



CSO Remedial Measures Operation & Maintenance and GI Performance Testing Plan

CSO REMEDIAL MEASURES PROGRAM

CITY OF PEORIA
3505 N DRIES LN, PEORIA, IL 61604
PHONE: (309) 494-8800 | PUBLICWORKS@PEORIAGO.V.ORG

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Revision Summary

May 2023

Section 1.2 Added details on inspection and maintenance implementation.

Section 2.3 Noted salt use to be minimal near GI plants.

Table 2 Clarified maintenance frequency.

Section 2.4 Added details on performance testing implementation.

Section 3.2 Noted inlets and cleanouts inspection and maintenance.

Table 4 Clarified maintenance frequency.

Section 3.4 Added details on performance testing implementation.

Section 4.3 Removed references to pressure washing.

Table 6 Clarified maintenance frequency.

Section 4.4 Added details on performance testing implementation.

Table 8 Clarified maintenance frequency.

Appendix C Added new appendix showing performance test setup examples.

Appendix D Added new appendix showing Field Maps examples.

January 2024

- Section 1.2 Clarified when as-built drawings will be generated.
- Section 2.4.1 Added reference to Appendix C.
- Section 2.4.2 Clarified remedial actions for addressing deficient post-construction performance test results.
- Section 2.4.3 Added number of tests per GI area and a summary of other monitoring that may be used to supplement performance testing.
- Section 3.4.1 Added reference to Appendix C.
- Section 3.4.2 Clarified remedial actions for addressing deficient post-construction performance test results.
- Section 3.4.3 Added number of tests per GI area and a summary of other monitoring that may be used to supplement performance testing.
- Section 4.3 Clarified use of INFIL-trackers.
- Section 4.4.1 Added reference to Appendix C.
- Section 4.4.2 Clarified remedial actions for addressing deficient post-construction performance test results.
- Section 4.4.3 Added number of tests per GI area. Clarified use of INFIL-trackers and added summary of other monitoring that may be used to supplement performance testing.
- Section 5.4.2 Added details for post-construction performance testing.
- Section 5.4.3 Added summary of monitoring that may be used to supplement performance testing.
- Appendix C Added details including steps for performance testing and performance testing data post processing.

May 2024

- Section 2.4.2 Clarified the applicability of different types of post-construction performance testing.
- Section 2.4.3 Clarified the applicability of different types of long-term performance testing.
- Section 3.4.2 Clarified the applicability of hydrant testing for post-construction performance testing.

Section 3.4.3 Clarified the applicability of hydrant testing for long-term performance testing.

Table 6 Updated maintenance frequency for vacuum sweeping of permeable pavement to include twice a year minimum.

Section 4.4.2 Clarified the applicability of different types of post-construction performance testing.

Section 4.4.3 Clarified the applicability of different types of long-term performance testing.

Appendix C Added personal protective equipment to the lists of required equipment and made updates to the hydrant testing section.

1.0 INTRODUCTION

1.1 Background

The City of Peoria (City) has maintained a system of combined sewers and outfalls for more than 100 years. Most of the combined sewers were originally constructed between 1880 and 1930 and initially discharged directly into the Illinois River. After the Greater Peoria Sanitary District (GPSD) was formed and the Riverfront Interceptor sewer and wastewater treatment plant (WWTP) were constructed in 1931, the combined sewers only discharged to the river during rainfall events. Previous improvements to the combined sewer system were constructed to limit combined sewer overflows (CSOs) to excess wet weather events. The City is committed to additional improvements to further reduce discharges from its combined sewer system, which encompasses approximately 5,300 acres and has 16 overflow points discharging into the Illinois River. As Green Infrastructure (GI) technologies have emerged as viable, cost-effective solutions to municipal CSO problems, the City has chosen to implement GI stormwater management as part of the solution to address the City's CSOs.

GI uses vegetation, soils, and natural processes to manage stormwater and create healthier urban environments. At the scale of a neighborhood or streetscape, GI refers to stormwater management systems that mimic nature by soaking up and storing water. The incorporation and enhancement of GI systems minimize costs by providing natural solutions to manage the rate, volume, and quality of stormwater runoff while employing strategies to maintain or restore natural hydrology. Examples of green infrastructure include bioretention, stormwater planters, bumpouts, green roofs, dry wells, and permeable pavement.

1.2 Overview

This Operation & Maintenance and Performance Testing Plan defines procedures for operating, inspecting, maintaining, and evaluating GI projects used for CSO reduction throughout the City. It provides a narrative on Surface Green Infrastructure, Subsurface Storage and Infiltration Cells, Permeable Pavement, and Stormwater Retention including definitions, general purpose, appropriate functioning, general operation and maintenance, and performance testing. Specific operation and maintenance checklists, and specified plants, shrubs, trees, and common weeds are provided. Inspection and maintenance and performance testing guidelines specified in this manual will be implemented to ensure that GI components achieve their full performance capabilities. As-built drawings will be generated after each GI project construction is completed and will be available to inspection and maintenance personnel.

The City is implementing a Geographic Information System (GIS) based approach to document inspection, maintenance, and performance testing of GI used for CSO control. GI facilities are added to the GIS database as the facilities are constructed. The database includes information regarding the type of GI, location of the GI facility, and as-built information. The inspection and maintenance

checklists, included in Appendix D, allow field inspections to be completed digitally and integrated with the GI facility using the Field Maps GIS mobile collection platform. Appendix D includes an example checklist for each type of GI; i.e., Surface Green Infrastructure, Subsurface Storage & Infiltration Cells, and Permeable Pavement. GI facilities of the same type will use the same GIS checklists. There are currently no Stormwater Retention projects planned so the checklists for this type of GI have not yet been built in the GI GIS tracking system, but it will be if/when Stormwater Retention projects are planned.

The City has an inspection and maintenance training program. Inspection and maintenance personnel are trained by an experienced GI inspector and a GIS specialist experienced with the GI GIS tracking system. The training starts with an office portion for staff to learn how to use the Field Maps application to document inspection and maintenance activities, including how to take photos of the GI. This is followed by a field portion of the training where field personnel visit locations where GI has been installed for CSO control and complete example GI inspection and maintenance forms for each type of GI that has been constructed to date. Additionally, the experienced inspector leading the training initially goes out with the field personnel performing the inspection and maintenance to ensure consistent implementation of the program and to answer questions from the crew.

The trained staff identify the type of maintenance that is required for each GI facility during the inspection and complete routine maintenance soon after. Non-routine maintenance needs identified during the inspection will be documented and the non-routine maintenance will be completed as soon as practicable. The GI GIS tracking system allows the City to track the GI facilities that exist, those that require inspection, those that require routine and non-maintenance, and the date when each task is completed. The GI GIS tracking system also allows the City to review the history of inspections and maintenance activities and generate tables summarizing these items. Routine inspection, and maintenance, if needed, will be completed at least four times per year from March through November, with one inspection occurring in November, and within 48 hours after each major rain event (more than 1-inch of rainfall), excluding weekends and holidays. It is the City's intent to perform GI inspections and routine maintenance during business hours.

Performance testing is conducted under the direction of an experienced and qualified professional. The GI GIS tracking system will be used to document and track performance testing results to verify long-term GI functionality.

2.0 SURFACE GREEN INFRASTRUCTURE

2.1 Introduction

This section defines recommendations for operating, inspecting, maintaining, and performance testing for Surface Green Infrastructure.

A Surface Green Infrastructure area is a landscaped area designed to receive, store, infiltrate and/or filter stormwater runoff. These GI systems are flexible, adaptable, and versatile stormwater management facilities that are effective for highly urban development and redevelopment to reduce runoff rates, runoff volumes, and pollutant loads. Because its shape is flexible, Surface Green Infrastructure can be adapted to many types of sites.

Surface Green Infrastructure may consist of a flow inlet structure, a pretreatment element, a temporary ponding area with overflow, an engineered soil mix planting bed, vegetation, an aggregate storage layer, and an outflow regulating structure (for example, an upturned underdrain). Each component of the Surface Green Infrastructure should be adequate to ensure the proper function and operation of the system.

2.2 Types of Surface Green Infrastructure

Numerous types of Surface Green Infrastructure are similar but have slightly different components, operations, or goals.

- Bioretention is a common Surface Green Infrastructure that has layers including a surface ponding area, vegetation, engineered media, and aggregate storage.
- Stormwater planters, also called rain gardens, are a smaller version of bioretention that can optionally be in a raised box.
- Bioswales are a linear version of bioretention that may have a longitudinal slope.
- Stormwater bumpouts/bumpins are similar to bioretention and are located in a parking lane or behind a curb. The inlet may directly connect to the aggregate storage, and the ponding depth may be excluded. The outlet may connect to another GI practice.
- Infiltration trenches are a linear version of bioretention that may exclude the engineered soil and vegetation for an aggregate surface.
- Native prairies are naturalized areas that promote vegetation in the urban environment. A native prairie may use natural soil layers rather than engineered soil layering.

2.3 Surface Green Infrastructure Inspection and Maintenance

Routine inspection and maintenance are essential to gain public acceptance of highly visible urban GI areas and ensure the proper functioning of the overall stormwater system. Inspection of Surface Green Infrastructure is required at least four times per year during the growing season (March

through November with one inspection occurring in November) and within 48 hours after each major rain (more than 1-inch of rainfall). Table 1 outlines basic inspection activities. An example inspection and maintenance checklist for Surface Green Infrastructure is included in Appendix D.

Surface Green Infrastructure is expected to develop into dynamic microcosms requiring little maintenance once species are established. However, light maintenance activities should be expected in the first two years to eliminate volunteer species and support the permanent establishment of the system. The function of Surface Green Infrastructure is enhanced by the vegetation. Maintenance activities should promote the site aesthetic, promote healthy vegetation, and minimize clogging potential. Excessive salt can adversely impact vegetation; de-icing salt use should be limited on pavement that drains to vegetated green infrastructure. Should inspection activities warrant maintenance, Table 2 outlines typical methods to ensure that the system continues to function as designed. An example inspection and maintenance form is provided in Appendix D.

Table 1 | Surface Green Infrastructure Inspection Activities

	Bioretention	Stormwater Planters	Bioswales	Stormwater Bumpout / Bumpin	Infiltration Trench	Native Prairie	Inspection Frequency
Vegetation							
Inspect for invasive species which include reed canary grass, purple loosestrife, common reed, Canada thistle, garlic mustard, and cheatgrass. Appendix B contains photos of these six common invasive species as well as a list of additional species which may be found.	X	X	X	X	X	X	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed
Inspect for invasive/volunteer trees	X	X	X	X	X	X	
At least 95% survival of established plants – no dead growth	X	X	X	X	N/A	X	
Vegetation confined to planted areas – no overgrown appearance, does not impede pedestrian access, does not cause line of sight or driver safety issues, infrastructure accessible	X	X	X	X	N/A	X	
Planter Bed							
No ponding – water drains within 48 hours	X	X	X	X	X	X	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed
Soil is well aerated, no evidence of compaction	X	X	X	X	X	X	
Inspect preferential inlet locations for erosion and undercutting	X	X	X	X	X	X	
No channelization or scouring	X	X	X	X	X	X	
No bare spots	X	X	X	X	X	X	
Mulch evenly distributed at the proper depth	X	X	X	X	X	X	
Debris							
Inspect for floatable debris	X	X	X	X	X	X	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed
No buildup of debris or sediment	X	X	X	X	X	X	
Inspect inlets and cleanouts, if present, for sustained ponding (greater than 48 hours), debris, or sediment accumulation	X	X	X	X	X	X	

Table 2 | Surface Green Infrastructure Maintenance Activities

	Bioretention	Stormwater Planters	Bioswales	Stormwater Bumpout / Bumpin	Infiltration Trench	Native Prairie	Maintenance Frequency
Watering to promote plant establishment. Once established, plants should only require water during drought conditions.	X	X	X	X	N/A	X	During Establishment Period
Remove invasive/volunteer species of plants	X	X	X	X	X	X	As Needed within 48 hours after rainfalls of more than 1-inch of depth
Remove invasive/volunteer species of trees	X	X	X	X	X	X	
Remove dead growth	X	X	X	X	N/A	X	
Rake/remove leaves	X	X	X	X	X	X	
Trim overgrown vegetation	X	X	X	X	X	X	
Remove floatable debris	X	X	X	X	X	X	
Remove debris and clear obstructions from curb lines, inlet grates, and overflow devices	X	X	X	X	X	X	
Remove debris and clear obstructions from inlet sumps, cleanouts, pipes	X	X	X	X	X	N/A	
Remove debris and clear obstructions from stormwater chambers and isolation chambers if present	X	X	X	X	X	N/A	
Restore erosion and undercutting on landscape slopes and overflow devices	X	X	X	X	X	X	
Restore landscape areas to proper grade, stabilize, and re-mulch. Appendix A contains tree and plant species that can be used to restore landscape areas.	X	X	X	X	X	X	
Infiltration testing can determine if soil compaction or sediment clogging may be the cause of the problem, which can be remedied by scarifying, tilling, shallow or deep aerating, or by replacing the soil in extreme cases.	X	X	X	X	X	X	If persistent ponding is observed (>48 hours)
Perform water jet cleaning of clogged underdrains if present.	X	X	X	X	X	N/A	

2.4 Surface Green Infrastructure Performance Testing

2.4.1 Pre-Construction

Pre-construction performance testing will be completed at Surface Green Infrastructure installations to determine the design native soil infiltration rate. Pre-construction performance testing will be completed at or just below the proposed native soil interface. Pre-construction performance testing may be completed using an approved infiltrometer or permeameter and will follow applicable ASTM standards, including applicable sections of ASTM D5126. See Appendix C for performance test setups and testing steps. The pre-construction design infiltration rate for the native soil, and where applicable the surface layer, will be documented in the GI GIS tracking system for each GI facility; see an example in Appendix D.

2.4.2 Post-Construction

Baseline performance testing of Surface Green Infrastructure installations will be conducted within six months of the completion of construction and will consist of hydrant testing and/or single ring infiltration testing. Hydrant testing (also known as simulated runoff testing) is used to test newly constructed Surface Green Infrastructure project sites to verify that water flows through the project as designed and to evaluate the subsurface native soil infiltration rate. This testing method will provide for the introduction of a controlled rate and volume of water under controlled conditions during dry weather. An inlet, clean out, or inspection port may be used to observe the subsurface drawdown rate. Single ring infiltration testing will be used to measure the surface infiltration rate of newly constructed Surface Green Infrastructure projects for types that rely on surface infiltration to direct flow to the subsurface storage. Testing will be performed a minimum of one per 6,000 square feet of installed Surface Green Infrastructure..

Prior to City acceptance of Surface Green Infrastructure projects, the satisfactory implementation of the completed work will be verified through post-construction performance testing and approval by the engineer. If the post-construction performance testing shows the GI is underperforming due to deficiencies in the work completed by the contractor such as improper installation of GI components or inadequately protecting GI during construction, then the contractor will perform remedial work to meet the plans and specifications. If the performance deficiency is due to typical maintenance issues such as accumulation of sediment or debris on the surface of the GI, then GI functionality will be restored as part of the City's routine maintenance activities.

In addition, the City will compare the post-construction infiltration rate to the pre-construction design infiltration rate. If the observed post-construction native soil infiltration rate is lower than the pre-construction design infiltration rate due to natural soil variability, the modeled infiltration rate will be reduced to the observed post-construction infiltration rate for the impacted facilities and future tests will be compared to this baseline. Post-construction performance testing results will be documented in the GI GIS tracking system; see an example in Appendix D.

2.4.3 Long-Term

Performance testing of Surface Green Infrastructure projects will be conducted at a minimum frequency of once every three years to track changes in performance. A minimum of one test per 6,000 square feet of installed Surface Green Infrastructure will be completed. Performance testing may be conducted using a single-ring infiltration testing to measure the surface infiltration rate and/or hydrant testing to measure the subsurface native soil infiltration rate, as appropriate based on the type of Surface Green Infrastructure. See performance test setups and testing steps in Appendix C.

In addition, system-wide flow monitoring, project-specific flow monitoring, and GI facility-specific monitoring, such as soil moisture sensors or visual inspection within 48 hours of a rainfall, may be used to supplement performance testing and provide information about how the GI performs during real rainfall events.

Surface Green Infrastructure may rely on the native soil infiltration rate, the surface infiltration rate, or both, to function properly, depending on the configuration. Performance testing will be conducted such that the infiltration rate of layers impacting GI performance can be compared to the pre-construction design infiltration rate. Long-term performance testing results will be documented in the GI GIS tracking system; see an example in Appendix D.

3.0 SUBSURFACE STORAGE & INFILTRATION CELLS

3.1 Introduction

This section defines recommendations for operating, inspecting, maintaining, and performance testing for Subsurface Storage and Infiltration Cells.

Subsurface Storage and Infiltration Cells may serve as the primary outlet for stormwater from the site or as part of a treatment train. Subsurface Storage and Infiltration Cells may consist of a cell completely backfilled with clean aggregate, a cell with manufactured stormwater chambers backfilled with clean aggregate, or a tree cell backfilled with an engineered media and/or aggregate. Stormwater will be directed to proposed Subsurface Storage and Infiltration Cells through an upstream inlet structure or stormwater best management practice (BMP).

Subsurface Storage and Infiltration Cells may be designed to receive, infiltrate and/or filter stormwater runoff. The systems are flexible, adaptable, and versatile stormwater management facilities that are effective for highly urban development and redevelopment to reduce runoff rates, runoff volumes, and pollutant loads.

Generally, Subsurface Storage and Infiltration Cells may consist of a flow inlet structure, a temporary ponding area, an aggregate layer, an engineered soil media, and a tree in the case of a tree cell. Each component of the system should be adequate to ensure proper functioning and operation of the system.

3.2 Types of Subsurface Storage & Infiltration Cells

Numerous types of Subsurface Storage and Infiltration Cells may be used including:

- Aggregate Storage is a subsurface layer of rock or gravel that stores and infiltrates stormwater.
- Storage Chambers are an open bottom pipe or arch structure that store and infiltrate stormwater. Storage Chambers are similar to Aggregate Storage but can store more stormwater per unit of area.
- Dry Wells are stormwater inlet structures that have an open bottom and often have weep holes to allow stormwater to infiltrate.
- Tree Cells are a suspended pavement system that allow an uncompacted engineered media to support tree growth, stormwater storage, and stormwater infiltration beneath a paved area.

Note that many types of GI, including types of Subsurface Storage & Infiltration Cells and Surface Green Infrastructure, require an inlet to capture stormwater and a cleanout to allow maintenance access. Inlets and cleanouts have inspection and maintenance considerations like other types of

Subsurface Storage & Infiltration Cells. Inlets and cleanouts will be included in the City's GI GIS tracking system and follow the same inspection and maintenance schedule.

3.3 Subsurface Storage & Infiltration Cells Inspection and Maintenance

Inspection of Subsurface Storage and Infiltration Cells is required at least four times per year during the growing season (March – November with one inspection occurring in November) and within 48 hours after each major rain (more than 1-inch of rainfall). Monitoring of inlets, cleanouts, and potential overflows can be utilized to understand if the system is working properly or requires maintenance. Table 3 outlines basic inspection activities for Subsurface Storage and Infiltration Cells. An example inspection and maintenance form is included in Appendix D.

Table 3 | Subsurface Storage and Infiltration Cells Inspection Activities

	Aggregate Storage	Storage Chambers	Dry Wells	Tree Cells	Frequency
Inlets, Cleanouts, and Overflow Devices					
Inspect for sustained ponding (greater than 48 hours), debris, or sediment accumulation	X	X	X	X	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed
Natural Intrusion					
Root intrusion	X	X	X	N/A	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed
Tree Health					
Inspect if tree is healthy	N/A	N/A	N/A	X	- Four times per year during the March – November growing season (one inspection must be in November), - Within 48 hours after rainfalls of more than 1-inch of depth, and - As needed

Maintenance activities should be expected to support the long-term function of Subsurface Storage and Infiltration Cells. Maintenance activities should promote the site aesthetic and minimize clogging potential. Should inspection activities warrant maintenance, Table 4 outlines typical methods to ensure that the system continues to function as designed. An example inspection and maintenance form is provided in Appendix D.

Table 4 | Subsurface Storage and Infiltration Cells Maintenance Activities

	Aggregate Storage	Storage Chambers	Dry Wells	Tree Cells	Maintenance Frequency
Watering to promote plant establishment. Once established, trees should only require water during drought conditions.	N/A	N/A	N/A	X	During Establishment
Clean inlet, cleanout, and overflow devices	X	X	X	X	As Needed within 48 hours after rainfalls of more than 1-inch of depth
Mitigate root intrusion	X	X	X	N/A	
Restore and stabilize adjacent landscape areas	X	X	X	X	
Remove leaves and debris from inlets and structures	X	X	X	X	
Remove sediment and debris from inlets and pipes	X	X	X	X	If persistent ponding is observed (>48 hours)
Infiltration testing can determine if soil compaction or sediment clogging may be the cause of the problem, which can be remedied by vacuuming sediment, scarifying, or by replacing the soil in extreme cases.	X	X	X	X	

3.4 Subsurface Storage & Infiltration Cells Performance Testing

3.4.1 Pre-Construction

Pre-construction performance testing will be completed at Subsurface Storage and Infiltration Cells to determine the design native soil infiltration rate. Performance testing will be completed at or just below the proposed native soil interface. Performance testing may be completed using an approved infiltrometer or permeameter and will follow applicable ASTM standards, including applicable sections of ASTM D5126. See Appendix C for performance test setups and testing steps. The pre-construction design infiltration rate for the native soil, and where applicable the surface layer, will be documented in the GI GIS tracking system for each GI facility, see an example in Appendix D.

3.4.2 Post-Construction

Baseline performance testing of Subsurface Storage and Infiltration Cell installations will be conducted within six months of the completion of construction. Hydrant testing (also known as simulated runoff testing) will be used to test newly constructed Subsurface Storage and Infiltration Cell project sites to verify that water flows through the project as designed and to evaluate the subsurface native soil infiltration rate. This testing method will provide for the introduction of a controlled rate and volume of water under controlled conditions during dry weather. An inlet, clean out, or inspection port may be used to observe the subsurface drawdown rate. Testing will be performed a minimum of one per 6,000 square feet of installed Subsurface Storage and Infiltration Cell.

Prior to City acceptance of Subsurface Storage and Infiltration Cell projects, the satisfactory implementation of the completed work will be verified through post-construction performance testing and approval by the engineer. If the post-construction performance testing shows the GI is underperforming due to deficiencies in the work completed by the contractor such as improper installation of GI components or inadequately protecting GI during construction, then the contractor will perform remedial work to meet the plans and specifications. If the performance deficiency is due to typical maintenance issues such as accumulation of sediment or debris in inlets, then GI functionality will be restored as part of the City's routine maintenance activities.

In addition, the City will compare the post-construction infiltration rate to the pre-construction design infiltration rate. If the observed post-construction native soil infiltration rate is lower than the pre-construction design infiltration rate due to natural soil variability, the modeled infiltration rate will be reduced to the observed post-construction infiltration rate for the impacted facilities and future tests will be compared to this baseline. Post-construction performance testing results will be documented in the GI GIS tracking system, see an example in Appendix D.

3.4.3 Long-Term

Performance testing of Subsurface Storage and Infiltration Cell projects will be conducted at a minimum frequency of once every three years to track changes in performance. A minimum of one test per 6,000 square feet of installed Subsurface Storage and Infiltration Cell will be completed. Performance testing will be conducted using hydrant testing. See performance test setups and testing steps in Appendix C.

In addition, system-wide flow monitoring, project specific flow monitoring, and GI facility specific monitoring, such as water level monitoring in the subsurface storage or visual inspection within 48 hours of a rainfall, may be used to supplement performance testing and provide information about how the GI performs during real rainfall events.

Subsurface Storage and Infiltration Cells rely on the native soil infiltration rate to function properly, with stormwater typically entering the subsurface storage through an inlet or piping. Performance testing will be conducted such that the native soil infiltration rate can be compared to the pre-construction design infiltration rate. Long-term performance testing results will be documented in the GI GIS tracking system, see an example in Appendix D.

4.0 PERMEABLE PAVEMENT

4.1 Introduction

This section defines recommendations for operating, inspecting, maintaining, and performance testing for Permeable Pavement.

Permeable Pavement is a paved surface that allows stormwater to infiltrate either through void spaces or joints into a subsurface storage layer and underlying native soil. Permeable pavement systems are flexible, adaptable, and versatile stormwater management facilities that are effective for highly urban development and redevelopment to reduce runoff rates, runoff volumes, and pollutant loads.

Permeable Pavement is intended to filter solids and sediments from stormwater runoff before routing the water to washed aggregate storage and infiltration cells beneath. The objective of Permeable Pavement is to provide a reliable roadway surface, promote immediate stormwater filtration and conveyance to the subsurface, and extend the longevity of the subsurface. Because this GI component is required to filter solids from stormwater runoff, maintenance activities are necessary throughout the life of the Permeable Pavement.

Salt should not be applied to Permeable Pavement surfaces. Use rubber edge blades for plowing snow from Permeable Pavement areas and set plow blades 1/2-inch to 1-inch above the pavement surface. Specific maintenance activities should follow the manufacturers' recommendations.

4.2 Types of Permeable Pavement

Numerous types of Permeable Pavement may be used including:

- Porous Asphalt is a flexible pavement surface that allows stormwater to infiltrate through void spaces.
- Pervious Concrete is a rigid pavement surface that allows stormwater to infiltrate through void spaces.
- Permeable Paver Bricks are a pavement surface that allows stormwater to infiltrate through joint spaces.
- Permeable Paver Blocks are a pavement surface that allows stormwater to infiltrate through joint spaces.

4.3 Permeable Pavement Inspections and Maintenance

Routine inspection of Permeable Pavement systems is important for the long-term function of the system. More frequent inspections should be performed during periods of construction until full site development is concluded, and acceptable performance is established. To adequately inspect Permeable Pavement, these areas need to be observed during and after rain events. If no surface

ponding is observed, then the Permeable Pavement is functioning adequately to meet the design goals of the stormwater management system. If ponding does occur, maintenance activities will be required as soon as practical. In addition, infiltration monitoring technology, such as INFIL-Trackers, may be used to supplement Permeable Pavement performance monitoring, provide information about how the GI performs during real rainfall events, and aid in determining when maintenance is required. Inspection of Permeable Pavement systems is required at least four times per year during the growing season (March – November with one inspection occurring in November) and within 48 hours after each major rain (more than 1-inch of rainfall). Table 5 outlines basic inspection activities for Permeable Pavement. An example inspection and maintenance form is included in Appendix D.

Table 5 | Permeable Pavement Inspection Activities

	Inspection Frequency
Inspect to ensure that pavement was installed and functioning properly	• Post-construction
Inspect areas for potential sand or sediment deposition from installation operations	
Permeable Pavement Surface	
Visibly inspect for evidence of sediment, debris (mulch, leaves, trash, etc.), ponding of water, clogging of pores, other damage	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed
Inspect surface for structural integrity. Inspect for evidence of deterioration or spalling.	
Adjacent Areas	
Inspect exposed soil areas discharging and adjacent to Permeable Pavement	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed
Ensure that the contributing area upstream of the Permeable Pavement is free of sediment and debris	
Determine if adjacent areas harm Permeable Pavement	
Overflow Devices	
Inspect overflow devices (pipes and inlets) for obstructions or debris that would prevent proper drainage when filtration capacity is exceeded	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed

Maintenance activities should be expected to support the long-term function of the Permeable Pavement. Maintenance activities should promote the site aesthetic and minimize clogging potential. Should inspection activities warrant maintenance, Table 6 outlines typical maintenance activities to ensure that the system continues to function as designed. An example inspection and maintenance form is provided in Appendix D.

Table 6 | Permeable Pavement Maintenance Activities

	Maintenance Frequency
Remove excess sediment from the construction area and stabilize adjacent areas with vegetation	• Post-construction
Vacuum sweep Permeable Pavement (with proper disposal of removed material).	• Twice a year, minimum, and • As needed within 48 hours after rainfall of more than 1-inch of depth
Prevent soil from being washed onto the pavement by ensuring that adjacent areas are stabilized. Keep landscape areas well maintained with lawn clippings removed to prevent clogging pavement.	• As needed within 48 hours after rainfalls of more than 1-inch of depth
Rake and remove fallen leaves and debris from deciduous trees and shrubs to reduce the risk of clogging.	
Remove debris and clear obstructions from overflow devices (pipes and inlets).	
If ponding persists, clogged Permeable Pavement must be repaired or replaced.	• If failure occurs

4.4 Permeable Pavement Performance Testing

4.4.1 Pre-Construction

Pre-construction performance testing will be completed at Permeable Pavement installations to determine the design native soil infiltration rate. Performance testing will be completed at or just below the proposed native soil interface. Performance testing may be completed using an approved infiltrometer or permeameter and will follow applicable ASTM standards, including applicable sections of ASTM D5126. See Appendix C for performance test setups and testing steps. The pre-construction design infiltration rate for the native soil, and where applicable the surface layer, will be documented in the GI GIS tracking system for each GI facility; see an example in Appendix D.

4.4.2 Post-Construction

Baseline performance testing of Permeable Pavement installations will be conducted within six months of the completion of construction and will consist of hydrant testing and/or single ring infiltration testing. Hydrant testing (also known as simulated runoff testing) will be used to test newly constructed Permeable Pavement project sites to verify that water flows through the project as designed and to evaluate the subsurface native soil infiltration rate. This testing method will provide for the introduction of a controlled rate and volume of water under controlled conditions during dry weather. An inlet, clean out, or inspection port may be used to observe the subsurface drawdown rate. Single ring infiltration testing will be used to measure the surface infiltration rate of newly constructed Permeable Pavement projects. The testing frequency will be a minimum of one per 6,000 square feet of installed Permeable Pavement.

Prior to City acceptance of Permeable Pavement projects, the satisfactory implementation of the completed work will be verified through post-construction performance testing and approval by the engineer. If the post-construction performance testing shows the GI is underperforming due to deficiencies in the work completed by the contractor such as improper installation of GI components or inadequately protecting GI during construction, then the contractor will perform remedial work to meet the plans and specifications. If the performance deficiency is due to typical maintenance issues such as accumulation of sediment or debris on the surface of the GI, then GI functionality will be restored as part of the City's routine maintenance activities.

In addition, the City will compare the post-construction infiltration rate to the pre-construction design infiltration rate. If the observed post-construction native soil infiltration rate is lower than the pre-construction design infiltration rate due to natural soil variability, the modeled infiltration rate will be reduced to the observed post-construction infiltration rate for the impacted facilities and future tests will be compared to this baseline. Post-construction performance testing results will be documented in the GI GIS tracking system, see an example in Appendix D.

4.4.3 Long-Term

Performance testing of Permeable Pavement projects will be conducted at a minimum frequency of once every three years to track changes in performance. A minimum of one test per 6,000 square feet of installed permeable pavement will be completed. Performance testing of the subsurface native soil infiltration rate will be conducted using hydrant testing. Performance testing of the Permeable Pavement surface infiltration rate will be conducted using either ASTM C1701 for porous pavements or ASTM C1781 for permeable paver systems. See performance test setups and testing steps in Appendix C.

In addition, system-wide flow monitoring, project-specific flow monitoring, GI facility-specific monitoring technology, such as INFIL-trackers, or visual inspection within 48 hours of a rainfall may be used to supplement performance testing and provide information about how the GI performs during real rainfall events.

Permeable pavement relies on the surface infiltration rate and the native soil infiltration rate to function properly. Performance testing will be conducted such that each layer can be compared to the pre-construction design infiltration rate. Long-term performance testing results will be documented in the GI GIS tracking system, see an example in Appendix D.

5.0 STORMWATER RETENTION

5.1 Introduction

This section defines recommendations for operating, inspecting, maintaining and performance testing for Stormwater Retention.

Stormwater Retention is intended to provide stormwater storage, reduce peak flow rates, and filter solids and sediments from stormwater runoff. These GI systems are flexible, adaptable, and versatile stormwater management facilities that are effective for highly urban development and redevelopment to reduce runoff rates, runoff volumes, and pollutant loads. Because its shape is flexible, Stormwater Retention can be adapted to many types of sites.

Generally, Stormwater Retention may consist of a flow inlet structure, a pretreatment element, a temporary ponding area with overflow, vegetation, and an outflow regulating structure (for example, an upturned underdrain). Each component of the Stormwater Retention should be adequate to ensure proper functioning and operation of the system.

5.2 Types of Stormwater Retention

Numerous types of Stormwater Retention may be used including:

- Constructed Wetlands use wetland soils and vegetation to retain stormwater, reduce peak flow rates, filter pollutants, and promote evapotranspiration.
- Detention Storage, which includes both dry ponds and wet ponds, are depressions in the landscape that retain stormwater, reduce peak flow rates, and promote water quality.
- Green Roofs consist of vegetation, planting media, and a water proofing system that allows rainfall to be stored and evapotranspired on a building roof.

5.3 Stormwater Retention Inspections and Maintenance

Routine operation and maintenance are essential to gain public acceptance of highly visible urban GI areas and ensure the proper functioning of the overall stormwater system. Inspection of Stormwater Retention is required at least four times per year during the growing season (March through November with one inspection occurring in November) and within 48 hours after each major rain (more than 1-inch of rainfall). Table 7 below outlines basic inspection activities. A sample inspection and maintenance form is included at the end of this section.

Table 7 | Stormwater Retention Inspection Activities

	Inspection Frequency
Vegetation	
Inspect for invasive species which include reed canary grass, purple loosestrife, common reed, Canada thistle, garlic mustard, and cheatgrass. Error! Reference source not found. contains photos of these six common invasive species as well as a list of additional species which may be found.	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed
Inspect for invasive/volunteer trees	
At least 95% survival of established plants – no dead growth	
Vegetation confined to planted areas – no overgrown appearance, does not impede pedestrian access, does not cause line of sight or driver safety issues, infrastructure accessible	
Surface	
No ponding above outlet – water drains within 48 hours	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed
Soil is well aerated, no evidence of compaction	
Inspect preferential inlet locations for erosion and undercutting	
No channelization or scouring	
No bare spots	
Debris	
Inspect for floatable debris	• Four times per year during the March – November growing season (one inspection must be in November), • Within 48 hours after rainfalls of more than 1-inch of depth, and • As needed
No buildup of debris or sediment	

Stormwater Retention practices are expected to develop into dynamic microcosms requiring little maintenance once species are established. The function of Stormwater Retention is enhanced by the vegetation. Maintenance activities should promote the site aesthetic, promote healthy vegetation, and minimize clogging potential. Should inspection activities warrant maintenance, Table 8 outlines typical methods to ensure that the system continues to function as designed. An inspection and maintenance checklist is provided below. The checklist will be integrated into the City's GI GIS tracking system if/when stormwater retention is planned as part of an annual GI project.

Table 8 | Stormwater Retention Maintenance Activities

	Maintenance Frequency
Watering to promote plant establishment. Once established, plants should only require water during drought conditions	During Establishment Period
Remove invasive/volunteer species of plants	As Needed within 48 hours after rainfalls of more than 1-inch of depth
Remove invasive/volunteer species of trees	
Remove dead growth	
Rake/remove leaves	
Trim overgrown vegetation	
Remove floatable debris	
Remove debris and clear obstructions from curb lines, inlets, and overflow devices (pipes and inlets)	
Restore erosion and undercutting on landscape slopes and overflow devices	
Restore landscape areas to proper grade, stabilize, and re-mulch. Appendix A contains tree and plant species that can be used to restore landscape areas.	
Inspect outlet structures for damage or clogging	If persistent ponding is observed (>48 hours)
Perform water jet cleaning of clogged underdrains if present	

STORMWATER RETENTION INSPECTION AND MAINTENANCE CHECKLIST

Project Name: _____
 GI Facility ID: _____ As-Built Plans
 Inspector: _____ Available?
 Date: _____ Time: _____

Previous Rainfall	
Days Since	
Amount (in)	

Inspection Item	Is Maintenance Required? (Y, N, N/A)	Notes
Vegetation		
Vegetation is healthy – at least 95% survival of established plants; no dead growth		
Vegetation confined to planted areas – not overgrown impairing pedestrian access or driver safety		
Specified vegetation is present		
Invasive species identified		
Plants are watered as needed		
Other		
Planter Bed		
Site dewateres within 48 hours		
Soil is well aerated, no evidence of compaction		
No channelization or scouring		
No bare spots		
Other		
Debris		
Remove all trash, leaves, and debris		
Ensure all curb turnouts are clear and free of obstructions		
Ensure all inlets and overflow devices are clear and free of obstructions		
Remove soil accumulation		
Other		
Actions to be taken:		

5.4 Stormwater Retention Performance Testing

5.4.1 Pre-Construction

Pre-construction performance testing of native soils for Stormwater Retention systems is not required since these systems do not infiltrate stormwater. However, existing site conditions will need to be determined for proper Stormwater Retention design.

5.4.2 Post-Construction

Constructed Wetlands and Detention Storage provide temporary stormwater storage that discharges through an outlet structure. The storage elevation, storage volume, and outlet structure will be inspected to ensure compliance with the original design.

Green Roofs infiltrate stormwater through the surface and convey stormwater to an outlet structure. The rate that stormwater is filtered through the surface of the Green Roof should be verified using an appropriate method.

Baseline performance testing of Stormwater Retention installations will be conducted within six months of the completion of construction. A visual inspection, per the Stormwater Retention and Maintenance Checklist in Section 5.3, within 48 hours of rainfall greater than the Design Storm will be used to test newly constructed Stormwater Retention projects to verify the project operates as designed.

Prior to City acceptance of Stormwater Retention projects, the satisfactory implementation of the completed work will be verified through post-construction performance testing and approval by the engineer. If the post-construction performance testing shows the GI is underperforming due to deficiencies in the work completed by the contractor such as improper installation of GI components or inadequately protecting GI during construction, then the contractor will perform remedial work to meet the plans and specifications. If the performance deficiency is due to typical maintenance issues such as accumulation of sediment or, then GI functionality will be restored as part of the City's routine maintenance activities.

5.4.3 Long-Term

Performance testing of Stormwater Retention projects will be conducted at a minimum frequency of once every three years to track changes in performance. A minimum of one Stormwater Retention facility per project will be tested. Performance testing may be conducted by a visual inspection, per the Stormwater Retention and Maintenance Checklist in Section 5.3, within 48 hours of rainfall greater than the Design Storm.

In addition, system-wide flow monitoring, project specific flow monitoring, and GI facility specific monitoring may be used to supplement performance testing and provide information about how the GI performs during real rainfall events.

6.0 GRAY INFRASTRUCTURE

6.1 Introduction

This section defines recommendations for operating, inspecting, and maintaining CSO control gray infrastructure. Gray infrastructure is a traditional approach to reduce combined sewer overflows. Gray infrastructure may be constructed to store or convey additional combined sewage flow volume, or to reduce wet weather inflows to the combined sewer system.

6.2 Types of Gray Infrastructure

Gray infrastructure includes many conventional technologies to store excess wet weather flow or reduce wet weather flow in the combined sewer system. Gray storage projects include in-system storage and offline storage. Gray infrastructure wet weather flow reduction projects may include sewer separation, sewer lining, and downspout disconnection.

6.3 Gray Infrastructure Inspection and Maintenance

Inspection and maintenance of existing CSO gray infrastructure is detailed in the City's Operation and Maintenance Plan for Combined Sewers. The City's sewers are currently cleaned and maintained by GPSD. The City intends to provide adequate budget to allow GPSD to perform future maintenance activities consistent with the principles and practices of GPSD's comprehensive Capacity, Management, Operation, and Maintenance (CMOM) plan. It is anticipated that future gray improvements such as sewer separation and in-system storage will be cleaned, operated, and maintained by GPSD.

Typical O&M procedures for CSO storage tank systems include inspection, cleaning, and maintenance of screens and pumping equipment and removal of solids. Specific O&M procedures will be defined once gray infrastructure CSO Remedial Measures methods have been selected and designed. It is anticipated that CSO-related storage tanks will be operated and maintained by GPSD following their standard procedures.

APPENDIX A

Project Tree and Plant List

APPENDIX A. PROJECT TREE AND PLANT LIST

DECIDUOUS TREES



crataegus spp

Thornless Hawthorn

Size: 20-30 feet tall, 20-35 feet wide

Habit: moderate growth rate; broad, round shape

Hardiness: zones 3 to 7

Tolerance: salt spray, drought

Foliage: dark glossy green leaves turn purplish in fall

Characteristics: beautiful white flowers in spring; persistent fruit in fall and winter



gleditsia triacanthos f. inermis

Thornless Honey Locust

Size: 30-70 feet tall, 30-70 feet wide

Habit: fast-growing, oval-shaped

Hardiness: zones 3 to 9

Tolerance: pollution, salt, and drought

Foliage: lacy green foliage, showy yellow in fall

Characteristics: yields brown seed pods 7-8" long by 1" wide

Note: transplants well, easy to grow

Suggested Cultivars: moraine, skyline



gymnocladus dioicus

Kentucky Coffee Tree

Size: 60-75 feet tall, 40-50 feet wide

Habit: moderate growth rate; irregular oval shape

Hardiness: zones 3 to 8

Tolerance: salt spray, pollution, drought

Foliage: blue-green leaves with mild yellow fall color

Characteristics: spreading canopy capable of blocking sunlight and adds visual interest and beauty to landscaping

Note: consider male cultivars to avoid messy fruit

Suggested Cultivars: Espresso, Prairie Titan, Stately Manor



platanus × acerifolia

London Plane Tree

Size: 70-100 feet tall, 65-80 feet wide

Habit: medium growing in a pyramidal shape that shifts to a more oval silhouette over time

Hardiness: zones 5 to 8

Tolerance: very tolerant of urban conditions

Characteristics: bark has gray-brown flaky scales that shed to expose mottled peeling patches of white, gray, and green

Note: easily transplanted, prefers large spaces

Suggested Cultivars: encore, exclamation



taxodium distichum

Bald Cypress

Size: 50-70 feet tall, 20-30 feet wide

Habit: medium-growing pyramid shape

Hardiness: zones 4-11

Tolerance: salt spray

Foliage: soft, feathery green needles turn russet-red in autumn before falling

Characteristics: deciduous conifer

Suggested Cultivars: Monarch of Illinois, Shawnee Brave



ulmus parvifolia

Chinese Elm

Size: 40-60 feet tall, 50-60 feet wide

Habit: fast-growing vase shaped

Hardiness: zones 5-9

Tolerance: dry sites and alkaline soils

Foliage: shiny dark green turns purplish in fall with exfoliating, mottled bark

Characteristics: resistant to Dutch elm disease and air pollution

SHRUBS



aronia melanocarpa

Black Chokeberry

Size: 5-8 feet

Habit: slow to moderate growing

Hardiness: zones 3-8

Foliage: dark green turns deep mahogany red in fall

Characteristics: attracts birds and butterflies

Suggested Cultivars: Iroquois Beauty

PERENNIALS



liatris spicata

Dense Blazing Star

Height: 3-5 feet

Color: Purple

Bloom Time: July-September



aster novae-angliae

New England Aster

Height: 3-6 feet

Color: pink, purple

Bloom Time: August-October



baptisia australis

Blue False Indigo

Height: 3-5 feet

Color: blue, purple

Bloom Time: April-July



penstemon digitalis

Foxglove Beard Tongue

Height: 1.5-3 feet

Color: white

Bloom Time: May-July



rudbeckia subtomentosa

Sweet Black-Eyed Susan

Height: 3-6 feet

Color: yellow

Bloom Time: July-September



iris virginica shrevei

Blue Flag Iris

Height: 1-3 feet

Color: blue, purple

Bloom Time: May



physostegia virginiana

Obedient Plant

Height: 3-5 feet

Color: pink, purple

Bloom Time: August-November



asclepias tuberosa

Butterfly Milkweed

Height: 1-1 feet

Color: orange, yellow

Bloom Time: May-September



echinacea purpurea

Purple Coneflower

Height: 2-5 feet

Color: pink, purple

Bloom Time: April-September

ORNAMENTAL GRASSES



sporobolus heterolepis

Prairie Dropseed

Height: 2-3 feet

Color: green leaves with golden fall color

Bloom Time: August-September



carex brachyglossa

Yellow Fox Sedge

Height: 1.5-3 feet

Color: green leaves with yellow spikelets

Bloom Time: late spring-early summer



deschampsia cespitosa

Tufted Hair Grass

Height: 1-2 feet

Color: brown

Bloom Time: May-June



schizachyrium scoparium

Little Blue Stem

Height: 3-6 feet

Color: white, green, brown

Bloom Time: June-December



panicum virgatum

Shenandoah Grass

Height: 3-4 feet

Color: green, golden, red-tinged

Bloom Time: July-February

APPENDIX B

Invasive Plant Species

APPENDIX B. INVASIVE PLANT SPECIES

Below are photos of invasive plant species and a species list of invasive plants that may be commonly found in vegetated areas.



Common Reed



Canada Thistle



Garlic Mustard



Purple Loosestrife



Reed Canary Grass



Cheatgrass

Below is a list of invasive plants that may be found in vegetated areas.

- Autumn Olive
- Black Locust Reed
- Chinese Silvergrass
- Common Reed
- Creeping Jenney
- Dames Rocket
- Japanese Honeysuckle
- Japanese Knotweed
- Multiflora Rose
- Norway Maple
- Purple Loosestrife
- Canarygrass
- Russian Olive
- Siberian Elm
- Smooth Brome
- Star-of-Bethlehem
- Tall Fescue
- Tree-of-Heaven
- White Mulberry
- Winged Burning Bush

A complete list of Illinois invasive plant species can be found at
<http://www.invasive.org/species/list.cfm?id=152>

APPENDIX C

Performance Test Setups and Testing Steps

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Revision Summary

January 2024

Section 1.0	Added section number and heading.
Section 1.1	Added test purpose, equipment, performance testing steps, and post processing information.
Section 1.2	Added test purpose, equipment, performance testing steps, and post processing information.
Section 2.0	Added section number and heading.
Section 2.1	Updated photo. Added test purpose, equipment, performance testing steps, and post processing information.
Section 2.2	Added test purpose, equipment, performance testing steps, and post processing information.
Section 2.3	Updated photo. Added test purpose, equipment, performance testing steps, and post processing information.
Section 2.4	Added section for surface infiltration testing of soils, including test purpose, equipment, performance testing steps, and post processing information.

May 2024

Section 1.1.3	Added personal protective equipment (PPE) to the list of required equipment.
Section 1.2.3	Added PPE to the list of required equipment.

Section 2.1	Updated to clarify that hydrant testing will be used to evaluate subsurface native soil infiltration rates and will not be used to determine surface infiltration rates.
Section 2.1.3	Added PPE to the list of required equipment.
Section 2.1.4	Added a reasonable maximum test duration for GI facilities with an inlet, clean out, or inspection port that allows for depth to water measurements.
Section 2.2.3	Added PPE to the list of required equipment.
Section 2.3.3	Added PPE to the list of required equipment.
Section 2.4.3	Added PPE to the list of required equipment.

1.0 Pre-Construction Testing

1.1 Guelph Permeameter

1.1.1 Purpose

Determine subsurface saturated hydraulic conductivity of in-situ soil for use in GI siting and design.



Figure 1 | Assembled Guelph Permeameter

1.1.2 Description

Above is a photo of an assembled Guelph permeameter as shown in the Guelph Permeameter Operating Instructions dated December 2012 (Soilmoisture Equipment Corp, 2012). The Guelph Permeameter measures the field-saturated hydraulic conductivity in an augured borehole, allowing measurement of subsurface hydraulic conductivity rates without significant excavation. A description of the borehole permeameter test method description can be found in the ASTM standard guide (American Society of Testing and Materials, 2016).

1.1.3 Equipment

The following equipment is required.

- Guelph permeameter kit
- Pliers
- Stopwatch
- Water containers
- Traffic cones
- High visibility safety vest
- Boots

1.1.4 Performance Testing Steps

The following steps should be completed for the performance test.

1. Bore a hole to the desired test depth with minimum disturbance to the wall of the hole. Borehole depth is typically the proposed depth to the bottom of the planned green infrastructure, generally around four to six feet below ground surface.
2. Log the soil texture and profile as the hole is bored.
3. Record the radius and depth dimensions of the borehole.
4. Determine the depth of water desired in the hole for test conditions. The depth of water is typically five times the radius of the soil auger used to complete the bore hole.
5. Set up the constant head system (refer to instrument user's manual).
6. Adjust the regulator tubes to maintain water at a constant level.
7. Check the water reservoir tank regularly and refill as needed.
8. Start the flow and stopwatch.
9. Record the water level in the reservoir tanks at regular intervals. Recommend recording water level at least every 30 seconds if testing permeability of sands and every two minutes if testing silt or clay soils.
10. Compute the flow rate for each measurement.
 - a. Continue measurements until flow rate becomes constant (when flow rate does not significantly change in three consecutive time intervals). The test is then complete.
 - b. In the event of unstable flow rate measurements, the test is complete when the water level in the bore hole has stabilized.
 - c. The test duration varies based on site conditions but, in general, test durations for sandy soils are in the 10 to 20 minute range and 30 to 45 minute range for silt and clay soils.

1.1.5 Post Processing

Use the following input data recorded during testing with the manufacturer's spreadsheet or computation guidelines for calculation of the field saturated hydraulic conductivity.

- r radius of borehole
- H height of water above bottom of hole (should be constant)
- Q steady state rate of water inflow to borehole needed to maintain constant H

Define the flow rate, Q, to use for the permeability calculations by averaging the last three flow rate measurements. In the event that flow rate measurements do not stabilize, use the lowest flow rate measurement after the water level in the borehole stabilized.

1.2 Compact Constant Head Permeameter (CCHP)

1.2.1 Purpose

Determine subsurface saturated hydraulic conductivity of in-situ soil for GI siting and design.



**Figure 2 | Compact Constant
Head Permeameter**

1.2.2 Description

Above is a photo of a compact constant head permeameter (CCHP), also known as an Amoozometer, as shown on ksatinc.com. The CCHP measures the field saturated hydraulic conductivity in an augured borehole, allowing measurement of subsurface hydraulic conductivity rates without significant excavation. A description of the borehole permeameter test method description can be found in the ASTM standard guide (American Society of Testing and Materials, 2016).

1.2.3 Equipment

The following equipment is required.

- Compact constant head permeameter
- Soil auger
- Stopwatch
- Water containers
- Traffic cones
- High visibility safety vest
- Boots

1.2.4 Performance Testing Steps

The following steps should be completed for the performance test.

1. Bore a hole to the desired test depth with minimum disturbance to the wall of the hole. Borehole depth is typically the proposed depth to the bottom of the planned green infrastructure, generally around four to six feet below ground surface.
2. Log the soil texture and profile as the hole is bored.
3. Record the radius and depth dimensions of the borehole.
4. Determine the depth of water desired in the hole under test conditions. Depth of water is typically five times the radius of the soil auger used to complete the bore hole.
5. Set up the constant head system (refer to instrument user's manual).
6. Adjust the regulator tubes to maintain water at a constant level.
7. Check the water reservoir tank regularly and refill as needed.
8. Start the flow and stopwatch. Record the water level in the reservoir tanks at regular intervals. Recommend recording water level at least every 30 seconds if testing permeability of sands and every two minutes if testing silt or clay soils.
9. Compute the flow rate for each measurement.
 - a. Continue recording measurements until the flow rate becomes constant (when flow rate does not significantly change in three consecutive time intervals). The test is then complete.
 - b. In the event of unstable flow rate measurements, the test is complete when the water level in the bore hole has stabilized.

- c. The test duration varies based on site conditions but, in general, test durations for sandy soils are in the 10 to 20 minute range and 30 to 45 minute range for silt and clay soils.

1.2.5 Post Processing

Use the following input data recorded during testing with manufacturer's spreadsheet or computation guidelines for calculation of the field saturated hydraulic conductivity.

- r radius of borehole
- H height of water above bottom of hole (should be constant)
- Q steady state rate of water inflow to borehole needed to maintain constant H

Define the flow rate, Q , for permeability calculations by averaging the last three flow rate measurements. In the event that flow rate measurements do not stabilize, use the lowest flow rate measurement after the water level in the borehole stabilized.

2.0 Post-Construction and Long-Term Testing

2.1 Hydrant Testing

2.1.1 Purpose

Determine the subsurface native soil infiltration rate of in-situ GI when the subsurface native soil layer is not accessible for a single ring test.



Figure 3 | Hydrant Testing to evaluate the Subsurface Native Soil Infiltration Rate below Permeable Pavers in Peoria

2.1.2 Description

Above is a photo of a hydrant test performed by Peoria to evaluate subsurface native soil infiltration rate of a permeable pavement GI facility.

Hydrant testing involves introducing a known rate of water to the GI facility and measuring the rate at which that water is infiltrated at the subsurface native soil interface. The rate that the water is introduced should exceed the rate that water is expected to infiltrate. After water has been introduced to the GI facility, the wetted area or the recession rate, also known as the drawdown rate, can be used to determine the infiltration rate at the native soil interface.

2.1.3 Equipment

The following equipment is required.

- Hydrant wrench
- Hydrant flow meter
- Fire hose
- Sandbags
- Stopwatch
- Measuring tape
- Traffic cones
- High visibility safety vest
- Boots

2.1.4 Performance Testing Steps

The following steps should be complete for the performance test.

1. Inspect GI facility for any issues that would prevent hydrant testing, such as high vehicle traffic, obstructions to the GI facility, or if the GI facility is in need of maintenance.
2. Calculate the minimum required test duration for a given GI facility and hydrant flow rate.
 - a. The minimum test duration is calculated from a mass balance on inflow from the hydrant, outflow from design native soil infiltration rate, and the change in storage volume in the GI facility. The storage volume is based on the GI facility geometry including the subsurface area, depth of storage, and porosity of storage. The minimum test duration results in the GI facility being full or overflowing if the native soil infiltration rate is at or below the design infiltration rate, respectively.
 - b. In general, the minimum calculated test durations for GI facilities typically range from 30 minutes to 3 hours when using a hydrant flow rate around 350 GPM.
 - c. If the GI facility has an available inlet, clean out, or inspection port that allows depth to water measurements, then a maximum test duration of 1.5 hours may be used. A maximum test duration is necessary to maintain reasonable test durations and avoid wasting excess water. The 1.5-hour maximum duration allows for sufficient accumulation in the storage layer to measure the depth to water multiple times following the test and to reduce the effects of the soil suction head.
3. Establish traffic control, if needed.
4. Set up the hydrant flow meter and hose. Direct the hose to pavement approximately 25 feet upstream of GI facility, or far enough that energy is dissipated from nozzle. Place sandbags as needed to direct flow and position fire hose.
5. Record the time and initial depth to water, for example in sumped inlets.
6. Open the hydrant with the hydrant wrench to the desired flow rate.
7. Start the stopwatch once the hydrant flow is set.

8. If the actual hydrant flow rate is different than the desired flow rate, adjust the minimum test duration calculated in Step 2 above based on actual flow rate from the hydrant.
9. Record the time and depth to water in the storage utilizing available inlets, clean outs, or inspection ports for observation throughout the test. Perform measurements at regular time intervals.
10. Observe the GI facility to confirm the subsurface storage is not full, resulting in “overflow” of stormwater from GI facility (flow coming out of GI and flowing overland to next downstream inlet or GI facility).
11. Stop the hydrant flow when the test duration exceeds the required minimum test duration or when the storage capacity is exceeded and “overflow” is observed, whichever occurs first.
12. Record the duration of test.
13. When the hydrant flow is stopped, measure the depth to water in the GI storage utilizing available inlets, clean outs, or inspection ports. Record the time and depth to water.
14. Perform additional measurements of the depth to water as the storage facility is draining, if possible. Record the time and depth to water, see Figure 4. Perform measurements at regular time intervals until water has fully drained or returned to initial level measured in Step 5.

2.1.5 Post Processing

Calculate the subsurface native soil infiltration rate using the hydrant flow rate, test duration, depth of water in subsurface storage, and geometry of the GI facility.

1. If the GI facility does not overflow, and there are no inlets, clean outs, or inspection ports to use for making water level observations:
 - a. The subsurface native soil infiltration rate is reported as greater than the design infiltration rate used to calculate the minimum test duration from a GI facility mass balance. This verifies that the facility is functioning at least as well as designed. The infiltration rate can only be reported as greater than, rather than a specific value, due to the GI facility not having an observation point for measuring the depth to water in the storage layer.
2. If the GI facility does not overflow, and drawdown of the water level is measured at inlets or clean outs following completion of the test:
 - a. The drawdown rate is calculated from the observed change in depth to water and change in time at each measured time interval, see example in Figure 4. This is completed for each inlet or clean out with depth to water measurements.
 - b. The measured subsurface native soil infiltration rate is the steady state drawdown rate. A steady state drawdown rate occurs if there is no change in the drawdown rate between consecutive measurements. If the infiltration rate does not achieve a clear steady state, the minimum drawdown rate is used as the measured native soil infiltration rate.
 - c. If the depth to water during the final observation is below the clean out or inlet invert, the rate for the time step is calculated using the depth to the invert and the actual drawdown rate is greater than the calculated drawdown rate. See Figure 4 for an

example. If there are multiple measurements of drawdown rates, the drawdown rate with the water level below the invert may be excluded as it is the least accurate.

- d. If the storage facility has a porosity less than 1, e.g., a stone aggregate, the measured drawdown rate is multiplied by the porosity to convert the field measurement to the volumetric drawdown rate.
3. If the GI facility does not overflow, and a steady state water level is maintained in the storage layer during the test:
 - a. The subsurface native soil infiltration rate is calculated as the hydrant inflow rate divided by the wetted native soil interface area. The native soil interface area is based on as built conditions and the entire area is assumed to be wetted.
 - b. If drawdown measurements are recorded after the hydrant is shut off, calculate the infiltration rate during drawdown following the procedure in Section 2.1.4, Step 2.a. Compare the rate during drawdown to the rate when the hydrant is flowing and use the minimum value as the native soil infiltration rate.
4. If the GI facility overflows before the minimum test duration inspect the GI facility for potential issues.
 - a. If the GI is underperforming due to deficiencies in the work completed by the contractor such as improper installation of GI components or inadequately protecting GI during construction, then the contractor will perform remedial work to meet the plans and specifications. Retest the GI facility after the contractor has completed remedial work.
 - b. If the performance deficiency is due to typical maintenance issues such as accumulation of sediment or debris on the surface of the GI, then GI functionality will be restored as part of the City's routine maintenance activities. Retest the GI facility after the City has completed routine maintenance activities.
 - c. If no construction deficiencies or maintenance issues are identified, the subsurface native soil infiltration rate is calculated using a mass balance on the hydrant flow rate and duration to fill the GI facility. This is the same approach used to calculate the minimum required test duration described in Hydrant Testing Performance Testing Step 2 but using the duration as an input and calculating the native soil infiltrate rate.

$$\text{Rate}_1 = \frac{\text{Depth}_2 - \text{Depth}_1}{\text{Time}_2 - \text{Time}_1} * \text{Porosity}$$

$$\text{Rate}_2 > \frac{\text{Invert Depth} - \text{Depth}_2}{\text{Time}_3 - \text{Time}_2} * \text{Porosity}$$

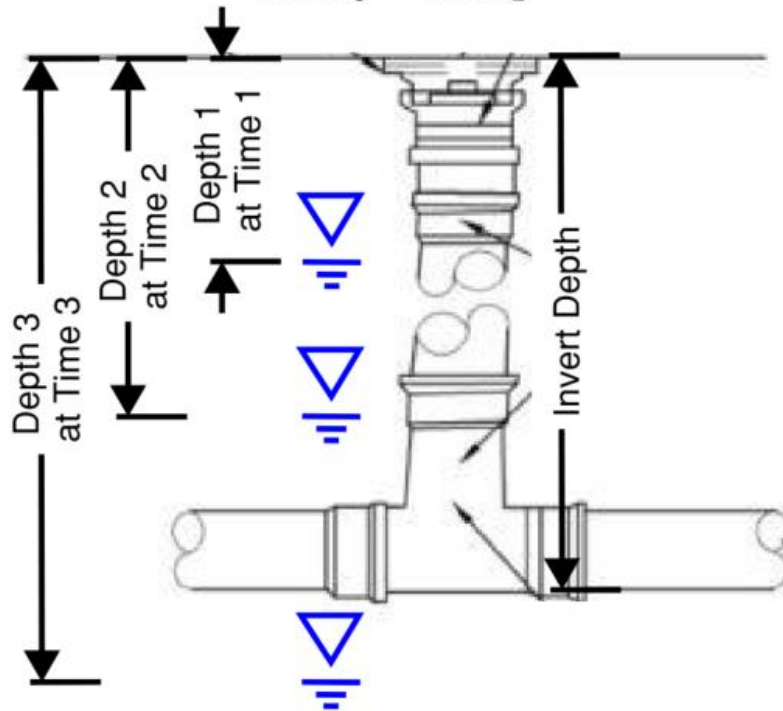


Figure 4 | Example Depth to Water Level Measurements in Clean Out or Inlet During Hydrant Testing. The depth to water at Time 3 is below the structure invert, and therefore the Depth 3 measurement cannot be completed, and the invert depth is used in its place.

2.2 Single Ring Infiltration Test for Porous Asphalt and Pervious Concrete

2.2.1 Purpose

Determine surface infiltration rate of porous asphalt and pervious concrete.



Figure 5 | Test Set Up Using ASTM C1701 for Porous Pavements

2.2.2 Description

Setup the test using ASTM C1701, which is a single ring infiltrometer test that uses the observed rate that water flows into the pavement to calculate the surface infiltration rate (American Society for Testing and Materials, 2018).

2.2.3 Equipment

The following equipment is required.

- Infiltration ring
- Scale
- Water containers
- Stopwatch
- Plumber's putty
- Traffic cones
- High visibility safety vest
- Boots

2.2.4 Performance Testing Steps

Follow steps 8.1 through 8.4 of ASTM Standard C1701 Standard Test Method for Infiltration Rate of In Place Pervious Concrete (American Society for Testing and Materials, 2018).

2.2.5 Post Processing

Calculate the surface infiltration rate using equation in step 9.1 of ASTM Standard C1701 Standard Test Method for Infiltration Rate of In Place Pervious Concrete (American Society for Testing and Materials, 2018).

Calculate the infiltration rate (I) as follows:

$$I = KM/(D^2 \cdot t)$$

where:

I = Infiltration rate, in/hr

M = Mass of infiltrated water, lb

D = Inside diameter of infiltration ring, in

t = time required for measured amount of water to infiltrate the surface, sec, and

K = 126 870

The factor K has units of [(in.³sec)/(lbhr)] and is needed to convert the recorded data (M, D, and t) to the infiltration rate I in in/hr

2.3 Single Ring Infiltration Test for Permeable Unit Pavement Systems

2.3.1 Purpose

Determine surface infiltration rate of permeable unit pavement systems.



Figure 6 | Test Set Up Using ASTM C1781 for a Permeable Paver System in Peoria

2.3.2 Description

Setup the test to evaluate the infiltration rate of Peoria's permeable paver system using ASTM C1781, which is a single ring infiltrometer test that uses the observed rate that water flows into the pavement to calculate the surface infiltration rate (American Society for Testing and Materials, 2021).

2.3.3 Equipment

The following equipment is required.

- Infiltration ring
- Scale
- Water containers
- Stopwatch
- Plumber's putty
- Chalk
- Camera
- Traffic cones
- High visibility safety vest
- Boots

2.3.4 Performance Testing Steps

Follow steps 8.1 through 8.8 of ASTM Standard C1781 Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems (American Society for Testing and Materials, 2021).

2.3.5 Post Processing

Calculate the surface infiltration rate using equation in step 9.1 of ASTM Standard C1781 Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems (American Society for Testing and Materials, 2021).

Calculate the infiltration rate (I) as follows:

$$I = KM/(D^2 \cdot t)$$

where:

I = Infiltration rate, in/hr

M = Mass of infiltrated water, lb

D = Inside diameter of infiltration ring, in

t = time required for measured amount of water to infiltrate the surface, sec, and

K = 126 870

The factor K has units of [(in³sec)/(lbhr)] and is needed to convert the recorded data (M, D, and t) to the infiltration rate I in in/hr

2.4 Single Ring Infiltration Test for Soil

2.4.1 Purpose

Determine surface saturated hydraulic conductivity of a soil, e.g., a bioswale.



Figure 7 | Test Set Up for Single Ring Soil Infiltration Test of Peoria Bioswale

2.4.2 Description

Test set up using a single ring infiltrometer that uses the observed water flow into the soil to calculate the surface saturated hydraulic conductivity of a bioswale in Peoria. The test follows the procedures described in NJ Stormwater Best Management Practices Manual, April 2022.

2.4.3 Equipment

The following equipment is required (NJ Stormwater Best Management Practices Manual, April 2022).

- Infiltration ring
- Water containers
- Stopwatch
- Level
- Hand sledge
- Wood block
- Small trowel
- Filter fabric
- Ruler
- Traffic cones
- High visibility safety vest
- Boots

2.4.4 Performance Testing Steps

The following steps should be completed for the performance test (NJ Stormwater Best Management Practices Manual, April 2022).

1. Test Location Preparation: The test location shall be prepared in accordance with the following steps:
 - a. Clear the sampling area of surface residue.
 - b. The surface of the soil shall be nearly level. However, do not compact the soil when leveling the surface.
 - c. Remove any rock fragments that will prevent the test ring from being driven into the soil.
2. Test Procedure
 - a. Step One: Drive the test ring into soil
 - i. Place the block of wood on top of the test ring. Using the hand sledge and block of wood, drive the test ring a depth of 3 inches into the test soil layer. Move the wood block around the edge of the test ring top every one or two blows so that the test ring will penetrate the soil uniformly. Do not shake or shift the test ring sideways so as to cause annular space between the test ring and the soil surface surrounding the test ring, which may lead to a leak of water from the annular space.
 - ii. Use a leveler to check whether the test ring is leveled.
 - iii. If the surface of the soil surrounding the wall of the test ring is only slightly disturbed, tamp the disturbed soil adjacent to the inside and outside wall of the test ring until the soil is as firm as it was prior to disturbance. If the surface of the soil

surrounding the wall of the test ring is excessively disturbed (signs of extensive cracking, excessive heave, and the like), reset the test ring to other locations.

b. Step Two: Pre-soaking the soil

- i. Place the piece of filter fabric on top of the soil in the center of the test ring.
- ii. For sandy textured soils, including sands, loamy sands and sandy loams, where a rapid infiltration rate is anticipated,
 - Place the ruler into the test ring if the test ring is not marked with a 1 inch mark.
 - Gently and slowly add water from a position close to the piece of filter fabric resting on the soil and slowly lift the water container as the water level rises. Fill the test ring to the top with water.
 - Let the water drain completely.
- iii. For other than sandy textured soils,
 - Place the ruler into the test ring if the test ring is not marked with a 1 inch mark.
 - Gently and slowly add water from a position close to the piece of filter fabric resting on the soil and slowly lift the water container as the water level rises. Fill the test ring to the top with water. Start stopwatch.
 - Let the water drain completely. If the elapsed time for the water level to drop to a height of 1 inch is more than 60 minutes, stop timing.

c. Step Three: Observed Field Intake Rate Determination

Immediately following the pre-soak procedure, the Observed Field Intake Rate shall be determined using the following procedure:

- i. Gently and slowly add water from a position close to the piece of filter fabric resting on the soil and slowly lift the water container as the water level rises. Fill the test ring to the top with water.
- ii. Start the stopwatch as soon as the water fills to the top of the test ring.
- iii. Measure the elapsed time for the water to drop 1 inch. Record the elapsed time in each test.
- iv. Repeat steps i to iii until the elapsed time to drop 1 inch of water becomes stabilized. If the difference between two measurements of the time is within five tenths of a second, it is deemed stabilized.
- v. The observed field intake rate (in/hr) is 1 inch divided by the stabilized elapsed time to drop 1 inch of water.
- vi. At least three observed field intake rates shall be observed before the test is ended.
- vii. If the elapsed time to drop 1 inch of water is more than 1 hour for two consecutive tests, the soil is deemed to have an observed field intake rate less than 1 in/hr and the test can be ended.

2.4.5 Post Processing

Convert the observed field intake rate to the hydraulic conductivity by using the following equation:

$$HC = 0.34239 \text{ OFIR}$$

where HC is the hydraulic conductivity in in/hr and OFIR is the Observed Field Intake Rate in in/hr.

3.0 References

American Society for Testing and Materials. (2018). ASTM C1701, Standard Test Method for Infiltration Rate of In Place Pervious Concrete.

American Society for Testing and Materials. (2021). STM C1781 – Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems.

American Society of Testing and Materials. (2016). ASTM D5126, Section 4.1.6–Standard Practice for Comparison of Field Methods for Determining Hydraulic Conductivity in Vadose Zone. Retrieved from <https://www.astm.org/d5126-16e01.html>

(April 2022). In New Jersey Department of Environmental Protection, *NJ Stormwater Best Management Practices Manual* (pp. Chapter 12, Subsection A5.).

Soilmoisture Equipment Corp. (2012, December). Retrieved from Guelph Permeameter Operating Instructions: https://www.soilmoisture.com/pdfs/Resource_Instructions_0898-2800_2800K1%20Guelph%20Permeameter%20.pdf

APPENDIX D

Field Maps Examples

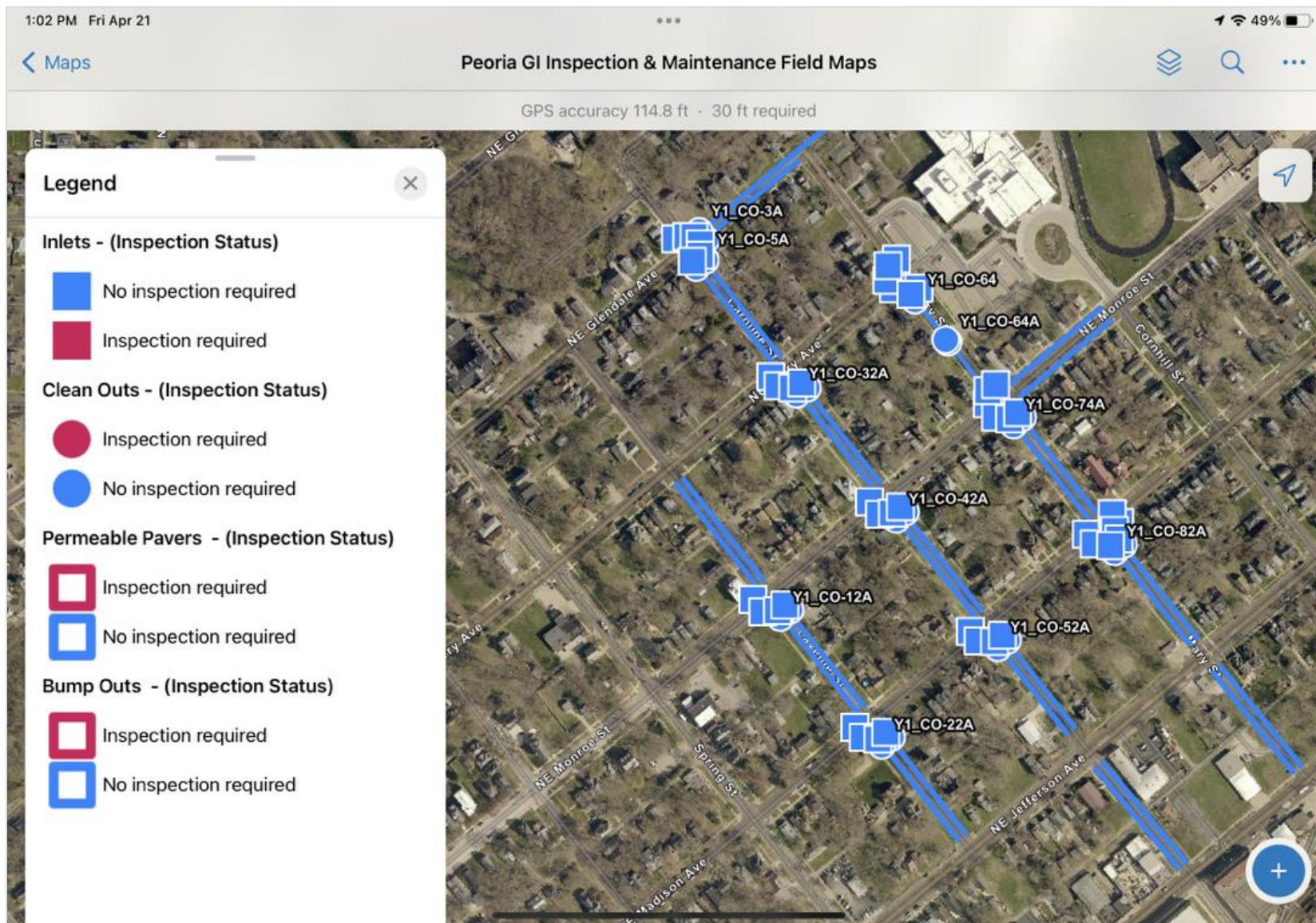


Figure 1 | GI Inspection and Maintenance Field Map App Showing a Map of the Year 1 CSO Control Project GI Facilities.

1:44 PM Mon Apr 24 *** 11%

Cancel Collect Submit

 Routine and Non-Routine -

 Take Photo  Attach

Asset ID
YA_BS-9

Inspection Date
4/24/23

Inspector

INSPECTION

Is vegetation overgrown?
Yes

Are invasive species present?
Yes

Do plants need water?
Yes

Does vegetation require maintenance?
Yes

Is standing water present?
Yes

Is erosion occurring?
Yes

Is trash or debris present?
Yes

Is there excess sediment accumulation?

Figure 2 | Bioswale Inspection Maintenance Checklist (Part 1 of 3; top of form).
Other Surface Green Infrastructure assets will use the same form.

1:44 PM Mon Apr 24 ... 12%

Cancel Collect Submit

 Routine and Non-Routine -

Is there excess sediment accumulation?

Yes ☒

Is the flow channel blocked?

Yes ☒

Is the curb turnout blocked?

Yes ☒

Other observations

Is maintenance required?

No value

No

Routine

Routine and Non-Routine ☒

Non-Routine

Inspection notes

Inspection and routine maintenance complete date

No Value 

ROUTINE MAINTENANCE 

Routine maintenance date

No Value 

Routine maintenance completed by

Figure 3 | Bioswale Inspection Maintenance Checklist (Part 2 of 3; middle of form).
Other Surface Green Infrastructure assets will use the same form.

1:45 PM Mon Apr 24 Collect Submit

 **Routine and Non-Routine -**

Inspection and routine maintenance complete date

No Value 

ROUTINE MAINTENANCE 

Routine maintenance date

No Value 

Routine maintenance completed by

Routine maintenance type

No value 

Routine maintenance notes

NON-ROUTINE MAINTENANCE 

Non-routine maintenance date

No Value 

Non-routine maintenance completed by

Non-routine maintenance type

Non-routine maintenance notes

Figure 4 | Bioswale Inspection Maintenance Checklist (Part 3 of 3; bottom of form).
Other Surface Green Infrastructure assets will use the same form.

1:42 PM Mon Apr 24 Collect Submit

Routine and Non-Routine -

 Take Photo  Attach

Asset ID
YC_DW-58

Inspection Date
4/24/23

Inspector

INSPECTION

Does the inlet box/sump need to be cleaned?
Yes

Does the inlet grate need to be cleaned?
Yes

Is there standing water in the inlet?
Yes

Does the upstream or downstream pipe require maintenance?
Yes

Other Observations

Is maintenance required?

No value

Routine

Routine and Non-Routine ✓

Non-Routine

Figure 5 | Dry Well Inspection Maintenance Checklist (Part 1 of 2; top of form).
Other Subsurface Storage & Infiltration assets will use the same form.

1:42 PM Mon Apr 24 ... 100% 10%

Cancel Collect Submit

 Routine and Non-Routine -

Inspection notes

Inspection and routine maintenance complete date

No Value

ROUTINE MAINTENANCE

Routine maintenance date

No Value

Routine maintenance completed by

Routine maintenance type

No Value

Routine maintenance notes

NON-ROUTINE MAINTENANCE

Non-routine maintenance date

No Value

Non-routine maintenance completed by

Non-routine maintenance type

Non-routine maintenance notes

Figure 6 | Dry Well Inspection Maintenance Checklist (Part 2 of 2; bottom of form).
Other Subsurface Storage & Infiltration assets will use the same form.

1:59 PM Mon Apr 24 Collect Submit

 Routine and Non-Routine -

Asset ID
YC_PP-33

Inspection Date
4/24/23

Inspector

INSPECTION

Is sediment or debris present on the permeable pavement?
Yes

Is there standing water on the permeable pavement?
Yes

Are the joints between the pavers clogged or accumulation debris?
Yes

Is there any visible settlement or damage to pavers?
Yes

Other observations

Is maintenance required?

No value

Routine

Routine and Non-Routine ✓

Non-Routine

No

Figure 7 | Permeable Paver Blocks Inspection Maintenance Checklist (Part 1 of 2; top of form).
Other Permeable Pavement assets will use the same form.

1:59 PM Mon Apr 24 Collect Submit

 **Routine and Non-Routine -**

Inspection Notes

Inspection and routine maintenance complete date
 

ROUTINE MAINTENANCE 

Routine maintenance date
 

Routine maintenance completed by

Routine maintenance type
 

Routine maintenance notes

NON-ROUTINE MAINTENANCE 

Non-routine maintenance date
 

Non-routine maintenance completed by

Non-routine maintenance type

Non-routine maintenance notes

Figure 8 | Permeable Paver Blocks Inspection Maintenance Checklist (Part 2 of 2; bottom of form).
Other Permeable Pavement assets will use the same form.

9:46 AM Tue Mar 28

Collect

Submit

Permeable Pavers: Y1_PP-17

Area 1,104.1 sq ft

Take Photo

Attach

Asset ID

Y1_PP-17

Date of last 1 inch rainfall

No Value

Last Inspection Date/Time

No Value

Inspected in last 90 days?

No value

Last Maintenance Date/Time

No Value

Surface Infiltration Rate (in/hr)

Native Soil Infiltration Rate (in/hr)

Notes

Figure 9 | Permeable Paver Blocks Feature Class Attributes.
Other GI assets will have similar attributes.

9:46 AM Tue Mar 28 Collect Submit 96%

[Y1_PP-17:](#)

 Take Photo  Attach

Asset ID
Y1_PP-17

Asset Type
Permeable Paver

GI Year
Y1

Surface Infiltration Rate
--

Native Soil Infiltration Rate
--

Testing Date
No Value

Testing Completed By

Test Reason
No value

Test Type
No value

Test Layer
No value

Test Rate

Rate Comparison
--

Figure 10 | Permeable Paver Blocks Performance Testing Table (Part 1 of 2; top of form).
Other GI assets will have a similar form to document post-construction and long-term performance testing.

9:46 AM Tue Mar 28 ... 96%

Cancel Collect Submit

 Y1_PP-17:

Asset Type

Permeable Paver

GI Year

Y1

Surface Infiltration Rate

--

Native Soil Infiltration Rate

--

Testing Date

No Value

Testing Completed By

Test Reason

No value

Test Type

No value

Test Layer

No value

Test Rate

Rate Comparison

--

Notes

Figure 11 | Permeable Paver Blocks Performance Testing Table (Part 2 of 2; bottom of form).
Other GI assets will have a similar form to document post-construction and long-term performance testing.