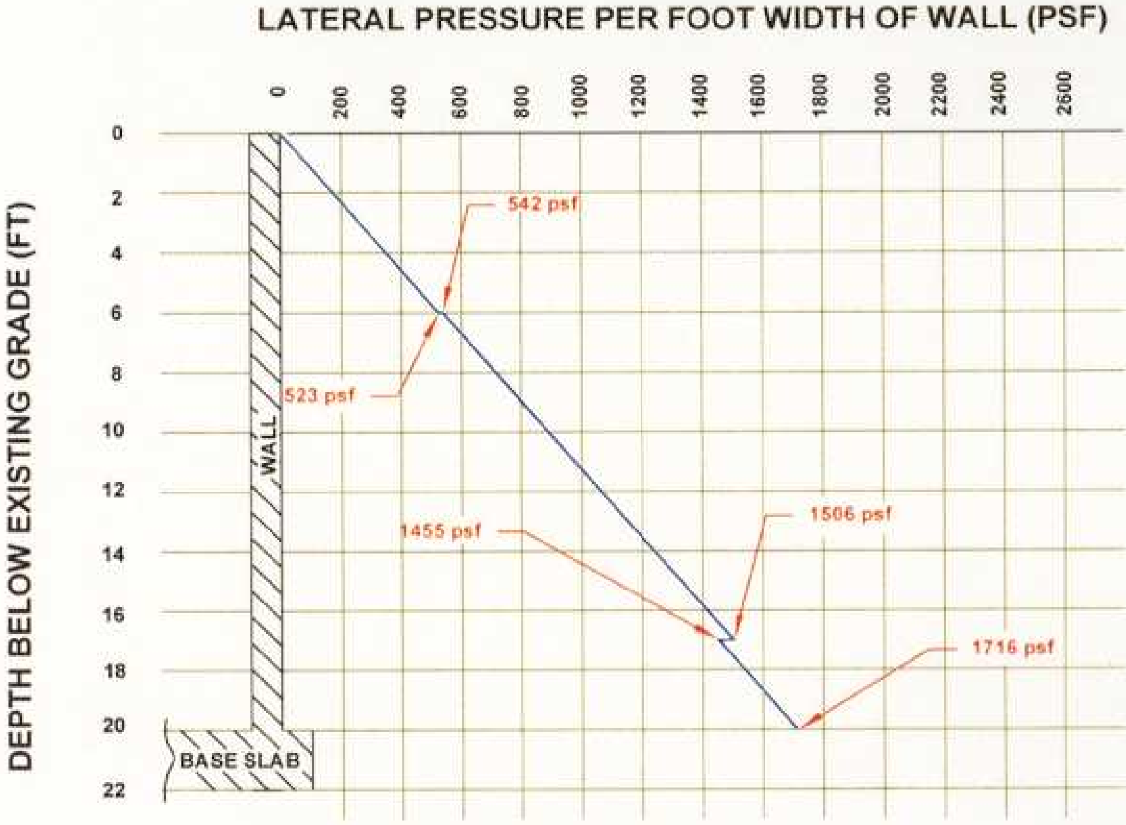
1808 Hayward Avenue
Chesapeake, Virginia 23325-0337

Scale:	----	Approved By:	Jon W. Ebbert, P.E.	Date:	5/20/02
Project:	Proposed Stormwater Pump Station Langley Air Force Base Hampton, Virginia				
Drawing Title:	Boring Location Plan			Drawing Number:	2



* Assumed subgrade wall inundated

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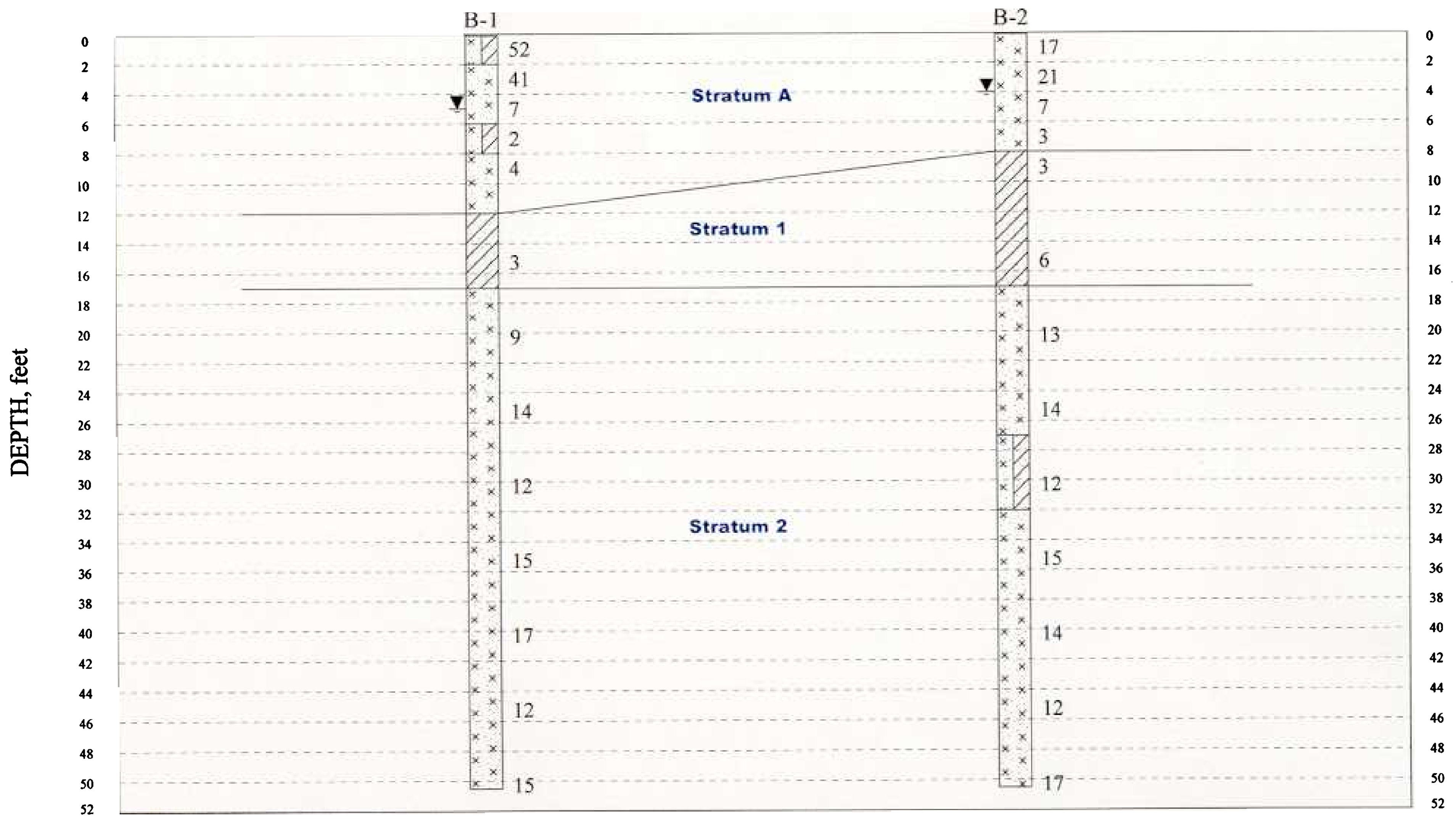
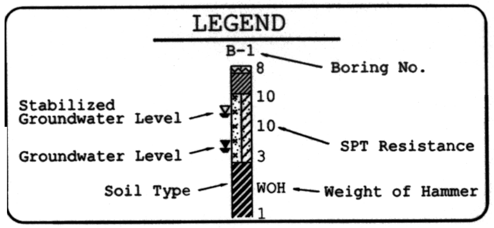
Chesapeake, Virginia 23325-0337

Scale:	As Shown	Approved By:	Jon W. Ebbert, P.E.	Date:	5/20/02
Project:	Proposed Stormwater Pump Station Langley Air Force Base Hampton, Virginia				
Drawing Title:	Lateral Pressure vs. Depth Below Existing Grade			Drawing Number:	3





Subsurface Profile

Drawing 4

PROJECT: Proposed Stormwater Pump Station, Langley AFB, Hampton, Virginia

PROJECT NO. 02-3101

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Unified Soil Classification System
ASTM Designation D 2487

Major Division	Subdivision	Group Symbol	Description
Coarse Grained Soils (More than 50% of materail retained on the No. 200 Sieve)	Gravels (more than 50% retained the No. 4 Sieve)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (more than 50% passing the No. 4 Sieve)	SW	Well graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine Grained Soils (More than 50% of materail passes on the No. 200 Sieve)	Silts & Clays (LL less than 50)	ML	Inorganic silts, very fine sands, silty or clayey fine sandsor clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays
		OL	Organic silts and organic silty clays of low plasticity
	Silts & Clays (LL greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, plastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity
	Highly Organic Soil	PEAT	Peat and other highly organic soils

Standard Pentration Test (SPT)
Resistance Correlations

Coarse Grained Soils

SPT
vs.
Relative Density

Blows/Ft	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Compact
31 - 50	Compact
Over 50	Very Compact

Fine Grained Soils

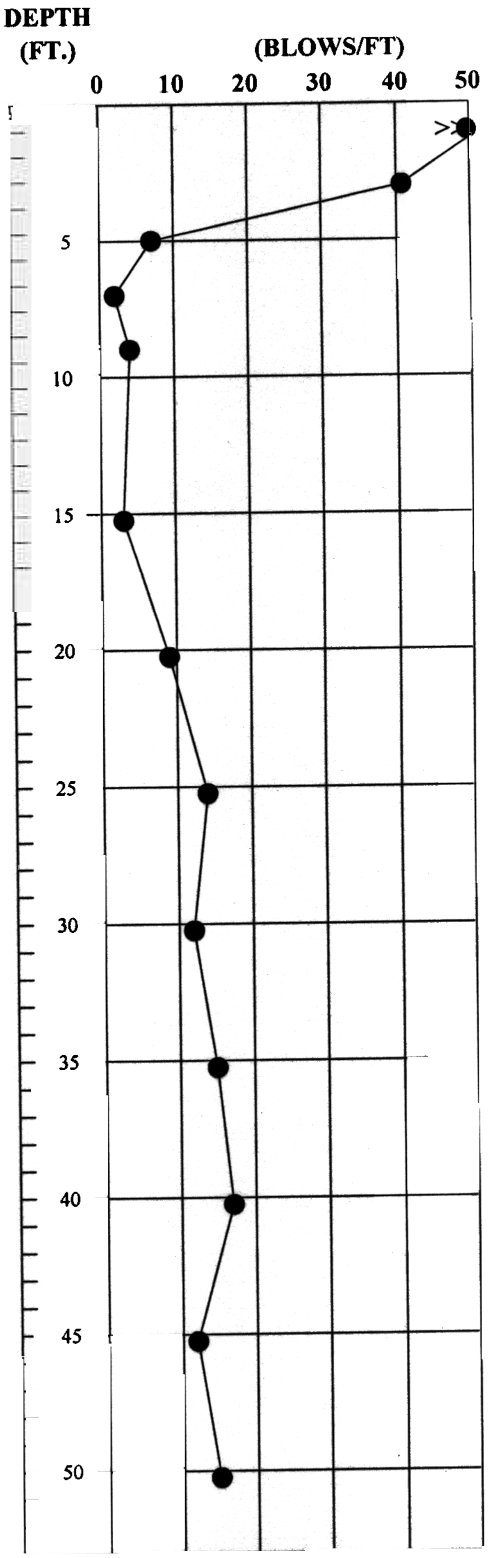
SPT
vs.
Consistency

Blows/Ft	Consistency
0 - 2	Very Soft
3 - 4	Soft
5 - 8	Medium Stiff
9 - 15	Stiff
16 - 30	Very Stiff
31 - 50	Hard
Over 50	Very Hard

STANDARD PENETRATION RESISTANCE

DEPTH (FT.)	DESCRIPTION
0.0	
0.1	Topsoil - 1"
2.0	Fill - Brown clayey silty fine sand with traces of gravel and brick, moist, very compact, SM-SC
	Fill - Gray silty fine sand with traces of clay, gravel, brick and shell fragments, moist, compact, SM
6.0	Same - wet, loose
8.0	Fill - Gray clayey silty fine sand with traces of gravel and shell fragments, wet, very loose, SM-SC
12.0	Fill - Brown silty fine sand with gravel, brick an traces of clay, wet, very loose, SM
17.0	Brownish gray silty clayey fine sand with traces of shell fragments, wet, very loose, SC
	Gray silty fine sand with traces of shell fragments, wet, loose, SM
	Same - medium compact
	Same
	Same
	Same
	Same
50.5	Same
	BORING TERMINATED AT 50.5 FEET

DEPTH (FT.)	(BLOWS/6 IN)
0	6-19-33-38
	12-17-24-30
5	3-3-4-5
	2-1-1-:
15	-1-2
20	3-4-5
25	5-4-10
30	4-5-7
45	4-5-7
50	5-7-8



NOTES: *Petroleum odor encountered in 4 to 10 ft. soil samples*

- Gradual Stratum Change
- Approximate Stratum Change
- ● - Penetration Resistance (N - value)
- ⊠ - Standard Penetration Test
- ▮ - Undisturbed Sample
- ▼ - Groundwater Level at Time of Boring
- ▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER	B-1
DATE DRILLED	May 20, 2002
PROJECT NUMBER	02-3101
PROJECT	Proposed Stormwater Pump Station
LOCATION	Langley Air Force Base, Hampton, VA

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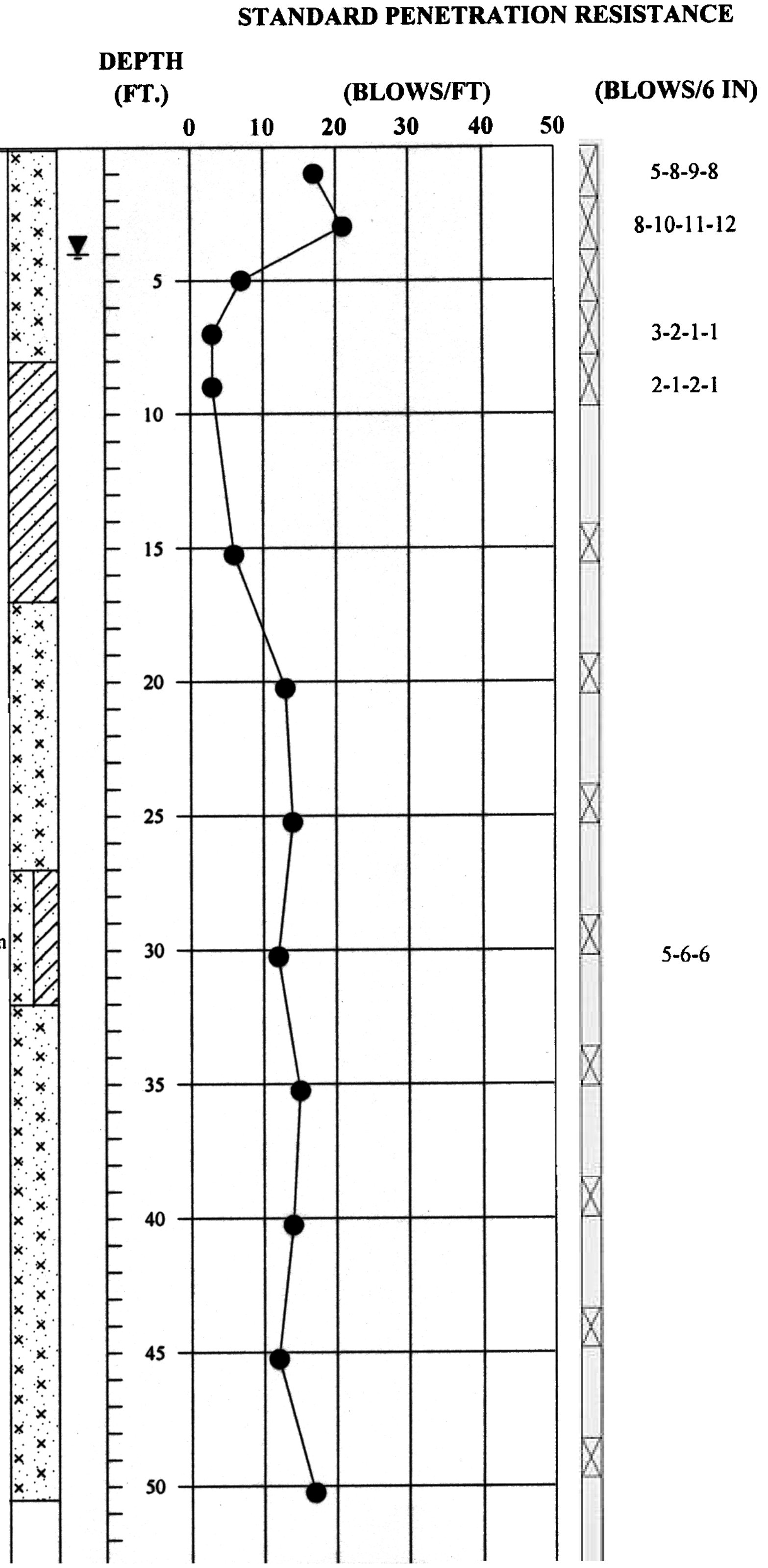
DEPTH (FT.)	DESCRIPTION	(BLOWS/6 IN)
0.0		
0.1	Topsoil - 1"	
	Fill - Brown silty fine sand with traces of clay, gravel, shell fragments and brick, moist, medium compact, SM	5-8-9-8
	Same	8-10-11-12
	Same - wet, loose	
	Same - gray, very loose	3-2-1-1
8.0	Brown silty clayey fine sand, wet, very loose, SC	2-1-2-1
	Same - with traces of shell fragments, loose	
0		
	Gray silty fine sand with traces of shell fragments, wet, medium compact, SM	
	Same	
27.0		
	Gray clayey silty fine sand with traces of shell fragments, wet, medium compact, SM-SC	5-6-6
32.0		
	Gray silty fine sand with traces of shell fragments, wet, medium compact, SM	
	Same	
	Same	
50.5	Same	
	BORING TERMINATED AT 50.5 FEET	



NOTES:

- - - - - - Gradual Stratum Change
— — — - Approximate Stratum Change
● - Penetration Resistance (N - value)
☒ - Standard Penetration Test
▮ - Undisturbed Sample
▼ - Groundwater Level at Time of Boring
▽ - Stabilized Groundwater Level Reading

TEST BORING RECORD

BORING NUMBER	B-2
DATE DRILLED	May 20, 2002
PROJECT NUMBER	02-3101
PROJECT	Proposed Stormwater Pump Station
LOCATION	Langley Air Force Base, Hampton, VA

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APPENDIX F

ENVIRONMENTAL FIELD NOTES