

**TABLE OF CONTENTS**

**LIST OF TABLES.....1**

**4-0100 PROCEDURES .....3**

4-0101 General Policy .....3

4-0102 Scope .....3

**4-0200 SOILS .....5**

4-0201 County Soil Units, Map and Classes .....5

4-0202 Class I Soils .....6

4-0203 Class II Soils.....7

4-0204 Class III Soils .....7

4-0205 Class IV Soils .....8

4-0206 Geotechnical Report Requirements Summary .....10

**4-0300 GEOTECHNICAL REPORT .....11**

4-0301 General Requirements and Procedures.....11

4-0302 Purpose of Geotechnical Investigation.....11

4-0303 General Guidelines .....11

**4-0400 CONSTRUCTION PLANS .....15**

4-0401 General Information .....15

4-0402 Footing and Drainage Design.....15

**4-0500 CONSTRUCTION TECHNIQUES.....17**

4-0501 Sheeting, Shoring and Filling.....17

4-0502 Inspection .....17

4-0503 Minimum Standards Required for Density Testing of Compacted Fill Soil.....18

**4-0600 GEOTECHNICAL REVIEW BOARD.....19**

4-0601 Membership.....19

4-0602 Nominations .....19

4-0603 Review and Processing of Reports, Plans and Specifications.....19

4-0604 Compensation.....19

**LIST OF TABLES**

Table 4.1 Geotechnical Report Requirements Summary .....10

Table 4.2 Minimum Standards Required for Density Testing of Compacted Fill Soils.....20



**4-0100 PROCEDURES (107-11-PFM)****4-0101 General Policy<sup>1</sup>**

4-0101.1 The purpose of these guidelines for the preparation of geotechnical reports is to outline minimum recommended procedures for planning, organizing and conducting subsurface exploration, sampling, testing and engineering analysis in conjunction with geotechnical studies. The guidelines are not to be considered as rigid. The planning of exploration, sampling and testing programs, and close supervision of the work shall be vested in a competent geotechnical engineer who has experience in this type of work and who is licensed by the State. Geotechnical reports must be prepared by, or under the direction of, a professional authorized by the State to perform such work.

4-0101.2 The Geotechnical Review Board (GRB) has been established to review geotechnical reports and associated plans referred to it by the Director and to provide recommendations to the Director on the sufficiency of the investigations, analyses and proposed designs and construction techniques. The GRB will review all geotechnical reports and associated plans for projects located in areas of problem soils that the Director determines pose a serious threat of soil-related problems.

**4-0102 Scope**

4-0102.1 Experience has shown that there are potential problems associated with certain types of soils including ground slippage and instability of Cretaceous Age deltaic clays, identified as Marumscos soils and/or "marine clays;" shrinking and swelling of certain clays; soils with shallow water tables; soils containing hazardous material; buried waste sites; uncompacted and/or undocumented fills; and/or earthen structures that would require special precautions for safety during and after construction activity. The extent of such soils has been approximately delineated on the County soils maps which have been adopted by the Board. Problem Soils are defined in Chapter 107 (Problem Soils) of the County Code. Any grading and/or construction of any building or structure, modification to add to the exterior dimensions of any existing building or structure, or any foundation related work on land containing problem soils must comply with the applicable provisions of Chapters 107 (Problem Soils), 112 (Zoning Ordinance), and 101 (Subdivision Ordinance) of the County Code and any applicable Federal or State Regulations.

4-0102.2 There are implied warranties for the foundation of new dwellings in accordance with Virginia Code § 55-70.1.

4-0102.3 The geotechnical report is generally prepared in support of an associated site or grading plan. The submission requirements for geotechnical report outlined in this section is in relation to the associated site or grading plan for the proposed project, as required by Chapter 107 (Problem Soils) of the Code. Other agencies may have geotechnical report requirements based on the Virginia Uniform Statewide Building Code (USBC).

---

<sup>1</sup> See also §§ 6-1605, 6-1606, 6-1607, and 11-0408 *et seq.*



**4-0200 SOILS (107-11-PFM)****4-0201 County Soil Units, Map and Classes**

4-0201.1 The comprehensive source of information about soils in the County is the Soil Survey of Fairfax County, prepared by the United States Department of Agriculture Natural Resources Conservation Service (NRCS), publicly released in January 2008. This survey describes 108 soil units, numbered 1-57, and 59-109. Names for the soil units were formulated using the NRCS' Soil Taxonomy, 2nd Ed. The soil survey was used to create the County soils map which depicts the soil unit boundaries and includes overlays of Marumsco soils, "marine clays," non-marine clay high shrink-swell soils, and asbestos-containing soils.

4-0201.2 Based on the severity of problems associated with these soils and the potential difficulty of analyzing and correcting those problems, the 108 units of soils are grouped into four classes (I, II, III, and IV). The designations serve as a guide to determine if and what type of geotechnical engineering study is required for proposed construction.

4-0201.3 As defined in Chapter 107 of the Code, Problem Soils include landslide susceptible soils, shrinking and swelling soils, soils with shallow water tables, soils containing hazardous material, buried waste sites, uncompacted and undocumented man-placed fills, and earthen structures that would require special precautions for safety during and after construction activity. Problem soils include areas of Marumsco soils, "marine clays," Class III, and Class IV soils, as shown and/or identified on the official map adopted by the Board of Supervisors or any other soil as determined by the Director of the Department of Public Works and Environmental Services.

4-0201.4 "Marine clay" is a term used locally for clay-rich sediments of the Cretaceous-Age Potomac Formation of the Atlantic Coastal Plain. The Potomac Formation, identified as unit Kp on USGS geologic maps, thickens from a few feet along the boundary with the Piedmont Province in the west to over 100 feet along the eastern boundary of Fairfax County. As a result of removal of younger deposits that have since eroded away, the sediments are commonly over-consolidated. The "marine clay" sediments consist mostly of montmorillonite minerals (which results in a high potential for shrink and swell with variations in moisture) that are commonly classified as elastic SILT (MH) and fat CLAY (CH) by the Unified Soil Classification System. Due to physical and chemical weathering, "marine clay" in the uppermost 20 feet of the Potomac Formation are preferentially weakened along fractures, joints and parting planes, and can cause landslides many years after the slopes are created. Sand layers, often water-bearing, are frequently mixed with the "marine clay" layers. The clays and silt are subject to large changes in volume with soil moisture changes.

4-0201.5 Areas containing "marine clay" soils were mapped by the County Soil Science Office<sup>2</sup> and designated as such on prior County soil maps. The more recent soil mapping by NRCS, which utilizes national standards for soil unit names and descriptions, does not include a specific soil unit for "marine clay." Areas mapped as containing "marine clay" soils in earlier survey work

---

<sup>2</sup> The County Soil Science Office closed in 1996.

are identified as “Previously Mapped Marine Clay” and are overlaid on the NRCS mapping. Undisturbed soils within the “Previously Mapped Marine Clay” overlay are mostly Marumsco soils, but in some locations other soil units occur. In those locations within the “Previously Mapped Marine Clay” overlay where the soils are mapped as something other than Class III soils, the requirements outlined in § 4-0205.2.2 for Class IVA soil shall be met, regardless of the classification based on the recent NRCS soil map. Regulations in the Fairfax County Zoning Ordinance, regarding “marine clay” are only applicable to the areas mapped as “Previously Mapped Marine Clay.”

#### **4-0202 Class I Soils**

4-0202.1 Class I soils are undisturbed natural soils that typically have few characteristics that would adversely affect building foundations or surrounding land. Class I soils consist of Soil Numbers 11, 28, 33, 38, 39, 76, 79, 80, 81, 84, 85, 87, 88, and 90. A geotechnical investigation is advised but not required as a condition of site or grading plan approval.

4-0202.2 The submission of a geotechnical report is typically not required under the following circumstances:

- a) The building footprint is more than 25 feet from any Class III or IV problem soil. The 25-foot margin allows for errors in soil mapping. If the building footprint is within 25 feet, a report is required unless waived by the Director.
- b) All proposed construction is in Class I and Class II soils and there is no grading activity in problem soils. If the proposed construction is partially located in a problem soil, especially Class III or IV soils, submission of a geotechnical report is required unless waived by the Director.
- c) There are no buildings with more than three stories, mat foundations, deep foundations, deep excavations, sheeting and shoring, or retaining walls over 6 feet high. On a case by case basis, any report that is prepared may be submitted with the building plans after site or grading plan approval.

4-0202.3 For site, grading, subdivision or construction plans, the following items must be addressed in the plan:

- a) Foundation drain details for proposed walls below-grade
- b) Yard or overlot drainage
- c) Construction notes for fill placement (acceptable material, lift thickness, density testing, frequency of testing, construction inspection notes as shown in §§ 4-0502.1 and 4-0502.2)
- d) Excavation Safety
- e) Impact on adjoining property

**4-0203 Class II Soils**

4-0203.1 Class II soils are undisturbed natural soils that typically have shallow water tables or restrictive soil layers. Class II soils consist of Soil Numbers 2, 7, 9, 31, 75, 77, 78, 92, and 93. A geotechnical investigation is strongly advised but not required as a condition of site or grading plan approval.

4-0203.2 The submission of a geotechnical report is typically not required under the following circumstances:

- a) The building footprint is more than 25 feet from any Class III or IV problem soil. The 25-foot margin allows for errors in soil mapping. If the building footprint is within 25 feet, a report is required unless waived by the Director.
- b) All proposed construction is within Class I and Class II soils and there is no grading activity in any problem soils. If the proposed construction is partially located in a problem soil, especially Class III or IV soils, submission of a geotechnical report is required unless waived by the Director.
- c) There are no buildings with more than three stories, mat foundations, deep foundations, deep excavations, sheeting and shoring, or retaining walls over 6 feet high. On a case by case basis, any report that is prepared may be submitted with the building plans after site or grading plan approval.

4-0203.3 For site, grading, subdivision or construction plans, the following items must be addressed in the plan:

- a) Groundwater problems are addressed with appropriate foundation drains and backfill on proposed walls below-grade
- b) Yard or overlot drainage
- c) Construction notes for fill placement (acceptable material, lift thickness, density testing, frequency of testing, construction inspection notes as shown in §§ 4-0502.1 and 4-0502.2)
- d) Excavation safety
- e) Impact on adjoining property

**4-0204 Class III Soils**

4-0204.1 Class III soils are undisturbed natural soils that have characteristics such as high shrink/swell potential, high compressibility, low bearing strength, and shallow water tables, which may result in poor drainage, building settlement, and unstable slopes, etc. Class III soils consist of Soil Numbers 1, 8, 10, 29, 30, 32, 34, 35, 36, 37, 48, 49, 59, 60, 61, 62, 63, 64, 65, 74, 82, 83, 89, 91, 94, and 109. The soil types or conditions included in this group are:

## 4-0000 GEOTECHNICAL GUIDELINES

- 1) Cretaceous-Age Potomac Group Clays (mapped as Marumsco soils and/or “marine clay”);
- 2) Other soils containing high shrink-swell clays;
- 3) Soils with a seasonal high water table at or near the surface for prolonged periods and low bearing strength (poor foundation support); and
- 4) Alluvial or floodplain soils.

A detailed geotechnical investigation and report are required.

4-0204.2 Geotechnical problems must be addressed with adequate engineering evaluations and designs prior to development. A geotechnical report, prepared according to the geotechnical guidelines in this chapter and the Virginia Uniform Statewide Building Code (USBC) is mandatory for all construction and grading within these problem soil areas. The engineering evaluation and report shall be submitted for approval, and the recommendations incorporated into the grading plans as requirements prior to plan approval. Construction inspections and certifications are required from the Engineer-of-Record.

### **4-0205 Class IV Soils**

4-0205.1 Class IV soils are soils that have been disturbed or altered as a result of grading or construction resulting in soils with variable characteristics. Class IV soils are divided into two groups, IVA and IVB.

4-0205.2 Class IVA Soils. Class IVA soils are disturbed soils that were originally Class III soils, and consist of Soil Nos. 13, 15, 17, 20, 21, 26, 27, 42, 43, 44, 47, 51, 52, 53, 54, 55, 56, 57, 69, 71, 73, 86, 103, and 106. Landfill and quarry areas are also grouped here. A detailed geotechnical investigation and report are required.

4-0205.2A Geotechnical problems must be addressed with adequate engineering evaluations and designs prior to development. A geotechnical report, prepared according to the geotechnical guidelines in this chapter and the Virginia Uniform Statewide Building Code (USBC) is mandatory for all construction and grading within these problem soil areas. The engineering evaluation and report shall be submitted for approval, and the recommendations incorporated into the grading plans as requirements prior to plan approval. Construction inspections and certifications are required from the Engineer-of-Record.

4-0205.3 Class IVB Soils. Class IVB soils are disturbed soils that were originally Class I or II soils, and consist of Soil Nos. 3, 4, 5, 6, 12, 14, 16, 18, 19, 22, 23, 24, 25, 40, 41, 45, 46, 50, 66, 67, 68, 70, 72, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 107, and 108.

## 4-0000 GEOTECHNICAL GUIDELINES

4-0205.3A A limited geotechnical investigation is required in the form of a letter report to be incorporated into the first submission of the site, subdivision, grading or construction plans. The information placed on the plans will consist of soil strength tests e.g., SPT boring logs and construction notes addressing identified problems and other requirements for construction such as those identified under CLASS II soils (§ 4-0203.3). For example, the letter report should be based on knowledge of the previous site disturbance, proposed construction, site grades, floor elevations, etc. Borings shall extend through any fill to depths below the proposed footing elevation. Standard engineering practice is a depth that is two to three times the width of the proposed footing. Depending on the issues identified during the review of the plan, (e.g., depth of existing fill, proposed construction, recommended foundation and slab support, stability of slopes, the need for referral to the Geotechnical Review Board), a detailed geotechnical report submitted separately may be required prior to the second submission of the site or grading plans. It is therefore advised that a comprehensive geotechnical report be obtained for these soils earlier in the process.

4-0205.3B For non-bonded lot grading plans, where proposed residential dwellings are to be located on properties containing Class IVB soils, a geotechnical investigation and report will not be required if a certification is provided stating that all eight of the items below are met. The certification must be signed and sealed by a professional authorized by the State to provide such information and incorporated into the plans. The eight items are:

1. Class III or Class IVA soils are not mapped by NRCS on the property.
2. Project does not require sheeting and shoring, retaining walls over 6 feet high, pile foundations, geopiers, mat foundation, or ground modification; such as dynamic compaction, stone columns, vibra compaction, chemical stabilization, etc.
3. Geotechnical reports are not required under any other county regulation or building codes.
4. Maximum depth of existing disturbed land on the property is less than 5 feet.
5. Footings and floor slabs will be supported on competent natural soils.
6. Existing slopes on the property are not steeper than 3:1(horizontal:vertical). If existing slopes are steeper than 3:1(horizontal:vertical), the County's geotechnical review engineer shall be contacted. Evaluation of the slopes may be required, depending on the proposed house location.
7. Structure is located at least 15 feet from the top of any 3:1(horizontal:vertical) or steeper slope and the influence zone of house footings does not intercept with any slope. The influence zone of a footing is defined as the area beneath a 45-degree line extending outward and downward from footing exterior edge.
8. Foundation drain details are included on the plans.

**4-0206 Geotechnical Report Requirements Summary**

4-0206.1 The geotechnical report requirements are summarized in Table 4.1.

<b>Table 4.1 Geotechnical Report Requirements Summary</b>					
<b>ITEM</b>	<b>SOIL CLASS</b>				
	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	
				<b>A</b>	<b>B</b>
Geotechnical Investigation	1	2	REQ	REQ	REQ
Geotechnical Report	NRQ	NRQ	REQ	REQ	3
Geotechnical Specification on Plans <sup>4</sup>	REQ	REQ	REQ	REQ	REQ
Footnotes: 1. Advised but not required. 2. Strongly advised, but not required. 3. Results of geotechnical investigation are required on the first submission of plans. For non-bonded lot grading plans, where the proposed residential dwellings are to be located on properties containing Class IVB soils, the certification referenced in § 4-0205.2.3 shall be incorporated into plans. 4. For Class I soils see § 4-0202.3, and for Class II soils see § 4-0203.3. For Class III, and Class IV soils, report recommendations must be stated as requirements in specifications.  NRQ=Not Required      REQ=Required					

4-0206.2 The installation of linear structures such as storm sewer or sanitary sewer lines, usually do not require submission of a geotechnical report. Notes addressing placement of backfill and OSHA excavation requirements are sufficient in most cases. The only exception would be in cases where such construction activity might trigger movement in adjoining slopes. Cutting of existing steep slopes in slide-prone areas (Marumsc or “marine clay” areas) requires slope stability analysis and submission of a geotechnical report prior to plan approval or permit issuance. Additions to residential structures and minor commercial buildings exempt from site or grading plan submission requirements only require an engineered foundation design submitted with building permit application.

**4-0300 GEOTECHNICAL REPORT (107-11-PFM)**

**4-0301 General Requirements and Procedures**

4-0301.1 At the preliminary and pre-site plan stages, notations may be made during review that compliance with the Subdivision Ordinance, Zoning Ordinance, and Chapter 107 (Problem Soils) of the Code will be required for proposed plans.

4-0301.2 For subdivisions and site plans in these difficult areas, a geotechnical report conforming to these guidelines must be submitted with the construction plans, and the construction plans must incorporate the recommendations of the geotechnical report as requirements. A geotechnical report submission fee must be paid upon initial submission of the geotechnical report.

4-0301.2A It shall be determined during staff review whether or not the project must be referred to the GRB.

4-0301.2B If a determination is made for referral, then three additional copies of the geotechnical report and the construction plans shall be required.

4-0301.2C When these additional copies are received, the geotechnical report and the construction plans shall be forwarded to the members of the GRB for their recommendations.

4-0301.2D The GRB shall review construction plans only in conjunction with the geotechnical report.

4-0301.3 If the Director determines that proposed construction on a site with problem soils will not adversely impact either the subject property or adjoining properties, the Director may waive the project from the requirement of a geotechnical report in accordance with Chapter 107 of the Code.

**4-0302 Purpose of Geotechnical Investigation**

4-0302.1 The purpose of any geotechnical investigation is to determine the character and physical properties of soil deposits for use as structure foundation or material for earthwork construction purposes. The type of structure to be built and anticipated geologic and field conditions have a major bearing on the type of investigation to be conducted.

4-0302.2 The investigation must, therefore, be planned with a knowledge of intended project size, land utilization and a broad knowledge of the geologic history of the area. Advice on geological features should be obtained from an experienced engineering geologist as required.

**4-0303 General Guidelines.** The site and soil exploration should include, but not be limited to, the following detailed factual information, analysis and recommendations:

## 4-0000 GEOTECHNICAL GUIDELINES

4-0303.1 Surface Features. Surface contours include, but are not limited to, old construction, rock outcrops, water courses, ditches, ponds, wooded areas, and filled-in areas. Particular emphasis must be given to identification of possible old slide areas. This should include a thorough surface reconnaissance of both the site being developed and surrounding area. Consideration should also be given to reviewing aerial photographs of the area.

4-0303.2 Hydrologic Features. The presence of seepage zones, depth to groundwater and the possible fluctuations with the seasons should be investigated.

### 4-0303.3 Subsurface Features

4-0303.3A A plotted record of the stratification of the soil deposits, both horizontal and vertical, shall be included in the geotechnical report. This record should indicate, in the soil profile, the surface elevation of all borings and test pits, and should also indicate the thickness and character of the soils encountered. The profiles should reach to such a depth as may be required, and are to include 24-hour water level readings.

4-0303.3B Information on the degree of compactness of granular soils and on the consistency of cohesive soils should be provided.

4-0303.4 Exploration Methods. Field explorations should follow the applicable standards and recognized procedures of geotechnical engineering as set forth by ASTM, ASCE, AASHTO, etc.

4-0303.4A The interval of soil sampling shall be determined on the basis of soils encountered, the type of structure and other conditions. Continuous sampling may be required. Test procedures utilized shall be identified.

4-0303.4B The spacing and depth of borings must be based on the site conditions and the proposed construction.

4-0303.4C Borings shall extend sufficiently into an underlying material of adequate bearing capacity and below the depth of a possible slope failure. The bore holes must be plugged after completion of the borings and obtaining 24-hour water level readings.

4-0303.4D All the information and data obtained from the explorations must be recorded properly in the geotechnical report.

4-0303.5 Groundwater Measurements. Information on groundwater elevations must be provided, including depth of permanent and perched water tables.

4-0303.5A Water tables should be determined after completing the boring and a minimum of 24 hours later.

4-0303.5B Perforated casings or piezometers may be required in selected bore holes satisfactory to the Director to obtain long-term water level readings.

4-0303.6 Classification and Description. Direct observation of soil samples from various depths and locations shall be required for correlation with the known geology of the area. Classification and description of soils shall be done by the USCS (ASTM Specification D2487), and by the Visual Manual Identification Procedure (ASTM D2488). All terms and nomenclatures used for textural description of the soils must be clearly defined. Complete soil descriptions must also include in-place conditions, geologic names, local names and any other information that is pertinent to the interpretation of the subsoil characteristics.

4-0303.7 Laboratory Testing. The nature and extent of laboratory testing deemed necessary is dependent upon the characteristics of the soil and the anticipated geotechnical problems requiring analysis.

4-0303.7A On granular soils, gradation tests on representative samples and water content determinations often are adequate.

4-0303.7B Testing of cohesive soils samples may include, but are not limited to, determination of water content, dry density and unconfined compressive strength.

4-0303.7C In stiff, fissured clays such as the Cretaceous Marumscu and/or “marine clays,” the results of unconfined compression tests alone cannot be used to assess the structural property of the soil *in-situ*. Atterberg limit and hydrometer analysis tests aid in classification and also in predicting certain properties.

4-0303.7D Consolidation tests should be performed on samples from relatively soft soils which may underlie the foundations. Expansive pressure of the clays should also be determined for foundation design.

4-0303.7E For the deltaic clays which have undergone relatively large strains in the past, the important properties for predicting long-term behavior are the residual effective friction angle and the residual cohesion intercept (the absolute minimum strength of clay material). These parameters should be determined by appropriate laboratory tests (drained direct shear tests using sufficient stress reversals to obtain large strains as discussed in the COE laboratory testing procedure EM 1110-2-1906). Many reversals are required to reach residual strengths. Some references suggest using a pre-split sample (Ref. Engineering Properties of Clay Shales Report No. 1, by W. Haley and B. N. MacIver). For less complex situations subject to approval of the Director, the required parameters may be estimated by comparison of other index properties (particularly the Atterberg limits) with those of similar soils for which test results are reported in the published literature and on the basis of past experience. Documentation shall be furnished when shear strength parameters are based on results other than laboratory tests. Such documentation must set forth the reasoning by which parameters were determined.

4-0303.8 Engineering Analysis and Recommendations

4-0303.8A The report of the soil studies shall include sufficient analytical foundation and slope stability studies to allow a reviewer to follow the logic and assumptions on which the analysis was based and conclusions reached. Recommendations and advice concerning pavement design, foundation design, earthwork, site grading, drainage, slope stabilization and construction procedures must be included in the report. The report shall include a complete record of the field and laboratory findings, information concerning structures to be built (types and elevations of basements), the conclusions reached from the study and the recommendations for use by the designer and the owner. Probable total and differential settlement of foundations, special basement problems and retaining wall design must be discussed and recommendations set forth.

4-0303.8B Where Marumsco soils and/or “marine clays” are found, an engineering analysis of the short and long-term stability of existing and planned slopes must be made including a careful evaluation of potential adverse effects on nearby properties. The stability analysis shall be made by acceptable methods of analysis. The long-term stability of Marumsco soils and/or “marine clays” shall be based on the “residual” shear strength parameters for the Marumsco soils and/or “marine clays.”

4-0303.8C In areas that are susceptible to high water table (permanent, perched and/or seasonal) the engineer shall provide pavement design, and measures to assure dry basements and to preclude wet yards, etc.

4-0303.8D Design criteria for retaining walls or structures shall be given.

4-0303.8E The report shall include a discussion on the problems of expansive soils. Clay soils containing montmorillonite have been found in a wide variety of locations in southern Fairfax County and could exist in the areas of problem soils. It is suggested that the design recommendations be based on expansive properties of the clay unless it is shown otherwise by X-ray defraction studies or other appropriate laboratory tests.

**4-0400 CONSTRUCTION PLANS (107-11-PFM)**

**4-0401 General Information**

4-0401.1 The recommendations in the geotechnical report shall be incorporated into the plans as requirements to be performed during construction.

4-0401.2 The soils engineer must review the final construction plans and state his opinion as to whether or not the plans have been prepared in accordance with his recommendations and note deviations from his recommendations.

**4-0402 Footing and Drainage Design**

4-0402.1 Where Cretaceous Age deltaic clays occur, roof drains shall be required and the downspouts from these drains shall be piped to a storm drainage system. However, the requirement may be waived or modified by the Director where soil conditions warrant.

4-0402.2 Foundation footings of structures must be placed at depths that will minimize differential settlement due to desiccation of underlying clays. The emplacement depth shall be based on the soil characteristics of the site. Consideration must be given to stratification of underlying materials, natural moisture content, gradation of backfill soils, site grading and adjacent vegetation. Consideration should also be given to special cases of potential volume change of clays underlying footings embedded in thin layers of natural or artificially compacted granular soils. Foundations in Marumsco and/or “marine clays” should be at least 4 feet deep. Where the geotechnical study has proven the 4 feet to be insufficient, the proper depth must be recommended. Foundations in areas of expansive clays developed in residual soils can usually be emplaced on firm underlying weathered rock materials.

4-0402.3 Surface and subsurface drainage shall be planned to minimize the amount of water entering the Marumsco soils and/or “marine clays.”

4-0402.4 Perimeter drains shall be provided around all basement areas.



**4-0500 CONSTRUCTION TECHNIQUES (107-11-PFM)**

**4-0501 Sheeting, Shoring and Filling**

4-0501.1 Sheeting and shoring or other approved methods for trench bracing may be required with the construction of underdrain or utility trenches and foundations.

4-0501.2 Engineered fill and backfill around structures shall be placed with approved select materials and uniform compaction throughout must be provided in 6-inch to 8-inch layers. Each layer of engineered fill shall be compacted at optimum moisture, plus or minus 2 percent, to a density of not less than 95 percent in accordance with AASHTO T-99 or ASTM D-698.

4-0501.3 Expansive Soils, such as Marumsco and/or “marine clays” are not permitted as structural fill for building pads, foundation backfill, backfill around structures, or behind retaining walls. Expansive Soil is defined by the International Building Code and International Residential Code as:

“Soils meeting all four of the following provisions shall be considered expansive, except that tests to show compliance with Items 1, 2 and 3 shall not be required if the test prescribed in Item 4 is conducted:

1. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D 4318.
2. More than 10 percent of the soil particles pass a No. 200 sieve (75 µm), determined in accordance with ASTM D 422.
3. More than 10 percent of the soil particles are less than 5 micrometers in size, determined in accordance with ASTM D 422.
4. Expansion Index greater than 20, determined in accordance with ASTM D 4829.”

If the PI of the soil is 20 or less (e.g.,  $PI \leq 20$ ) and the LL is 45 or less (e.g.,  $LL \leq 45$ ), the Plasticity Index Corrected ( $PI_{cor}$ ) or the Expansion Index Corrected ( $EI_{cor}$ ) may be substituted in the above definition of expansive soils.  $PI_{cor}$  and  $EI_{cor}$  are defined as:

$$PI_{cor} = \frac{PI \times (\% \text{ Passing No. 40 Sieve})}{100} \quad \text{and} \quad EI_{cor} = \frac{EI \times (\% \text{ Passing No. 4 Sieve})}{100}$$

**4-0502 Inspection**

4-0502.1 All construction involving problem soils must be performed under the full-time inspection of the geotechnical engineer.

4-0502.2 The geotechnical engineer shall furnish a written opinion to the County as to whether or not work has been performed in accordance with the approved plans, and his recommendations for work in the vicinity of the units to be occupied prior to the issuance of residential or nonresidential use permits.

**4-0503 Minimum Standards Required for Density Testing of Compacted Fill Soil (68-00-PFM)**

4-0503.1 (68-00-PFM) The minimum frequency of field density testing shall be as listed in Table 4.2, unless otherwise approved by the Director. The testing frequencies are the minimums considered necessary to provide effective quality control of soil and aggregate material compactive effort under normal conditions. Additional testing other than that specified should be performed if deemed necessary by the Inspection and Testing Agency, the Geotechnical Engineer of Record, or the Fairfax County Site Inspector. All testing shall be in conformance with approved VDOT test methods. In the event that the testing frequencies are specified to be greater in other applicable standards or specifications, those frequencies shall supersede the frequencies listed in Table 4.2.

**4-0600 GEOTECHNICAL REVIEW BOARD (107-11-PFM)**

**4-0601 Membership.** The Geotechnical Review Board (GRB), as established by the Board, shall consist of three members and three respective alternates appointed by the Board.

4-0601.1 Members and alternates shall be either Professional Engineers registered in Virginia, specializing in soil and foundation engineering, or Engineering Geologists, licensed to practice engineering in Virginia.

4-0601.2 Appointments shall be made for three years, with staggered terms, from a list of eligible nominees recommended by the County Executive.

**4-0602 Nominations**

4-0602.1 The list of eligible nominees shall be furnished to the County Executive by the Director.

4-0602.2 The Director shall solicit candidates or nominees from the following professional organizations of soil engineers and engineering geologists and from other sources: ASCE, American Council of Engineering Companies of Metropolitan Washington (ACEC/MW), ASFE, Virginia Society of Professional Engineers, Virginia Tech, and WACEL. Names of candidates shall be submitted along with supporting data to substantiate the qualifications of the candidate(s).

4-0602.3 The Director of Land Development Services, DPWES, shall serve as secretary to the GRB, and shall be a nonvoting member.

4-0602.4 The respective alternate to a member of the GRB shall serve whenever that member cannot serve due to illness, conflict of interest or other reasons.

**4-0603 Review and Processing of Reports, Plans and Specifications**

4-0603.1 The GRB shall review reports, plans, and specifications submitted to the Director and make recommendations to the Director. The recommendations may be for approval, denial, additional information or revisions of plans and specifications as appropriate. This review is intended to be limited to geotechnical aspects and foundation design only.

4-0603.2 Decisions for approval of plans are to be made by the Director taking into consideration recommendations received from the GRB. The recommendations of the GRB shall not be binding on the Director.

**4-0604 Compensation.** GRB members shall be compensated at the rate determined by the Board for work performed in connection with the review of projects assigned by the Director.

4-0000 GEOTECHNICAL GUIDELINES

**Table 4.2 Minimum Standards Required for Density Testing of Compacted Fill Soils**  
(92-06-PFM, 68-00-PFM)

TEST LOCATIONS	TESTING FREQUENCY
<b>Embankments</b> Fill sections for streets, travelways, and pipestem driveways	One density test shall be performed per 5,000 ft <sup>2</sup> per 6-in. compacted lift. The embankment test shall not be performed at the same spot where the utility trench backfill test was performed. Trench testing shall be performed in addition to the embankment test. Under curb and gutter, one density test shall be performed per 300 ft. on alternating sides.
<b>Subgrade</b> Cut in existing fill for streets, travelways, and pipestem driveways	Proofrolling, evaluation and approval by the geotechnical engineer of record (undercut and stabilization may be necessary as determined by the geotechnical engineer of record). The exception to this is in the proposed underground utilities, where the existing fill shall be completely removed and replaced with new engineered fill placed and compacted as per 4-0503.1, for utility support.
<b>Subgrade</b> Cut in natural soils	Proofrolling, evaluation and approval by the geotechnical-cal engineer of record.
<b>Subbase Material</b> For streets, travelways, and pipestem driveways	One density test shall be performed per 5,000 ft <sup>2</sup> per 6-in. compacted lift. When the subbase aggregate is placed in layers or lifts, each lift shall be tested. Under curb and gutter when placed before the subbase material in the street, perform one density test per 300 ft. on alternating sides.
<b>Base Material</b>	One density test shall be performed per 5,000 ft <sup>2</sup> at the finished base grade. When the base aggregate is placed in layers or lifts, each 6-in. compacted lift shall be tested at the required frequency.
<b>Storm Drainage System - Backfill *</b>	One density test shall be performed per 300 ft. and at vertical intervals not to exceed 12 inches.
<b>Sanitary Sewer, Water and Gas Mains - Backfill *</b> (Note: Field density test reports must be provided to the Fairfax County Site Inspector before field approval is given for issuance of tap permits.)	One density test shall be performed per 300 ft. or between manholes if less than 300 ft. apart and at vertical intervals not to exceed 12 inches. Refer to § 10-0104.2L(13) and Plate Nos. 18-10 or 19-10.
<b>Sanitary Sewer, Water and Gas Laterals - Backfill for Stub Constructed in Conjunction with Utility Main *</b>	One density test shall be performed per 5 laterals and at vertical intervals not to exceed 12 inches.
<b>Sidewalks and Driveway Aprons</b>	Sidewalk subgrade: One density test shall be performed per 500 ft on alternating sides at the subgrade elevation. A minimum of two density tests per street is required. Driveway apron: One density test per apron shall be performed.

## 4-0000 GEOTECHNICAL GUIDELINES

### **Asphalt Concrete Pavement**

(Note: The thin lift nuclear density test can be used for any surface course placed directly over an aggregate pavement or on a lift of 135 lbs/yd<sup>2</sup> (or greater) that is placed on an asphalt pavement course).

#### *Saw Cuts or Cores*

- Two cuts or cores represent one test. A minimum of two tests per street are required regardless of the street length.
- One test shall be performed per 500 ft. of roadway or 1000 ft. of any pass made by a paving train.

#### *OR Conventional Nuclear Density Gauge*

- One test shall be performed per 500 ft. of roadway.
- Five tests shall be performed in each test section. A minimum of two test sections per street is required regardless of the length of the street.

#### *Thin Lift Nuclear Density Gauge*

Test areas are defined as lots and sublots. A lot consists of 5,000 ft. of a pass made by a paving train. Each lot is divided into five sublots of equal size. Two tests will be performed on each subplot. Each separate street shall consist of at least one lot. Streets less than 500 ft. in length shall be tested a minimum of twice.

\* Testing required beneath structures only, including but not limited to sidewalks, driveways, streets and stoops.