

APPENDIX G

INFILTRATION TESTING

APPENDIX G

INFILTRATION TESTING

To properly size and locate stormwater management facilities, it is necessary to characterize the soil infiltration conditions at the location of the proposed facility. All projects that propose onsite infiltration must evaluate existing site conditions and determine:

1. If the infiltration rate is adequate to support the proposed stormwater management facility (satisfied through presence of mapped NRCS Type A & B Soils or the Simplified Approach infiltration test) or;
2. The design infiltration rate prior to facility design (satisfied through the Presumptive Approach infiltration testing conducted by a qualified professional).

The following sections provide the approved standard infiltration testing specifications.

Simplified Approach Open Pit Infiltration Test

The purpose of the Simplified Approach is to provide a method which can be conducted by a nonprofessional for design of simple stormwater systems on small projects. The Simplified Approach open pit test is applicable only to projects on private property with less than 15,000 square feet of new or redeveloped impervious area. The results of infiltration testing must be documented on the Simplified Approach Form.

The Simplified Approach cannot be used to find a design infiltration rate. The intent of the open pit test is to determine whether or not the local infiltration rate is adequate (2 inches/hour or greater) for the predesigned stormwater facilities described in Chapter 2 (infiltration swales, basins, planters, drywells, and trenches). The Simplified Approach Infiltration Test does not need to be conducted by a licensed professional.

Simplified Approach Procedure

A simple open pit infiltration test is required for each facility designed through the Simplified Approach. The test should be where the facility is proposed or within the immediate vicinity.

Excavate a test hole to the depth of the bottom of the infiltration system, or otherwise to 4 feet. The test hole can be excavated with small excavation equipment or by hand using a shovel, auger, or post hole digger. If a layer hard enough to prevent further excavation is encountered, or if noticeable moisture/water is encountered in the soil, stop and measure this depth from the surface and record it on the Simplified Approach Form. Proceed with the test at this depth.

Fill the hole with water to a height of about 6 inches from the bottom of the hole, and record the exact time. Check the water level at regular intervals (every 1 minute for fast-draining soils to every 10 minutes for slower-draining soils) for a minimum of 1 hour or until all of the water has infiltrated. Record the distance the water has dropped from the top edge of the hole.

Repeat this process two more times, for a total of three rounds of testing. These tests should be performed as close together as possible to accurately portray the soil's ability to infiltrate at different levels of saturation. The **third test** provides the best measure of the saturated infiltration rate.

For each test pit required, submit all three testing results with the date, duration, drop in water height, and conversion into inches per hour.

If the results of the Simplified Approach open pit test show an infiltration rate greater than 2.0 inches per hour, the applicant can proceed with Simplified Approach facility design (where applicable). If the applicant would like to use an infiltration rate for design purposes, a Presumptive Infiltration Test must be conducted.

Presumptive Infiltration Testing

The Presumptive Approach must be used for all public and private developments where the Simplified Approach is not applicable. The qualified professional must exercise judgment in the selection of the infiltration test method. The three infiltration available testing methods used to determine a design infiltration rate are:

- Open pit falling head
- Encased falling head
- Double-ring infiltrometer

Where satisfactory data from adjacent areas is available that demonstrates infiltration testing is not necessary, the infiltration testing requirement may be waived. Waiver of the site specific testing is subject to approval by the City. Recommendation for foregoing infiltration testing must be submitted in a report which includes supporting data and is stamped and signed by the project engineer or geologist.

Testing Criteria

Testing must be conducted or overseen by a qualified professional. This professional must be a Professional Engineer, Registered Geologist, Soil Scientist or other professional testing service with equivalent training and experience in determining the permeability of soils.

The depth of the test must correspond to the facility depth. If a confining layer is observed during the subsurface investigation to be within 4 feet of the bottom of the planned infiltration system, the testing should be conducted within that confining layer.

Tests must be performed in the immediate vicinity of the proposed facility. Exceptions can be made to the test location provided the qualified professional can support that the strata are consistent from the proposed facility to the test location.

Infiltration testing should not be conducted in engineered or undocumented fill.

Minimum Number of Required Tests

The simplified Approach requires one infiltration test for every proposed facility. The Presumptive Approach requires one infiltration test for every proposed facility or one test for every 100 feet of proposed linear facility. Generalized soil infiltration rates may be used if facilities are proposed in areas of consistent topography and soil strata as outlined in a Geotechnical report.

Factor of Safety

A minimum factor of safety of 2 shall be applied to field obtained infiltration rates where infiltration of the flood control design storm is proposed.

Presumptive Infiltration Testing Instructions

Open Pit Falling Head Procedure

The open pit falling head procedure is performed in an open excavation and therefore is a test of the combination of vertical and lateral infiltration.

1. Excavate a hole with bottom dimensions of approximately 2 feet by 2 feet into the native soil to the elevation of the proposed facility bottom. Smooth excavations should be scratched and loose material removed.
2. Fill the hole with clean water a minimum of 1 foot above the soil to be tested, and maintain this depth of water for at least 4 hours (or overnight if clay soils are present) to presoak the native material. In sandy soils with little or no clay or silt, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.
3. Determine how the water level will be accurately measured. The measurements should be made with reference to a fixed point.
4. After the presaturation period, refill the hole with water to 12 inches above the soil and record the time. Alternative water head heights may be used for testing provided the presaturation height is adjusted accordingly. Measure the water level at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower soils) or until all of the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval in order to obtain a well defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing.
5. Repeat the test. Successive trials should be run until the percent change in measured infiltration rate between two successive trials is minimal. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level is readjusted to the 12 inch level.
6. The average infiltration rate over the last trial should be used to calculate the unfactored infiltration rate. The final rate must be reported in inches per hour.
7. For very rapidly draining soils, it may not be possible to maintain a water head above the bottom of the test pit. A rate based test may be used if the infiltration rate meets or exceeds the flow of water into the test pit.

Note that a maximum infiltration rate of 20 inches per hour can be used in stormwater system design.

Encased Falling Head Test

The encased falling head procedure is performed with a 6-inch casing that is embedded approximately 6 inches into the native soil. The goal of this field test is to evaluate the vertical infiltration rate through a 6-inch plug of soil, without allowing any lateral

infiltration. The test is not appropriate in gravelly soils or in other soils where a good seal with the casing cannot be established.

Embed a solid 6-inch diameter casing into the native soil at the elevation of the proposed facility bottom. Ensure that the embedment provides a good seal around the pipe casing so that percolation will be limited to the 6-inch plug of the material within the casing. This method can also be used when testing within hollow stem augers, provided the driller and tester are reasonably certain that a good seal has been achieved between the soil and auger.

Fill the pipe with clean water a minimum of 1 foot above the soil to be tested, and maintain this depth for at least 4 hours (or overnight if clay soils are present) to presoak the native material. Any soil that sloughed into the hole during the soaking period should be removed. In sandy soils with little or no clay or silt, soaking is not necessary. If after filling the hole twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.

To conduct the first trial of the test, fill the pipe to approximately 12 inches above the soil and measure the water level. Alternative water head heights may be used for testing provided the presaturation height is adjusted accordingly. The level should be measured with reference to a fixed point. Record the exact time.

Measure the water level at 10-minute intervals for a total period of 1 hour (or 20-minute intervals for 2 hours in slower soils) or until all of the water has drained. In faster draining soils (sands and gravels), it may be necessary to shorten the measurement interval in order to obtain a well defined infiltration rate curve. Constant head tests may be substituted for falling head tests at the discretion of the professional overseeing the infiltration testing. Successive trials should be run until the percent change in measured infiltration rate between two successive trials is minimal. The trial should be discounted if the infiltration rate between successive trials increases. At least three trials must be conducted. After each trial, the water level is readjusted to the 12 inch level.

The average infiltration rate over the last trial should be used to calculate the unfactored infiltration rate. Alternatively, the infiltration rate measured over the range of water head applicable to the project stormwater system design may be used at the discretion of the professional overseeing the testing. The final rate must be reported in inches per hour.

Double Ring Infiltrometer Test

The double-ring infiltrometer test procedure should be performed in accordance with ASTM 3385-94. The test is performed within two concentric casings embedded and sealed to the native soils. The outer ring maintains a volume of water to diminish the potential of lateral infiltration through the center casing. The volume of water added to the center ring to maintain a static water level is used to calculate the infiltration rate. The double-ring infiltrometer is appropriate only in soils where an adequate seal can be established.

Reporting Requirements

The following information should be included in the Infiltration Testing Report. The Infiltration Testing Report should be attached to the project's Stormwater Management Report:

1. Statement of project understanding (proposed stormwater system).
2. Summary of subsurface conditions encountered.
3. Summary of infiltration testing including location and number of tests and testing method used. Discussion of how the tests were performed (i.e. pipe type or diameter or test pit dimensions).
4. Infiltration testing results in inches per hour.
5. Recommended design infiltration rate including factors of safety.
6. Groundwater observations within exploration and an estimate of the depth to seasonal high groundwater.
7. Site plan showing location of infiltration tests.
8. Boring or test pit logs. The logs should include an associated soil classification consistent with ASTM D2488-00, Standard Practice for Classification for Description and Identification of Soils (Visual-Manual Procedure). The logs should also include any additional pertinent subsurface information, such as soil moisture conditions, depth and description of undocumented or engineered fill, soil color and mottling conditions, soil stiffness or density, and approximate depth of contact between soil types.
9. Infiltration Test Data

This Page Intentionally Left Blank