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September 30, 2009

Mr. Edward Snoble, AIA
The Jenkins Group, Inc.
300 Park Boulevard, Suite 250
Itasca, Illinois 60143

Subject: **Geotechnical Engineering Study, NSA Joint Commissary and Navy Exchange, Annapolis, Maryland (SE Reference No. 09140037.00)**

Dear Mr. Snoble:

Submitted herewith are three copies of our report for the above referenced project. This report has been prepared in accordance with our proposal/agreement dated May 5, 2009.

Services performed under this agreement included the drilling of twenty two soil test borings, two in-situ infiltration tests, soil laboratory testing, and preparation of this geotechnical engineering report for this project.

We appreciate the opportunity to be of service to you for this project. Please contact this office, if you have any questions concerning this report.

Sincerely,

SCHNABEL ENGINEERING, LLC

David L. Carpenter, P.E.
Project Engineer

Geotechnical Engineering Study
NSA Joint Commissary and Navy Exchange
Annapolis, Maryland

September 30, 2009

Prepared for:

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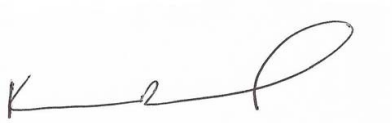
SE Project 09140037.00



David L. Carpenter, P.E.
Project Engineer

Kenneth E. Derrenbacher, P.E
Principal

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the state of Maryland.

License No. 25765, Expiration Date: 1/15/10

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EXECUTIVE SUMMARY

The executive summary is intended to provide a brief summary of the recommendations included in this report. This summary should not be used in lieu of the attached report.

This geotechnical engineering study was performed to assess subsurface conditions and provide geotechnical design recommendations for the proposed Commissary and Navy Exchange in Annapolis, Maryland. The Commissary will measure about 205 feet by 245 feet in plan view. The Exchange will measure about 345 feet by 245 feet in plan view. The maximum expected column and wall loads for the new building are 150 kips and 7 kips per foot, respectively, and the finished floor grade will be at about EL 78.5. A large parking lot, access roads, and a loading dock are also planned. A new stormwater management facility will be constructed at the south end of the proposed parking lot.

Two to 5.5 feet of existing fill soils were encountered in four of the test borings. Natural Coastal Plain deposits of the Talbot, Aquia, and Monmouth formations were encountered below the fill soils to the boring termination depths of 10 to 50 feet. Long term water level observations performed in the test borings indicated that the test borings were dry, except for test boring P-2, in which water was observed at a depth of 7.2 feet below the ground surface (EL 69.8) 24 hours after completion of drilling. We believe that the water encountered in the test borings is perched and is not representative of the static groundwater levels at the site.

Existing structures, pavements, and utilities are present on the site. Therefore, grading and excavation activities may encounter buried foundations and other debris associated with demolition of the existing structures. We recommend the complete removal of existing foundations, if any, from within the proposed new building and pavement areas. Existing utilities and drainage structures should properly abandoned or removed and replaced with compacted structural fill.

Spread footings founded on firm natural soils or new compacted fill are considered suitable for support of the new structure. Based on the test borings, natural soils will be encountered at the planned foundation subgrade elevation of about EL 76, except at test borings B-3 and B-4, where existing fill soils were encountered. Therefore, lowering the footings to natural soils or undercutting the fill soils and replacement with compacted fill will be required at these locations. Considering column loads of up to 150 kips and wall loads of up to 7 kips per foot, we recommend a design soil bearing pressure of 3,000 psf for spread footings. All footings should be founded at least 2.5 feet below exterior grades.

Natural soils, new compacted fills or existing fills are expected at the floor slab subgrades. The existing fill soils are not considered suitable for support of the floor slabs. Where encountered, these soils should be removed to a minimum depth of 2 feet below the proposed floor slab subgrades or to firm natural soils and replaced with new compacted fills. We expect that about 30% of the floor slab subgrades will be undercut. The floor slabs may be designed for a modulus of subgrade reaction, k, of 200 pci when the subgrades are prepared as described herein.

We recommend an IBC Seismic Site Class D be used for design of the new building additions. Lateral earth pressure recommendations for design of below grade (rigid) walls and cantilever retaining walls are included in Section 4.5 of this report.

Flexible asphalt pavement sections are provided for the parking lot, loading dock, and access roads. Due to the presence of existing fill soils, some undercutting of the pavement subgrades (estimate 10%) will be required. We recommend a section of 4 inches of asphalt over 8 inches of graded aggregate base for the flexible asphalt pavements in the parking lot. A pavement section of 5 inches of asphalt over 8 inches of graded aggregate base is recommended for the loading dock and access roads. Concrete pavements should be considered for the loading dock truck pads and turn areas.

Infiltration appears suitable at depths of approximately 9 feet below the ground surface (EL 60) at boring SWM-1 and below a depth of about 3 feet (EL 73) at borings SWM-2. An infiltration rate of 2.4 inches/hour should be used for design.

Structural fill should be compacted to at least 92 percent of the maximum dry density in accordance with ASTM D-1557, Modified Proctor. The top one-foot of compacted fill for pavement support should be compacted to at least 97 percent of the maximum dry density per ASTM D-1557, Modified Proctor. Graded aggregate base material placed for pavement support should be compacted to at least 97 percent of the maximum dry density per ASTM D-1557, Modified Proctor. Most of the on-site soils obtained from footing or utility excavations should be suitable for use as compacted fill. Moisture contents are believed to be below to above the optimum for compaction, so wetting or drying of these soils should be expected. We strongly recommend that earthwork operations be scheduled during the dryer months to minimize delays and costs associated with wet soils.

The same geotechnical firm that provided the site investigation and geotechnical engineering report (Schnabel) must be retained to be on-site during construction to observe footing, fill, and floor subgrades, and observe earthwork operations. On-site inspection is recommended to confirm that soil conditions are similar to those assumed herein and to verify that the recommendations provided herein have been properly interpreted and performed.

GEOTECHNICAL ENGINEERING STUDY
Joint Commissary and Navy Exchange
Naval Station Annapolis, Maryland

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APPENDIX A

Subsurface Investigation Data
Subsurface Investigation Procedures
General Notes for Test Boring Logs
Test Boring Logs (23 sheets)

APPENDIX B

Laboratory Results
Identification of Soils
Summary of Soil Laboratory Tests (2 sheets)
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APPENDIX C

Infiltration Tests
Infiltration Test Procedures
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1.0 OBJECTIVE AND SCOPE

The objective of our geotechnical engineering study was to evaluate the subsurface conditions at the project site and provide geotechnical recommendations for construction of a single-story shopping center, parking lots and access roads, and a stormwater management facility. Our scope of services included drilling twenty-two test borings, two infiltration tests, soil laboratory testing, and preparation of this geotechnical engineering report. The geotechnical engineering report includes the evaluation of test borings, geology, physical soil tests, and related structural data to develop the following:

- Our evaluation of the estimated subsurface conditions based on the test borings.
- Foundation requirements for support of the proposed structure including a recommended allowable soil bearing pressure, bearing grades, and estimated building settlements for shallow spread footings supported on natural soils and/or compacted fills.
- International Building Code (IBC) seismic site class based on assumed soil stratification.
- Recommendations for floor slab support, including a modulus of subgrade reaction (k) value for design.
- Recommended lateral earth pressure diagrams for the design of rigid and cantilevered retaining walls.
- Recommendations regarding handling of groundwater in design, including subdrainage design requirements, if required.
- Assessment of on-site soils for reuse as compacted fills.
- Assessment of subgrade conditions for support of flexible and rigid pavements, including recommended pavement designs for heavy duty and light duty pavements.
- Estimated infiltration rates, based on USDA Textural Classification and in-situ percolation tests, for use in design of stormwater management structures.
- Earthwork recommendations for construction of storm water management ponds.
- Discussion of construction considerations related to subgrade preparation, foundation installation, temporary dewatering, earthwork and compaction, and scope of quality control work necessary during construction.
- Comments regarding geotechnical construction considerations that should be considered both in the design and in the construction plans and specifications.

Services with respect to erosion control, cost or quantity estimates, review of design and contract documents, and construction observation and testing were not included in our scope of services.

2.0 SITE AND PROJECT DESCRIPTION

2.1 Site Description

The site is located at 66 Greenbury Point Road in Annapolis, Maryland on the current grounds of the existing storage facility for the U.S. Naval Academy. The site is bounded by Greenbury Point Road to the north, Kinkaid Road to the south, existing structures to the west and the Naval Academy Golf Course to the east. The site is approximately 0.3 miles northeast of the Severn River and 0.75 miles west of the Chesapeake Bay. A Vicinity Map is included as Figure 1 at the end of this report.

The site is relatively flat with grades sloping gently down from approximately EL 80 at the northwest corner of the site to approximately EL 69 at the southeast corner of the site. The majority of the site consists of rolling grass fields. The northeast corner of the proposed commissary will be built over the current storage facility. The facility has basement level, although the size of the basement is unknown. The storage facility is surrounded by paved and gravel covered areas for access to the loading docks on the west and east sides of the building. The south side of the storage facility is enclosed by a fence. Two additional existing buildings are present on the south edge of the site along the north side of Kinkaid Road. The west building is the single-story Fleet Family Support Center. The east building is a single-story clinic and does not appear to be occupied. Both buildings have asphalt paved parking areas and access to Kinkaid Road.

Known utilities at the site include underground communication, electric, gas, water, sanitary sewer, and storm drains. Communication and electric lines are parallel to Greenbury Point Road. There are many utilities located around the storage facility, particularly under the pavement west of and northeast of the building, where electrical duct banks are present. There is also a major electric line that runs across the field between the support center and the clinic. There are several utilities present around the clinic, with water lines connecting existing hydrants as well as another electrical duct bank. Gas lines were located running into the south wall of the clinic.

We obtained the site information from the proposed site plan dated April 23, 2009, prepared by The Jenkins Group, and through our site visits.

2.2 Proposed Construction

A new single story Commissary and Navy Exchange are planned for the site. The Commissary will measure about 205 feet by 245 feet in plan view. The Exchange will measure about 345 feet by 245 feet in plan view. The total footprint of the two combined structures will be approximately 135,000 square feet. The maximum expected column and wall loads for the new building are 150 kips and 7 kips per foot, respectively, and the finished floor grade will be at about EL 78.5.

New parking lot areas are to be located south of the proposed buildings. The main parking lot will be approximately 80-feet south of the buildings and will have 466 parking spaces. An additional parking lot is connected to the southeast end of the main parking lot and will hold another 98 spaces. A new access road will connect the parking lots to Greenbury Point Road and will contain an additional 11 spaces. Two other access roads will connect to Kinkaid Road from the center and the southwest corner of the main parking lot.

A new stormwater management facility is planned at the southeast end of the site. The Jenkins Group provided the details.

3.0 SUBSURFACE EXPLORATION AND DATA ANALYSIS

3.1 Data Collection Techniques

Recon Drilling, Inc. drilled 22 borings at this site from August 3 to 7, 2009 under the supervision of our representative. Appendix A includes specific observations, remarks, and logs for the borings; classification criteria; and sampling protocols. Figure 1 shows the approximate boring locations. Appendix A includes the logs from our subsurface exploration data, and a location plan. We will retain soil samples up to 45 days beyond the issuance of this report, unless you request other disposition.

Our geotechnical laboratory conducted tests on selected samples obtained in the borings. This testing aided in the classification of soils encountered in the subsurface exploration, and provided data for use in the development of foundation and earthwork recommendations. The logs in Appendix A show the natural moisture content values of selected soil samples. Appendix B presents the results of the remaining laboratory tests.

3.2 Geology

We reviewed existing geologic data and information in our files. Based on this review, the geologic stratigraphy consists of existing fill soils placed during previous construction and site grading. The underling soils are believed to be Coastal Plain sediments of the Talbot, Aquia, and Monmouth Formations.

3.3 Generalized Subsurface Stratigraphy

We have characterized the following generalized subsurface soil stratigraphy based on the boring and test pit data presented in Appendix B:

Existing Pavements and Topsoil (Ground Cover):
Topsoil was encountered in most of the test borings. The topsoil depths ranged from about 1 to 4 inches. The remaining test borings B-3, B-4, SWM-1, and SWM-2 encountered asphalt pavements with recorded asphalt thicknesses of 2 to 4 inches over 5 to 10 inches of gravel base material.

Stratum A: Existing Fill and Probable Fill
Existing fill soils were encountered below the topsoil in boring P-6, and below the asphalt at borings B-3, B-4, and SWM-1. The fill was observed to depths of 2.0 to 5.5 feet below the existing ground surface. The fills generally consisted of gray and brown Clayey Sand, and contained various amounts of gravel. The N-value of the fill soil in boring P-6 was high (N = 66) due to the presence of concrete fragments within the stratum. The natural moisture contents of the Stratum A soils varied from 8.6 to 9.3 percent. Based on the standard penetration tests performed, with the exception of test boring P-6, the fills appear to have been placed with variable compactive effort: N = 7 to 22 blows per foot (bpf).

Stratum B: Talbot Formation

Below the ground surface or fill soils of Stratum A, all of the borings encountered the Talbot Formation. The Talbot Formation consists of Pleistocene soils from the Quaternary Age, and was encountered to depths of 12 to 22 feet below the ground surface or to the boring termination depth of 10 feet in test borings P-1 to P-9. These soils consisted of tan, orange, brown, pink, and white SAND (SP-SM, SP-SC, SM, SC, SP), CLAY (CL, CH), and SILT (ML), with varying amounts of gravel. The soil samples tested within this stratum had the following properties:

Liquid Limit =	21 to 72
Plasticity Index =	10 to 15
Passing No. 200 Sieve =	70.0 to 83.4%
Moisture Content =	1.5 to 19.1%

Based on the results of the laboratory tests presented above, the granular soils of the Talbot Formation are generally non-plastic and the cohesive soils are generally medium to high plasticity. Based on the standard penetration tests performed, this stratum has densities ranging from very loose to very dense and consistencies of soft to hard: N = 3 to 60 bpf.

We conducted California Bearing Ratio (CBR) tests on bulk samples obtained from the near surface soils of Stratum B. The samples consisted of CLAYEY SAND and classified as SC in accordance with Unified Soil Classification System. Moisture-density relation testing was performed per ASTM D-1557, Modified Proctor. The maximum dry density of the samples ranged from 132.0 to 132.5 pcf at an optimum moisture content of 8.0 to 9.0 percent, respectively. We obtained laboratory CBR values of 28.0, 28.5, and 59.5 with swell values of 0.0 to 0.2 percent when compacted to 95 percent of the maximum dry density.

Stratum C: Aquia Formation

Below Stratum B, all of the building and stormwater management borings encountered the Aquia Formation. The Aquia Formation consists of Eocene soils from the Tertiary Age, and was encountered to a depth of 41 feet below the ground surface in test boring B-6 or to the boring termination depths of 15 to 30 feet below the ground surface in the remaining borings. These soils consisted of speckled orange, brown, green, red, gray, and white SAND (SP-SM, SP-SC, SM, SC, SP), with varying amounts of limonite. Based on the standard penetration tests performed, the soils of Stratum C are generally loose to medium dense: N = 10 to 23 bpf.

Stratum D: Monmouth Formation

Monmouth Formation soils of Stratum D were encountered from 41.0-feet below the ground surface to the boring termination depth of 50.0-feet in test boring B-6. The Monmouth Formation consists of Upper Cretaceous Aged soils. These soils generally consisted of red, brown, and white POORLY GRADED SAND WITH SILT (SP-SM). Based on the standard penetration tests performed, the soils of the Monmouth Formation are generally medium dense: N = 15 to 21 bpf.

3.4 Ground Water

The boring logs note ground water level readings obtained in the borings during and up to about 24 hours after completion of drilling. Water levels obtained during drilling indicate that ground water was encountered at about 8.5 to 26.5 feet below the ground surface (EL 50.5 to 68.5) in three of the test borings. Long term water level readings indicated all of the borings were dry except for boring P-2, which had a long term water level of 7.2 feet below the ground surface (EL 69.8). Long term cave depths recorded the borings ranged from 5.3 to 40.5-feet below the ground surface. Based on our observations, we believe that the groundwater encountered in the test borings is perched and is not representative of the static groundwater levels at the site. Perched water is groundwater that rests on relatively impermeable soil layers below. Perched water may be encountered at higher elevations at other unexplored areas of the site. Based on an online review of the USGS groundwater monitoring well database, the static groundwater levels around the site appear to be at or below about EL 5.

The water level readings are considered a reliable indication of the ground water depth at the time the observations were made. Fluctuations of the ground water should be anticipated based on variations in precipitation, runoff, flooding, stream levels, evaporation, leaking utilities, season, and similar factors.

4.0 GEOTECHNICAL ENGINEERING ANALYSIS AND RECOMMENDATIONS

The geotechnical engineering analysis was based on the subsurface information developed by our field investigation, structural loads, and site information supplied to us. We recommend a shallow foundation system consisting of spread footings founded on natural soils or properly compacted fill for support of the new buildings.

4.1 Earthwork

The contractor should strip vegetation, topsoil, and organic matter from subgrades to receive compacted structural fill for building and pavement support. Our subsurface exploration indicated topsoil to depths of up to 4 inches. However, deeper areas of topsoil may be encountered at other areas of the site. Care should be exercised during the stripping operation to minimize disturbance and contamination of the underlying soils.

Existing structures, pavements, and utilities are present on the site. Therefore, grading and excavation activities may encounter buried foundations and other debris associated with demolition of the existing structures. We recommend the complete removal of existing foundations, if any, from within the proposed new building and pavement areas as described in Section 7.1. Existing utilities and drainage structures should properly abandoned or removed and replaced with compacted structural fill.

Before any fill placement, a Schnabel Representative should evaluate the fill subgrades for suitability based on observations of proofrolling with a loaded dump truck. The contractor should excavate areas exhibiting excessive pumping, weaving, or rutting, and replace these areas with additional compacted structural fill.

4.2 Spread Footings

We consider shallow spread footings suitable for support of the proposed structures. Footings should be supported on suitable natural soils of the Talbot Formation or on new compacted structural fill. Some existing fill soils were encountered in the test borings to depths of up to 5.5 feet below the ground surface. Where encountered during foundation excavation, the spread footings should be lowered to firm, natural soils of the Stratum B. Alternately, the footing subgrades may be undercut to natural soils and backfilled with new compacted fill as described in Sections 7.2 and 7.4 and as shown on Figure No. 3. Some deeper pockets of existing fill soils may be encountered adjacent to the existing structures, in utility trenches, or at other unexplored areas of the site. The table below presents the estimated highest elevation at each boring location where soils suitable for support of the spread footing foundations are present:

Boring Number	Estimated Highest Elevation of Suitable Foundation Soils
B-1	El 79
B-2	El 78
B-3	El 74
B-4	El 74
B-5	El 78
B-6	El 76
B-7	El 77
B-8	El 74
B-9	El 75
B-10	El 77
B-11	El 79

Footings may be designed for a net allowable soil bearing pressure of 3,000 pounds per square foot (psf) when founded on suitable materials as described herein. This bearing pressure provides a factor of safety of at least 3.0 against general shear failure. The above allowable soil bearing pressure should not be increased by 33 percent for wind and seismic loads unless used in conjunction with load combinations defined in IBC Section 1605.3.2, Alternative Basic Load Combinations for use with allowable stress design or other applicable code exceptions.

Settlements of shallow foundations supported on suitable natural soils and on properly placed compacted structural fill are not expected to exceed about one inch. Differential settlements between similarly loaded footings are not expected to exceed about half this value. Minimum widths of 36 inches should be maintained for column footings and 18 inches for wall footings for shear considerations.

Exterior footings, or those which may be exposed to climate variation, should be founded below a depth of 2.5 feet for frost considerations. The laboratory testing performed on selected samples of the Talbot Formation indicates that the low plasticity soils of this stratum exhibit a low volume change potential. Accordingly, we do not believe perimeter footings need to be set any deeper than the minimum depth of 2.5 feet below final exterior grade that is necessary for frost protection. Interior footing grades may be set at nominal depths below the floor slab. A maximum allowable slope of 1.5 horizontal to 1 vertical (1.5H:1V) should be maintained between the bottom edges of adjacent footings when founded at different elevations.

The contractor should place footing concrete as soon as possible after excavation to limit the potential for moisture changes at the foundation level. Similarly, the contractor should backfill foundation walls as soon as possible to reduce the potential for infiltration of water into the soils beneath the footings. Backfilling should follow the recommendations for placement of compacted structural fill. Final grades should allow positive drainage away from the structure so that water does not accumulate around the foundation. In addition, the design should provide gutters and downspouts to collect and convey roof water well away from the building.

4.3 Floor Slabs

Based on the test borings and a finished floor elevation of about EL 78, natural Talbot Formation soils are primarily expected at the floor slab subgrades. Some existing fill soils were encountered at the proposed floor slab subgrade elevation. Existing fill soils are not considered suitable for support of the floor slabs. Where encountered, these soils should be removed to a minimum depth of 2 feet or to firm natural soils and replaced with new compacted fills. Based on the test borings, we expect that existing fills soils will be encountered in about 30 percent of the building to depths of up to 4 feet.

All fill and floor slab subgrades should be proofrolled as described in Section 7.3 of this report. Compacted fill for floor slab support should be placed as described in Section 7.4. The floor slabs may be designed for a modulus of subgrade reaction, k, of 200 pci when the subgrades are prepared as described herein.

The test borings did not encounter shallow groundwater, so a special subdrainage system under the floor slab is not considered necessary. However, a 4-inch layer of washed gravel or crushed stone should be placed below the floor slab as a moisture barrier. The gravel or stone should be AASHTO Size No. 57 and be compacted with a minimum of 2 passes of vibratory type compaction equipment. The stone should be covered with polyethylene sheeting to prevent concrete intrusion.

4.4 Seismic Site Classification

We have evaluated the Seismic Site Class for this project according to IBC Section 1615 (2006). We recommend Site Class D be used for seismic design on this project. This Site Class was evaluated based on Standard Penetration Test N-values. This classification is estimated from assumed subsurface conditions below the borings to a 100-foot depth. The estimate also assumed shear wave velocities from the standard penetration tests. Site specific studies may be performed to better determine the shear wave velocities and possibly refine the seismic site class.

We mapped the project using the USGS' *Earthquake Ground Motion Parameters 5.0.9* software. Based on the recommended site class and the project location, the following seismic design parameters were calculated;

Period	Site Coefficient	Mapped Maximum Considered Spectral Response Acceleration		Design Spectral Response Acceleration
		For Site Class D	Site Adjusted	
Short (0.2 sec)	Fa = 1.6	Ss = 0.156	Sms = 0.249	S_{DS} = 0.166
1 second	Fv = 2.4	S_1 = 0.050	Sm_1 = 0.119	S_{D1} = 0.079

4.5 Lateral Earth Pressures

Based on the structural information provided to us, the floor slabs for the new buildings will be at or near the ground surface. Therefore, we do not expect that below grade walls will be constructed for the new buildings. However, other semi-rigid walls such as loading dock walls may be required. These should be designed to resist lateral earth pressures developed from the soil backfill behind the walls, and any surcharge loads. A recommended pressure diagram for design of semi-rigid walls is included as Figure No. 4 at the end of this report. An average equivalent fluid pressure of 52H (psf) is recommended for design of semi-rigid walls (walls which are restrained horizontally).

Cantilevered retaining walls may be required on the site due to site grading. A recommended pressure diagram for the design of cantilevered retaining walls is included on Figure No. 5. An average equivalent fluid pressure of 42H (psf) is recommended for design of cantilevered walls with level backfill. If slopes are planned behind or in front of the walls, we should be notified so that we can revise our recommendations, if required. A factor of safety of at least 1.5 should be used for evaluation of overturning and sliding of cantilevered walls.

Compacted fill behind and in front of the walls should meet the recommendations in Section 7.4. Compaction equipment exceeding 3,000 pounds in static weight should not be used within four-feet of the walls in order to avoid overloading the walls. These walls do not need to be designed for hydrostatic pressure if the weep holes and/or drainage systems are installed as shown on Figure Nos. 3 and 4. Ponding of precipitation behind the walls should be avoided during construction, as the pressure diagram included herein does not include hydrostatic pressure.

The drainage panels detailed on Figure Nos. 4 and 5 should have minimum flow of 5 gallons per minute per foot at a hydraulic gradient of 0.1 per ASTM D 4716. The panels should be covered with geotextile as specified on the figures. The panels should be continuous over the back of the wall and extend from the drainage pipe to two (2) feet below the ground surface. Alternatively, a minimum 6-inch thick layer of open graded stone (AASHTO M-43, No. 7) may be used as a drainage material. The stone should be placed directly behind the wall and covered with geotextile, as specified on Figure Nos. 4 and 5. The stone should extend from the drainage pipes to two (2) feet below ground.

5.0 PAVEMENT RECOMMENDATIONS

New flexible asphalt pavements are planned for the new parking lots, access roads, and loading docks. Expected traffic loads include passenger cars, emergency vehicles, and delivery trucks.

5.1 Pavement Subgrades

Cuts of up to 6 feet and fills of up to 5 feet are expected to reach the proposed site grades. Therefore, we expect that natural soils or new compacted fills will be encountered at the pavement subgrades. These soils are considered suitable for pavement support. Existing fill soils consisting of Sandy Silt were encountered in test boring P-6 and may be present at other unexplored locations. The existing fills were observed to contain concrete fragments and are not expected to be suitable for support of the pavements.

Where existing fills are encountered, we recommend that the subgrades be undercut to firm natural soils or to a minimum depth of 2 feet and replaced with new compacted fill. Pavement subgrades should be prepared as described in Section 7.4 of this report. We anticipate that approximately 10% of the pavement subgrades will be undercut and replaced with new compacted fill. Additional undercutting should be expected if construction is performed during wetter months.

The key to pavement performance is generally the performance of the subgrade. It is extremely important that the entire subgrade be carefully observed, proofrolled, and compacted. All unsuitable subgrades should be removed and replaced with compacted fill. The amount of subgrade preparation required will also be affected by construction traffic disturbance and weather conditions at the time of preparation. Unit rates and an allowance should be established for undercutting of unsuitable subgrades.

Compacted fill for pavement support should meet the same material and placement requirements for compacted fill as described in Section 7.4 of this report, except that the top one-foot of compacted fill should be compacted to at least 97 percent of the maximum dry density per ASTM D-1557, Modified Proctor. Graded aggregate base material placed for pavement support should be compacted to at least 97 percent of the maximum dry density per ASTM D-1557, Modified Proctor.

5.2 Estimated Traffic Loads

The following data was used to develop pavement recommendations. The traffic volumes used to develop the Equivalent Axle loads were estimated by us and should be verified by the site engineer.

We have assumed the following traffic loads for the pavements:

Pavement	Traffic Loads (trips per day)	Design Equivalent Axle Load (EAL)
Parking lot	3,000 passenger cars, 10 delivery vehicles, 3 heavy trucks	156,011
Loading Dock and Access Roads	3,000 passenger cars 20 delivery trucks 10 heavy trucks	357,207

5.3 Flexible Pavements

A sample of soil obtained from boring P-8 that is expected to represent the natural soils encountered at the pavement subgrades had a CBR value of 28. We believe that most of the pavements at the site

will be underlain by either these soils or by new compacted fills. We expect that the onsite soils consisting of CL or better will be used for new compacted fill at the site. Therefore, we recommend that the CBR value of 4 be used for design of the new pavements to represent the fill soils. The subgrade resilient modulus was selected based on the design CBR value.

The pavement sections were designed using recommendations provided by "Low Volume Road Design," in AASHTO's "Guide for Design of Pavement Structures," 1993 and the 2006 Maryland SHA Pavement Design Guide. The following assumptions were used in our pavement design:

Design Life: 15 years
Resilient Modulus: 6,000 psi
Layer Coefficients: Hot Mix Asphalt Superpave 12.5 mm for Surface (PG 64-22, level 2) - 0.44
Hot Mix Asphalt Superpave 25 mm for Base (PG 64-22, level 2) - 0.40
Graded Aggregate Base (GAB) - 0.12

Initial Serviceability Index: 4.2
Final Serviceability Index: 2.4

The following flexible pavement sections are recommended for the project:

Pavement Section	Surface Asphalt (12.5 mm HMA)	Base Asphalt (25.0 mm HMA)	Subbase (GAB)
Parking Lot	1.5 inches	2.5 inches	8.0 inches
Loading Dock and Access Roads	1.5 inches	3.5 inches	8.0 inches

Both the asphalt and graded aggregate base are available from local quarries and asphalt plants and should conform to Maryland State Highway Administration Standard Specifications for Construction and Materials. Rigid concrete pavement may be used at the loading dock truck pads and turn areas to reduce the potential for excess fatigue and rutting of the flexible asphalt pavements.

6.0 STORMWATER INFILTRATION RECOMMENDATIONS

We understand that a new stormwater management (SWM) facility will be constructed in the southeast corner of the site. The Maryland Department of the Environment has set particular standards and specifications for the design and construction of stormwater infiltration devices. These regulations include parameters on soil textures, depth of limiting zones, topographic conditions, and other considerations. We believe that the subsurface conditions encountered at this site are generally suitable for infiltration through the facility bottom at both borings SWM-1 and SWM-2, as described in the following sections.

6.1 Soil Textures

The 2000 Maryland "Stormwater Design Manual" requires USDA Soil Textural Classifications for each type of soil at the infiltration device. These classifications are used to correlate the material with typical minimum infiltration rates. The State recommends that soil textures with a minimum infiltration of greater than 0.52-inches per hour are generally required for infiltration.

Samples from test boring SWM-1 and SWM-2 were classified based on soil laboratory testing in accordance with the USDA Soil Textural Classification System. The 2000 Maryland "Stormwater Design Manual" recommends the following minimum infiltration rates be assigned to the tested soils:

Boring Number Depth/(Elevation)	Textural Classification	Infiltration Rate (in/hr)
SWM-1 8.5 to 10/(EL 60.5 to 59)	LOAMY SAND	2.41
SWM-2 8.5 to 10/(EL 67.5 to 66)	GRAVELLY LOAMY SAND	2.41

Based on the above classification and infiltration rates, the Silty Sand, Poorly Graded Sand, Clayey Sand, and Lean Clay materials of Stratum B are considered suitable for infiltration. These materials were found in borings SWM-1 and SWM-2 below depths of 1.0-feet below the ground surface (below EL 68 to 75).

6.2 Depth to Limiting Zones

The 2000 Maryland "Stormwater Design Manual" recommends that a 2 to 4 foot distance be provided between the bottom of the infiltration system and any limiting zone. Limiting zones are defined as a seasonably high water table or bedrock. Groundwater and rock were not encountered in either of the test boring performed at the proposed SWM facility location. Therefore, we believe that groundwater and rock should not be a limiting factor.

6.3 In-Situ Infiltration Tests

In order to confirm the infiltration rates from the soil textural classification, in-situ infiltration tests are required. Infiltration tests were performed adjacent to borings SWM-1 and SWM-2. The tests were performed at depths of 10 and 9 feet below the existing site grades, respectively. The infiltration tests were performed in general accordance with Appendix D.1 of the 2000 Maryland Department of Environment (MDE) Stormwater Design Manual guidelines. The test procedure is described in Appendix C.

The results of the infiltration tests are summarized in the table below. The results of the tests are also included in Appendix C.

Location	Test Depth / Elevation (feet)	USDA Textual Classification	Average In-Situ Infiltration Rate (inches/hour)
SWM-1	10.0 / EL 59	LOAMY SAND	11.75
SWM-2	9.0 / EL 67	GRAVELLY LOAMY SAND	24.00

We have provided field infiltration test data using the MDE test described in Appendix C. It should be noted that such testing is only an approximation of the in-situ soil permeability and variations may be expected from the data as collected.

6.4 Conclusions

Based on the test borings, infiltration tests, and USDA textural classifications, infiltration appears suitable at depths of approximately 9 feet below the ground surface (EL 60) at boring SWM-1 and below a depth of about 3 feet (EL 73) at borings SWM-2. An infiltration rate of 2.4-inches/hour should be used for design.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Existing Structures and Utilities

Existing structures, pavements, and utilities are present on the site. We recommend that the existing structures be properly demolished and removed from the site by the contractor that is building the new structure. All foundations and floor slabs should be removed and replaced with new compacted fill as described in Section 7.4. After complete removal of the existing structures, pavements, and utilities, the fill subgrades should be observed and approved by our representative. New compacted fill placed to backfill existing basements should be placed in loose, level lifts not exceeding 8-inches in thickness, and compacted to at least 92 percent of the maximum dry density per ASTM D-1557, Modified Proctor.

If the demolition is performed by a different contractor and the demolition is not performed as described above, new grading and excavation activities may encounter buried foundations, basements, and other debris associated with demolition of the existing structures. Existing foundations, floor slabs, pavements, and other debris must be completely removed from within the proposed new building and pavement areas and backfilled with new compacted fill as described in Section 7.4. Existing utilities and drainage structures should properly abandoned or removed and replaced with compacted structural fill. All abandoned utilities left in place should be completely filled with lean concrete or flowable fill. If the demolition excavations are not property backfilled, then unsuitable soils will be present below the new structures, and pavements which will require removal and replacement with new compacted fill.

7.2 Spread Footings

All footings should be founded on firm natural soils or new compacted fill. Where subgrades consist of newly compacted fills, field density tests should be performed in the wall footing subgrades at least every 25 feet in length to determine the relative compaction of the subgrade soils. The subgrade soils should be compacted to at least 92 percent relative density per ASTM D 1557, Modified Proctor. A Schnabel representative should observe and approve all footing subgrades.

When existing fill soils are encountered at the footing subgrades, undercutting will be required. The undercut footing excavations should be extended to firm natural soils and the subgrades should be approved by a Schnabel representative. The undercut footing subgrades should be backfilled with compacted fill, as described in Section 7.4 of this report. The undercut soils should extend at least 0.5-feet horizontally from the edge of the foundation. Based on the test borings performed in the proposed building area, we do not expect undercuts of more than 2 feet. However, some areas of deeper fill may be present over existing utilities or adjacent to existing buildings. Excavations deeper than 4 feet should be sloped, benched, or shored according to OSHA standards. Based on the soils encountered in the test borings, we recommend maximum slopes of 1H:1V or flatter for deep excavations. However, the sloped soils must be reevaluated by our representative during construction. Alternately, the undercut subgrades may be backfilled with flowable fill or lean concrete.

Care should be taken during excavation for spread footings to minimize the disturbance of the subgrade soils. Disturbed, frozen, wet, or loose soils should be removed prior to placement of concrete. The footings must be poured the same day they are excavated and approved to minimize exposure and disturbance. The site should be graded to prevent surface water from entering the footing excavations. Additional foundation costs and delays should be expected if foundations are installed during the winter and spring months.

Final bearing surfaces should be observed by a Schnabel representative to ascertain that foundations are placed on suitable bearing material. The inspection of footing subgrades is described in Section 7.4 of this report.

7.3 Floor, Pavement, and Fill Subgrades

A research of the available utility plans should be made to locate the existing utilities. These utilities should be properly abandoned or removed and replaced with compacted fill as described in Section 7.4. Costs for removal of underground structures and replacement with compacted fill should be included in the construction estimates.

Floor, pavement, and fill subgrades should be stripped of topsoil and unsuitable, loose, or soft surface soils. Where existing fill soils are encountered at the floor slab subgrades, the unsuitable material should be excavated to firm natural soils or to a minimum depth of 2-feet. The undercut subgrades should be compacted with a minimum of two passes of a 10-ton static weight, vibratory roller, under the observation of a geotechnical engineer and the undercut areas should be backfilled as described in Section 7.4.

All pavement subgrades should be rolled with a minimum two passes of a 10-ton static weight, vibratory roller, under the observation of our representative. Areas that are observed to pump or rut, or cannot be suitable compacted should be undercut to firm natural soils or to a minimum depth of 2-feet and replaced with new compacted fill as described in Section 7.4. Where the subgrade has been excessively

disturbed due to construction activity or if unsuitable soils are discovered, the unsuitable materials should be properly recompacted or removed to firm subgrades and replaced with compacted fill. Some compaction or undercutting of subgrades should be expected if unsuitable soils are encountered or if subgrades are loosened during construction operations or exposed to water.

7.4 Compacted Fill

On-site sources are expected for the new compacted fill soils. Based on the test borings, most of the onsite soils will be suitable for re-use as compacted fill, with the exception of the CL soils. All compacted fill for footing, floor slabs, and pavement support should consist of material classified ML, SC, SM, SP, SW, GC, GM, GP or GW in accordance with ASTM D-2487. The liquid limit of the fill soils should be less than 50, and the plasticity index of the soil should be less than 25 when tested according to ASTM D-4318. The structural fill should be free of organics, roots, debris, and rock larger than 4-inches in diameter. The suitability of the fill soils should be determined by a Schnabel representative during construction.

The compacted fill should be placed in loose, level lifts not exceeding 8-inches in thickness, and compacted to at least 92 percent of the maximum dry density per ASTM D-1557, Modified Proctor. Lifts for fills placed with hand tampers should not exceed 4 inches.

Natural moisture contents of the on-site soils collected from the test borings were found to range from 1.9 to 19.1 percent which is believed to be below to above the optimum moisture content required for compaction. Therefore, some wetting or drying of the on-site soils may be required to achieve suitable compaction. We recommend that earthwork operations be scheduled from May to October to reduce the risks of delays and difficulties associated with wet fill soils.

7.5 Observation and Testing

There is the possibility that variations in the soil conditions assumed herein will be encountered during construction. In order to permit correlation between the subsurface investigation data and the actual subsoil conditions encountered during construction, it is imperative that the same geotechnical engineering firm who performed the geotechnical study and report during design (Schnabel) be retained to provide the following additional services:

Footing Subgrade Observations: All final footing and undercut subgrades must be observed by our representative. The subgrade observation should determine if the subgrade is level, if all observed loose, frozen, or disturbed soils have been removed, and correlate the actual soil conditions observed in the footing subgrades with those indicated by the test borings. Field density tests should also be performed to assess proper compaction of the footing subgrade fills as described as described in Section 7.2.

Fill, Pavement, and Floor Subgrades: The Schnabel representative should observe the subgrades during proofrolling and compaction as described in Section 7.3. Undercutting and repair of subgrades, if any, should be performed under our observation.

Fill Placement and Compaction: The Schnabel representative should observe all filling operations to document that the fill is placed in accordance with our recommendations. The representative should also evaluate the fill materials used to determine their suitability.

Schnabel Engineering can provide comprehensive observation and testing services during construction.

8.0 GENERAL AND LIMITATIONS

The analyses and recommendations contained in this report are based on the data obtained from the referenced subsurface explorations. The borings indicate subsurface conditions only at the specific locations and times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. The validity of the recommendations is based, in part, on assumptions about the stratigraphy made by the geotechnical engineer. Such assumptions may be confirmed only during earthwork and foundation construction. If subsurface conditions different from those described are noted during construction, recommendations in this report must be re-evaluated. It is strongly advised that Schnabel Engineering be retained to observe geotechnical related construction in order to help confirm that the assumptions and recommendations are valid or to modify them accordingly.

Recommendations contained in this report have been prepared for the evaluation of this project and to assist the design professionals in the design of the project. Significant changes in loads, structural configuration, location, or grades should be brought to our attention to determine how the changes may affect the conclusions and recommendations provided herein.

An allowance should be established to account for possible additional costs that may be required for construction of foundations as recommended in this report. Additional costs may be incurred for various reasons including additional excavation and fill, removing unsuitable soils, undercutting footing excavations, dewatering, wetting or drying fill soils, additional stripping depths, removing and backfilling of below grade structures, etc.

This report has been prepared to assist the design professionals in the design and preparation of drawings and specifications for this project. It should be made available to prospective bidders for informational purposes. We recommend that the project specifications contain the following statement:

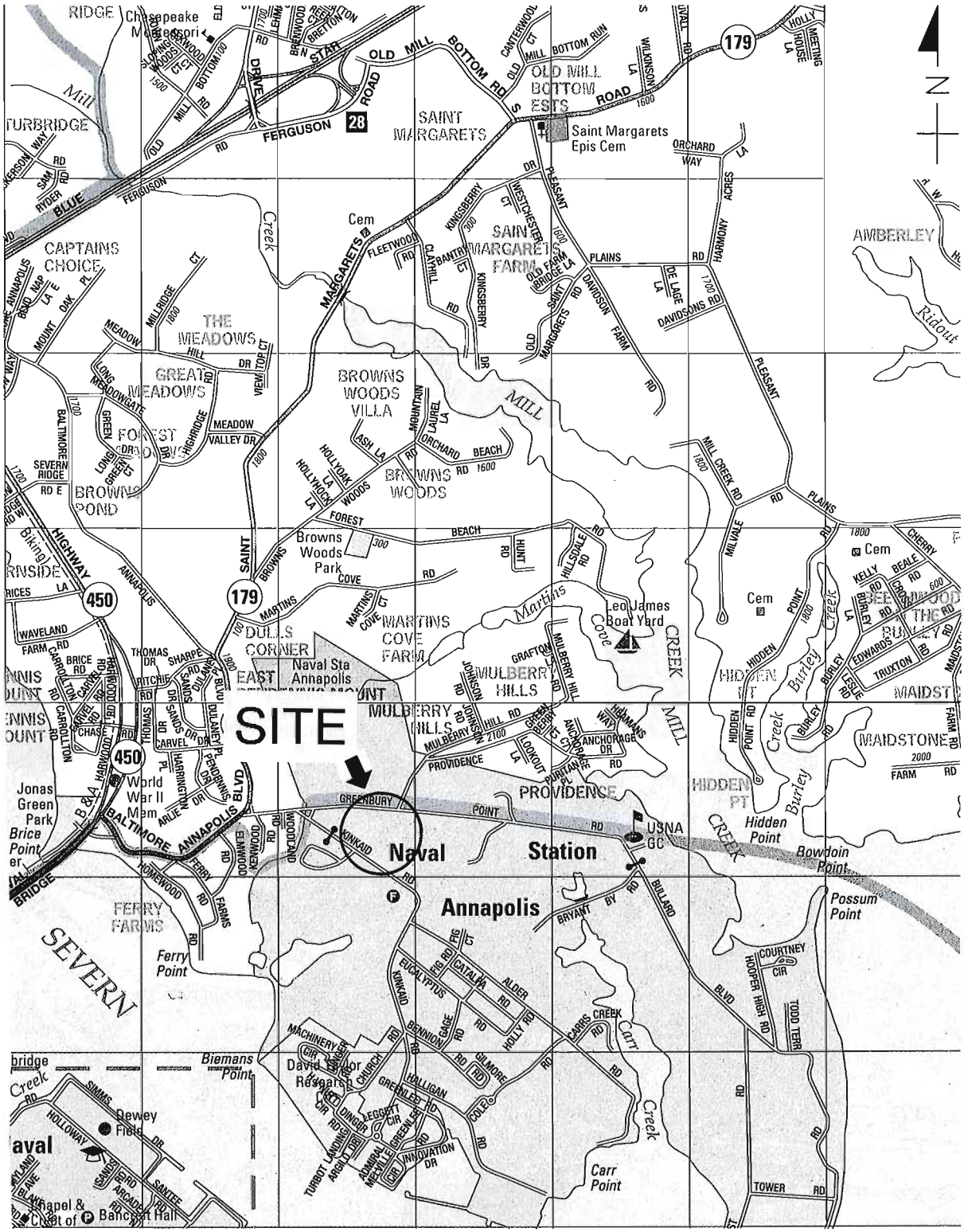
> "A geotechnical engineering report has been prepared for this project by Schnabel Engineering. This report is for informational purposes only and should not be considered part of the contract documents. The opinions expressed in this report are those of the geotechnical engineer and represent his interpretation of the subsurface conditions, tests, and the results of analyses which he has conducted. Should the data contained in this report not be adequate for the contractor's purposes, the contractor may make his own exploration, tests, and analyses prior to bidding. Contractors desiring to conduct additional subsurface explorations prior to bidding should contact the architect for arrangements to enter the project site."

Additional data and reports as prepared by others that could impact upon a contractor's bid should also be made available to prospective bidders for informational purposes.

This report has been prepared for the exclusive use of the Client for specific application to this project. Schnabel has endeavored to comply with generally accepted geotechnical engineering practice common to the local area, and makes no other warranty, express or implied.

FIGURES

Figure No. 1, Vicinity Map
Figure No. 2, Test Boring Location Plan
Figure No. 3, Detail for Undercutting Footing Subgrades
Figure No. 4, Lateral Earth Pressures for Semi-Rigid Walls
Figure No. 5, Lateral Earth Pressures for Cantilever Retaining Walls



GRAPHIC SCALE

0 1000' 2000'

1 inch = 2000 ft.

REFERENCE: ADC THE MAP PEOPLE, PERMITTED USE NO. 20598757

Schnabel Engineering	JOINT COMMISSARY AND NAVY EXCHANGE, NSA ANNAPOLIS, MARYLAND	DRAWN BY: DLC	DATE: SEPT. 2009	VICINITY MAP
		CHECKED BY: KED	SCALE: AS SHOWN	PROJECT 09140037.00 FIGURE 1

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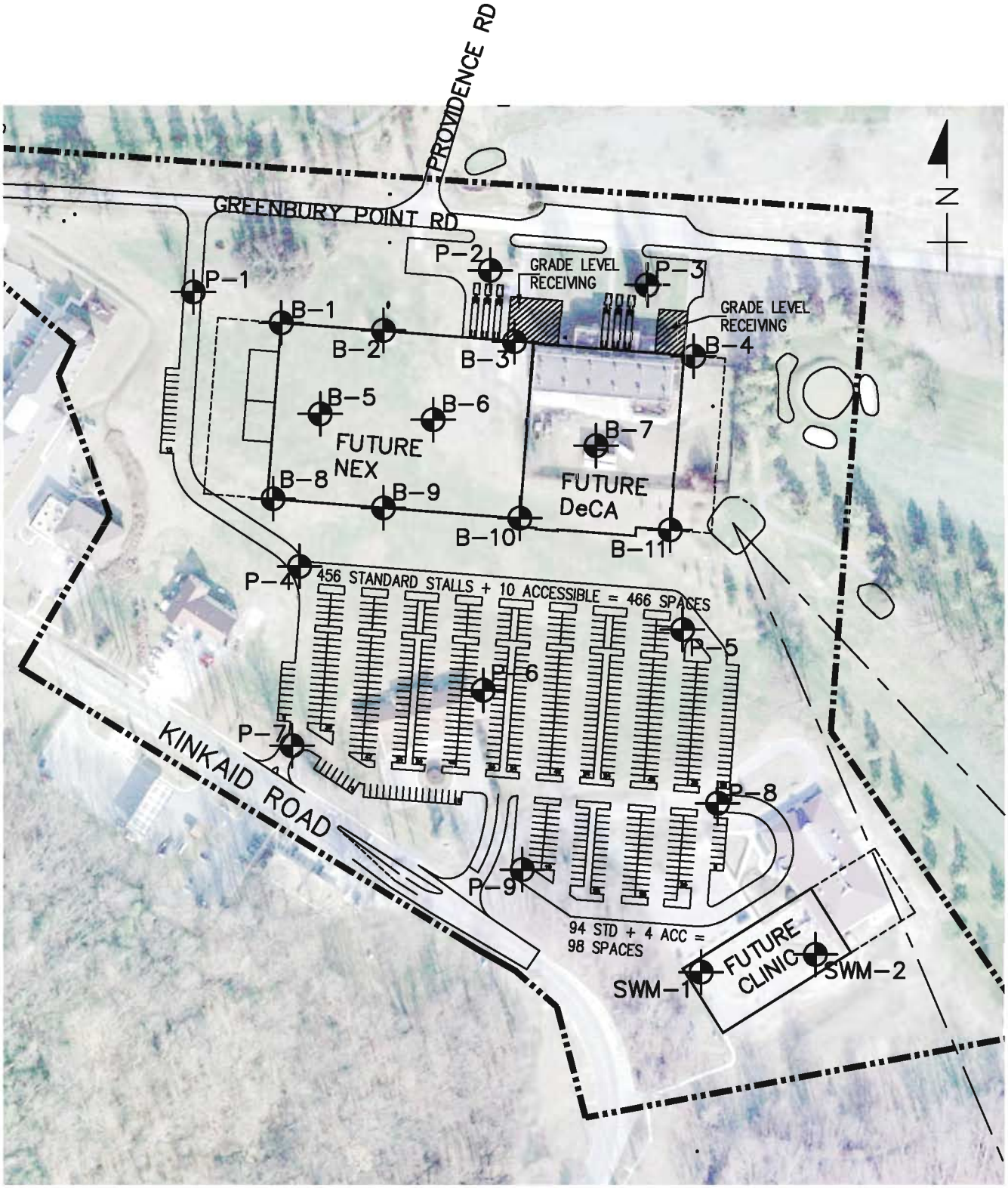

GRAPHIC SCALE

0 100' 200'

1 inch = 200 ft.

LEGEND

– APPROXIMATE TEST BORING LOCATION

REFERENCE: The Jenkins Group provided the base plan for this drawing.

G:\2009 Projects\Baltimore\09140037.00 Joint Commissary and Navy Exchange\Drawings\annapolis-site_19-aug-09

Schnabel Engineering	JOINT COMMISSARY AND NAVY EXCHANGE, NSA ANNAPOLIS, MARYLAND	DRAWN BY: CDC	DATE: SEPT. 2009	TEST BORING LOCATION PLAN
		CHECKED BY: DLC	SCALE: AS SHOWN	PROJECT 09140037.00 FIGURE 2

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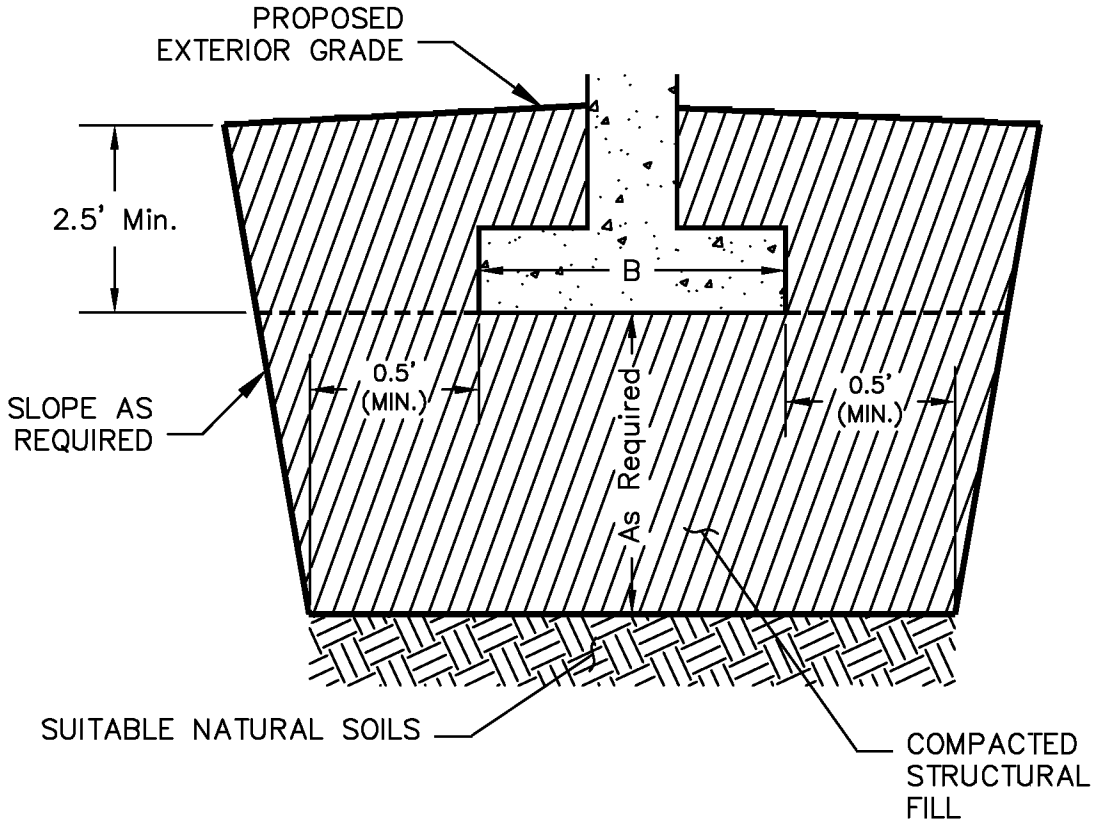
Detail for Undercutting Footing Subgrades



Notes:

1. Footing subgrades must be observed by a Schnabel Engineering representative.

2. Where existing fill soils are encountered, excavate unsuitable subgrade soils to firm natural soils.

3. Undercut subgrades should be evaluated by a Schnabel Engineering representitive.

4. Place compacted structural fill as required and compact in maximum 8 inch loose lifts to 92% of maximum dry density per ASTM D–1557.

5. Compacted structural fill placed to backfill undercuts should be classified as ML, SC, SM, SP, SW, GM, GC, GP or GW per ASTM D–2487.

Schnabel Schnabel Engineering	JOINT COMMISSARY AND NAVY EXCHANGE NAVAL STATION ANNAPOLIS, MARYLAND	DETAIL FOR UNDERCUTTING FOOTING SUBGRADES PROJECT NO.: 09140037.00 FIGURE NO.: 3 SEPT 2009

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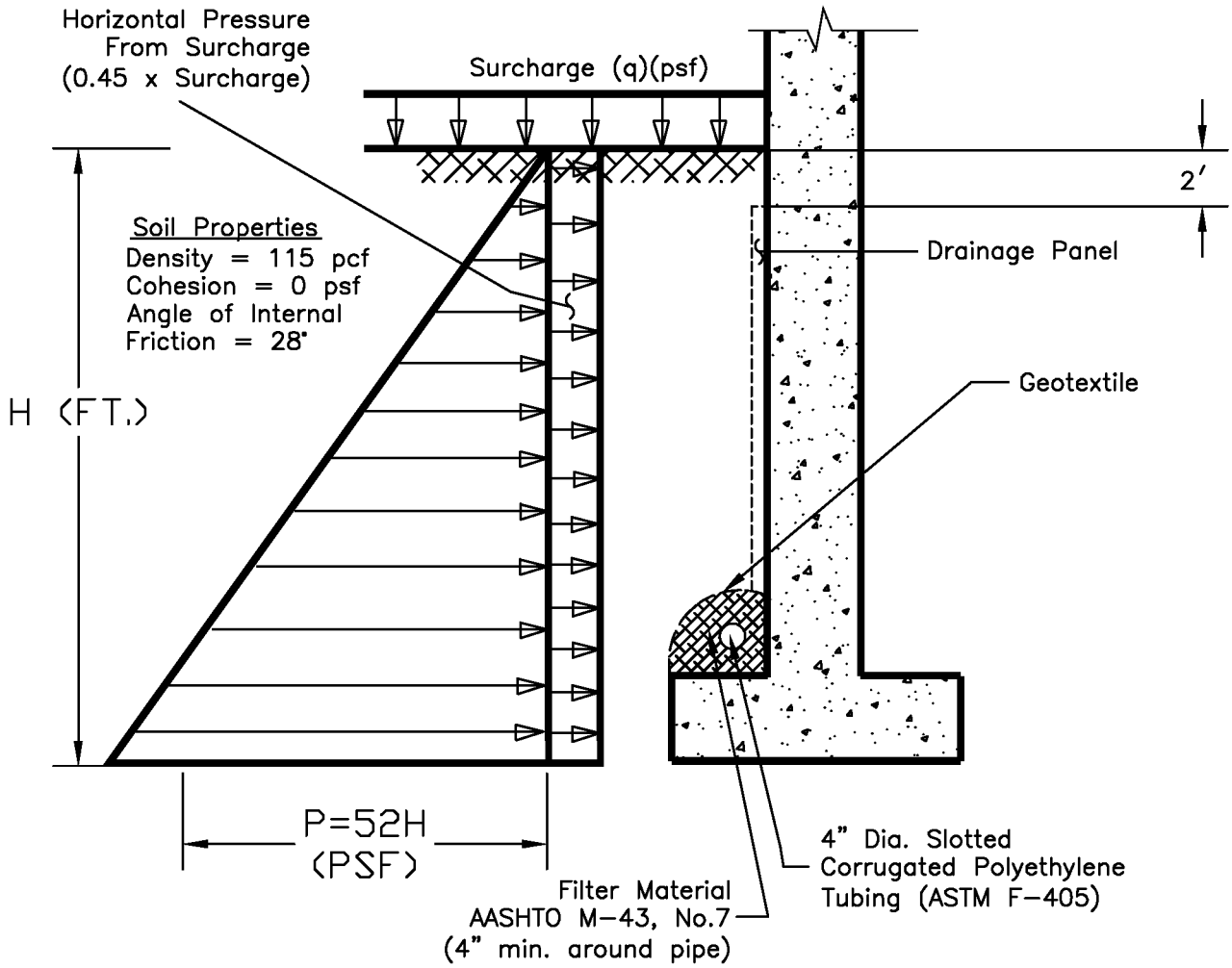
Lateral Earth Pressures For Semi-Rigid Walls



Geotextile Requirements

Grab strength lbs. (ASTM D4632)	120 lbs. (minimum)
Elongation (%) (ASTM D4632)	N/A
Puncture strength (ASTM 4833)	60 lbs. (minimum)
Burst stength (ASTM 3786)	225 PSI (minimum)
Trapezoidal tear (ASTM D4533)	50 lbs. (minimum)
Apparent opening size (ASTM D-5741)	<#70 U.S. Standard Sieve Minimum
Permittivity (ASTM D4491)	1.0 sec^{-1} (minimum)
Ultraviolet degradation at 150 hours (ASTM D4355)	70% strength retained

Schnabel Engineering	JOINT COMMISSARY AND NAVY EXCHANGE NAVAL STATION ANNAPOLIS, MARYLAND	LATERAL EARTH PRESSURES FOR SEMI-RIGID WALLS
		PROJECT NO.: 09140037.00
		FIGURE NO.: 4 — SEPT 2009

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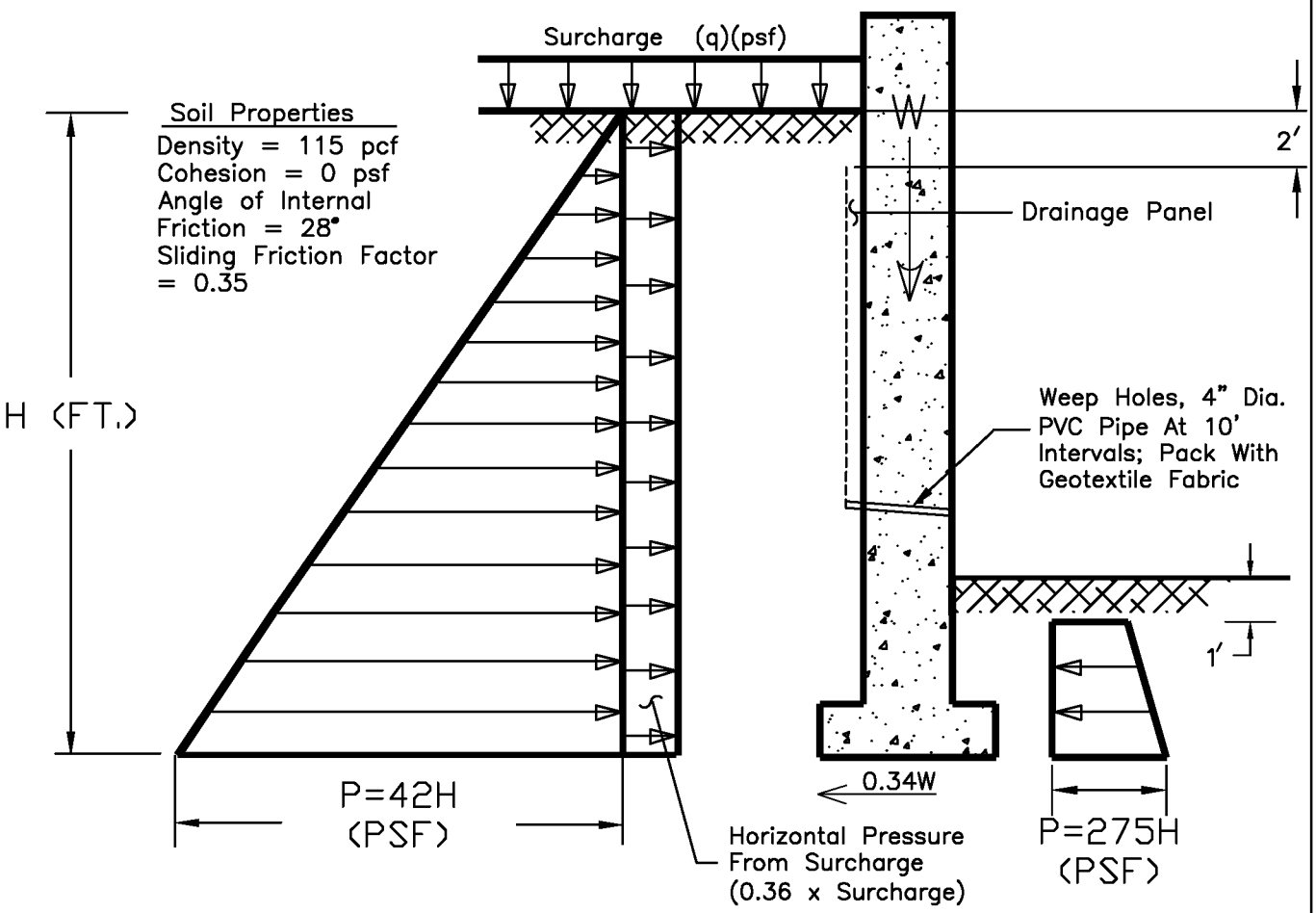
Lateral Earth Pressures For Cantilever Retaining Walls



Geotextile Requirements

Grab strength lbs. (ASTM D4632)	120 lbs. (minimum)
Elongation (%) (ASTM D4632)	N/A
Puncture strength (ASTM 4833)	60 lbs. (minimum)
Burst strength (ASTM 3786)	225 PSI (minimum)
Trapezoidal tear (ASTM D4533)	50 lbs. (minimum)
Apparent opening size (ASTM D4751)	<#70 U.S. Standard Sieve
Permittivity (ASTM D4491)	1.0 sec^{-1} (minimum)
Ultraviolet degradation at 150 hours (ASTM D4355)	70% strength retained

Schnabel Engineering	JOINT COMMISSARY AND NAVY EXCHANGE NAVAL STATION ANNAPOLIS, MARYLAND	LATERAL EARTH PRESSURES FOR CANTILEVER WALLS
		PROJECT NO.: 09140037.00
		FIGURE NO.: 5 SEPT 2009

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APPENDIX A

SUBSURFACE INVESTIGATION DATA

Subsurface Investigation Procedures
General Notes for Test Boring Logs
Test Boring Logs, B-1 to B-11, P-1 to P-9, SWM-1, SWM-2

SUBSURFACE INVESTIGATION PROCEDURES

1. Test Borings

The borings are advanced by turning an auger with a center opening of 2-1/4 inches. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger by standard methods. No water was introduced into the boring using this procedure.

2. Standard Penetration Test

Testing is performed by driving a 2-inch O.D., 1-3/8 inch I.D., sampling spoon through three, 6-inch intervals or as indicated, using an automatically tripped 140-pound hammer falling 30 inches, according to ASTM D-1586. N values indicate the penetration resistance in blows per foot of the sampling spoon. After the initial 6 inches to assure the sampler is in undisturbed material, the number of blows required to drive the sampler the final 12 inches is taken as the N value. The sampler is driven to a total penetration resistance of 100 blows or 18 inches, whichever occurs first.

3. Boring Locations and Grades

The borings were located by our personnel by measuring from the existing site features, and should be considered accurate to within 10 feet. Boring elevations were determined using *Google Earth Pro*. Elevations should be considered accurate to ±2 feet.

SCHNABEL ENGINEERING
GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2 inch O.D., 1-3/8 inch I.D. sampling spoon 6 inches using a 140 pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6 inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM-1586.

2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D-2487 group symbols (e.g. CL) shown in the classification column are based on visual observations.

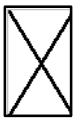
3. Estimated ground water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.

4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 100 blows for 2 inches or less of penetration.

5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and ground water conditions at the subsurface exploration location.

6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

7. Key to symbols and abbreviations:



S-1, SPT	- Sample No., Standard Penetration Test
5+10+1	- Number of blows in each 6-in increment

UND, UNDIST	- Sample No., 2" or 3" Undisturbed Tube Sample
REC=24", 100%	- Recovery in inches, Percent Recovery

C-1, CORE	- Core No., Rock Core
Run = 5.0 ft	- Run Length in feet
REC = 60" 100%	- Recovery in inches, Percent Recovery
RQD = 60" 100%	- RQD in inches, Percent RQD
MC	- Moisture Content
PP	- Pocket Penetrometer Reading (tsf)
FID	- Flame Ionization Detector Reading (ppm)
PID	- Photoionization Detector Reading (ppm)
GP	- Geostick Penetration Reading (inches)
LL	- Liquid Limit
PL	- Plastic Limit
TPH	- Total Petroleum Hydrocarbons

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-1** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/4/09

Ground Surface Elevation: 80± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/4	10:15 AM	Dry	28.5'	---
Completion	8/4	10:15 AM	Dry	28.5'	---
Casing Pulled	8/4	10:30 AM	Dry	---	21.8'
After Drilling	8/5	9:10 AM	Dry	---	21.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		79.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated 5 - 10% roots	ML				S-1, SPT 3+5+6 REC=16", 89%		
2.0			78.0					
	POORLY GRADED SAND WITH SILT, fine to medium grained sand; moist, orangish brown, contains gravel	SP-SM				S-2, SPT 3+2+4 REC=18", 100%	LL = NP MC = 5.6% % Passing #200 = 8.1	
4.5			75.5					
	POORLY GRADED SAND, fine to medium grained sand; moist, orangish brown with bands of white, contains silt				5	S-3, SPT 4+5+6 REC=18", 100%	MC = 6.7%	
	Changes to white, no silt	SP		B		S-4, SPT 6+6+8 REC=17", 94%	MC = 7.2%	
					10			
12.0	FAT CLAY; moist, white to orange	CH	68.0					
14.0	POORLY GRADED SAND; moist, orangish brown, estimated 10 - 15% gravel, contains pinkish fat clay modules	SP	66.0		15	S-5, SPT 5+6+19 REC=18", 100%	MC = 18.8%	
17.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; moist, dark brown with bands of white, contains mica		63.0					Aquia Formation
					20	S-6, SPT 6+6+8 REC=18", 100%		
		SP-SM		C	25	S-7, SPT 6+6+7 REC=18", 100%		
30.0			50.0		30	S-8, SPT 6+6+7 REC=18", 100%		

Bottom of Boring at 30.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-2** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/4/09

Ground Surface Elevation: 79± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/4	8:40 AM	Dry	28.5'	---
Completion	8/4	8:40 AM	Dry	28.5'	---
Casing Pulled	8/4	8:55 AM	Dry	---	22.7'
After Drilling	8/5	8:55 AM	Dry	---	22.4'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		78.8					Talbot Formation
2.0	SANDY SILT; dry, light brown, estimated 5 - 10% roots	ML	77.0			S-1, SPT 3+5+8 REC=16", 89%		
	POORLY GRADED SAND, fine to coarse grained sand; moist, tan to orangish brown, contains fine gravel	SP		B	5	S-2, SPT 1+1+2 REC=18", 100% S-3, SPT 2+3+5 REC=18", 100%		
8.5	SILTY SAND, fine to medium grained sand; moist, tan to orangish brown, contains pockets of white to pink fat clay	SM	70.5		10	S-4, SPT 6+8+7 REC=18", 100%		
12.0	POORLY GRADED SAND, fine to coarse grained sand; moist, reddish brown, contains lignite, contains gravel	SP	67.0					
14.3	CLAYEY SAND, fine to medium grained sand; moist, with speckles of dark green and white	SC	64.7		15	S-5, SPT 15+9+9 REC=18", 100%		Aquia Formation
18.5	POORLY GRADED SAND, fine to medium grained sand; moist, with speckles of dark green and white, estimated <5% mica	SP	60.5	C	20 25	S-6, SPT 5+6+9 REC=18", 100% S-7, SPT 7+5+8 REC=18", 100%		
28.5	CLAYEY SAND, fine to medium grained sand; moist, dark brown, estimated <5% mica	SC	50.5		30	S-8, SPT 6+6+8 REC=18", 100%		
30.0			49.0					

Bottom of Boring at 30.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-3** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/6/09

Ground Surface Elevation: 77± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	4:00 PM	26.5'	28.5'	---
Completion	8/6	4:00 PM	27.0'	28.5'	---
Casing Pulled	8/6	4:10 PM	Dry	---	24.0'
After Drilling	8/7	8:35 AM	Dry	---	23.3'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Asphalt; = 2-inches		76.8					Fill
1.0	Gravel Base; = 10-inches		76.0	A		S-1, SPT 5+4+3 REC=18", 100%	MC = 8.6%	
	FILL, sampled as clayey sand, fine to medium grained sand; moist, gray and brown	FILL						
3.0	SILTY SAND, fine to medium grained sand; moist, orangish tan, contains gravel	SM	74.0		5	S-2, SPT 4+3+2 REC=18", 100%	LL = NP MC = 6.8% % Passing #200 = 13.0	Talbot Formation
6.9	POORLY GRADED SAND WITH CLAY, fine to medium grained sand; moist, orangish tan	SP-SC	70.1	B		S-3, SPT 7+10+12 REC=18", 100%	MC = 11.3%	
8.0	SILT; moist, pinkish brown	ML	69.0		10	S-4, SPT 7+4+5 REC=18", 100%	MC = 19.1%	
12.0	POORLY GRADED SAND WITH CLAY, fine to medium grained sand; moist, speckled reddish brown and green, contains limonite fragments	SP-SC	65.0		15	S-5, SPT 11+7+5 REC=12", 67%		Aquia Formation
17.0	SILTY SAND, fine to medium grained sand; moist, reddish brown with speckles of green	SM	60.0	C	20	S-6, SPT 7+7+8 REC=18", 100%		
	Changes to with speckles of green and white				25	S-7, SPT 6+7+7 REC=18", 100%		
	Changes to wet							
30.0			47.0		30	S-8, SPT 4+5+7 REC=18", 100%		

Bottom of Boring at 30.0 ft.
Boring offset 7-feet west due to utilities

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Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-4** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/7/09 **Finished:** 8/7/09

Ground Surface Elevation: 77± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/7	8:10 AM	Dry	28 .5	---
Completion	8/7	8:10 AM	Dry	28.5'	---
Casing Pulled	8/7	8:20 AM	Dry	---	25.0'
After Drilling	8/7	9:25 AM	Dry	---	25.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Asphalt; = 2-inches		76.8					Fill
1.0	Gravel Base= 7-inches		76.0	A				
	FILL, sampled as clayey sand, fine to medium grained sand; moist, dark brownish gray, contains fine gravel, organic odor	FILL				S-1, SPT 7+9+8 REC=16", 89% S-2, SPT 5+5+7 REC=18", 100%		
3.0			74.0					Talbot Formation
	SILTY SAND, fine to medium grained sand; moist, orangish tan, contains pockets of clay	SM			5	S-3, SPT 7+6+9 REC=14", 78%		
6.9			70.1	B				
8.0	POORLY GRADED SAND, fine to medium grained sand; moist, orange and tan, contains pockets of lean clay and limonite	SP	69.0			S-4, SPT 6+8+9 REC=18", 100%		
	SILT; moist, pink, contains fat clay seams from 8.7-9.3-feet	ML			10			
12.0	SILTY SAND, fine to medium grained sand; moist, dark gray with speckles of white		65.0					Aquia Formation
					15	S-5, SPT 10+5+9 REC=12", 67%		
					20	S-6, SPT 6+6+7 REC=16", 89%		
		SM		C				
					25	S-7, SPT 9+8+8 REC=15", 83%		
	Changes to reddish brown with speckles of green and white							
30.0			47.0		30	S-8, SPT 8+7+10 REC=14", 78%		

Bottom of Boring at 30.0 ft.
Boring offset 5-feet west due to utilities

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-5** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/4/09

Ground Surface Elevation: 79± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	8/4	12:50 PM	14.5'	13.5'	---
Completion	8/4	1:15 PM	Dry	28.5'	---
Casing Pulled	8/4	1:30 PM	Dry	---	22.0'
After Drilling	8/5	12:55 PM	Dry	---	22.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		78.8					Talbot Formation
2.0	SANDY SILT; dry, light tan, estimated 5 - 10% roots	ML	77.0					
	POORLY GRADED SAND, fine to medium grained sand; moist, white to orangish brown Changes to white with streaks of black and brown	SP		B	5	S-1, SPT 3+5+6 REC=18", 100% S-2, SPT 2+2+6 REC=18", 100% S-3, SPT 4+5+7 REC=18", 100%		
9.5	CLAYEY SAND, fine to medium grained sand; moist, white to orangish brown	SC	69.5		10	S-4, SPT 4+4+6 REC=18", 100%		
12.0	SANDY LEAN CLAY WITH GRAVEL; moist, orangish brown with gray ▽	CL	67.0		15	S-5, SPT 6+6+7 REC=18", 100%		
17.0	SILTY SAND, fine to medium grained sand; wet, greenish brown with speckles of white, contains mica	SM	62.0		20	S-6, SPT 6+6+8 REC=18", 100%		Aquia Formation
22.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; greenish gray with speckles of white	SP-SM	57.0	C	25	S-7, SPT 5+6+7 REC=17", 94%		
30.0			49.0		30	S-8, SPT 5+6+8 REC=18", 100%		

Bottom of Boring at 30.0 ft.
Boring offset 5-feet west

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Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-6** Contract Number: 09140037.00 Sheet: 1 of 2

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/3/09 **Finished:** 8/3/09

Ground Surface Elevation: 77± (ft) **Total Depth:** 50.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/3	3:15 PM	Dry	48.5'	---
Completion	8/3	3:15 PM	Dry	48.5'	---
Casing Pulled	8/3	3:45 PM	Dry	---	40.5'
After Drilling	8/4	3:30 PM	Dry	---	40.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		76.8					Talbot Formation
	SANDY SILT; moist, light brown, contains roots	ML				S-1, SPT 6+9+12 REC=16", 89%		
2.0	SILTY SAND, fine to medium grained sand; moist, orangish brown		75.0			S-2, SPT 5+5+7 REC=18", 100%	LL = NP MC = 5.7% % Passing #200 = 13.0	
	Changes to estimated <5% gravel				5	S-3, SPT 5+6+11 REC=18", 100%	MC = 5.8%	
				B		S-4, SPT 7+10+11 REC=18", 100%	MC = 12.8%	
	Changes to white, contains pockets of lean clay	SM			10			
	Changes to no clay					S-5, SPT 7+14+15 REC=17", 94%		
					15			
17.0	CLAYEY SAND, fine to medium grained sand; moist, greenish gray with speckles of white		60.0					Aquia Formation
						S-6, SPT 5+8+10 REC=18", 100%		
	Changes to reddish brown with streaks of black				20			
	Changes to greenish gray with speckles of white	SC		C		S-7, SPT 5+6+7 REC=18", 100%		
					25			
						S-8, SPT 5+6+6 REC=15", 83%		

(continued)

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-6** Contract Number: 09140037.00 Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
		SC		C	35	S-9, SPT 6+7+8 REC=18", 100%		
					40	S-10, SPT 5+8+8 REC=18", 100%		
	Changes to dark reddish brown with speckles of black, contains gravel							
41.0	POORLY GRADED SAND WITH SILT, fine to medium grained sand; moist, reddish brown with streaks of red, and speckles of white, contains trace mica	SP-SM	36.0	D	45	S-11, SPT 4+6+9 REC=16", 89%		Monmouth Formation
					50	S-12, SPT 9+10+11 REC=18", 100%		
50.0			27.0					

Bottom of Boring at 50.0 ft.
Boring offset 5-feet northwest due to utilities

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-7** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/6/09

Ground Surface Elevation: 78± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	2:15 PM	Dry	28.5'	---
Completion	8/6	2:15 PM	Dry	28.5'	---
Casing Pulled	8/6	2:30 PM	Dry	---	23.5'
After Drilling	8/7	8:40 AM	Dry	---	23.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.1	Topsoil; = 1-inch		77.9					Talbot Formation
	SANDY SILT; dry, light tan, contains gravel	ML				S-1, SPT 15+15+10 REC=15", 83%		
2.0			76.0					
	POORLY GRADED SAND, fine to coarse grained sand; moist, tan, contains fine gravel					S-2, SPT 3+6+8 REC=16", 89%		
	Changes to fine to medium grained sand				5	S-3, SPT 4+6+9 REC=14", 78%		
	Changes to tan and orange	SP		B	10	S-4, SPT 8+10+16 REC=18", 100%		
	Changes to fine to coarse grained sand; contains limonite fragments				15	S-5, SPT 7+9+15 REC=5", 28%		
17.0	CLAYEY SAND, fine to medium grained sand; moist, greenish gray with streaks of reddish brown, and speckles of white	SC	61.0		20	S-6, SPT 7+7+12 REC=18", 100%		Aquia Formation
22.0	POORLY GRADED SAND WITH CLAY, fine to medium grained sand; moist, greenish gray with streaks of orange, and grains of white	SP-SC	56.0	C	25	S-7, SPT 7+9+13 REC=14", 78%		
30.0			48.0		30	S-8, SPT 5+7+8 REC=16", 89%		

Bottom of Boring at 30.0 ft.
Boring offset 18-feet south due to utilities

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Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-8** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/7/09

Ground Surface Elevation: 75± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/4	2:50 PM	Dry	28.5'	---
Completion	8/4	2:50 PM	Dry	28.5'	---
Casing Pulled	8/4	3:00 PM	Dry	---	28.2'
After Drilling	8/5	1:15 PM	Dry	---	23.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		74.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots	ML				S-1, SPT 4+7+13 REC=18", 100%		
2.0	SILTY SAND, fine to medium grained sand; moist, orangish brown with white, contains limonite	SM	73.0			S-2, SPT 3+4+4 REC=18", 100%	MC = 4.2%	
					5	S-3, SPT 3+4+6 REC=17", 94%	MC = 7.1%	
8.0	CLAYEY SAND, fine to medium grained sand; moist, pink and orange, contains gravel	CL	67.0	B	10	S-4, SPT 1+3+6 REC=17", 94%	LL = 21 PL = 13 MC = 16.6% % Passing #200 = 40.4	
12.0	SILTY SAND, fine to medium grained sand; moist, orangish tan, contains pockets of lean clay	SM	63.0		15	S-5, SPT 5+16+25 REC=18", 100%		
18.5	CLAYEY SAND, fine to medium grained sand; moist, dark greenish gray	SC	56.5		20	S-6, SPT 4+4+6 REC=18", 100%		Aquia Formation
22.0	SILTY SAND, fine to medium grained sand; moist, dark greenish gray with speckles of white	SM	53.0	C	25	S-7, SPT 6+8+8 REC=18", 100%		
30.0			45.0		30	S-8, SPT 7+6+8 REC=18", 100%		

Bottom of Boring at 30.0 ft.
Boring offset 8-feet east due to utilities

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-9** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 76± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	8:25 AM	Dry	28.5'	---
Completion	8/5	8:25 AM	Dry	28.5'	---
Casing Pulled	8/5	8:40 AM	Dry	---	30.5'
After Drilling	8/6	12:25 PM	Dry	---	28.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		75.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots, estimated <5% gravel	ML				S-1, SPT 3+5+10 REC=16", 89%		
2.0	POORLY GRADED SAND, fine to medium grained sand; moist, orangish tan	SP	74.0			S-2, SPT 3+4+7 REC=14", 78%		
					5	S-3, SPT 5+6+7 REC=14", 78%		
9.0	LEAN CLAY; moist, orangish tan with streaks of pink	CL	67.0	B		S-4, SPT 7+7+8 REC=15", 83%		
9.9	SILTY SAND, fine to medium grained sand; moist, orangish tan, estimated <5% mica	SM	66.1		10			
					15	S-5, SPT 7+10+9 REC=16", 89%		
19.5	CLAYEY SAND, fine to medium grained sand; moist, dark gray with speckles of white, contains limonite	SC	56.5	C	20	S-6, SPT 5+9+9 REC=10", 56%		Aquia Formation
					25	S-7, SPT 8+9+11 REC=15", 83%		
30.0			46.0		30	S-8, SPT 8+7+8 REC=14", 78%		

Bottom of Boring at 30.0 ft.

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Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-10** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 78± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	10:25 AM	Dry	28.5'	---
Completion	8/5	10:25 AM	Dry	28.5'	---
Casing Pulled	8/5	10:40 AM	Dry	---	20.0'
After Drilling	8/6	1:10 PM	Dry	---	20.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		77.8					
	SANDY SILT; dry, light tan, estimated <5% gravel	ML				S-1, SPT 7+14+16 REC=14", 78%	MC = 1.9%	Talbot Formation
2.0	CLAYEY SAND WITH GRAVEL; moist, orangish tan	SM	76.0			S-2, SPT 5+9+9 REC=10", 56%	MC = 5.7%	
4.5	POORLY GRADED SAND WITH SILT, fine to medium grained sand; moist, orangish tan	SP-SM	73.5	B	5	S-3, SPT 5+6+9 REC=12", 67%	MC = 4.5%	
					10	S-4, SPT 6+7+14 REC=18", 100%	MC = 9.8%	
					15	S-5, SPT 7+9+8 REC=14", 78%		
18.7	CLAYEY SAND, fine to medium grained sand; moist, dark greenish gray with streaks of dark red, speckled with black and white	SC	59.3	C	20	S-6, SPT 9+10+9 REC=16", 89%		Aquia Formation
					25	S-7, SPT 7+8+8 REC=18", 100%		
30.0			48.0		30	S-8, SPT 8+8+7 REC=16", 89%		

Bottom of Boring at 30.0 ft.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **B-11** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 80± (ft) **Total Depth:** 30.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	12:45 PM	Dry	28.5'	---
Completion	8/5	12:45 PM	Dry	28.5'	---
Casing Pulled	8/5	1:00 PM	Dry	---	21.0'
After Drilling	8/6	1:20 PM	Dry	---	20.8'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Topsoil; = 3-inches		79.7			S-1, SPT 2+4+3 REC=16", 89%	MC = 1.5%	Talbot Formation
	SANDY SILT; dry, light tan, contains roots	ML						
2.8	POORLY GRADED SAND, fine to medium grained sand; moist, tan		77.2			S-2, SPT 2+2+3 REC=16", 89%	MC = 4.6%	
		SP			5	S-3, SPT 3+4+5 REC=12", 67%	MC = 3.4%	
	Changes to fine to coarse grained sand; orangish tan, contains black angular rock fragments, trace sit							
7.5	SILTY SAND, fine to medium grained sand; moist, orangish tan		72.5			S-4, SPT 2+2+1 REC=14", 78%	MC = 6.4%	
					10			
				B				
		SM			15	S-5, SPT 7+9+12 REC=15", 83%		Contains 2-inch lean clay seam from 13.7 - 13.9-feet
	Changes to streaked black							
	Changes to contains pockets of lean clay				20	S-6, SPT 14+15+18 REC=18", 100%		
22.0	SILTY SAND, fine to medium grained sand; moist, orangish gray with speckles of white		58.0					Aquia Formation
					25	S-7, SPT 7+8+8 REC=18", 100%		
		SM		C				
30.0			50.0		30	S-8, SPT 7+11+12 REC=18", 100%		

Bottom of Boring at 30.0 ft.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-1** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/4/09

Ground Surface Elevation: 79± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/4	11:10 AM	Dry	8.5'	---
Completion	8/4	11:10 AM	Dry	8.5'	---
Casing Pulled	8/4	11:15 AM	Dry	---	7.0'
After Drilling	8/5	9:15 AM	Dry	---	7.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.1	Topsoil; = 1-inch		78.9					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots, contains gravel	ML				S-1, SPT 5+7+9 REC=17", 94%		
2.0	POORLY GRADED SAND, fine to medium grained sand; moist, yellowish tan	SP	77.0			S-2, SPT 2+4+5 REC=16", 89%	MC = 3.1%	
				B	5	S-3, SPT 4+3+10 REC=15", 83%		
6.0	LEAN CLAY; moist, pinkish brown	CL	73.0					
9.0	POORLY GRADED SAND, fine to medium grained sand; moist, tan	SP	70.0			S-4, SPT 10+12+12 REC=18", 100%		
10.0			69.0		10			

Bottom of Boring at 10.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-2** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/3/09 **Finished:** 8/3/09

Ground Surface Elevation: 77± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/3	4:25 PM	8.5'	8.5'	---
Completion	8/3	4:30 PM	8.0'	8.5'	---
Casing Pulled	8/3	4:35 PM	7.4'	---	7.7'
After Drilling	8/4	3:35 PM	7.2'	---	7.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		76.8					
	SANDY LEAN CLAY; dry, light tan with streaks of orange, contains gravel	CL				S-1, SPT 7+19+19 REC=16", 89%	LL = 31 PL = 13 % Passing #200 = 21.5	Talbot Formation Bulk sample taken from 0-5-feet.
2.0	CLAYEY SAND, fine to coarse grained sand; moist, orangish brown, contains gravel		75.0			S-2, SPT 5+12+14 REC=18", 100%	MC = 9.9%	
	Changes to fine to medium grained sand	SC		B	5	S-3, SPT 4+7+7 REC=14", 78%		
	Changes to wet					S-4, SPT 12+23+15 REC=18", 100%		
10.0			67.0		10			

Bottom of Boring at 10.0 ft.
Boring offset 5-feet south due to utilities.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-3** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 75± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	2:35 PM	Dry	8.5'	---
Completion	8/5	2:35 PM	Dry	8.5'	---
Casing Pulled	8/5	2:45 PM	Dry	---	5.7'
After Drilling	8/6	4:50 PM	Dry	---	5.4'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.3	Topsoil; = 4-inches		74.7					Talbot Formation
	SANDY SILT; dry, light tan, estimated 5 - 10% roots Changes to no roots	ML				S-1, SPT 4+20+40 REC=16", 89%		
2.0	SILTY SAND, fine to medium grained sand; moist, orangish tan	SM	73.0			S-2, SPT 4+4+5 REC=15", 83%	MC = 6.2%	
				B	5	S-3, SPT 4+7+8 REC=16", 89%		
6.0	CLAYEY SAND WITH GRAVEL, fine to medium grained sand; moist, reddish brown	SC	69.0					
						S-4, SPT 5+7+5 REC=18", 100%		
9.2	LEAN CLAY; moist, whitish gray with streaks of pink	CL	65.8					
10.0			65.0		10			

Bottom of Boring at 10.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-4** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/4/09 **Finished:** 8/4/09

Ground Surface Elevation: 76± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/4	4:20 PM	Dry	8.5'	---
Completion	8/4	4:20 PM	Dry	8.5'	---
Casing Pulled	8/4	4:20 PM	Dry	---	6.0'
After Drilling	8/5	2:50 PM	Dry	---	6.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		75.8					
	SANDY LEAN CLAY; dry, light tan, estimated <5% roots	CL				S-1, SPT 3+5+7 REC=18", 100%	LL = 22 PL = 10 % Passing #200 = 26.8	Talbot Formation Bulk sample taken from 0 to 5-feet
2.0	CLAYEY SAND, fine to coarse grained sand; moist, orangish tan, contains gravel		74.0					CBR= 28.5
						S-2, SPT 2+5+9 REC=18", 100%	MC = 3.8%	
	Changes to fine to medium grained sand	SC		B	5	S-3, SPT 6+8+12 REC=18", 100%	MC = 10.4%	
	Changes to fine to coarse grained sand							
7.5	LEAN CLAY; moist, orangish gray, contains gravel	CL	68.5					
						S-4, SPT 3+5+7 REC=18", 100%		
10.0			66.0		10			

Bottom of Boring at 10.0 ft.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-5** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 79± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	1:40 PM	Dry	8.5'	---
Completion	8/5	1:40 PM	Dry	8.5'	---
Casing Pulled	8/5	1:40 PM	Dry	---	5.4'
After Drilling	8/6	4:55 PM	Dry	---	5.3'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		78.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots, contains gravel	ML				S-1, SPT 3+9+17 REC=16", 89%		
2.0	CLAYEY SAND, fine to medium grained sand; moist, orangish brown	SC	77.0	B		S-2, SPT 1+1+2 REC=12", 67%	MC = 11.1%	
					5	S-3, SPT 4+5+7 REC=12", 67%		
8.8	POORLY GRADED SAND WITH GRAVEL, fine to coarse grained sand; moist, orangish tan	SP	70.2			S-4, SPT 4+6+6 REC=16", 89%		
10.0			69.0		10			

Bottom of Boring at 10.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-6** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/6/09

Ground Surface Elevation: 76± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	1:10 PM	Dry	8.5'	---
Completion	8/6	1:10 PM	Dry	8.5'	---
Casing Pulled	8/6	1:15 PM	Dry	---	7.0'
After Drilling	8/7	8:45 AM	Dry	---	5.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		75.8					Fill
	FILL, sampled as sandy silt; dry, light brown, estimated <5% gravel, contains concrete	FILL		A		S-1, SPT 34+41+25 REC=12", 67%		
2.0	CLAYEY SAND WITH GRAVEL; moist, orangish brown		74.0					Talbot Formation
						S-2, SPT 4+4+4 REC=16", 89%	MC = 8.5%	
					5	S-3, SPT 5+6+4 REC=18", 100%		
		SC		B				
						S-4, SPT 10+15+30 REC=14", 78%		
10.0			66.0		10			

Bottom of Boring at 10.0 ft.
Boring offset 11-feet north due to utilities

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-7** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/6/09

Ground Surface Elevation: 81± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	11:25 AM	Dry	8.5'	---
Completion	8/6	11:25 AM	Dry	8.5'	---
Casing Pulled	8/6	11:25 AM	Dry	---	7.0'
After Drilling	8/7	8:50 AM	Dry	---	6.3'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		80.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots	ML				S-1, SPT 3+6+8 REC=15", 83%		
2.0	LEAN CLAY; moist, pink, estimated 5 - 10% roots		79.0			S-2, SPT 9+13+16 REC=14", 78%	MC = 18.5%	
	Changes to no roots	CL		B	5	S-3, SPT 9+14+17 REC=12", 67%		
	Changes to contains limonite from 7.5 - 7.8-feet							
8.5	SILTY SAND, fine grained sand; moist, orangish tan	SM	72.5			S-4, SPT 11+14+14 REC=14", 78%		
10.0			71.0		10			

Bottom of Boring at 10.0 ft.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-8** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/7/09

Ground Surface Elevation: 76± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	8:45 AM	Dry	8.5'	---
Completion	8/6	8:45 AM	Dry	8.5'	---
Casing Pulled	8/6	8:50 AM	Dry	---	6.4'
After Drilling	8/7	9:00 AM	Dry	---	6.2'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		75.8					
	SANDY LEAN CLAY; dry, light tan, estimated <5% roots	CL				S-1, SPT 5+5+6 REC=14", 78%	LL = 42 PL = 15 % Passing #200 = 29.2	Talbot Formation Bulk sample taken from 0 to 5-feet
2.0	CLAYEY SAND, fine to medium grained sand; moist, orangish tan, contains rock fragments	SC	74.0			S-2, SPT 7+6+6 REC=14", 78%	MC = 12.0%	CBR= 28.0
4.5	POORLY GRADED SAND WITH CLAY, fine to medium grained sand; moist, orangish tan	SP-SC	71.5	B	5	S-3, SPT 4+5+5 REC=18", 100%	MC = 7.0%	
9.0	SILTY SAND, fine to medium grained sand; moist, brown Changes to orangish brown	SM	67.0			S-4, SPT 5+10+10 REC=17", 94%		
10.0			66.0		10			

Bottom of Boring at 10.0 ft.

TEST BORING LOG 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 9/16/09

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **P-9** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/6/09 **Finished:** 8/6/09

Ground Surface Elevation: 78± (ft) **Total Depth:** 10.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/6	9:40 AM	Dry	8.5'	---
Completion	8/6	9:40 AM	Dry	8.5'	---
Casing Pulled	8/6	9:40 AM	Dry	---	6.5'
After Drilling	8/7	8:55 AM	Dry	---	6.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.2	Topsoil; = 2-inches		77.8					Talbot Formation
	SANDY SILT; dry, light tan, estimated <5% roots	ML				S-1, SPT 3+9+10 REC=18", 100%		
2.0	SILTY SAND, fine to medium grained sand; moist, orangish tan	SM	76.0			S-2, SPT 7+10+11 REC=18", 100%		
4.5	CLAYEY SAND, fine to coarse grained sand; wet, light tan	SC	73.5	B	5	S-3, SPT 5+7+8 REC=14", 78%		
7.5	LEAN CLAY; moist, pink	CL	70.5			S-4, SPT 9+13+14 REC=12", 67%		
	Changes to contains sand							
10.0			68.0		10			

Bottom of Boring at 10.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **SWM-1** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 69± (ft) **Total Depth:** 15.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	3:40 PM	Dry	13.5'	---
Completion	8/5	3:40 PM	Dry	13.5'	---
Casing Pulled	8/5	4:05 PM	Dry	---	11.0'
After Drilling	8/6	5:00 PM	Dry	---	10.5'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.4	Asphalt; = 4-inches		68.6					
1.0	Gravel Base= 6-inches		68.0					
	FILL, sampled as clayey sand, fine to medium grained sand; moist, grayish brown, estimated <5% gravel	FILL		A		S-1, SPT 7+10+12 REC=18", 100%	MC = 9.3%	Fill
						S-2, SPT 4+7+10 REC=18", 100%		
					5			
5.5	LEAN CLAY; moist, whitish gray with streaks of orange	CL	63.5	B		S-3, SPT 4+5+8 REC=18", 100%	MC = 18.2%	Talbot Formation
						S-4, SPT 4+10+20 REC=18", 100%	MC = 8.9% % Passing #200 = 14.3	USDA Classification: LOAMY SAND
9.3	CLAYEY SAND, fine to medium grained sand; moist, orangish tan, contains gravel	SC	59.7		10			
12.0	CLAYEY SAND, fine to medium grained sand; moist, dark gray with speckles of white	SC	57.0	C				Aquia Formation
						S-5, SPT 5+6+7 REC=16", 89%		
15.0			54.0		15			

Bottom of Boring at 15.0 ft.

Schnabel Engineering	TEST BORING LOG	Project: Joint Commissary and Navy Exchange Naval Station Annapolis Annapolis, Maryland	Boring Number: **SWM-2** Contract Number: 09140037.00 Sheet: 1 of 1

Contractor: Recon Drilling

Contractor Foreman: W. Rodas

Schnabel Representative: J. Andrews

Equipment: Diedrich D-50 (Truck)

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)

Dates Started: 8/5/09 **Finished:** 8/5/09

Ground Surface Elevation: 76± (ft) **Total Depth:** 15.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	8/5	5:10 PM	Dry	13.5'	---
Completion	8/5	5:10 PM	Dry	13.5'	---
Casing Pulled	8/5	5:15 PM	Dry	---	9.0'
After Drilling	8/6	5:10 PM	Dry	---	8.9'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DEPTH	SAMPLING DATA	TESTS	REMARKS
0.4	Asphalt; = 4-inches		75.6					Talbot Formation
1.0	gravel base= 5-inches		75.0					
	SILTY SAND, fine to coarse grained sand; moist, orangish tan	SM				S-1, SPT 5+6+6 REC=18", 100%	MC = 7.8%	
3.0	POORLY GRADED SAND, fine to medium grained sand; moist, light orangish tan	SP	73.0			S-2, SPT 3+4+5 REC=18", 100%		
					5			
5.5	SILTY SAND, fine to medium grained sand; moist, light orangish brown		70.5	B		S-3, SPT 4+5+5 REC=18", 100%	MC = 9.8%	
	Changes to WITH GRAVEL; dark gray with streaks of red	SM				S-4, SPT 9+10+9 REC=16", 89%	MC = 7.7% % Passing #200 = 10.8	USDA Classification: GRAVELLY LOAMY SAND
					10			
12.0	SILTY SAND, fine to medium grained sand; moist, light orangish brown		64.0					Aquia Formation
		SM		C		S-5, SPT 4+6+7 REC=15", 83%		
15.0			61.0		15			

Bottom of Boring at 15.0 ft.

APPENDIX B

SOIL LABORATORY TESTS

Identification of Soil
Summary of Soils Laboratory Test Results (2 pages)
Gradation Curves (9 pages)
Moisture-Density Relation Curves (3 pages)
California Bearing Ratio Tests (3 pages)

SCHNABEL ENGINEERING
IDENTIFICATION OF SOILS

I. DEFINITION OF SOIL GROUP NAMES (ASTM D-2487)

			SYMBOL	GROUP NAME
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor		PT	PEAT

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D-2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS ..... Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.

FILL..... Man-made deposit containing soil, rock and often foreign matter.

PROBABLE FILL..... Soils which contain no visually detected foreign matter but which are suspect with regard to origin.

DISINTEGRATED ROCK (DR)..... Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2" or less penetration.

PARTIALLY WEATHERED ROCK (PWR) ..... Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as a SPT of 100 blows for 2" or less penetration.

BOULDERS & COBBLES ..... Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inch size.

LENSES..... 0 to ½ inch seam within a material in a test pit.

LAYERS..... ½ to 12 inch seam within a material in a test pit.

POCKET ..... Discontinuous body within a material in a test pit.

MOISTURE CONDITIONS.... Wet, moist or dry to indicate visual appearance of specimen.

COLOR ..... Overall color, with modifiers such as light to dark or variation in coloration.

MICA..... The estimated amounts of mica are based on approximate volume estimations from visual observations and should be considered approximate.

Summary Of Laboratory Tests

Project Number: 09140037.00

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Retained No. 4 Sieve	Proctor Test Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR Percent Swell	CBR Value
B-1	2.5 - 4.0 / 77.5 - 76.0	Jar	POORLY GRADED SAND WITH SILT (SP-SM), orangish brown	5.6	NP	NP	NP	8.1	0.2	--	--	--	--	--
B-3	3.5 - 5.0 / 73.5 - 72.0	Jar	SILTY SAND (SM), contains gravel, orangish brown	6.8	NP	NP	NP	13.0	1.9	--	--	--	--	--
B-6	2.5 - 4.0 / 74.5 - 73.0	Jar	SILTY SAND (SM), brown	5.7	NP	NP	NP	13.0	0.0	--	--	--	--	--
B-8	8.5 - 10.0 / 66.5 - 65.0	Jar	CLAYEY SAND (SC), contains gravel, brown	16.6	21	13	8	40.4	0.5	--	--	--	--	--
P-2	0.0 - 5.0 / 77.0 - 72.0	Bulk	CLAYEY SAND (SC), contains gravel, dark brown	--	31	13	18	21.5	3.7	1557B	132.5	8.5	0.0	59.5
P-4	0.0 - 5.0 / 76.0 - 71.0	Bulk	CLAYEY SAND (SC), contains gravel, dark brown	--	22	10	12	26.8	0.8	1557B	132.5	9.0	0.1	28.5
P-8	0.0 - 5.0 / 76.0 - 71.0	Bulk	CLAYEY SAND (SC), contains gravel, brown	--	42	15	27	29.2	2.7	1557B	132.5	8.0	0.2	28.0

Notes:
1. Soil tests in general accordance with ASTM, ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487, USDA(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

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DYNAMIC LAB SUMMARY 09140037.00.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 9/16/09

Summary Of Laboratory Tests

Project Number: 09140037.00

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 200 Sieve	% Retained No. 4 Sieve	Proctor Test Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	CBR Percent Swell	CBR Value
SWM-1	8.5 - 10.0 / 60.5 - 59.0	Jar	LOAMY SAND, orangish brown	8.9	--	--	--	14.3	2.5	--	--	--	--	--
SWM-2	8.5 - 10.0 / 67.5 - 66.0	Jar	GRAVELLY LOAMY SAND, brown	7.7	--	--	--	10.8	21.0	--	--	--	--	--

Notes:
1. Soil tests in general accordance with ASTM, ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487, USDA(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

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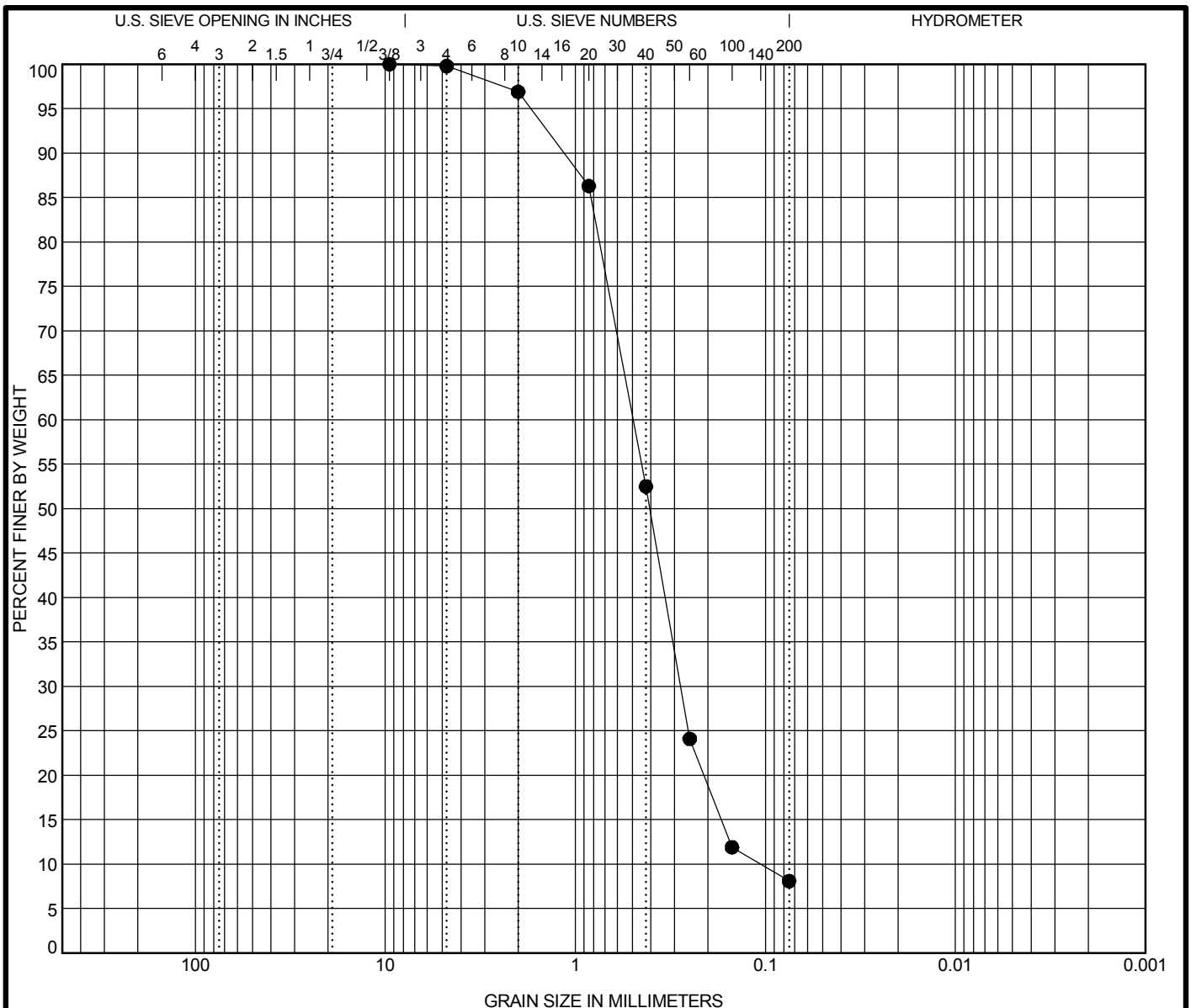

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-1	2.5 ft	**POORLY GRADED SAND WITH SILT (SP-SM), orangish brown**	**NP**	**NP**	**NP**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**9.5**	**0.496**	**0.279**	**0.106**	**0.2**	**91.7**	**8.1**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5
% Finer	08.1	11.9	24.1	52.5	86.3	96.9	99.8	100.0

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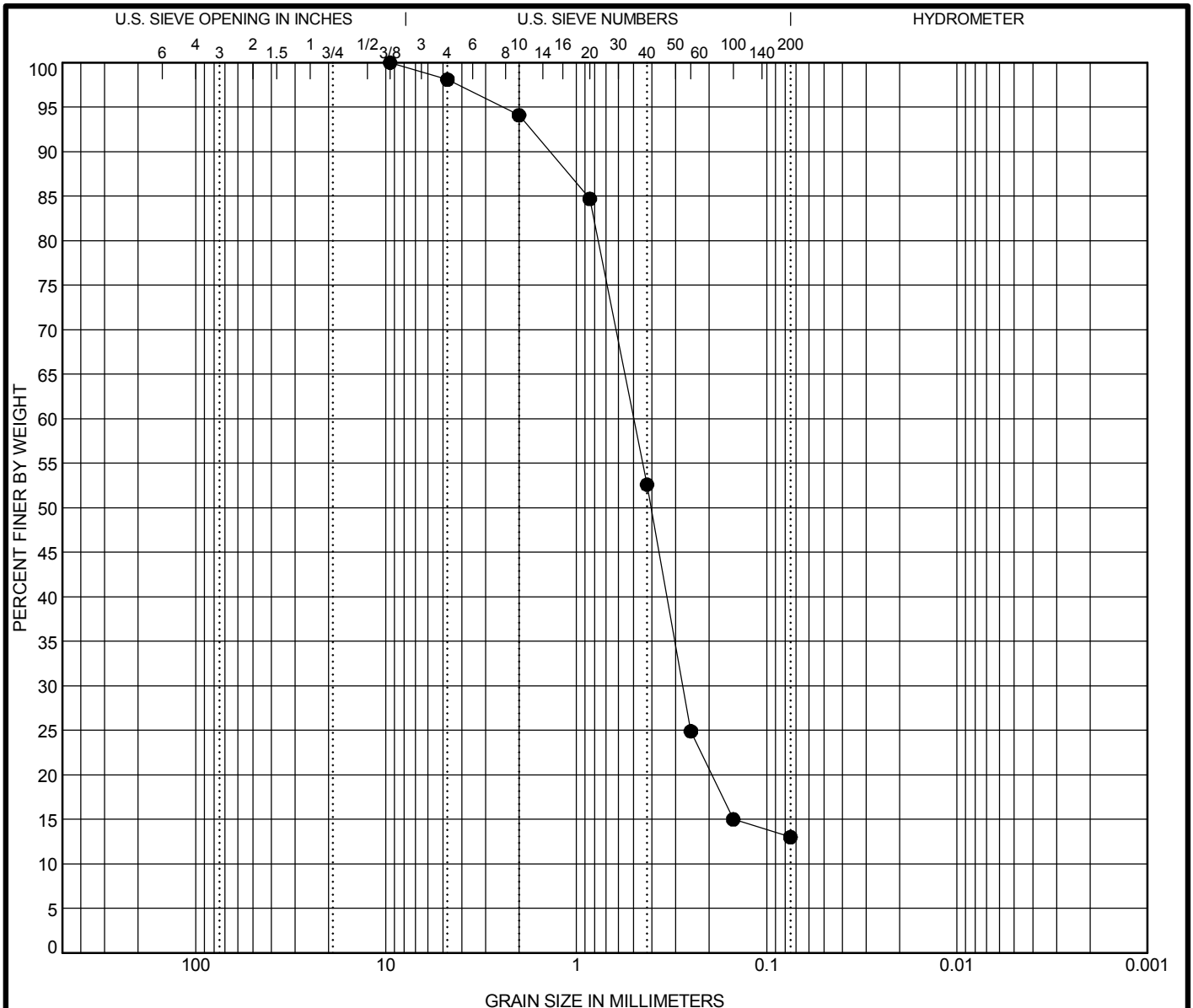

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-3	3.5 ft	**SILTY SAND (SM), contains gravel, orangish brown**	**NP**	**NP**	**NP**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**9.5**	**0.499**	**0.276**		**1.9**	**85.1**	**13.0**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5
% Finer	13.0	15.0	24.9	52.6	84.7	94.1	98.1	100.0

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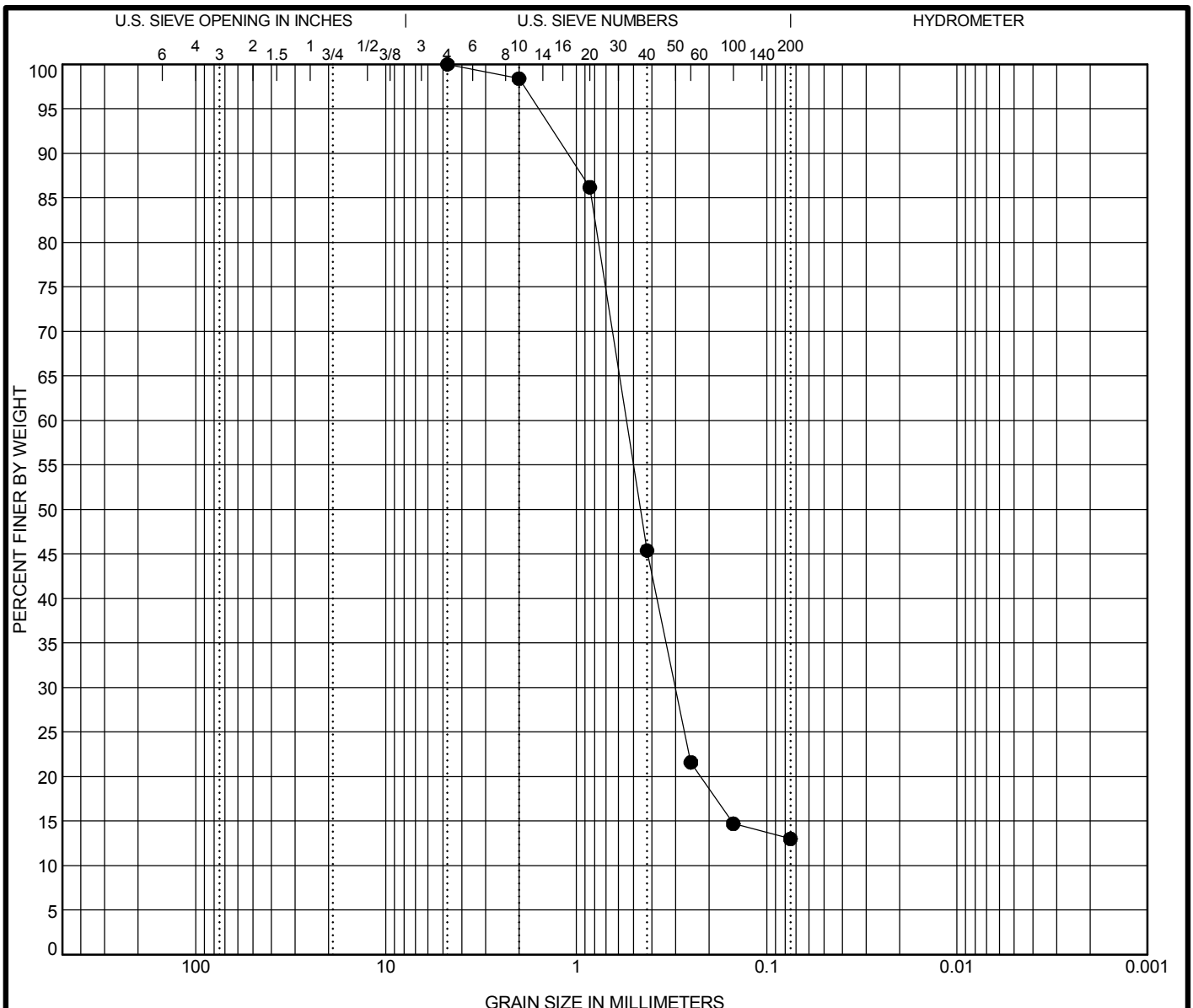

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-6	2.5 ft	**SILTY SAND (SM), brown**	**NP**	**NP**	**NP**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**4.75**	**0.545**	**0.301**		**0.0**	**87.0**	**13.0**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75
% Finer	13.0	14.7	21.6	45.4	86.2	98.4	100.0

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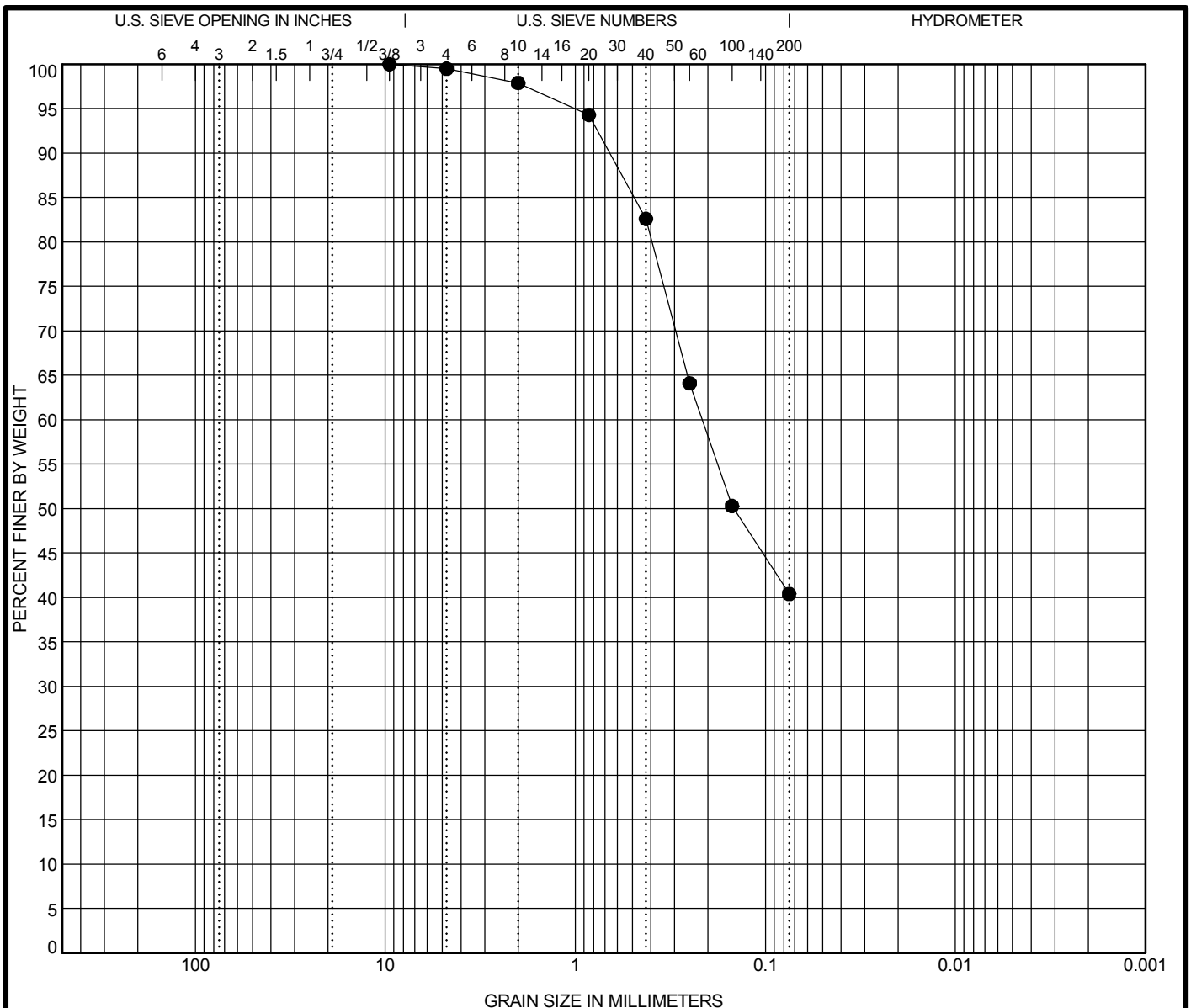

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● B-8	8.5 ft	**CLAYEY SAND (SC), contains gravel, brown**	**21**	**13**	**8**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**9.5**	**0.215**			**0.5**	**59.1**	**40.4**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5
% Finer	40.4	50.3	64.1	82.6	94.3	97.9	99.5	100.0

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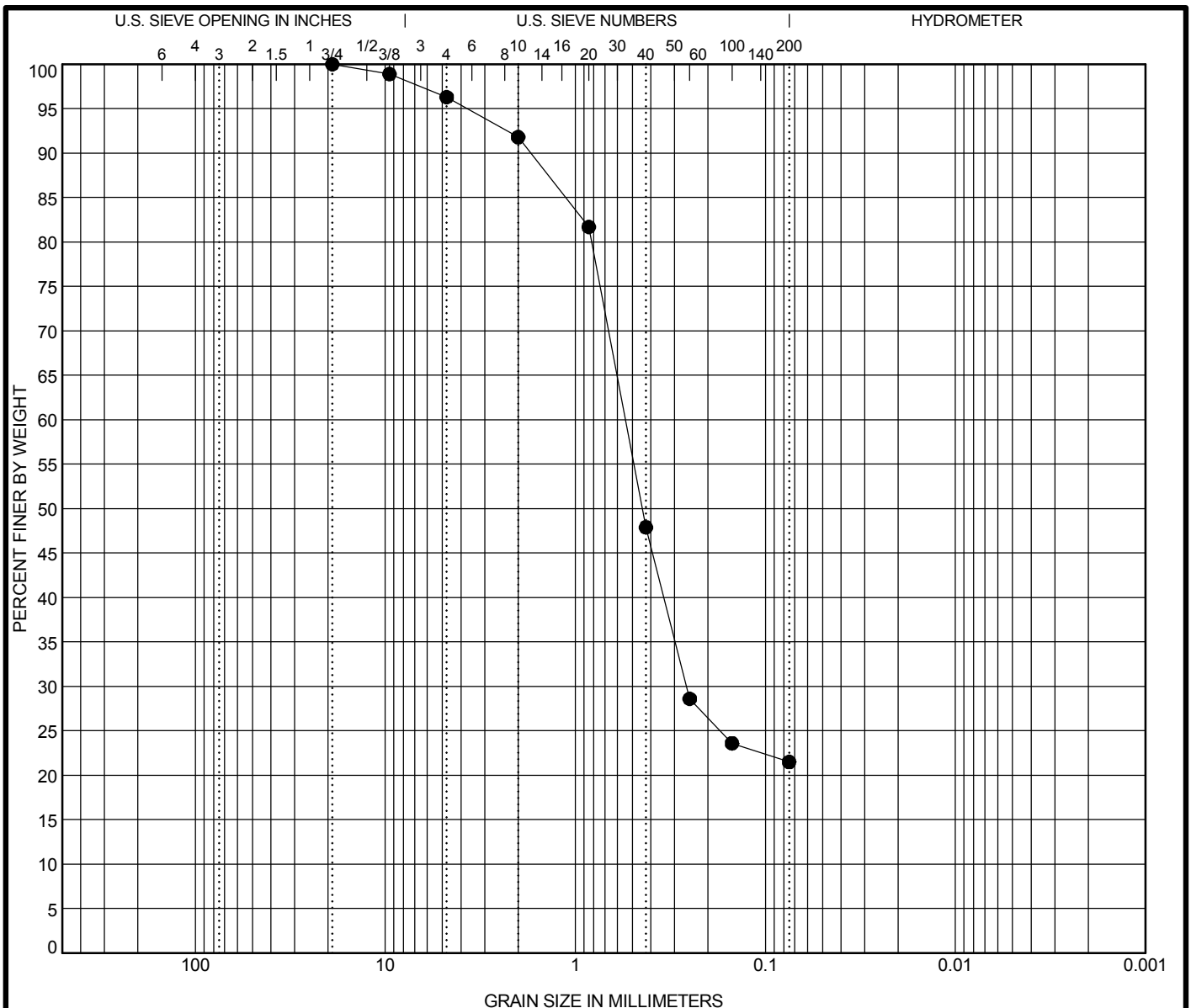

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● P-2	0.0 ft	**CLAYEY SAND (SC), contains gravel, dark brown**	**31**	**13**	**18**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**19**	**0.545**	**0.26**		**3.7**	**74.8**	**21.5**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5	19
% Finer	21.5	23.6	28.6	47.9	81.7	91.8	96.3	98.9	100.0

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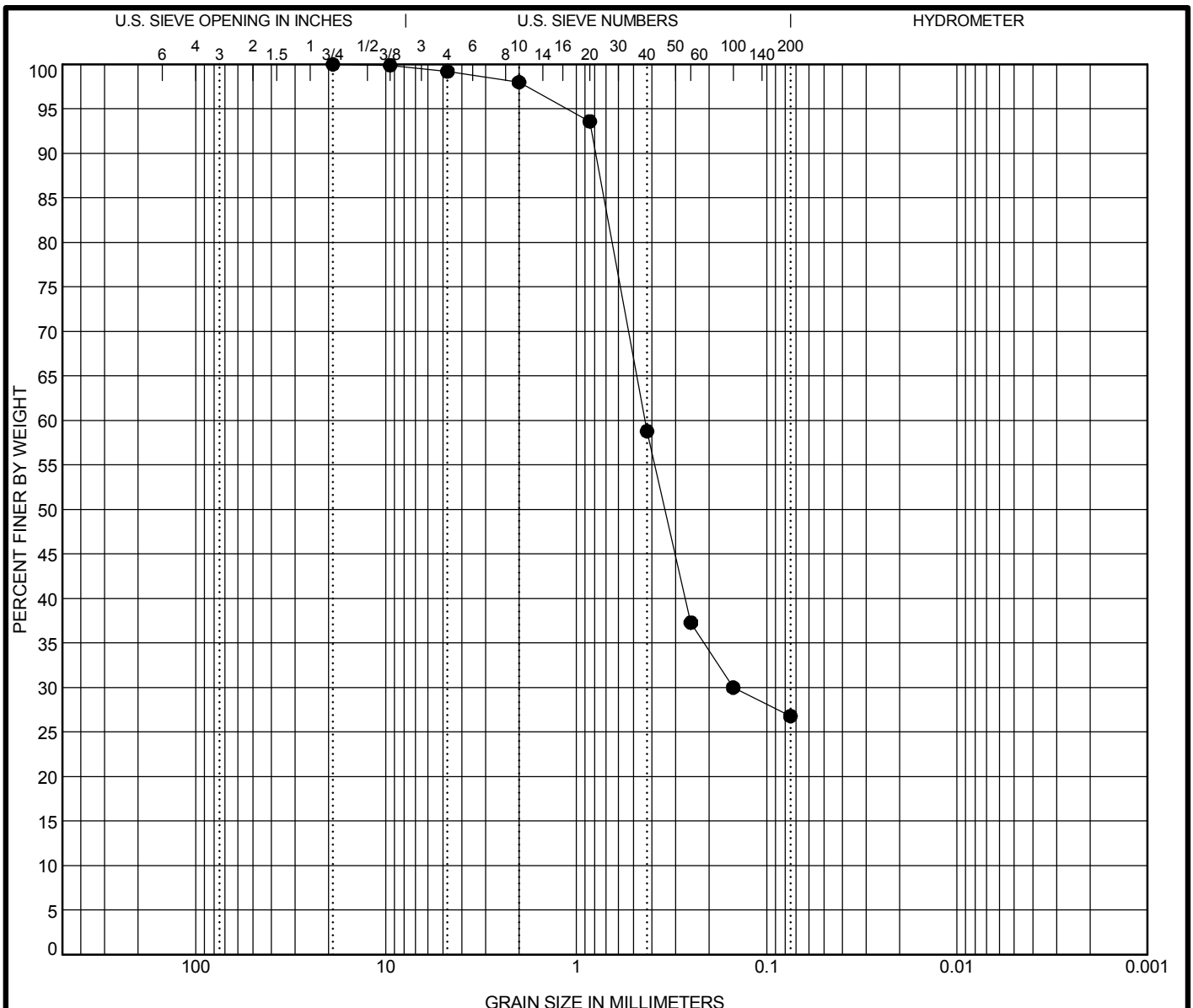

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● P-4	0.0 ft	**CLAYEY SAND (SC), contains gravel, dark brown**	**22**	**10**	**12**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**19**	**0.435**	**0.15**		**0.8**	**72.4**	**26.8**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5	19
% Finer	26.8	30.0	37.3	58.8	93.6	98.0	99.2	99.9	100.0

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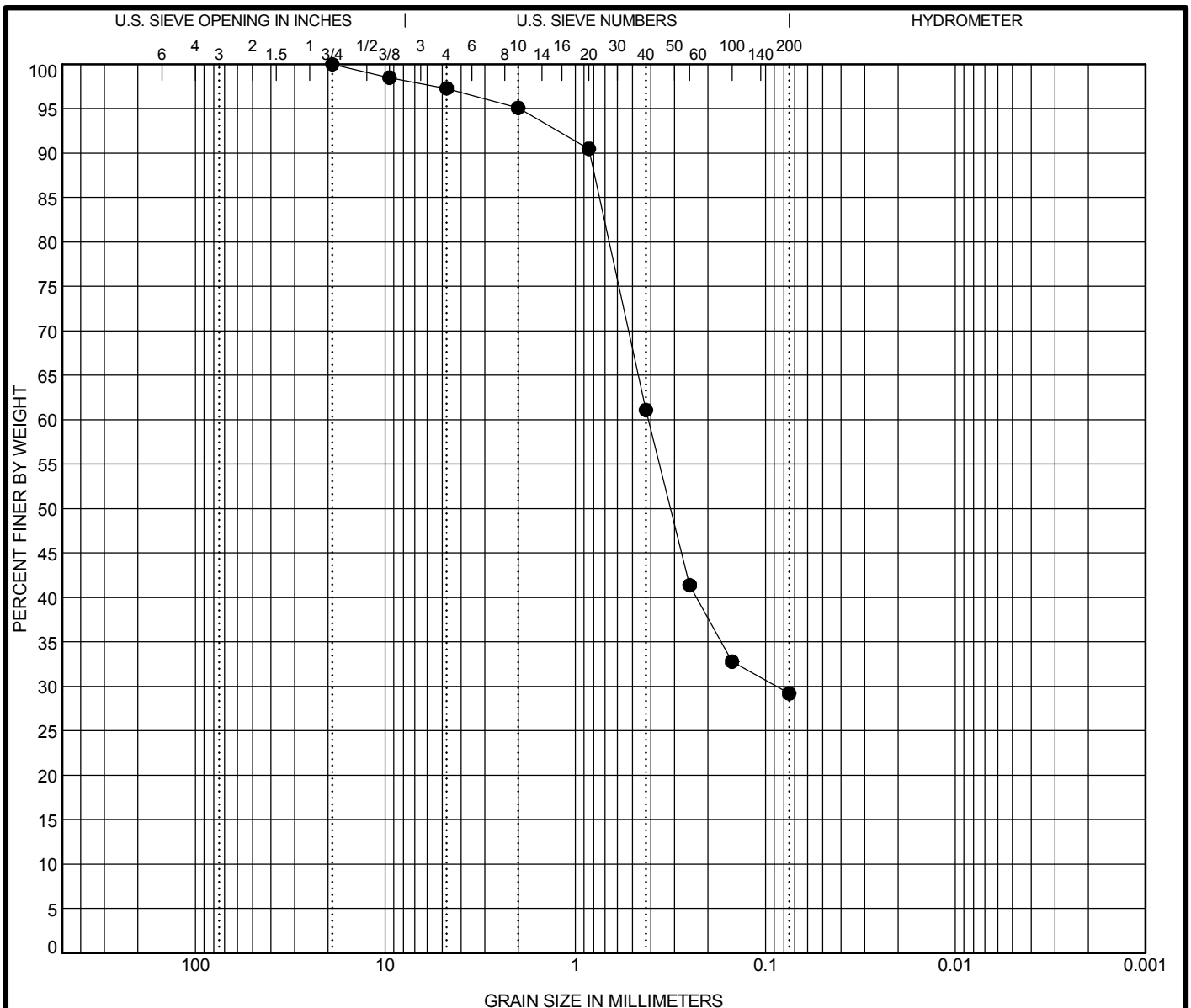

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● P-8	0.0 ft	**CLAYEY SAND (SC), contains gravel, brown**	**42**	**15**	**27**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**19**	**0.413**	**0.087**		**2.7**	**68.1**	**29.2**	

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5	19
% Finer	29.2	32.8	41.4	61.1	90.5	95.1	97.3	98.5	100.0

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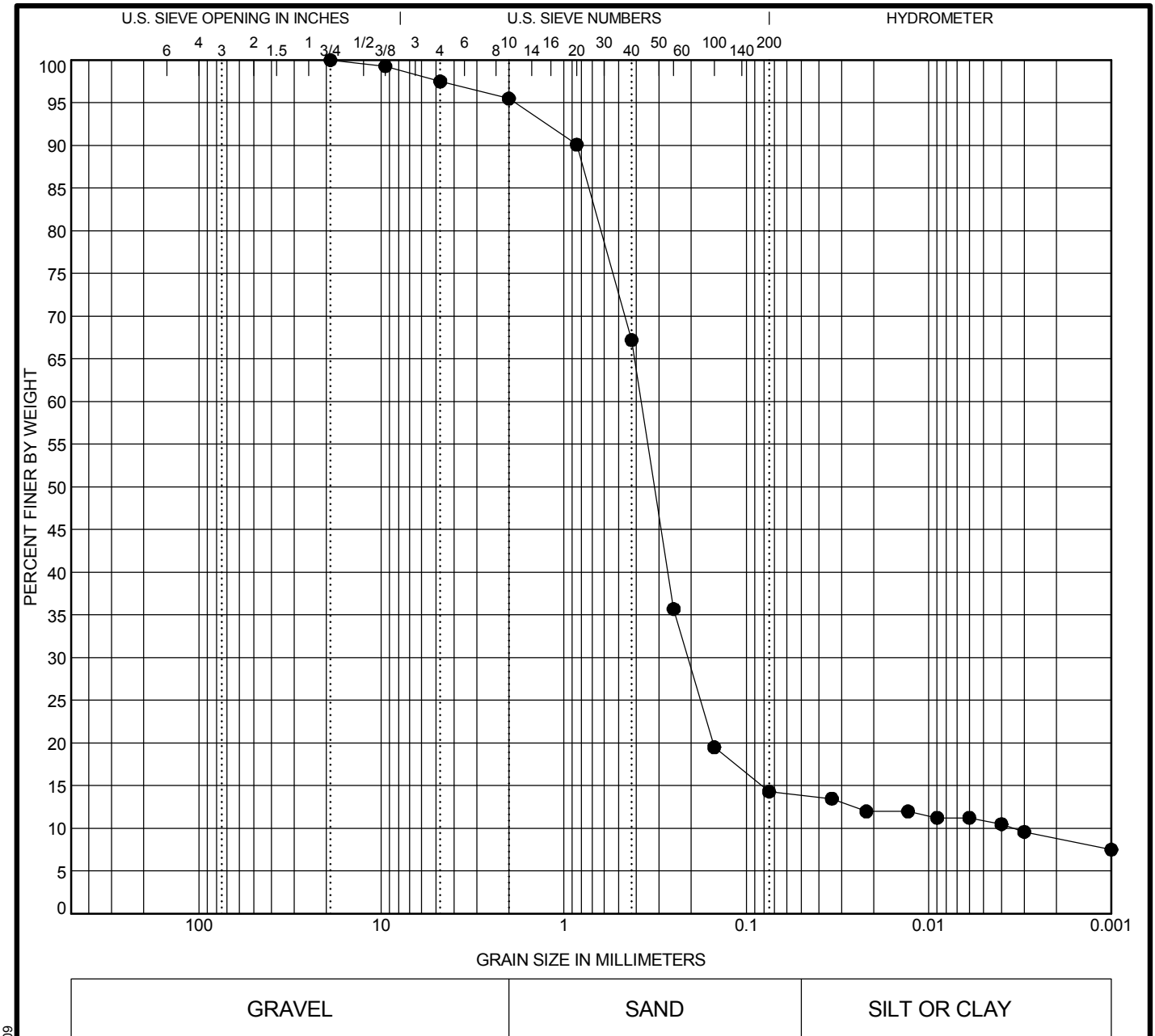

GRAVEL	SAND	SILT OR CLAY

Specimen		Sample Description	LL	PL	PI
● SWM-1	8.5 ft	**LOAMY SAND** (USDA)	--	--	--

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**	**0.376**	**0.209**	**0.003**	**4.5**	**81.6**	**5.1**	**8.8**
					Used in Classification	**85.4**	**5.3**	**9.2**

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5	19
% Finer	14.3	19.5	35.7	67.2	90.1	95.5	97.5	99.3	100.0

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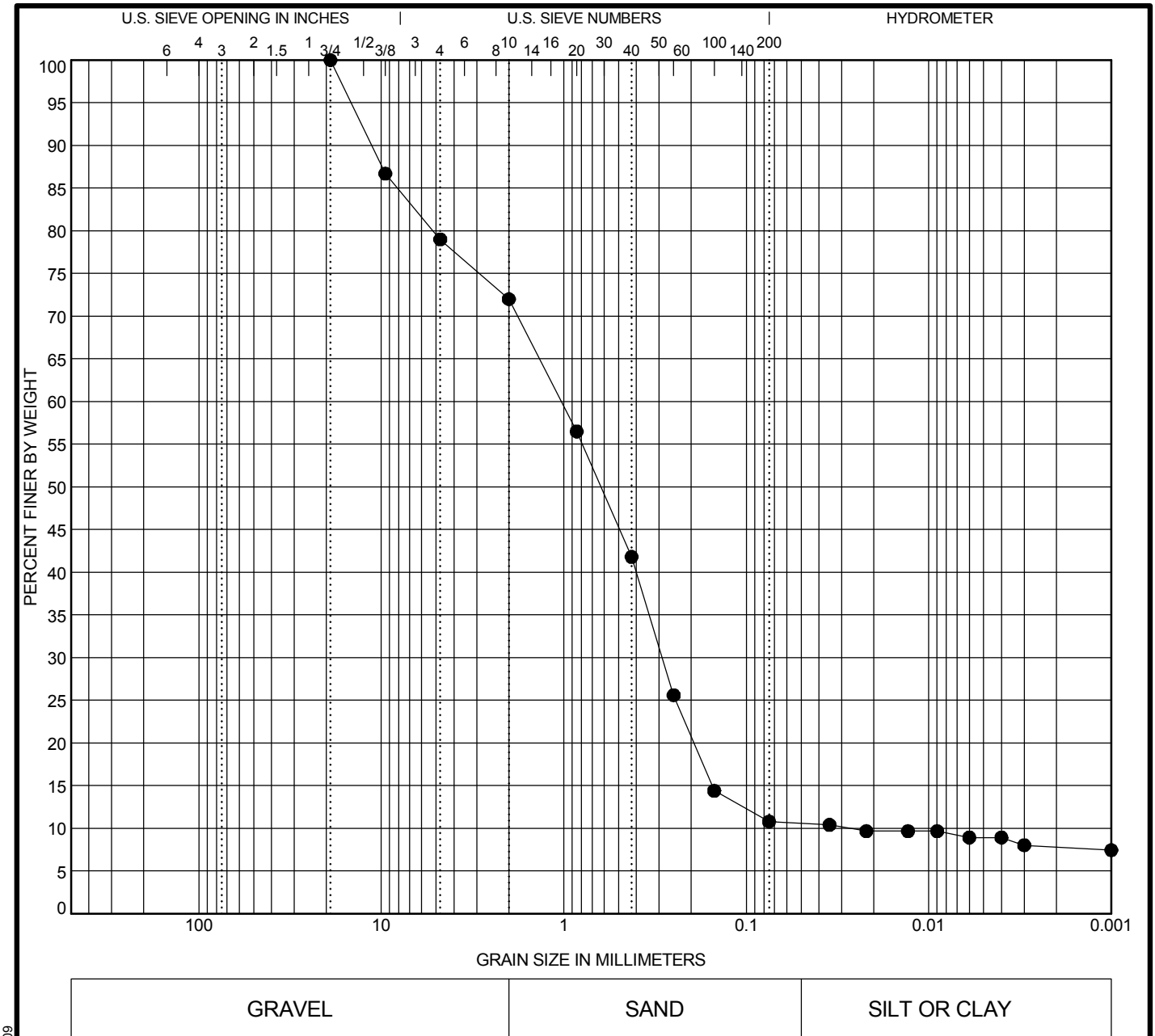

GRAVEL	SAND	SILT OR CLAY

Specimen		Sample Description	LL	PL	PI
● SWM-2	8.5 ft	**LOAMY SAND** (USDA)	--	--	--

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D6913	**19**	**1.031**	**0.289**	**0.027**	**28.0**	**61.4**	**2.8**	**7.8**
					Used in Classification	**85.3**	**3.9**	**10.8**

Percent Finer

Sieve Size (mm)	0.075	0.15	0.25	0.425	0.85	2	4.75	9.5	19
% Finer	10.8	14.4	25.6	41.8	56.5	72.0	79.0	86.7	100.0

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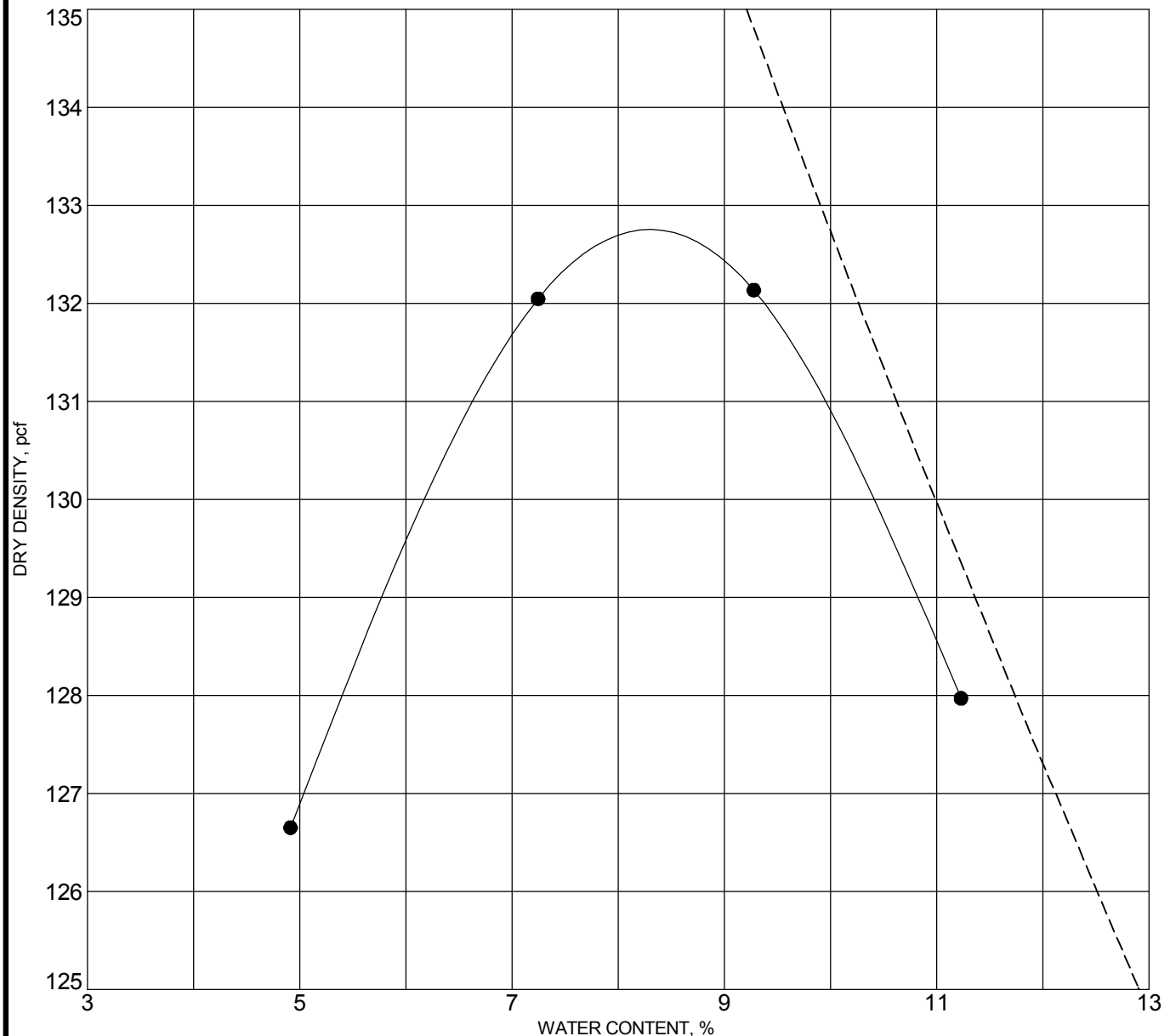

Sample Description:	CLAYEY SAND (SC), contains gravel, dark brown	Assumed Specific Gravity:	2.70
		Max. Dry Density (pcf):	132.5
		Opt. Moisture (%):	8.5
Sample Source:	P-2, 0.0 ft		
Test Methods:	ASTM D1557 Method B		

Liquid Limit (LL):	31	Comments:
Plasticity Index (PI):	18	
% Retained #4 Sieve:	3.7	
% Passing # 200 Sieve:	21.5	

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MOISTURE DENSITY RELATIONSHIP

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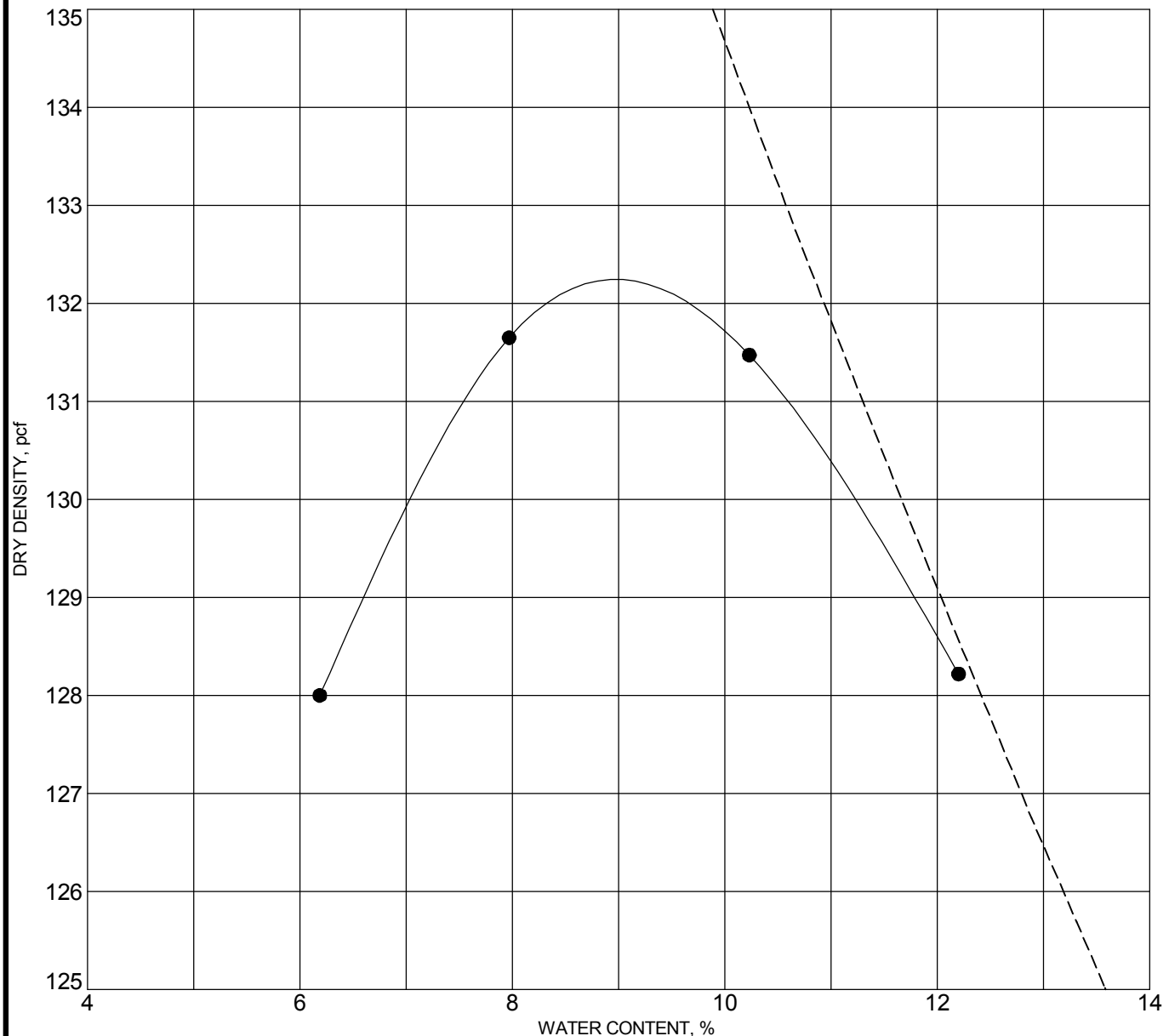

Sample Description:	CLAYEY SAND (SC), contains gravel, dark brown	Assumed Specific Gravity:	2.75
		Max. Dry Density (pcf):	132.5
		Opt. Moisture (%):	9.0
Sample Source:	P-4, 0.0 ft		
Test Methods:	ASTM D1557 Method B		

Liquid Limit (LL):	22	Comments:
Plasticity Index (PI):	12	
% Retained #4 Sieve:	0.8	
% Passing # 200 Sieve:	26.8	

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MOISTURE DENSITY RELATIONSHIP

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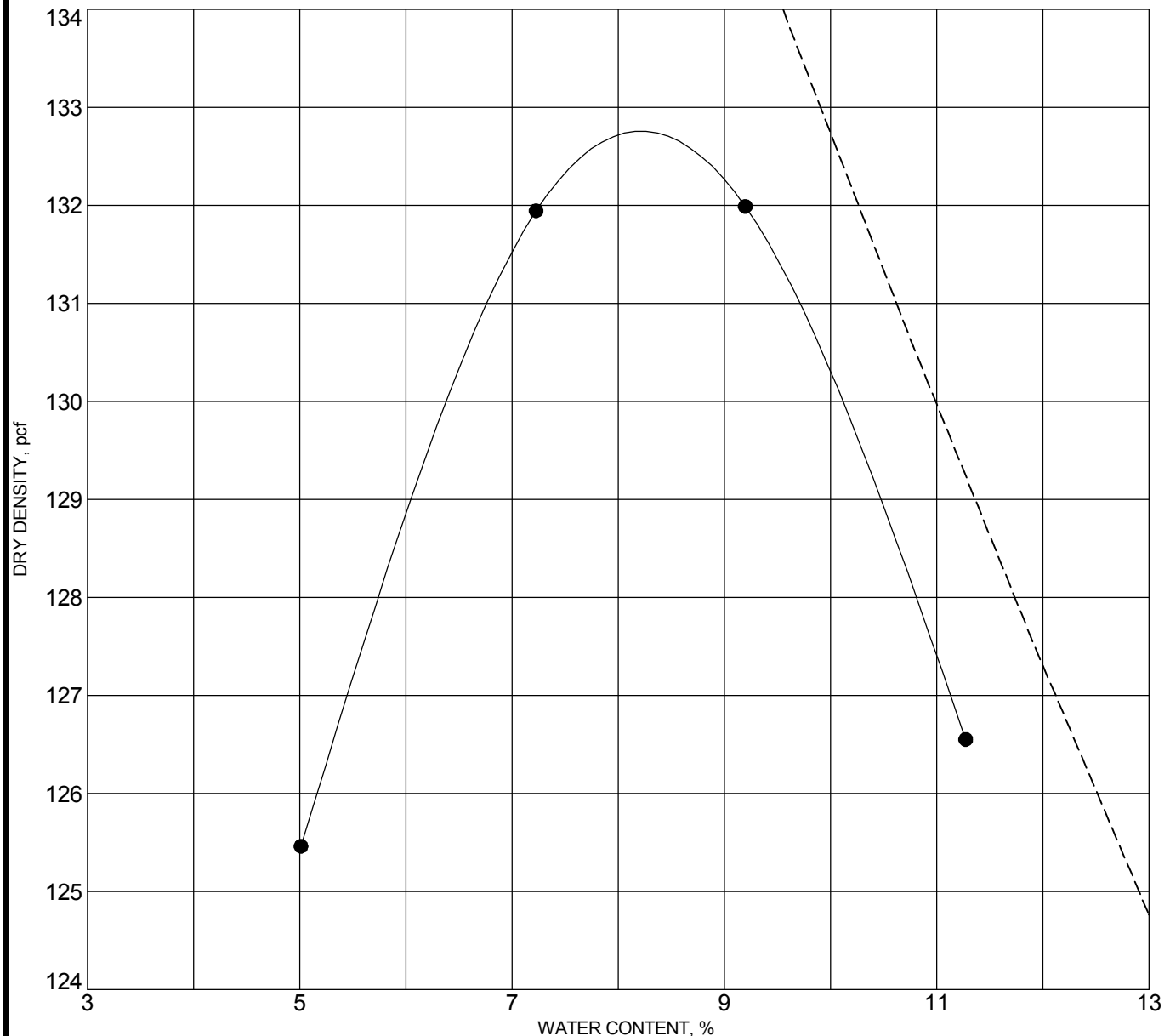

Sample Description:	CLAYEY SAND (SC), contains gravel, brown	Assumed Specific Gravity:	2.70
		Max. Dry Density (pcf):	132.5
		Opt. Moisture (%):	8.0
Sample Source:	P-8, 0.0 ft		
Test Methods:	ASTM D1557 Method B		

Liquid Limit (LL):	42	Comments:
Plasticity Index (PI):	27	
% Retained #4 Sieve:	2.7	
% Passing # 200 Sieve:	29.2	

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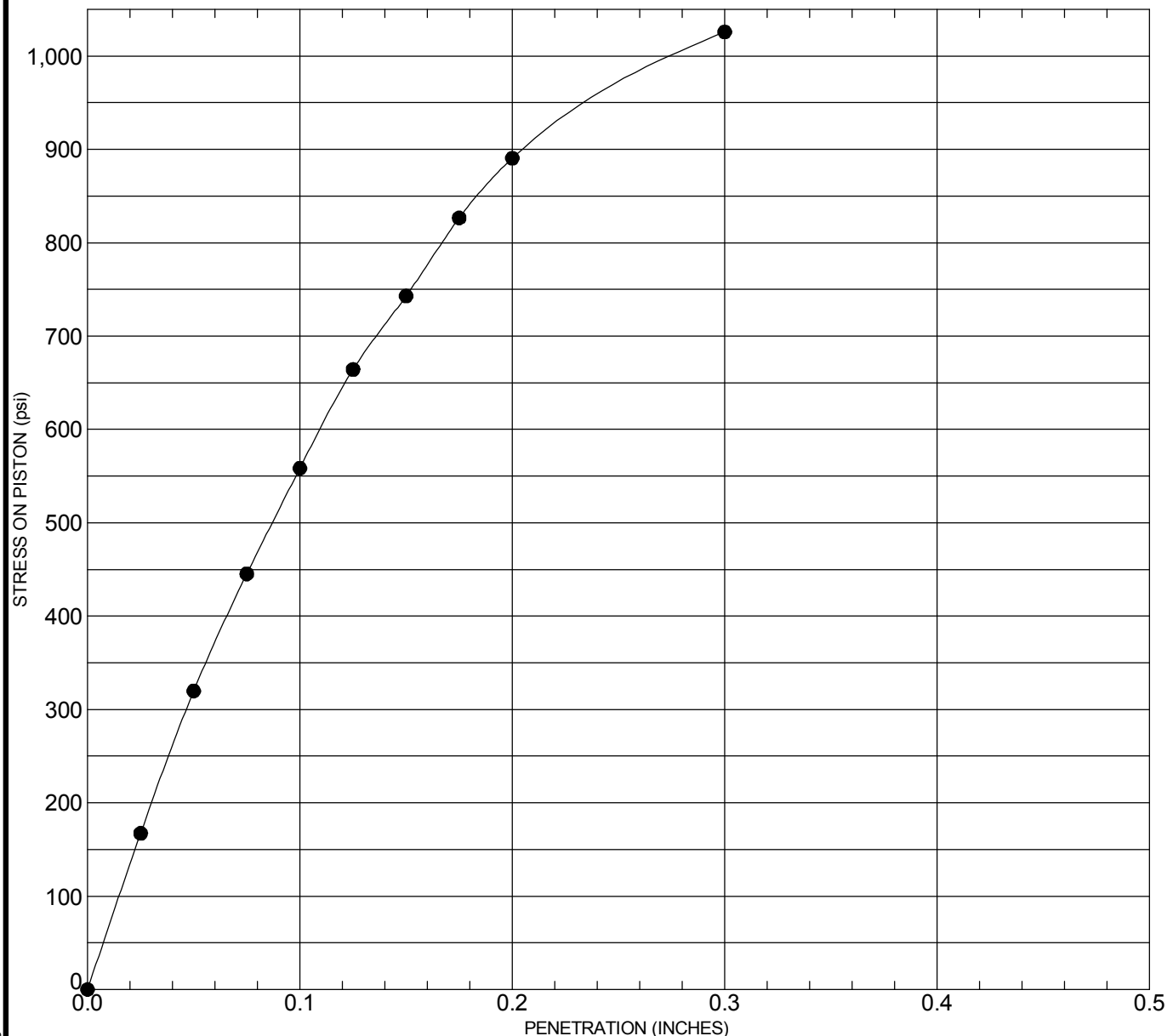

Sample Description:	CLAYEY SAND (SC), contains gravel, dark brown
Sample Source:	P-2
Sample Depth:	0.0 ft
Test Method:	ASTM D1883

Dry Density Before Soaking (pcf):	126.3
Dry Density After Soaking (pcf):	126.2
Maximum Dry Density (pcf):	132.5
Moisture Content Before Soaking (%):	8.1
Moisture Content After Soaking (Avg) (%):	11.1
Moisture Content Top Inch After Soak (%):	
Optimum Moisture Content (%):	8.5

Liquid Limit (LL):	31
Plasticity Index (PI):	18
% Retained #4 Sieve:	3.7
% Passing # 200 Sieve:	21.5

CBR:	59.5, Soaked
Surcharge (psf):	50
Swell (%):	0.0

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CALIFORNIA BEARING RATIO TEST

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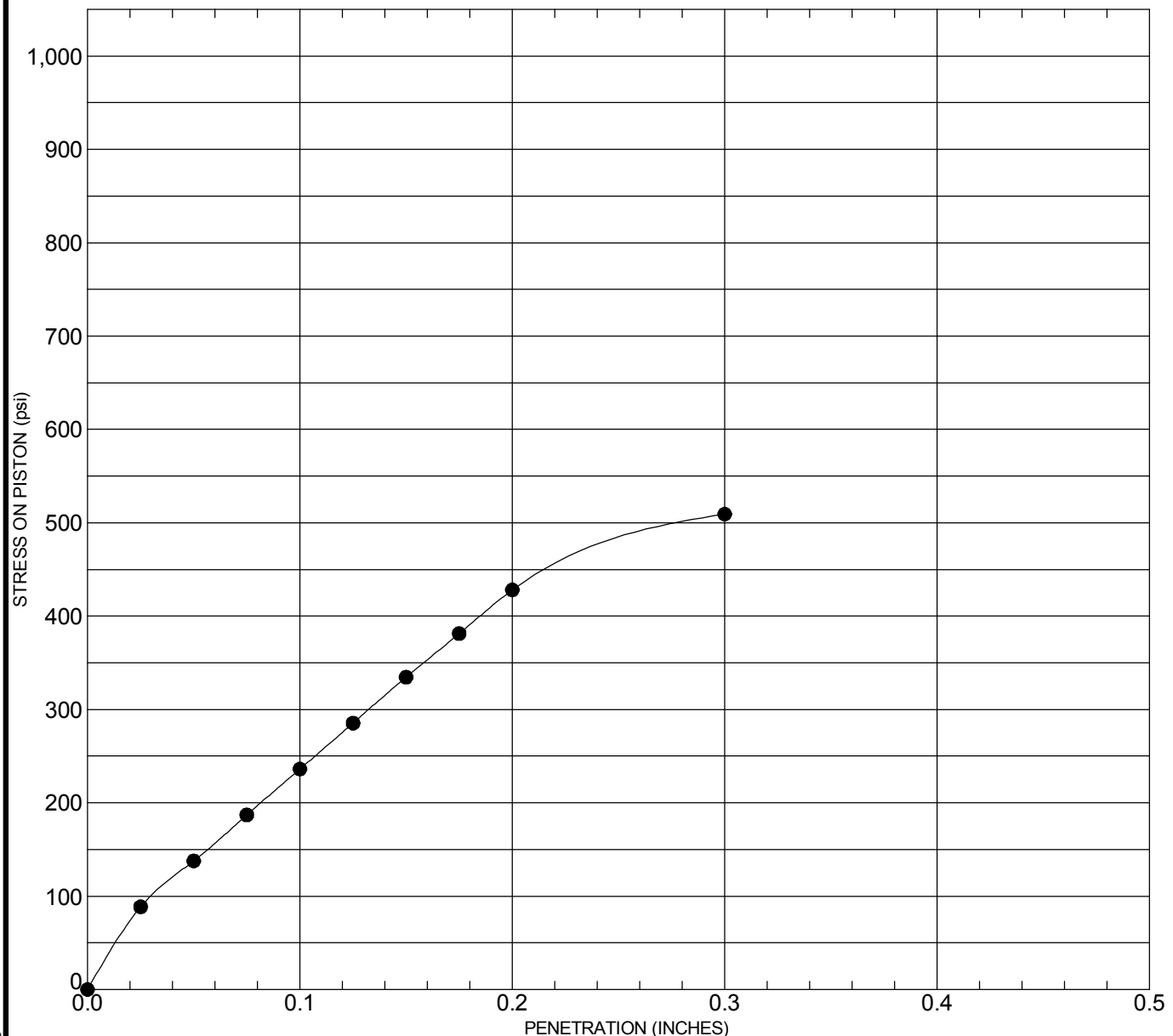

Sample Description:	CLAYEY SAND (SC), contains gravel, dark brown
Sample Source:	P-4
Sample Depth:	0.0 ft
Test Method:	ASTM D1883

Dry Density Before Soaking (pcf):	125.4
Dry Density After Soaking (pcf):	125.3
Maximum Dry Density (pcf):	132.5
Moisture Content Before Soaking (%):	9.2
Moisture Content After Soaking (Avg) (%):	9.6
Moisture Content Top Inch After Soak (%):	
Optimum Moisture Content (%):	9

Liquid Limit (LL):	22
Plasticity Index (PI):	12
% Retained #4 Sieve:	0.8
% Passing # 200 Sieve:	26.8

CBR:	28.5, Soaked
Surcharge (psf):	50
Swell (%):	0.1

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CALIFORNIA BEARING RATIO TEST

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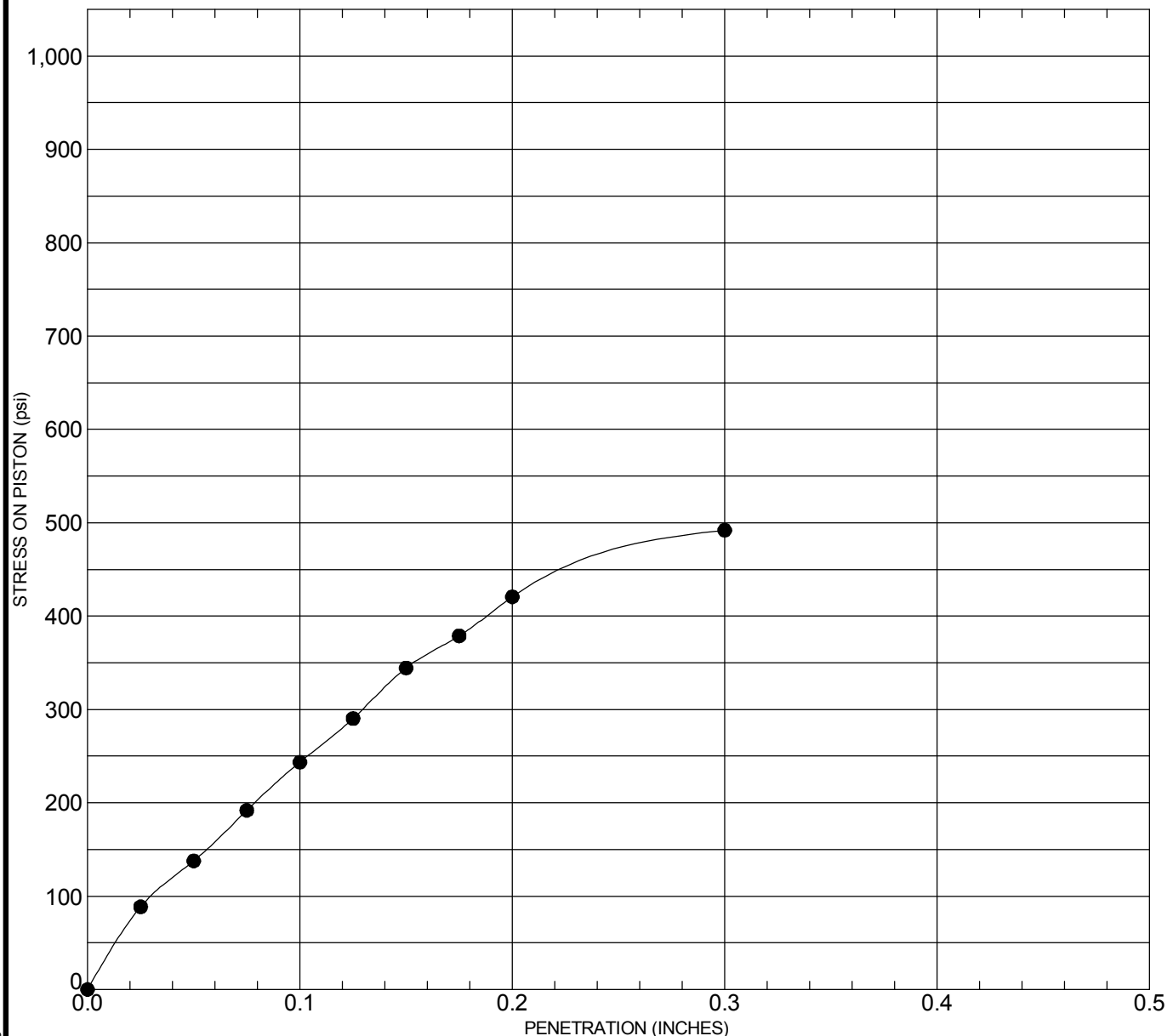

Sample Description:	CLAYEY SAND (SC), contains gravel, brown
Sample Source:	P-8
Sample Depth:	0.0 ft
Test Method:	ASTM D1883

Dry Density Before Soaking (pcf):	126.1
Dry Density After Soaking (pcf):	125.9
Maximum Dry Density (pcf):	132.5
Moisture Content Before Soaking (%):	8.1
Moisture Content After Soaking (Avg) (%):	9.5
Moisture Content Top Inch After Soak (%):	
Optimum Moisture Content (%):	8

Liquid Limit (LL):	42
Plasticity Index (PI):	27
% Retained #4 Sieve:	2.7
% Passing # 200 Sieve:	29.2

CBR:	28, Soaked
Surcharge (psf):	50
Swell (%):	0.2

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CALIFORNIA BEARING RATIO TEST

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APPENDIX C

INFILTRATION TESTS

Infiltration Test Procedures
Infiltration Test Data Sheets (2 pages)

INFILTRATION TEST PROCEDURES

Infiltration testing was performed by auguring a hole to the depths indicated. The auger was removed and a 4-inch diameter PVC pipe was installed. The pipe was seated using the drill rig. Approximately 24-inches depth of water was poured into the pipe and the water was allowed to presoak the soils for about 24-hours. After the presoak was completed, another 24-inches of water was added to the pipe and the water level was measured at the beginning and end of a one hour period. This process was repeated three times and the test results were averaged.

INFILTRATION TEST RESULTS

Project: NSA Joint Commissary and Navy Exchange
Test No: I-1
Location: SWM-1
Test Depth: 10 feet
Test EL: 59.0

Project No: 09140037
Date: 8/7/2009
SE Rep. J. Andrews
Sfc EL: 69.0

PRESOAK:

Date: 8/6/2009
Time: 10:45 AM
Depth of Water: 24 inches
USCS Soil Description: CLAYEY SAND
USDA Soil Description: LOAMY SAND

24-Hour Reading
Date: 8/7/09
Time: 11:30 AM
Depth of Water: DRY

TEST:

Run	Date	Begin		Interim		End		Infiltration Rate (in/hr)
		Time	Depth (in)	Time	Depth (in)	Time	Depth (in)	
1	8/7	11:54 AM	17.0	12:24 PM	8.0	12:54 PM	4.0	13.0
2	8/7	12:59 PM	18.0	1:29 AM	13.0	1:58 PM	9.0	9.0
3	8/7	2:00 PM	25.0	2:29 PM	18.0	3:00 PM	12.0	13.0
4	8/7	3:02 PM	25.0	3:31 PM	17.0	4:02 PM	13.0	12.0
							AVERAGE INFILTRATION RATE (in/hr)	**11.75**

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INFILTRATION TEST RESULTS

Project: NSA Joint Commissary and Navy Exchange
Test No: I-2
Location: SWM-2
Test Depth: 9.0 feet
Test EL: 67.0

Project No: 09140037
Date: 8/7/2009
SE Rep. J. Andrews
Sfc EL: 76.0

PRESOAK:

Date: 8/6/2009
Time: 11:00 AM
Depth of Water: 24 inches
USCS Soil Description: SILTY SAND
USDA Soil Description: GRAVELLY LOAMY SAND

24-Hour Reading
Date: 8/7/09
Time: 11:35 AM
Depth of Water: DRY

TEST:

Run	Date	Begin		Interim		End		Infiltration Rate (in/hr)
		Time	Depth (in)	Time	Depth (in)	Time	Depth (in)	
1	8/7	11:50 AM	24.0	12:05 PM	0.0	12:50 PM	0.0	24.0
2	8/7	12:49 PM	24.0	1:04 PM	0.0	1:49 PM	0.0	24.0
3	8/7	1:50 PM	24.0	2:05 PM	0.0	2:50 PM	0.0	24.0
4	8/7	2:54 PM	24.0	3:04 PM	0.0	3:54 PM	0.0	24.0
AVERAGE INFILTRATION RATE (in/hr)								**24.00**

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