Proposed Amendment to Chapter 4 (Geotechnical Guidelines)
of
the Public Facilities Manual

Amend Section 4-0206 (Geotechnical Report Requirements Summary), Subsection 4-0206.5 (For Class IVB Soils), by revising Paragraph 4-0206.5B (not including the nine subsequent items) to read as follows:

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~~ nine 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~~ nine items are:

Amend Section 4-0206 (Geotechnical Report Requirements Summary), Subsection 4-0206.5 (For Class IVB Soils), Paragraph 4-0206.5B, by adding new Subparagraph 9 to read as follows:

9. The basement or lowest finished floor elevation of the proposed building meets the requirements of § 4-0305 for setting elevations above the groundwater table.

Amend Section 4-0206 (Geotechnical Report Requirements Summary), Subsection 4-0206.6 (For In-ground Swimming Pools), Paragraph 4-0206.6B, by revising Subparagraph 2 to read as follows:

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 design is defined as the area beneath a line extending outward and downward at a 2H:1V slope from the bottom of the footing exterior edge. ~~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.~~

Amend Article 4-0300 (GEOTECHNICAL REPORT), Section 4-0301 (General Requirements and Procedures), by adding Subsection 4-0301.4 to read as follows:

4-0301.4 The geotechnical report must have been signed and dated within one year before submittal to the County. For geotechnical reports prepared more than one year before submittal, an updated report or letter will be required, at a minimum, to verify the validity and applicability of the original report.

Amend Section 4-0303 (General Guidelines for Geotechnical Investigation and Engineering Recommendations), Subsection 4-0303.5 (Groundwater Measurements), by revising Paragraph 4-0303.5A to read as follows:

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

A. Water level reading within the boring ~~tables should~~ must be determined after completing the boring and a minimum of 24 hours later.

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

Amend Section 4-0303 (General Guidelines for Geotechnical Investigation and Engineering Recommendations), by revising Subsection 4-0303.7 to read as follows:

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. 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)). Technicians performing specific tests must be certified, per the requirements of WACEL or AASHTO, to perform those specific tests.

Amend Section 4-0303 (General Guidelines for Geotechnical Investigation and Engineering Recommendations), Subsection 4-0303.8 (Engineering Analysis and Recommendations), by revising Paragraph 4-0303.8D to read as follows:

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

Add Section 4-0304 (Minimum Geotechnical Exploration Requirements for Deep Foundations) and Section 4-0305 (Setting Basement or Lowest Finished Floor Elevation Above the Groundwater Table) to read as follows:

4-0304 Minimum Geotechnical Exploration Requirements for Deep Foundations

4-0304.1 Deep foundations, such as piles or drilled shafts, must be designed considering the capabilities of the supporting material based on laboratory test results and geotechnical data. The geotechnical engineer must obtain onsite data a minimum of 10 feet, or two times the foundation diameter, whichever is greater, below the bottom of the proposed foundation. If auger refusal is encountered due to shallow rock before reaching the minimum required depth of exploration, the rock must be cored to reach a minimum of 10 feet below the bottom of the proposed foundation. The foundation must be designed for all column and wall base reactions (axial, lateral, and moment) and downdrag loads for compressible soils. Soil creep must also be considered when determining the foundation design loads.

4-0304.2 For piles greater than 24 inches in diameter, capacity may be governed by limiting the settlement to a maximum of 1 inch. Pile tip elevations must be clearly established by the geotechnical engineer. The design criteria must meet or exceed the minimum standards and criteria described in this chapter.

4-0304.3 Logs of borings, CPT soundings, test pits, and other subsurface data should be obtained.

4-0304.4 Boring logs must provide raw (unmodified) N-values if SPT's are performed; CPT probe logs must provide raw QC-values and plots of raw sleeve friction values.

4-0305 Setting Basement or Lowest Finished Floor Elevation Above the Groundwater Table

4-0305.1 For construction of residential single-family detached and attached dwellings, including stacked townhouses, where a geotechnical investigation and/or report must be submitted for approval, design engineers must evaluate the proposed basement floor elevation or the lowest finished floor elevation as compared to the seasonal high water table (SHWT) elevation and include appropriate mitigation on the plans to avoid anticipated problems with groundwater intrusion into basements or lowest finished floors and its impacts on the site and adjacent or downstream properties. The required groundwater mitigations depend on the freeboard outlined below. Freeboard is defined as the distance between the SHWT and basement or lowest finished floor elevation.

A. Case 1: Freeboard is greater than 2.5 feet (SHWT is more than 2.5 feet below the basement or lowest finished floor elevation). For this case:

   1. Groundwater mitigation is not required and standard perimeter underdrains, both exterior and interior, connected to a sump pit are considered adequate.

   2. Foundation drain details must be included on the plans.

B. Case 2: Freeboard is greater than 1 foot and up to 2.5 feet. For this case:

   1. Every effort must be made to raise the basement or lowest finished floor elevation to achieve the required freeboard of Case 1.

   2. If raising the basement or lowest finished floor elevation is not feasible and the site topography allows for a gravity outfall, installation of an underdrain system connecting to a structure associated with a gravity storm drainage system or to a free gravity outfall condition is required. The hydraulic gradient of the underdrain pipe is to be calculated from the 10-year hydraulic gradient of the mainline storm drainage system.

   3. Foundation drain details must be included on the plans.

   4. In case the site topography or storm drainage system elevation do not allow for a gravity outfall or gravity connection from the underdrain, a dual pump system will be permitted provided each pump is rated and designed for the anticipated load, and the system is equipped with backup power.

C. Case 3: Freeboard is negative, and groundwater is above the surface of the basement or the lowest finished floor or freeboard is less than or equal to 1 foot. For this case:

   1. Every effort must be made to raise the basement or lowest finished floor elevation to achieve the required freeboard of Case 1.

   2. If that is not feasible and the Director concurs, the basement or lowest finished floor elevation must be raised to Case 2.

   3. If that is also not feasible, provide a crawl-space meeting Case 1; if not possible, Case 2 may be used.

4-0305.2 The Director may consider a modification of the policy for setting the basement or lowest finished floor elevation above the groundwater table. In considering the request, the Director will apply the provisions of § 1-0100.8, subject to conditions deemed appropriate by the Director to address the potential for basement flooding and adverse impact on the site and adjacent or downstream properties.

4-0305.3 Determination of the SHWT by direct observation of groundwater levels must be performed in accordance with § 4-0702.2; however, where final design cannot 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), the geotechnical engineer may consider compensating for the possible seasonal fluctuations by adding a minimum of 2 feet to the encountered water table elevation reading.

4-0305.4 The SHWT must be determined by a certified professional as defined in § 4-0702.3. Field investigations (i.e., test pits, test borings, etc.) should extend no less than 6 feet below the proposed basement or lowest finished floor elevation. Water level readings must be determined a minimum of 24 hours after completing the field investigation. In the case of test borings, if boreholes are likely to cave within the 6-foot depth below the proposed basement or lowest finished floor elevation, standpipes can be used to perform the required ground water monitoring.

Amend Article 4-0400 (CONSTRUCTION PLANS), Section 4-0401 (General Information), by revising Subsection 4-0401.1 to read as follows:

4-0401.1 The recommendations in the geotechnical report must be incorporated into the plans as requirements to be performed during construction. The geotechnical engineer's requirements must be stated in such a way that the intent is clear using a directive, such as "shall" and "will" with each provision. Where required by the Director, changes to requirements must be made by the geotechnical engineer who certified the plan.

Amend Article 4-0500 (CONSTRUCTION TECHNIQUES), Section 4-0501 (Sheeting, Shoring and Filling), by revising Subsection 4-0501.2 to read as follows:

4-0501.2 Engineered fill and backfill around structures 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 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 D698. The use of alternative fill and backfill from what

is recommended by the geotechnical report must be reviewed and approved by the geotechnical engineer and the Director before the fill placement. The use of flowable fill as backfill material for retaining structures must also be approved by the Director before the fill placement.

Add Article 4-0800 (GUIDELINES FOR THE USE OF LIME FOR DRYING, MODIFICATION & STABILIZATION OF SOIL) to read as follows:

4-0800 GUIDELINES FOR THE USE OF LIME FOR DRYING, MODIFICATION & STABILIZATION OF SOIL

4-0801 Applicability and Restrictions

4-0801.1 This section presents geotechnical guidelines and minimum requirements for the design and construction of projects using lime for drying, modification and stabilization of soil. The following definitions apply to this geotechnical guideline:

A. **Active Zone or Zone of Seasonal Fluctuation** is the zone under and around a structure where the soil's moisture content is appreciably affected by climactic conditions and environmental factors. For building footings, the Active Zone extends up to a minimum of 4 feet below the exterior finished grade, or 2 feet below the bottom of the footing, whichever is deeper. For pavements, the Active Zone extends to 4 feet below the finished pavement surface.

B. **Expansive Soil within the Active Zone** is defined by the International Building 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, and the Expansion Index is found to be equal to or less than 20:

1. Plasticity Index (PI) of 15 or greater, determined in accordance with ASTM D4318.

2. More than 10 percent of the soil particles pass a No. 200 sieve (75 µm), determined in accordance with ASTM D422.

3. More than 10 percent of the soil particles are less than 5 microns in size, determined in accordance with ASTM D422.

4. Expansion Index greater than 20, determined in accordance with ASTM D4829."

C. **Mellowing** is the textural change of soil due to the phenomenon of cation exchange followed by flocculation and agglomeration due to the chemical reaction between lime and clay soil particles.

D. **Soil Drying** is a rapid decrease in soil moisture content due to the chemical reaction between water in the soil and lime and is limited to non-expansive soil.

E. **Soil Modification** is a reduction in soil plasticity, increase in optimum moisture content, decrease in maximum dry density, and improved compactibility due to the chemical reaction between soil and lime. Soil Modification will not be considered permanent.

F. **Soil Stabilization** is a permanent reduction in soil plasticity or expansion index, so the soil is not expansive, and permanent strength gain occurs through pozzolanic reaction due to the chemical reaction between soil and lime.

G. **Lime** is quicklime or hydrated lime meeting the requirements of ASTM C977, "Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization."

4-0801.2 Soil Drying is limited to soils that meet the standards of suitable structural fill material as established by the VDOT Road and Bridge Specifications, Virginia Uniform Statewide Building Code, the Public Facilities Manual, and project documents approved by the Director. For Soil Drying, a separate geotechnical study or report is not required to be submitted to LDS; however, notice in writing must be given to LDS prior to the use of lime for Soil Drying.

4-0801.3 Soil Modification is limited to soils that are present below the Active Zone. For Soil Modification, a geotechnical study or report must be submitted to LDS for approval. The lime modified soils below the Active Zone must have a Plasticity Index (PI) of 20 or less.

4-0801.4 Stabilization of expansive soils by mixing or blending with dry or slurry lime may be considered for various engineering applications requiring the placement of structural or engineered fill within the Active Zone. For Soil Stabilization, a geotechnical study or report must be submitted to LDS for approval. The recommendations made in the approved report must be incorporated into the project plans as specifications or requirements to be implemented during construction.

4-0801.5 Lime storage, handling and mixing may not allow airborne dust particles to leave the property. Additionally, lime storage, handling and mixing may not occur where

occupied structures or areas of public use are within 300 feet, unless the contractor can demonstrate, to the satisfaction of the Director, that the construction techniques will not allow visible airborne dust particles to drift over the occupied structures or areas of public use.

4-0801.6 Before plan approval, regardless of location, adjoining property owner notices must be served on all properties adjoining the proposed lime project site. A minimum of five adjoining properties must be served with notices at the time of geotechnical report submission. The format of such notices must be approved by the Director.

4-0801.7 Each proposal to use lime will be reviewed and approved on a case by case basis, except when lime is used for Soil Drying, in which case a written notice must be provided to the Site Inspector before the use of lime for Soil Drying.

4-0801.8 Lime Stabilization may not be used if the soluble sulfate content by weight in the expansive soils exceeds 5,000 parts per million. The soluble sulfate content in soils to be stabilized must be determined in accordance with AASHTO T 290.

4-0801.9 Strength gain due to the pozzolanic reaction of lime treated soils may not be included in the design of slopes.

4-0801.10 Soil Stabilization will only be recognized in pavement design in the following manner: The Thickness Index must be determined based on the CBR values in accordance with VTM-8 of the natural subgrade soils before stabilization. Only the top 8 inches of the stabilized soil may be considered as part of the pavement structure necessary to achieve the required Thickness Index.

4-0801.11 Soil modified or stabilized by lime may not be used as backfill for basement walls and retaining walls unless approved otherwise by the Director.

4-0801.12 Lime modification and lime stabilization will not be permitted when the soil, aggregate or the surface on which the lime treated soil is to be placed is frozen, and manipulation (i.e., mixing) may not be started until the surface is free of frost. Lime stabilization may not start until the air temperature at the project site is at least 40 degrees Fahrenheit.

4-0801.13 All lime stabilization within the VDOT Right-of-Way must be completed in accordance with the current VDOT Road and Bridge Specifications and this policy. If there is a conflict between the current VDOT Road and Bridge Specifications and this policy, the most restrictive requirement will apply.

4-0801.14 Lime may not be used in Storm Water Management facilities.

4-0802 Expansive Soil Determination

4-0802.1 The geotechnical engineer must use the properties identified in § 4-0801.1B to evaluate the volume change of potentially expansive soils. These tests must be performed on representative samples from each soil mapping unit deemed potentially expansive soils impacting the proposed construction.

4-0802.2 All laboratory test data, interpretations and supporting graphs must be included in the geotechnical report.

4-0803 Mixture Design for Lime Stabilization of Soil

4-0803.1 The appropriate lime content for field application must be determined in accordance with the National Lime Association (NLA) Technical Brief, *Mixture Design and Testing Procedures for Lime Stabilized Soil*, dated October 2006 with the following amendments:

A. Organic Content – The soil proposed to be stabilized must be natural inorganic soil as defined by ASTM D2487 and may contain no more than two percent organic material by weight as determined by ASTM D2974. The intentional mixing of organic material with natural inorganic soil is not permitted.

B. Expansion Index (EI) Testing Procedures – In accordance with the Virginia Uniform Statewide Building Code, ASTM D4829 must be used for EI Testing.

C. Lime used to perform the laboratory tests must be of the same type, grade, and consistency as the lime to be used for field application.

D. Validation testing for the prescribed minimum amount of lime determined for stabilization of soil:

1. Determine the Expansive Index (EI) of the cured specimens using a minimum of two duplicate tests conducted in accordance with ASTM D4829. The EI must be equal to or less than 20 for lime stabilization to be considered as effective in controlling soil expansion; or

2. Determine the Plasticity Index (PI) of the material from the cured specimens in accordance with ASTM D4318. The PI must be less than 15 for lime stabilization to be considered as effective in controlling soil expansion.

E. To allow for variations in the soil properties in the field, increase the required minimum lime content as determined by the above procedures by at least 0.5 percent by dry weight and use this value as the design lime content.

F. Maps, boring logs and laboratory test data and their interpretations (including analysis; plots; the location of each of the proposed lime mix designs including the depth and lateral extent of the proposed lime stabilization; and conclusions) must be included in the geotechnical report.

4-0804 Lime Treatment Requirements for Lime Stabilization of Soil

4-0804.1 The minimum depth and lateral extent of treatment specified below must be used in the absence of engineering analyses and/or controlled experiments or pilot studies substantiating the adequacy of alternative treatment depths and areas. If vegetation is to be established, it must be planted in non-stabilized soil in accordance with standard landscaping practices.

A. Fills – The depth and extent of treatment must conform to the minimum requirements specified below for the specific engineered structure to be supported by the fill.

B. Building Pads – When lime stabilization is used, the depth of stabilization must extend throughout the active zone. The lime stabilization must extend at least five feet beyond the projected perimeter of the building's or structure's footing/foundation.

C. Backfill behind Basement Walls and Retaining Walls – Lime modified and lime stabilized soils may not be placed as backfill behind basement walls and retaining walls, unless approved otherwise by the Director.

D. Backfill for Utility Trenches – Lime modified and lime stabilized soils may be used to backfill utility trenches.

E. Roadway and Parking Lot Subgrades – In fill areas, the depth of stabilization must be at least 4 feet below the finished pavement surface. In cut areas, the depth of stabilization must extend to at least 2 feet below the subgrade elevation. The lime stabilization must extend at least 2 feet beyond the proposed edges of the pavement, shoulders and sidewalks.

4-0804.2 If lime stabilized soils are to be used in the determination of the Thickness Index for the pavement design, the stabilized soil must have a minimum unconfined compressive strength of 150 psi when prepared and tested in accordance with VTM-11. The required pavement Thickness Index is determined based on the

CBR values in accordance with VTM-8 of the natural subgrade soils before stabilization. Only the top 8 inches of the stabilized soil may be considered as part of the pavement structure necessary to achieve the required Thickness Index.

4-0804.3 Alternative treatment depths and areas may be used provided their adequacy is satisfactorily demonstrated and pursuant to obtaining approval from the Director. All supporting data, logic, rationale, assumptions, field control procedures and conclusions must be thoroughly documented in the geotechnical report.

A. The geotechnical engineer must evaluate the variation of the swell potential and swell pressure with depth for the expansive soils encountered at a particular site.

B. Swell tests must be conducted on disturbed or undisturbed soil samples or both depending on the requirements of the particular application. These tests must be conducted in accordance with ASTM D4546 (Method B), ASTM D4829 and/or other testing methods approved by the Director. The tests must take into account field conditions, including moisture variation, compacted densities, and surcharge loads.

C. Based on pilot studies, the geotechnical engineer may recommend alternative treatment for the depth and lateral extent to which treatment should extend in order to achieve the desired performance or required design parameters, such as allowable differential movement and swelling pressures.

4-0805 Health and Safety Precautions for Soil Treatment with Lime

4-0805.1 Various types of lime can be used in a dry or slurry form for soil treatment. Care must be taken during construction to avoid skin and eye burns, especially if quicklime is used. Water must be applied, and mixing operations must be started immediately after spreading lime in order to avoid or minimize unnecessary exposure.

4-0805.2 The contractor is responsible for controlling fugitive dust due to lime application, on and off the project limits. Dry lime may not be delivered, spread or mixed when wind or other conditions would allow lime dust to leave the construction site. If lime leaves or appears likely to leave the construction site—as determined from visual observation—the contractor must immediately cease operations. Operations may not be resumed until working conditions are suitable or alternate construction techniques are employed to ensure that lime dust does not leave the construction site.

4-0805.3 Water runoff from any project site must be controlled by the contractor. Lime must not be allowed to flow with water runoff to any surface water body on or off a project site or onto an adjacent site.

4-0805.4 Before approval of the soil report or site plan, a Health and Safety Plan must be provided for incorporation into the project specifications. The Health and Safety Plan must include the identification of precautions for exposure to lime, associated operations and products, protocols for ensuring adherence to the plan requirements, and emergency medical treatment available on and near the job site. The Health and Safety Plan must be prepared by a competent professional for the contractor. A copy of the Health and Safety Plan must remain on site at all times for reference. The Health and Safety Plan must be incorporated into the approved set of plans.

4-0806 Lime Stabilization Specifications

4-0806.1 Lime stabilization must be accomplished according to a set of specifications prepared by the Geotechnical Engineer of Record registered in the Commonwealth of Virginia, which must include a Field Quality Control Plan meeting the minimum requirements of §§ 4-0801, 4-0804, and 4-0807. These specifications must be submitted in the form of a geotechnical report. The complete package provided for submission must include the Health and Safety Plan and the site, subdivision or grading plans. After the geotechnical report has been approved, the approved recommendations must be incorporated into the plans as project specifications.

4-0806.2 The specifications must describe the work, identify suitable material (lime, water, etc.) requirements, identify the type of equipment for mixing, describe the contractor's experience and address at a minimum, the following construction methods: soil preparation; lime spreading; mixing and watering; mellowing; and compaction and finishing.

4-0807 Field Quality Control for Lime Modification and Stabilization of Soil

4-0807.1 Field quality control must be provided on every project where lime modification and lime stabilization is used and must be monitored under the direction of the Geotechnical Engineer of Record qualified and experienced in soil and foundation engineering. Daily written documentation of all monitoring activities, including field observations, construction equipment, source, type, grade and consistency of lime distribution, sampling and test locations, test results and supporting measurements, etc., must be maintained and readily available at the project field office and be made available upon request.

4-0807.2 At a minimum, the following elements must be included in the geotechnical report which must be submitted for review before approval of the Site Plan. Where required, random sampling, measurement and testing locations, and random locations must be determined in accordance with ASTM D3665.

A. Depth of Lime Treatment – The depth of treatment must be investigated for every application by digging test holes and spraying a non-hazardous color sensitive indicator solution on the treated soil exposed on the sides of the test holes. If lime is present in the soil, it should react with the indicator solution and cause a change in color to develop. For subgrade stabilization applications, one test hole is required per 3,000 square foot area of treated soil. A minimum of three test holes are required for any subgrade stabilization application. The test holes must be randomly located. The minimum number of test holes required is on a per layer (lift) basis when mixing is accomplished in-place by a traveling mixer. When lime-soil mixing is accomplished using a stationary mixer, the minimum number of test holes required may be based on the surface area of the total thickness of lime stabilized soil.

B. Lateral Extent of Lime Treatment – Before stabilizing an area, the limits of lime treatment must be established in the field by a survey. The extent of the treated areas will be identified by the geotechnical engineer and the field surveys must be conducted by a professional land surveyor or registered design professional registered in the Commonwealth of Virginia. In addition, test holes used to check the depth of treatment must also be used to verify the lateral extent of treatment.

C. Dry Lime Spread Rate – The spread rate of dry lime must be determined or measured for every lift in terms of pounds of lime per unit area of surface. If lime is applied in bags, the spread rate can be determined from: the number of bags used, the weight of lime per bag, and the area being treated. If lime is applied in bulk via mechanical means, a one-square-yard piece of canvas or other suitable material must be placed on the ground at random locations at least once per day during continuous operation, and the weight of lime spread on it measured after lime application is completed. A minimum of three measurements must be conducted for bulk applications, with one test being conducted at the start of spreading lime.

D. Spread Rate of Lime-Slurry Composition – The spread rate of lime-slurry over a known (measured) area can be based on the lime solids content. The amount of lime solids in a lime-slurry mixture can be determined by measuring the specific gravity of the slurry. The specific gravity must be determined via hydrometer test in accordance with ASTM D422. Alternative methods to measure the specific gravity of lime slurry may be proposed for review and

approval. A minimum of one test must be conducted for every 2,500 gallons of slurry mix or portion thereof. Samples must be taken at random locations after slurry spreading begins.

E. Mellowing and Pulverization – A minimum duration of 24 hours is required for mellowing, unless laboratory studies show that the PI is reduced to less than 15 in a shorter period of time. Tests must be conducted in the field to assure proper pulverization after mellowing and before final placement or compaction. The lime treated material must be mixed until 100 percent of it, exclusive of the coarse aggregate, passes the 1-inch sieve and a minimum of 60 percent of it, exclusive of the coarse aggregate, passes the U.S. Number 4 sieve. If the lime stabilization is completed in two days or less, three tests must be conducted, with one test being conducted at the start of operations. If the lime stabilization is completed in more than 2 days, at least one test per lift must be conducted each day during continuous operation.

F. Testing Before Final Compaction – The maximum allowable loose lift thickness is 8 inches. After pulverization, and before final compaction, samples from random locations within each lift must be taken for pH (ASTM D6276) and PI (ASTM D4318) or EI (ASTM D4829) determinations. One soil sample must be taken and tested for every 1,000 cubic yards of stabilized soil with a minimum of one soil sample per day from each lift of stabilized soil. However, if the test results indicate the work is not in compliance with the approved specifications, the Director may require a greater testing frequency. The pH determination may not be less than a pH of 12.2 and no more than 10 percent of pH determinations must be less than a pH of 12.3. Field pH testing is not required for lime modified soil.

G. Compaction Characteristics – For every type of expansive soil to be modified or stabilized at the job site, laboratory moisture density curves must be determined for a mixture of that soil with the design lime content. The laboratory compaction test must be conducted in accordance with ASTM D698. The compaction in the field must be monitored based on the laboratory moisture-density test results. One field density test must be conducted per 10,000 square foot area of each compacted lift, with a minimum of three tests per lift. Tests must be made at random locations within each lift. Field density tests must be conducted in accordance with ASTM D6938 or ASTM D1556 or a combination of the two standards. Since the moisture-density relationships change with time during curing, testing for field moisture-density characteristics must be conducted as soon as the compaction of the mixture has been completed.

H. Other Engineering Characteristics – Other field tests may be appropriate to demonstrate the quality control or verify the anticipated performance of the lime-treated material for the particular application. The type, purpose, frequency, and location of all other field tests must be documented in the quality control plan.

I. The Geotechnical Engineer of Record must compile a summary report of all site observations and testing performed daily and submit signed and sealed reports within 5 business days. All technicians performing work within the VDOT Right-of-Way must obtain certification through VDOT, and certification by any other agency is not acceptable.

4-0808 Quality Assurance

4-0808.1 Quality assurance must be provided by the Geotechnical Engineer of Record on every project where lime treatment is used, and must include at a minimum, a weekly audit of field quality control activities and a final written summary report.

A. The final report must be signed and sealed by the Geotechnical Engineer of Record and must include a summary of all monitoring data; audit results; steps taken to correct any deficiencies or items not in compliance with the specifications and Field Quality Control Plan; a statement indicating whether or not lime modification or stabilization for all applications of the subject project has been performed in accordance with the specifications and Field Quality Control Plan; a recommendation for any work to be completed before the release of performance bonds and/or the issuance of residential or non-residential use permits; and all supporting data.

B. The audits and final summary report must be conducted and prepared under the direction of a Virginia registered design professional, specializing in soil and foundation engineering.

C. The final summary report must be submitted to LDS within 30 days following the completion of lime stabilization. Review and approval of the final summary report is required before the release of performance bonds and/or the issuance of the Certificate of Occupancy related to the subject project.