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4-0100 PROCEDURES ~~(107-11 PFM)~~**4-0101 General Policy**¹

4-0101.1 ~~The purpose of these guidelines for the preparation of geotechnical reports is to~~ This chapter outlines 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~~ must 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 Marumseo 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, as defined in § 4-0201.3 below, 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](#).

¹ See also §§ [6-1605](#), [6-1606](#), [6-1607](#), and [11-0103.2C](#) ~~11-0408~~ *et seq.*

- 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 \(USBC\)](#).
- 4-0102.4 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.

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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 ~~all 108~~ soil units, ~~numbered 1-57, and 59-109~~ mapped in the County. 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 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 [Land Development Services](#) ~~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 ~~(125-18-PFM)~~ Areas containing “marine clay” soils were mapped by the County Soil Science Office² 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 are identified as “Previously Mapped Marine Clay” and are overlaid on the County soils map. 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](#) for Class III soil ~~shall~~ must be met, regardless of the classification based on the County soils map. Regulations in the Fairfax County [Zoning Ordinance](#), regarding “marine clay” are only applicable to the areas mapped as “Previously Mapped Marine Clay.”

~~4.0201.6~~ Naturally occurring asbestos (NOA) can potentially be found in the bedrock of some soils. Such areas are shown as an overlay on the County soils map. The [Virginia Department of Labor and Industry](#) administers [Occupational Safety and Health Administration \(OSHA\)](#) regulations concerning asbestos exposure in the construction industry. Text of the regulations is found in the [Code of Federal Regulations: 29 CFR 1926.1101](#). The County website contains general information and safety recommendations for construction in areas of NOA.

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 if the conditions in [§ 4-0206](#) are met.

~~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~~

² The County Soil Science Office closed in 1996.

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~~problem soil, especially Class III or IV soils, submission of a geotechnical report is required unless waived by the Director.~~

~~e) 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~~
- ~~e) 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 if the conditions in § 4-0206 are met.

~~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. A detailed geotechnical investigation and report are required.

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Geotechnical report requirements are summarized in [§ 4-0206](#) and discussed in detail in [§ 4-0300](#). The soil types or conditions included in this group are:

- A. 1) Cretaceous-Age Potomac Group Clays (mapped as Marumscos soils and/or “marine clay”);
- B. 2) Other soils containing high shrink-swell clays;
- C. 3) Soils with a seasonal high water table at or near the surface for prolonged periods and low bearing strength (poor foundation support); and
- D. 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. Geotechnical report requirements are summarized in [§ 4-0206](#) and discussed in detail in [§ 4-0300](#).

~~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~~

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~~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. A limited geotechnical investigation or soil certification as described in § 4-0206 is required.

~~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.~~

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- ~~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](#).

4-0206.2 For Class I and II soils, the submission of a geotechnical report is typically not required under the following circumstances:

- A. The building or in-ground swimming pool 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 or in-ground swimming pool 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.

4-0206.3 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. For Class II soils, foundation drains and backfill must appropriately address potential groundwater problems.
- B. Yard or overlot drainage.

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- 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.

4-0206.4 For Class III and IVA Soils

- A. Geotechnical problems must be addressed with adequate engineering evaluations and designs before 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 must be submitted for approval, and the recommendations incorporated into the grading plans as requirements before plan approval. Construction inspections and certifications are required from the Engineer-of-Record.

4-0206.5 For Class IVB soils

- A. 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, laboratory test results and construction notes addressing identified problems and other requirements for construction such as those identified under Class II soils ([§ 4-0206.3](#)). For example, the letter report should be based on knowledge of the previous site disturbance, proposed construction, site grades, floor elevations, etc. Borings must 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 before the second submission of the site or grading plans. Therefore, a comprehensive geotechnical report should be obtained for these soils earlier in the process.
- B. For non-bonded lot grading plans, where proposed residential dwellings or in-ground swimming pools 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, mat foundation, or ground modification; such as dynamic compaction, stone columns, aggregate piers, 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. To determine the maximum depth of existing disturbed land on the property, the basement floor elevation of the existing building must be subtracted from the existing ground surface. One foot must then be added to the calculated value to account for the existing slab and foundation depths.
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 must 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 the bottom of the footing exterior edge.
8. Foundation drain details are included on the plans.

4-0206.6 For In-ground Swimming Pools

- A. Pool designs must always consider the geotechnical effects of subsoil, groundwater, and slopes. In addition, designs of pool construction projects must consider structural stability, drainage impacts, and trees. To improve efficiency associated with review of in-ground swimming pool projects proposed for single-family detached lots with problem soils, the procedure of this section has been established to meet the requirements of [Chapter 107](#)

(Problem Soils) of the Code and Chapter 4 (Geotechnical Guidelines) of the PFM.

- B. For non-bonded lot grading plans, where proposed in-ground swimming pools are to be located on properties containing Class III or IVA 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. The in-ground swimming pool is not proposed on existing slopes steeper than 3H:1V (horizontal:vertical) or the swimming pool is located at least 15 feet from the top of any 3H:1V or steeper slopes. Evaluation of the slopes may be required depending on proposed location of swimming pool relative to existing and proposed structures.
 2. The bottom exterior edge of the swimming pool does not intercept the influence zone of any adjacent retaining wall/building foundation (“Footing”). The influence zone of a Footing for the purpose of the in-ground swimming pool is defined as envelopes starting at the lowest point of the footing exterior edge continuing upwards and downwards at 2H:1V inclination up to the horizontal projection of the footing exterior edge.
 3. The project does not require sheeting and shoring, retaining walls over 6 feet high, pile foundations, mat foundations or ground modification such as dynamic compaction, stone columns, aggregate piers, chemical stabilization, etc. and geotechnical reports are not required under any other County regulation or building codes.
 4. The bottom of the proposed pool does not extend below the water table elevation.
 5. The bottom of the swimming pool is supported on a uniform competent natural soil or engineered fill. (Please note when a portion of the pool excavation is in bedrock or in existing uncontrolled fill, differential settlement can occur.)
 6. There are no Marumsco soils, Marumsco complexes, or soils previously mapped as marine clays mapped on the property. In case of the existence of expansive or Marumsco soils, the requirements of chapter 4 must be followed.
 7. The construction of the proposed swimming pool will not have an adverse impact on adjoining properties due to existing fill, slide-susceptible soils, steep grades, proximity to existing structures, etc.

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- 8. The geotechnical recommendations addressing fill placement, compaction, foundation slab, and/or drainage are included in the plan and are adequate.
- C. The professional authorized by the State must also certify that all of the requirements of § 4-0206.6B have been met and that all field investigations and reviews necessary to evaluate these requirements have been performed.
- D. If any of the eight items listed in § 4-0206.6B certification statement is not met, a detailed geotechnical report must be submitted for approval in accordance with § 4-0204.1 and/or § 4-0205.2.
- E. For grading plans where residential dwellings and/or swimming pools are to be located in Class IVB soils, a geotechnical investigation and report will not be required if a certification is provided in accordance with § 4-0206.5B.
- F. Pool projects that do not require a grading plan, or pool projects for a conservation plan can continue to follow the requirements outlined in the [Soil Requirements for Minor Construction Projects](#).

Table 4.1 Geotechnical Report Requirements Summary

ITEM	SOIL CLASS				
	I	II	III	IV	
				A	B
Geotechnical Investigation	1	2	REQ	REQ	REQ
Geotechnical Report	NRQ	NRQ	REQ	REQ ³	4 ³
Geotechnical Specification on Plans ⁵	REQ	REQ	REQ	REQ	REQ

Footnotes:

1. Advised but not required.
2. Strongly advised, but not required.
3. 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. For non-bonded lots with Class III or IVA soils, where proposed in-ground swimming pools require a grading plan, the certification referenced in § 4-0206.6 may be incorporated instead of submitting a separate report to the County for review.
4. 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 § 4-0206.5B 4-0205.2.3 shall may be incorporated into plans instead of incorporating the limited geotechnical report into the first submission of the site, subdivision, grading or construction plans.
5. For Class I soils see § 4-0206.2 4-0202.3, and for Class II soils see § 4-0206.2 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

4-0206.7

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 (Marumsco or “marine clay” areas) requires slope stability analysis and submission of a geotechnical report ~~prior to~~ before 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.~~

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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 ~~A.~~ A. It ~~shall be~~ is determined during staff review whether ~~or not~~ the project ~~must~~ should be referred to the [GRB](#).

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

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

4-0301.2D ~~D.~~ D. The [GRB](#) ~~shall~~ reviews 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 for Geotechnical Investigation and Engineering Recommendations.** The site and soil exploration should include, but not be limited to, the following detailed factual information, analysis and recommendations:
- 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. A plotted record of the stratification of the soil deposits, both horizontal and vertical, ~~shall~~ must 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~~ B. 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~~ A. The interval of soil sampling ~~shall~~ should be determined on the basis of soils encountered, the type of structure and other conditions. Continuous sampling may be required. Test procedures utilized ~~shall~~ must be identified.
- ~~4-0303.4B~~ B. The spacing and depth of borings must be based on the site conditions and the proposed construction.
- 4-0303.4C C. Borings ~~shall~~ must 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~~

4-0000 GEOTECHNICAL GUIDELINES

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

E. The minimum exploration acceptable for a building less than 5,000 ft² is two exploration boreholes. In addition to the minimum exploration requirements, a more comprehensive scope for the geotechnical subsurface exploration can be adopted by consultants for a safe, environmentally suitable, and economical foundation system.

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

~~4-0303.5A~~

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

~~4-0303.5B~~

B. 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~~ is required for correlation with the known geology of the area. Classification and description of soils ~~shall~~ must 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 (~~123-16 PFM~~). The nature and extent of laboratory testing deemed necessary is dependent upon the characteristics of the soil and the anticipated geotechnical problems requiring analysis. The laboratory must be an approved facility by a recognized accreditation organization (i.e., [WACEL](#) and the [American Association of State Highway and Transportation Officials \(AASHTO\)](#)).

~~4-0303.7A~~

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

~~4-0303.7B~~

B. 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~~

C. In stiff, fissured clays such as the Cretaceous Marumsco, Marumsco complexes, and soils previously mapped as marine clays, the results of unconfined compression tests alone cannot be used to assess the structural

property of the soil *in-situ*. Atterberg limits and hydrometer analysis tests aid in classification and in the prediction of physical properties.

4-0303.7D

D. Consolidation tests should be performed on samples from relatively soft clayey soils (i.e., primarily, but not limited to, those mapped as Dulles, Elbert, Jackland, Kelly, Haymarket, Hattontown, Orange and their complexes) that may underlie the foundations. Expansive pressure of the soft clayey soils should also be determined for foundation design.

4-0303.7E

E. For the stiff fissured clays and deltaic clays that have undergone relatively large strains in the past, the important properties for predicting long-term slope behavior are the residual effective friction angle and the residual cohesion intercept (the absolute minimum strength of clay material). Any cohesion of the fissured and deltaic clays should be ignored in the evaluation of the long-term stability of a slope. The shear strength 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~~ [USACE](#) laboratory testing procedure [EM 1110-2-1906](#)).

4-0303.7E(1)

1. Many reversals are required to reach residual strengths, but must never be less than three reversals at any particular normal stress. The strain rate(s) selected to shear the samples must be based on either the consolidation data at the first normal stress or experience with similar soils. The strain rate used during each reversal may be varied (i.e., a slightly higher rate than specified in [EM 1110-2-1906](#)), but the rate during the last reversal at each normal stress ~~shall~~ may not exceed 1.44 inches per day. The geotechnical engineer ~~shall~~ must be aware of unintended buildup of pore water pressure during testing and ~~shall~~ must lower the strain rates accordingly. To obtain the strength envelope for the sample, the direct shear test must be repeated at two other normal stresses.

4-0303.7E(2)

2. Some references suggest using a pre-split sample (Ref. [Engineering Properties of Clay Shales Report No. 1, by W. Haley and B. N. MacIver](#)). Shearing an intact, stiff to hard *in-situ* specimen may overestimate the results (see [U.S. Geological Survey Professional Paper 1344: Relationship Between Geology and Engineering Characteristics of Soils and Weathered Rocks of Fairfax County and Vicinity, Virginia \[1986\]](#)). Shearing such a specimen could also pose practical difficulties with some lab equipment (see [EM 1110-2-1906](#)); the test results from such samples should only be used with extreme caution. Only an intact or a reconstituted sample or a pre-split *in-situ* sample must be selected for the testing. The geotechnical report ~~shall~~ must identify the type of sample and the strain rates used in the testing.

4-0303.7E(3)

3. For less complex situations subject to approval of the Director, the required shear strength parameters may be estimated by comparison of other index properties (particularly the Atterberg limits and grain-size sieve analysis) with those of similar soils for which test results are reported in published literature and on the basis of past experience. Correlations may be based on either [U.S. Geological Survey Bulletin 1556: Engineering Geology and Design of Slopes for Cretaceous Potomac Deposits in Fairfax County, Virginia, and Vicinity \(1984\)](#) or [“Empirical Correlations - Drained Shear Strength for Slope Stability Analyses” by Stark & Hussain \(ASCE Journal of Geotechnical and Geoenvironmental Engineering \[2013\]\)](#). Documentation ~~shall~~ must be furnished when shear strength parameters are based on results other than laboratory tests. Such documentation must set forth the reasoning by which the parameters were estimated. The residual friction angle ~~shall~~ must be limited to a maximum of 12° when obtained through correlations, however, the Director may allow an angle greater than 12° when shear testing data from an adjoining site suggest that such an angle may be acceptable.

4-0303.8 Engineering Analysis and Recommendations (~~123-16-PFM~~)
4-0303.8A

- A. The report of the soil studies ~~shall~~ must 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~~ must 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. A “Critical” slope or retaining structure is defined as any slope or retaining structure that meets one of the following criteria:
1. Greater than 25 feet in height and a slope inclination of 3H:1V or steeper for non-Potomac formation soils, or greater than 25 feet in height and a slope inclination of 5H:1V or steeper for Potomac formation soils;
 2. Greater than 8 feet in height with a proposed/existing structure (excluding surface parking areas) within its active failure zone;
 3. Impoundment slopes or structures that retain water for more than 48 hours.
- B. Where Marumscos soils, Marumscos complexes, and soils previously mapped as marine clays are found, an engineering analysis of the short- and long-term

4-0303.8B

stability of the existing and planned slopes must be performed. The analyses shall must include a careful evaluation of potential adverse effects on adjoining properties. The stability analyses shall must be performed using methods acceptable to the Director. The long-term stability of slopes containing these soils shall must be performed using the “residual” shear strength parameters as well as a conservative representation of the long-term groundwater conditions. Perched groundwater is common over these soils during wet seasons and must always be modeled in the long-term stability analysis as being at least 1 foot above the top of the formation. A model without perched groundwater may be allowed if the Director decides either that the model would result in unreasonable flooding or an extended-time set of groundwater level readings demonstrates that the assumed perched water level is unreasonable. For long-term stability, a minimum Factor of Safety (FS) of 1.25 is required when supported with sufficient field and laboratory characterization of the slope’s soils. Otherwise, a minimum FS of 1.5 is required. In case of Critical slope or structure, a minimum FS of 1.5 is required unless a laboratory measured residual strength test is obtained and used in the analysis. In this case, a minimum FS of 1.25 is required when supported with sufficient field and laboratory characterization of the soils. Cohesion values must be ignored in the long-term stability analysis.

- C. For long-term stability of the soil formations other than Potomac Formation clay if slope stability analysis is deemed necessary by the engineer or if it is required by the County, a minimum Factor of Safety (FS) of 1.25 is only acceptable when the slope is not Critical and the analysis is supported with sufficient site-specific *in-situ* or laboratory strength tests of the encountered soils. Otherwise, a minimum factor of safety of 1.5 must be used in the analysis. Cohesion values must be ignored in the long-term stability analysis. Site specific *in-situ* tests include both ground water measurements and Standard Penetration Test (SPT) but may also include Cone Penetrometer Test (CPT) or Flat Dilatometer (DMT).

4-0303.8C

- D. In areas that are susceptible to high water table conditions (permanent, perched and/or seasonal), the engineer shall must recommend sub-pavement drainage design and other measures to assure dry basements, yards, etc.

4-0303.8D

- E. Design criteria for retaining walls or structures shall must be provided. A preliminary global stability analysis for retaining walls over 8-feet tall shall must be performed to determine whether structural or earthwork measures are needed in order to achieve a sufficient factor of safety against slope failure as defined in [§ 4-0303.8B](#).

4-0303.8E

- F. The report shall must include a discussion on the problems associated with expansive soils as defined in [§ 4-0501.3](#). Expansive clay soils containing

montmorillonite, which generally have a high expansion potential, have been found in various locations in southern and eastern Fairfax County. Expansive properties may also exist in other problem soil types mapped in ~~the central and northern~~ other parts of the County. It is suggested that the design recommendations be based on expansive properties of the clay unless it is shown otherwise by X-ray diffraction studies or other appropriate laboratory tests.

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4-0400 CONSTRUCTION PLANS (~~107-11 PFM~~)**4-0401 General Information**

4-0401.1 The recommendations in the geotechnical report ~~shall~~ must 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~~ their opinion as to whether ~~or not~~ the plans have been prepared in accordance with ~~his~~ their recommendations and note deviations from ~~his~~ those recommendations.

4-0402 Footing and Drainage Design (~~123-16 PFM~~)

4-0402.1 Where Cretaceous Age deltaic clays occur (i.e., Marumsc soils or soils previously mapped as marine clay), roof drains ~~shall be~~ are required and the downspouts from these drains ~~shall~~ must 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 Foundations of structures must be placed at depths that will minimize the possibility of heaving or shrinkage settlement due to desiccation of underlying expansive soils. The emplacement depth ~~shall~~ must 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 expansive soils underlying footings embedded in thin layers of natural or artificially compacted granular soils. Exterior foundations in Marumsc soils, Marumsc complexes, other soils previously mapped as marine clays, and expansive soils (i.e., those mapped as Dulles, Elbert, Jackland, Kelly, Haymarket, Hattontown, Orange and their complexes) should be at least 4 feet below the nearest finished exterior grade, or to the bottom of the expansive soil stratum, whichever occurs first. Where the Director has determined that the geotechnical study has demonstrated that a 4-foot vertical buffer is insufficient, the proper buffer depth must be recommended by the geotechnical engineer.

4-0402.3 Surface and subsurface drainage ~~shall~~ must be planned to minimize the amount of water entering Marumsc soils, Marumsc complexes, and other soils previously mapped as marine clays.

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

4-0402.5 Floor slabs that will be designed to be ground-supported ~~shall~~ may not directly bear on expansive soils, even when the floor slab is at the basement level, to

minimize the possibility of heaving or shrinkage settlement. Slabs underlain by Marumsco soils, Marumsco complexes, other soils previously mapped as marine clays, and expansive soils (e.g., Dulles, Elbert, etc.) ~~shall~~ must bear on a vertical buffer of at least 2 feet of non-expansive soils, or below the bottom of the expansive soil stratum, whichever occurs first. Where the geotechnical study has demonstrated that a 2-foot vertical buffer is insufficient to reasonably reduce the impact of shrink-swell cycles of the expansive soil, the proper depth of the buffer ~~shall~~ must be a part of the geotechnical engineer's recommendation.

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4-0500 CONSTRUCTION TECHNIQUES (107-11-PFM)**4-0501 Sheet piling, Shoring and Filling**

- 4-0501.1 Sheet piling 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~~ must 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~~ must 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:
- A. “Soils meeting all four of the following provisions ~~shall~~ must 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](#).”
- B. 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~~ must 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 before 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~~ must 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~~ must be in conformance with to approved [VDOT](#) test methods. ~~In the event that~~ If the testing frequencies are specified to be greater in other applicable standards or specifications, those frequencies ~~shall~~ must supersede the frequencies listed in [Table 4.2](#).

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
Embankments Fill sections for streets, travelways, and pipestem driveways	One density test shall <u>must</u> be performed per 5,000 ft ² per 6-in. compacted lift. The embankment test shall <u>may</u> not be performed at the same spot where the utility trench backfill test was performed. Trench testing shall <u>must</u> be performed in addition to the embankment test. Under curb and gutter, one density test shall <u>must</u> be performed per 300 ft. on alternating sides.
Subgrade 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 <u>must</u> be completely removed and replaced with new engineered fill placed and compacted as per § 4-0503.1 , for utility support.
Subgrade Cut in natural soils	Proofrolling, evaluation and approval by the geotechnical engineer of record.
Subbase Material For streets, travelways, and pipestem driveways	One density test shall <u>must</u> be performed per 5,000 ft ² per 6-in. compacted lift. When the subbase aggregate is placed in layers or lifts, each lift shall <u>must</u> 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.
Base Material	One density test shall <u>must</u> be performed per 5,000 ft ² at the finished base grade. When the base aggregate is placed in layers or lifts, each 6-in. compacted lift shall <u>must</u> be tested at the required frequency.
Storm Drainage System - Backfill *	One density test shall <u>must</u> be performed per 300 ft. and at vertical intervals not to exceed 12 inches.
Sanitary Sewer, Water and Gas Mains - Backfill * (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 <u>must</u> 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 Plates Nos. 18-10 or 19-10 .
Sanitary Sewer, Water and Gas Laterals - Backfill for Stub Constructed in Conjunction with Utility Main *	One density test shall <u>must</u> be performed per 5 laterals and at vertical intervals not to exceed 12 inches.
Sidewalks and Driveway Aprons	Sidewalk subgrade: One density test shall <u>must</u> 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 <u>must</u> be performed.

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

TEST LOCATIONS	TESTING FREQUENCY
<p>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/yd² (or greater) that is placed on an asphalt pavement course).</p>	<p><i>Saw Cuts or Cores</i></p> <ul style="list-style-type: none"> Two cuts or cores represent one test. A minimum of two tests per street are required regardless of the street length. One test shall <u>must</u> be performed per 500 ft. of roadway or 1000 ft. of any pass made by a paving train. <p><i>OR Conventional Nuclear Density Gauge</i></p> <ul style="list-style-type: none"> One test shall <u>must</u> be performed per 500 ft. of roadway. Five tests shall <u>must</u> be performed in each test section. A minimum of two test sections per street is required regardless of the length of the street. <p><i>Thin Lift Nuclear Density Gauge</i> 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 <u>must</u> consist of at least one lot. Streets less than 500 ft. in length shall <u>must</u> be tested a minimum of twice.</p>
<p>* Testing required beneath structures only, including but not limited to sidewalks, driveways, streets and stoops.</p>	

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 must 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 are made for three years, with staggered terms, from a list of eligible nominees recommended by the [Director](#) ~~County Executive~~.

4-0602 Nominations

4-0602.1 The list of eligible nominees shall will be furnished to the [County Executive](#) by the Director.

4-0602.2 The Director shall should 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 \(ACEC/MW\)](#), [Geoprofessional Business Association \(GBA\)](#) ~~ASPE~~, [Virginia Society of Professional Engineers](#), [University of Maryland](#), [Virginia Tech](#), and [WACEL](#). Names of candidates shall will 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 will serve as secretary to the [GRB](#), and shall will be a nonvoting member.

4-0602.4 The respective alternate to a member of the [GRB](#) shall will 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 will 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 will not be binding on the Director.

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

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4-0700 TESTING FOR INFILTRATION FACILITIES (~~411-13 PFM~~)**4-0701 Purpose and Scope**

4-0701.1 The purpose of infiltration testing is to determine the character, physical properties and Seasonal High Water Table (SHWT) of natural soil deposits proposed to be used for infiltration of stormwater. Infiltration facilities include facilities such as percolation trenches ([PFM § 6-1303](#)), pervious pavement with full or partial exfiltration ([PFM § 6-1304](#)) and bioretention basins or rain gardens ([PFM § 6-1307](#)). For a general discussion of the design of the infiltration facilities see [Virginia DCR DEQ Stormwater Design Specification No. 8, Infiltration Practices](#).

4-0701.2 The scope of the investigation must be planned with knowledge of the intended project size, facility size, land utilization and general subsurface characteristics. The complete evaluation must include a Geotechnical Investigation in the field, laboratory testing of select soil samples retrieved in the field to confirm soil and strata classifications and a final report.

4-0702 Geotechnical Investigation

4-0702.1 Geotechnical investigation to be performed by borings or a combination of borings and test pit per [§ 4-0702.5](#).

4-0702.2 Determination of the SHWT by direct observation of groundwater levels should be performed during the months of November through May. SHWT determination by direct observation of the ground water level should not be performed during the months of June through October unless the value of the [Palmer Drought Severity Index \(PDSI\)](#) is equal to or greater than 2.0 (i.e., wet). If the value of the [PDSI](#) is less than 2.0 (i.e., near normal or drier), the determination of SHWT by direct observation and testing conducted during the months of June through October may be used for preliminary design only. Final design ~~shall~~ **must** then be based on a confirmatory investigation performed during the months of November through May (or anytime of the year when the [PDSI](#) is greater than 2.0). Weekly values of the [PDSI](#) are available online from the [National Weather Service Climate Prediction Center](#). Fairfax County is located in Virginia Climate Division #4.

4-0702.3 The SHWT may be determined using soil morphology throughout the year by a certified/licensed professional registered in the Commonwealth of Virginia with training and experience in soil morphology (certified/licensed professional soil scientist, licensed onsite soil evaluator, certified professional wetland delineator, or certified professional geologist). Professional engineers registered in Virginia with experience in the field of geotechnical engineering may also be certified to determine the SHWT, if provided that they have successfully completed the Soil

Morphology Training Class offered by the [Northern Virginia Soil and Water Conservation District \(NVSWCD\)](#) and are on its list of certified professionals.

- 4-0702.4 Evaluation of the SHWT utilizing soil morphology ~~shall~~ should be based on low-chroma colors, mottles and redoximorphic features of the soil. Unlike other types of field tests which may be performed by an individual under the responsible charge of the registered professional, this evaluation must be performed by the registered professional personally. If the registered professional performing the evaluation determines that a follow-up confirmatory field measurement of the SHWT is required, or if required by the County, the follow-up evaluation ~~shall~~ must be performed when the [Palmer Drought Severity Index \(PDSI\)](#) is equal or greater than 2.0, or anytime during the months of November through May.
- 4-0702.5 Each proposed facility requires a minimum of three borings, or a test pit and two borings, located within the footprint of the proposed infiltration facility.
- 4-0702.5A A. The first or initial boring, which could also be a test pit, should be located approximately in the center of the footprint of the proposed facility. The first boring or test pit is performed to document the soil profile, horizons, groundwater table, depth of bedrock (defined in [§ 4-0702.5B](#)) and the general suitability of the site for infiltration.
- 4-0702.5B B. Bedrock is defined as materials exhibiting a minimum SPT N-value of 60. In the Triassic (Culpeper) Basin and Piedmont Upland physiographic provinces, the aforementioned minimum SPT N-value will correlate approximately to weathered rock (i.e., in such areas, the separation is measured to a weathered rock surface, especially where underlain by shale, siltstone, sandstone and/or schist).
- 4-0702.5C C. The soil description must include all soil horizons.
- 4-0702.5D D. Soil textures should be identified according to the [Unified Soil Classification System \(USCS\)](#) per [ASTM D-2488](#) (Description and Identification of Soils Visual-Manual Procedure) and the [USDA Textural Classification](#).
- 4-0702.5E E. Dynamic Cone Penetrometer (DCP) [[ASTM Special Technical Publication #399](#)] test or Standard Penetration Test (SPT) [[ASTM D1586-99](#)] results should be provided for the initial boring or test pit.
- 4-0702.5F F. The boring or test pit depth ~~shall~~ must extend no less than 48 inches below the invert of the proposed facility.
- 4-0702.5G

- G. The boring ~~shall~~ must be continuously sampled from 24 inches above the anticipated or proposed facility invert to the termination depth of the boring to better evaluate the subsurface conditions.
- 4-0702.5H
- H. Groundwater elevations are to be recorded at the time of the boring and at least 24 hours following its completion.
- 4-0702.5I
- I. The shallowest measurement may be used as the SHWT if the conditions of [§ 4-0702.2](#) are met.
- 4-0702.6 The second and third borings, with minimum diameters defined in ~~§ 4-0703.3B~~ [§ 4-0703.2B](#) and drilled at an offset distance of not less than 5 feet from the initial boring or test pit, are used for the infiltration tests.
- 4-0702.7 Additional profile borings/test pits ~~shall~~ must be provided for every 100 linear feet or every 10,000 square feet of the proposed infiltration facility. Additional borings/test pits may also be performed at the discretion of the certified/licensed professional to adequately characterize infiltration characteristics.
- 4-0702.8 Additional infiltration tests ~~shall be~~ are required for every 50 linear feet or every 2,000 square feet of the proposed facility. Additional infiltration tests may also be performed at the discretion of the certified/licensed professional to adequately characterize infiltration characteristics.
- 4-0702.9 The field infiltration rate is based on the average of all field tests located within the facility.
- 4-0703 Infiltration Testing**
- 4-0703.1 Actual infiltration rates ~~shall~~ must be determined via on-site test(s) conducted within 24 inches of the anticipated or proposed facility invert.
- 4-0703.2 Specific requirements are as follows:
- 4-0703.2A
- A. Drill two borings adjacent to the initial test pit or boring, each at an offset of greater than 5 feet, and to a depth of within 24 inches of the anticipated or proposed invert of the facility. The diameter of the boring ~~shall~~ must snugly fit the diameter of the casing (see ~~§ 4-0703.3B~~ [§ 4-0703.2B](#)). Remove any loose material from each boring.
- 4-0703.2B
- B. Install a solid casing 3 to 5 inches in diameter to the bottom of the boring. Remove any smeared soil surfaces and loose material from the casing. A 2-inch layer of coarse sand or fine gravel may be placed at the bottom of the boring to prevent scouring and sedimentation.

4-0703.2C

- C. Fill the standpipe with water to a height of at least 24 inches above the bottom of the casing, and allow pre-soaking for 24 hours.

4-0703.2D

- D. After 24 hours, refill the standpipe to a height of 24 inches above the bottom of the casing and record the water level drop in inches after one hour. Repeat the procedure three times by filling the standpipe to a height of 24 inches and measuring the drop in water level after one hour. A total of four observations ~~shall~~ must be completed. The infiltration rate of each test boring is the average of the change in water level readings in inches per hour, or the last reading, whichever is the most representative of the subsurface conditions based on the opinion of the certified/licensed professional conducting the tests. Should the infiltration rates in the two borings prove inconsistent, additional borings and infiltration tests must be performed or the lowest infiltration rate obtained ~~shall~~ must be used as the field infiltration rate.

4-0703.2E

- E. The field infiltration rate for a proposed facility is the average of all field infiltration rates conducted within that facility, per [§ 4-0702.9](#). A field infiltration rate of at least 0.5 inches per hour at the design depth of the proposed facility must be obtained for the infiltration to be considered feasible. The design infiltration rate for the facility is one-half of the field infiltration rate. If field infiltration rates of 8 or more inches per hour are recorded, the design professional ~~shall~~ must be contacted to confirm that the facility is in a suitable location with respect to environmental concerns.

4-0703.2F

- F. Soil boring locations ~~shall~~ must be accurately documented on the plans.

4-0703.2G

- G. Infiltration testing ~~shall~~ must be performed by a qualified professional or his/her authorized representatives. The professional ~~shall~~ must either be a Virginia licensed professional engineer with experience in geotechnical engineering and soil evaluation, a Virginia certified/licensed professional soil scientist, or a Virginia certified professional geologist.

4-0703.2H

- H. A change in design at the permitting plan review stage may necessitate additional testing. The final design invert of the proposed facility must be within 24 inches of the elevation at which the infiltration test(s) used for design were conducted.

4-0703.2I

- I. Septic percolation tests are not acceptable as an alternative to infiltration tests.

4-0704 Laboratory Testing

- 4-0704.1 Grain-size sieve analyses and hydrometer tests must be performed to determine the [USDA](#) textural and [USCS](#) classifications at the proposed or anticipated invert of the facility.
- 4-0704.2 The tests should also be done on representative samples from all soil layers encountered to a depth of 4 feet below the final invert of the facility.

4-0705 Report Presentation and Submission

- 4-0705.1 The report ~~shall~~ must include the proposed infiltration facility plan, the boring locations, all boring logs and laboratory test data.
- 4-0705.1A A. [USDA](#) textural classification and [USCS](#) soil description ~~shall~~ must be provided in the report as well as on the boring logs.
- 4-0705.1B B. A table ~~shall~~ must be included in the report showing the dates, times and hourly readings of the water level for each infiltration test along with the averaged field infiltration rates for each test within the proposed facility.
- 4-0705.1C C. The report ~~shall~~ must discuss the feasibility of the proposed facility and the impact of the proposed facility on adjoining properties. The report ~~shall~~ must provide recommendations for construction as well as the design infiltration rate for the proposed facility.
- 4-0705.2 The report can be included as part of the formal geotechnical report submitted for a site, subdivision or infill grading plan.
- 4-0705.2A A. The report may also be submitted as part of the site, subdivision or infill grading plan, ~~provided~~ if it is included on the first submission.
- 4-0705.2B B. The report may also be submitted separately as a geotechnical report or as an addendum to a geotechnical report if a separate report was previously submitted.

4-0706 Pre-construction Meeting

- 4-0706.1 A pre-construction meeting ~~shall~~ must be held with representatives of the owner/developer, the contractor, the third-party inspection firm and the [Site Development and Inspections Division](#). The PFM and site-specific requirements and the third-party inspection certification ~~shall~~ must be reviewed and discussed.