SCA Green Infrastructure Design Guidelines

Prepared for:

New York City School Construction Authority
30-30 Thomson Avenue
Long Island City, NY 11101

December 18, 2023

YU & Associates Engineers, P.C.
611 River Drive, Center 3, 3rd Floor, Elmwood Park, NJ 07407
Tel: 201-791-0075 • Fax: 201-791-4533

Consultant Team

Mary C. Lang, PE, PP, ENV SP
Principal
mlang@yu-associates.com

Desiree A. Sullivan, PE
Project Manager
dascrate@yu-associates.com

Giuliano I. Giudici, P.E, PP.
Senior Project Manager
ggiudici@yu-associates.com

Catherine Mancheno
Staff Engineer II
cmancheno@yu-associates.com

Contributors

New York City School Construction Authority
Jeremy Shannon, AIA, CEM, LEED AP BD+C
Director, Sustainable Design and Resiliency

Gendel Metlitsky, RA, LEED AP BD+C
Managing Architect, Sustainable Design and Resiliency

Farah Qadeer, RA, LEED AP BD+C
Senior Sustainable Design Project Manager, Sustainable Design and Resiliency

Robert Garino, PE
Civil Geotechnical Engineer, Design and Construction Services

Harry Cethoute
Managing Engineer, Technical Standards and Support

Division of School Facilities
Ken Mahadeo, Director of Maintenance and Optimization

EME Consulting Engineering Group
Michael Balagur, CEM, LEED AP, Sustainability Department Manager

Table of Contents

SECTION 1 | Introduction 13

SECTION 2 | Stormwater Rules and Regulations 15

2.1 New York City Administrative Code 15

2.1.1 Drainage and Sewer Control 15

2.1.2 Water Pollution Control 15

2.1.3 Construction Documents for Covered Developments 16

2.1.4 Post-Construction Stormwater Management Facilities 16

2.1.5 Discharge of Sewage and Management of Stormwater Runoff 16

2.1.6 Roof Assemblies and Rooftop Structures 17

2.1.7 Private On-Site Storm Water Disposal Systems and Detention Facilities 17

2.1.8 Soils and Foundations 17

2.1.9 Protection Required 18

2.2 The Rules of the City of New York 18

2.2.1 Use of the Public Sewers 18

2.2.2 Industrial, Commercial, Construction, and Post-Construction Stormwater 18

2.2.3 Construction of Private Sewers or Private Drains 19

2.2.4 Rule Governing House/Site Connections to the Sewer System 19

2.2.5 Stormwater Penalty Schedule 20

2.2.6 Local Laws 20

NYC Local Law 94 20

NYC Local Law 97/19 (Sustainable Buildings) 21

NYC Local Law 97/17 (Green Infrastructure Feasibility)

2.3 Green Schools Guide Credit 21
SECTION 3 | CSS and MS4 Tier Charts 24
3.1 Combined Sewer System (CSS) 24
3.2 Municipal Separate Sewer System (MS4) 25
SECTION 4 | Stormwater Management Practices 26
Viable Stormwater Management Practices 26
General Guidelines 26
4.1 Bioretention 26
4.1.1 Definition 26
4.1.2 Feasibility for SCA Projects 28
4.1.3 Pros and Cons 28
4.1.4 Maintenance Tasks 29
4.1.5 Maintenance Frequency 30
4.1.6 Maintenance Cost Data 30
4.1.7 Lifecycle Information 29
4.2 Rain Garden 30
4.2.1 Definition 30
4.2.2 Feasibility for SCA 31
4.2.3 Pros and Cons 31
4.2.4 Maintenance Tasks 32
4.2.5 Maintenance Frequency 33
4.2.6 Maintenance Cost Data 33
4.2.7 Lifecycle Information 33
4.3 Stormwater Planter 34
4.3.1 Definition 34
4.3.2 Feasibility for SCA 34

4.3.3 Pros and Cons 34
4.3.4 Maintenance Tasks 35
4.3.5 Maintenance Frequency 35
4.3.6 Maintenance Cost Data 35
4.3.7 Lifecycle Information 36
4.4 Green Roof 36
4.4.1 Definition 36
4.4.2 Green Roof with Retention 36
4.4.3 Feasibility for SCA Projects 36
4.4.4 Pros and Cons 37
4.4.5 Field Assessment – M041 Manhattan 36
4.4.6 Maintenance Tasks 38
4.4.7 Maintenance Frequency 38
4.4.8 Maintenance Cost Data 39
4.4.9 Lifecycle Information 38
4.5 Tree Planting/Preservation 39
4.5.1 Definition 39
4.5.2 Feasibility for SCA Projects 39
4.5.3 Pros and Cons 41
4.5.4 Maintenance Tasks 41
4.5.5 Maintenance Frequency 42
4.5.6 Maintenance Cost Data 42
4.5.7 Lifecycle Information 42
4.6 Dry Basin 43
4.6.1 Definition 43
4.6.2 Feasibility for SCA 43

4.6.3 Pros and Cons 43
4.6.4 Maintenance Tasks 44
4.6.5 Maintenance Frequency 45
4.6.6 Maintenance Cost Data 45
4.6.7 Lifecycle Information 45
4.7 Grass Filter Strip 46
4.7.1 Definition 46
4.7.2 Feasibility for SCA 46
4.7.3 Pros and Cons 46
4.7.4 Maintenance Tasks 47
4.7.5 Maintenance Frequency 47
4.7.6 Maintenance Cost Data 47
4.7.7 Lifecycle Information 47
4.8 Vegetated Swale 48
4.8.1 Definition 48
4.8.2 Feasibility for SCA 48
4.8.3 Pros and Cons 48
4.8.4 Maintenance Tasks 49
4.8.5 Maintenance Frequency 48
4.8.6 Maintenance Cost Data 49
4.8.7 Lifecycle Information 49
4.9 Dry Well 51
4.9.1 Definition 51
4.9.2 Feasibility for SCA Projects 51
4.9.3 Pros and Cons 51
4.9.4 Maintenance Tasks 52

4.9.5 Maintenance Frequency 52
4.9.6 Maintenance Cost Data 52
4.9.7 Lifecycle Information 52
4.10 Stormwater Gallery 53
4.10.1 Definition........ 53
4.10.2 Feasibility for SCA 53
4.10.3 Pros and Cons 53
4.10.4 Maintenance Tasks 54
4.10.5 Maintenance Frequency 54
4.10.6 Maintenance Cost Data 54
4.10.7 Lifecycle Information 55
4.11 Stone Trench 55
4.11.1 Definition........ 55
4.11.2 Feasibility for SCA 55
4.11.3 Pros and Cons 55
4.11.4 Maintenance Tasks 56
4.11.5 Maintenance Frequency 56
4.11.6 Maintenance Cost Data 56
4.11.7 Lifecycle Information 56
4.12 Porous Pavement 57
4.12.1 Definition........ 57
4.12.2 Feasibility........ 57
4.12.3 Pros and Cons 57
4.12.3.1 Field Inspection - R062 Staten Island Porous Pavement........ 57

4.12.4 Maintenance Tasks 58

4.12.5 Maintenance Frequency 58

4.12.6 Maintenance Cost Data 58

4.12.7 Lifecycle Information 59

4.13 Synthetic Turf Field 58

4.13.1 Definition 58

4.13.2 Feasibility for SCA 58

4.13.3 Pros and Cons 58

4.13.3.1 Field Inspection- R062 Synthetic Turf 59

4.13.4 Maintenance Tasks 59

4.13.5 Maintenance Frequency 61

4.13.6 Maintenance Cost Data 61

4.13.7 Lifecycle Information 61

4.14 Subsurface Gallery 62

4.14.1 Definition 62

4.14.2 Feasibility for SCA 62

4.14.3 Pros and Cons 62

4.14.4 Maintenance Tasks 62

4.14.5 Maintenance Frequency 63

4.14.6 Maintenance Cost Data 63

4.14.7 Lifecycle Information 63

4.15 Blue Roof 64

4.15.1 Definition 64

4.15.2 Feasibility for SCA 64

4.15.3 Pros and Cons 64

4.15.4 Maintenance Tasks 64

4.15.5 Maintenance Frequency 65

4.15.6 Maintenance Cost data 65

4.15.7 Lifecycle Information 65

4.16 Detention Tank 66

4.16.1 Definition 66

4.16.2 Feasibility for SCA 66

4.16.3 Pros and Cons 66

4.16.4 Maintenance Tasks 66

4.16.5 Maintenance Frequency 67

4.16.6 Maintenance Cost Data 67

4.16.7 Lifecycle Information 67

4.17 Sand Filter 68

4.17.1 Definition 68

4.17.2 Feasibility for SCA 68

4.17.3 Pros and Cons 68

4.17.4 Maintenance Tasks 68

4.17.5 Maintenance Frequency 68

4.17.6 Maintenance Cost Data 69

4.17.7 Lifecycle Information 69

4.18 Organic Filter 70

4.18.1 Definition 70

4.18.2 Feasibility for SCA 70

4.18.3 Pros and Cons 70

4.18.4 Maintenance Tasks 71

4.18.5 Maintenance Frequency 72

4.18.6 Maintenance Cost Data 73

4.18.7 Lifecycle Information 73

Non-Viable Stormwater Management Practices 74

4.19 Constructed Wetland 74

4.19.1 Definition 74

4.19.2 Feasibility for SCA 74

4.20 Wet Basin/Pond 75

4.20.1 Definition 75

4.20.2 Feasibility for SCA 75

SECTION 5| Site Assessment 77

5.1 Site Assessment 77

5.2 Evaluation Checklist 78

5.3 Flood Zones and Resiliency Impacts on Green Infrastructure 79

5.4 NYC Stormwater Resiliency Plan 79

5.5 New York City Flood Maps 80

5.6 Flood Risk Assessment Chart of SMPs.. 80

SECTION 6| Design Examples 83

6.1 Example Calculations for Choosing and Sizing Stormwater Management Practices 83

6.2 CSS Area - New School - 6315 14th Avenue, Brooklyn NY 84

6.3 MS4 Area - Addition to Existing School - PS 206 Brooklyn, NY.......................... 85

Conclusion……… 94

References……… 95

Appendix - Tables and Charts

Appendix - SMP Sample Calculations

EXECUTIVE SUMMARY

The purpose of this study is to create an SCA-specific green infrastructure assessment and design guideline based on the 2022 New York City Stormwater Manual and new regulations in the Department of Environmental Protections stormwater rules.

The average SCA site may present challenges for design teams when trying to incorporate green infrastructure (GI). For instance, design teams may often find themselves working on zero-lot-line buildings. As such, there is less surrounding area available to implement GI practices. This eliminates GI practices that would require some ground level square footage to be constructed. Design teams must also work with competing requirements. Program requirements may dictate that a playground must be provided, but the dimensions and design of that playground may not allow enough space for GI. Local law requirements, including that of Local Law 94, also permit the use of PV panels in rooftop system design. While PV panels are also being incorporated into more schools as a source of sustainable energy, they take up space that could be utilized for green roofs unless a hybrid solar green roof is utilized.

It is also difficult to achieve the required infiltration rate of soil in many areas of New York, and water infiltration is a large component of most green infrastructure practices.

New York City schools must abide by Department of Environmental Protection (DEP) rules, in addition to state building codes and school program requirements. Amendments were made to the Unified Stormwater Rule in February of 2022 that included changes to chapters 31 and 19.1 of the Rules of the City of New York. Chapter 31 updates the requirements for Site Connection Proposals and House Connection Proposals. Chapter 19.1 deals with the Stormwater Construction Permitting Program, which sets different requirements for compliance. For more information on the requirements specific to CSO and MS4 areas, refer to Section 2 of this report. There is a new retention-first approach for stormwater management practices outlined in the manual. A hierarchy of practices determines what practices design teams must consider, and when Vegetated Retention practices can be used, they must be used. If it is determined that Vegetated Retention is not viable, then Non-Vegetated Retention practices are considered. If Non-Vegetated Retention is ruled out, designers must move on to Vegetated Detention practices. Of the 20 stormwater management practices (SMPs) listed in the manual, there is an emphasis on retention and vegetation focused practices over detention and non-vegetated practices. This study will explain why some practices are more viable than others, based on the unique nature of New York City schools and construction projects.

SECTION 1 | Introduction

SECTION 1 | Introduction

In the following report, the current rules and regulations of stormwater management have been analyzed with respect to how they will impact the New York City School Construction Authority. Using information from existing green infrastructure projects, this report will examine the various stormwater management practices (SMPs) that are recommended by the 2022 NYC Stormwater Manual and determine which of them are most applicable to the needs and constraints of New York City public schools. For additional guidance, the NYC Stormwater Manual provides descriptions of each SMP and the requirements for each one to function.

SMPs were assessed based on the realistic space, cost and commitment required to install and maintain these structures. The biggest challenges that SCA will face with regards to implementing SMPs are finding acceptably permeable soil and finding large enough sections of land to accommodate the SMPs. Additionally, the NYC Department of Education (DOE) will be faced with a challenge in maintenance of the GI measures.

In addition to guidelines and best practices governing SMPs, this report will walk through the steps necessary to assess the stormwater needs of a site and size an SMP accordingly.

SECTION 2 | Stormwater

Rules and Regulations

- 2.1 New York Administrative Code
- 2.1.1 Drainage and Sewer Control
- 2.1.2 Water Pollution Control
- 2.1.3 Construction Documents for Covered Developments
- 2.1.4 Post-Construction Stormwater Management Facilities
- 2.1.5 Discharge of Sewage and Discharge and/or Management of Stormwater Runoff
- 2.1.6 Roof Assemblies and Rooftop Structures
- 2.1.7 Private On-Site Storm Water Disposal Systems and Detention
- Facilities
- 2.1.8 Soils and Foundations
- 2.1.9 Protection Required
- 2.2 The Rules of the City of New York
- 2.2.1 Use of the Public Sewers
- 2.2.2 Industrial, Commercial, Construction, and Post-Construction Stormwater Sources
- 2.2.3 Construction of Private Sewers or Private Drains
- 2.2.4 Rule Governing House/Site Connections to the Sewer System
- 2.2.5 Stormwater Penalty Schedule
- 2.2.6 Local Laws
- 2.3 Green Schools Guide Credit

SECTION 2 | Stormwater Rules and Regulations

2.1 New York City Administrative Code

2.1.1 Drainage and Sewer Control

New York City Administrative Code Title 24 Chapter 5 Drainage and Sewer Control (N.Y.C. Admin. Code §24-5)

This section contains information regarding sewer and drainage control. New projects must submit plans to connect to the existing sewer systems based on the City General Plan. The city will then maintain these new and existing sewer systems. Private sewers and drains must connect to city sewers, and proper authorizations must be obtained, and fees paid to do so. When the city constructs a sewerage system near a building that uses sanitary plumbing, the owner of the building must connect to the constructed pipes.

Whenever a sewer or associated structure is to be constructed, altered, or repaired in an area of a public service corporation, the contractor shall give notice at least forty-eight hours before breaking ground. Owners of lots that will create stormwater runoff must properly convey that stormwater into the appropriate sewer system, which is generally located within 500ft from the property. If a sewer system is not located within 500ft of the property, the commissioner will determine the proper method of disposal of stormwater.

2.1.2 Water Pollution Control

New York City Administrative Code Title 24 Chapter 5-A Water Pollution Control (N.Y.C. Admin. Code §24-5-A)

This chapter discusses the ways in which stormwater runoff from construction sites can be reduced and prevent pollutants from entering the sewer systems that empty into nearby bodies of water. It is unlawful to develop a site without a stormwater construction permit (NY DEC State Pollution Discharge Elimination System, also known as a General Construction Permit). It is also unlawful to develop a site without a stormwater pollution prevention plan. A copy of the Storm Water Prevention Plan (SWPPP) is required to be kept on site from the beginning to the end of construction, and records of inspections and tests must be kept an additional 5 years after construction has ended. A permit may be revoked if noncompliance with rules is found, or if an issue with the initial permit is discovered. With the implementation of the Unified Stormwater Rule, DEP requires a SWPPP for projects over ½ acre or where over 5000 SF of pervious area is being made impervious for both the MS4 area and Combined Sewer Area through their portal, though filing with the state is still only required when over 1 acre. Projects must also have a stormwater maintenance permit after completion of a project, and the permit must be renewed every 5 years.

2.1.3 Construction Documents for Covered Developments

New York City Administrative Code Title 28 Chapter 1 Article 104 Section 11 Construction documents for sites that are covered development projects as defined in section 24-541 of the administrative code (N.Y.C. Admin. Code §28-104.11)

This section sets forth the supporting documentation to be submitted with the application for approval and statements to be included in the construction documents. A stormwater construction permit issued by the Department of Environmental Protection (DEP) and the Storm Water Pollution Prevention Plan must be included with the application for construction document approval. Construction documents must indicate if the proposed work is part of a covered development project. A covered development project involves or results in an amount of soil disturbance greater than or equal to 20,000 square feet; or creation of 5,000 square feet or more of impervious surface; or a covered maintenance activity. Such term includes development activity that is part of a larger common plan of development or sale involving or resulting in soil disturbance greater than or equal to 20,000 square feet or creation of 5,000 square feet or more of impervious surface.

2.1.4 Post-Construction Stormwater Management Facilities

New York City Administrative Code Title 28 Chapter 1 Article 116 Section 7 Post-construction stormwater management facilities (N.Y.C. Admin. Code §28-116.7)

A stormwater maintenance permit issued by the Department of Environmental Protection (DEP) is required for any post-construction management facilities serving buildings or premises before the certificate of occupancy or letter of completion for the buildings or premises.

2.1.5 Discharge of Sewage and Management of Stormwater Runoff

New York City Administrative Code Title 28 Chapter 7 Article 701 Section 2 Chapter 1 Section BC107.11 Discharge of sewage and discharge and/or management of stormwater runoff (N.Y.C. Admin. Code §28-701.2. BC 107.11)

The Department of Environmental Protect (DEP) requires certification of the feasibility or availability of the connection. The DEP or the applicant may submit the certification on the appropriate forms. DEP certification may be conditional and require on-site systems or alternative disposal methods where the connection is feasible and available. Where the connection is unavailable or not feasible, either the DEP or the applicant may submit the certification on the appropriate forms. A proposal of design for an on-site disposal system will be required and subject to approval.

2.1.6 Roof Assemblies and Rooftop Structures

New York City Administrative Code Title 28 Chapter 7 Article 701 Section 2 Chapter 15: Roof Assemblies and Rooftop Structures (N.Y.C. Admin. Code §28-701.2.15)

This section outlines the requirements for roof assemblies under Local Law 94 of 2019. Green roof requirements are contained in section 1511. Green roof systems shall comply with ANSI/SPRI RP-14 and ANSI/SPRI VF-1, or with FM DS 1-35, except where the area is less than 250 sq. ft., is less than 22 ft. above street level, or the system is a container garden. Solar panels/modules shall comply with the NYC Building and Fire Codes.

A Solar system capable of at least 4kW shall be installed in a contiguous area of less than 200 sq. ft. If the slope is less than 17% and the generating capacity is less than 4kW, a green system should be installed. The sustainable roofing zone shall occupy 100% of the roof except where used as a setback, access, terrace, recreational space, the roof slope is greater than 17%, occupied by roof and/or stormwater structures, or as determined unfavorable by the NYC Department of Buildings.

2.1.7 Private On-Site Storm Water Disposal Systems and Detention Facilities

New York City Administrative Code Title 28 Chapter 7 Article 701 Section 2 Chapter 17 Section BC1704.21 Private on-site storm water disposal systems and detention facilities (N.Y.C. Admin. Code §28-701.2. BC1704.21)

The stormwater detention and retention systems must comply with section 1114 of the NYC Plumbing Code. Test pits, soil borings, and soil percolation tests must be performed before application approval.

All subsurface testing is to conform the Building and Plumbing Codes. The registered design professional shall be notified of any test not meeting the proposed design criteria. The private on-site stormwater disposal systems and detention facilities shall be inspected to confirm conformance with the approved documents. Minor variations for site conditions shall be acceptable and at the discretion of the applicant of record.

2.1.8 Soils and Foundations

New York City Administrative Code Title 28 Chapter 7 Article 701 Section 2 Chapter 18: Soils and Foundations (N.Y.C. Admin. Code §28-701.2.18)

Subsoil drainage is required to be discharged in accordance with these applicable rules. By New York City DEP definition, groundwater is any water collected below the surface of the ground. By the way that NYCDEP construes that definition, foundation drains cannot be connected to the local collection system and can only be discharged through an infiltration practice.

2.1.9 Protection Required

New York City Administrative Code Title 28 Chapter 7 Article 701 Section 2 Chapter 33 Section BC 3309.1 Protection required (N.Y.C. Admin. Code §28-701.2.3309.1)

This section clarifies that public and private property, including the people within them, must be protected from injury during construction and demolition work. There must also be protections in place for water run-off and erosion during construction or demolition. If a stormwater construction permit has been issued for a covered development project, then necessary run-off and erosion controls must be installed according to the rules of the Department of Environmental Protection.

2.2 The Rules of the City of New York

2.2.1 Use of the Public Sewers

The Rules of the City of New York Title 15 Chapter 19: Use of the Public Sewers (15 RCNY § 19)

These are the sewer use rules that govern what may be discharged into the local collection system. This chapter contains the rules for the municipal separate storm sewer areas of the city. In these areas, the quantity and quality of stormwater discharge is regulated. With the advent of the Unified Stormwater Rule on February 15 of 2022, the quality and infiltration rules come into effect citywide. The city's desire is that these rules are met using green infrastructure that provides both positive infiltration effects and generally involves the use of plants to make the city greener. This chapter also contains practices that are to be followed during construction as well as requirements for ongoing maintenance of stormwater management practices, all of which is based on the New York State Department of Environmental Conservation stormwater rules.

2.2.2 Industrial, Commercial, Construction, and Post-Construction Stormwater

The Rules of the City of New York Title 15 Chapter 19.1: [Industrial, Commercial, Construction, and Post-Construction Stormwater Sources] (15 RCNY § 19.1)

This section details the practices for stormwater discharge in MS4 areas as well as the discharge of water from covered development projects. This section also contains the details for permit program requirements and stormwater construction permit requirements. Please see section 19.1-03.3 for these details. Finally, this section details how one is to use the SMP Hierarchy in the NYC Stormwater Manual as found in Section 3 of this report. Vegetated retention practices must be used to the maximum possible extent. When those are not possible, site constraints must be documented, and non-vegetated retention practices must be used to the maximum extent. If non-vegetated retention practices are not possible, vegetated, or non-vegetated detention practices can be used, but the site constraints must be documented. Site constraints must all be documented and included in the SWPPP and will be reviewed by the

Department. DEP has prepared a USWR Case Study to provide designers with guidance on site constraints. Chapter 19.1 expands the Stormwater Construction Permitting Program, setting new thresholds for compliance and a new retention-first approach for design of post-construction stormwater management practices. Chapter 19.1 also includes a new New York City Stormwater Manual to provide guidance for permit applicants.

2.2.3 Construction of Private Sewers or Private Drains

The Rules of the City of New York Title 15 Chapter 23: Construction of Private Sewers or Private Drains (15 RCNY § 23)

This section details the requirements for private drains and private drain plans. When proposing to construct a private drain for a development, a drainage proposal must be submitted to the department. These proposals must be prepared by or under the supervision of a professional engineer or registered architect licensed in the state of New York. All information necessary to submit a drainage proposal can be found in section 23-02 of the RCNY, and all legal documentation necessary to submit a proposal can be found in section 23-03. The general insurance, bonding, security and indemnity requirements for private sewers and drains can be found in section 23-04 of the RCNY Standards for the approval of Drainage Proposals and Private Sewer/Drain Plans can be found in sections 23-05 and 23-06 respectively. Requirements for Permit applications for Private Sewer/Drain construction can be found in section 23-07. All applications submitted will be subject to the corresponding fees, which can be obtained from the Department by request. There may be additional fees added if the Department determines that major revisions need to be made to the initial application. There will also be a new fee required for the renewal of an expired drainage proposal or private sewer plan.

This chapter also includes 5 appendices that detail the design standards for sewers and drains, requirements for submission of proposals, requirements for submission of plans, requirements for standard notes, requirements for specific notes, survey requirements, requirements for Professional Engineer/Architect cost estimates, and requirements for boring logs/reports.

2.2.4 Rule Governing House/Site Connections to the Sewer System

The Rules of the City of New York Title 15 Chapter 31: Rule Governing House/ Site Connections to the Sewer System (15 RCNY § 31)

These are the rules that govern site connections within the City. Initially these rules established a maximum discharge into local collection system at 10% of the developed flow from the lot area within the hundred feet of the street line. Subsequently on April 30, 2012, the maximum release rate was reduced to 0.25 cubic feet per second and the minimum orifice size to a nominal 2”. The only way that that value was increased was by an extremely long street frontage, which is not typical of most New York City school properties. With the advent of the Unified Stormwater Rule, the maximum release rate has been reduced to 0.10 cfs/acre for CSS areas and 1.0 cfs/acre for MS4 areas, and the minimum orifice size has been set to a nominal 1" size to help achieve the release rate. Chapter 31 updates the stormwater quantity and flow rates for Site Connection Proposals and House Connection Proposals. In addition, the following updates have been made:

2.2.5 Stormwater Penalty Schedule

The Rules of the City of New York Title 15 Chapter 55: Stormwater Penalty Schedule (15 RCNY § 55)

This section of the Rules of the City of New York details the penalties one may face when not in compliance with the regulations set forth in previous chapters. A first offense may be mitigated if the respondent follows the mitigation instructions detailed in the table. If a respondent does not appear at mitigation and does not attempt to reschedule, they will be subject to the fee in the "default" column. The "stipulation" column refers to the respondent admitting they were in violation of the rule and agreeing to pay the accompanied penalty. If the respondent violates the same rule within two years of the first violation, it will be counted as a second offense. If the respondent violates the same rule within two years of the second offense, it will count as a third offense.

2.2.6 Local Laws

NYC Local Law 94

Local Law 94 for the year 2019, amends and adds several sections to the Administrative and NYC Building Code. The changes are outlined as follows:

Exception 12.4 was added to Section 1, Exception 12 of Section 28-101.4.3 of the Administrative Code. The exception defines what type of roofing work on existing buildings must comply with section 1511.2 of the NYC Building Code. It also amends section 1502.1 of the NYC Building Code to define a sustainable roof zone. A sustainable roof zone is an area occupied by either a solar, green roof or a combination of both.

Section 1504.9 has been amended to add minimum values for solar reflectance, thermal emittance and solar reflectance index for roofs with a slope exceeding 17%. The values established are 0.25, 0.75, and 39, respectively.

Section 1511.2 was added to the NYC Building Code, establishing 100% of the roof area as a sustainable roofing zone and the requirements based on the roof configuration and various exceptions.

NYC Local Law 97/2019 (Sustainable Buildings)

Local Law 97 for the year 2019, amends the NYC charter and administrative code and adds new articles to the administrative code. The implementation of green infrastructure and any such natural stormwater management treatment solutions can help reduce carbon emissions.

The changes are outlined below:

Section 651 has been added to section 1 of Chapter 26 of the NYC Charter. This section establishes the Office of building energy and emissions performance, along with the role and responsibilities of the Office.

The amendment of Subdivision e of section 24-802 of the administrative code expands the definition of City government operations to include operations, facilities, and other assets that are owned or leased by the city for which the city pays all or part of the annual energy bills.

Subdivisions a and b of section 24-803 of the administrative code were amended to revise the percent emission and deadlines for emission reductions in the city. Subdivision b also adds energy efficiency retrofits as an option to achieve the target reductions, a clause to address equitable investment and benefit and provides the percent emissions, and compliance dates for the NYC Housing Authority.

Articles 320 and 321 were added to the administrative code. Both articles establish definitions related to the annual building emissions, provide the emissions limits for specified calendar year intervals, reporting requirements and penalties for non-compliance.

NYC Local Law 97/2017 (Green Infrastructure Feasibility)

A low energy intensity building, as defined in Local Law 31 of 2016, must consider the feasibility of designing and constructing such project to incorporate green infrastructure. Green Schools Guide prerequisite S2.3P – Green Infrastructure Assessment addresses this requirement.

2.3 Green Schools Guide Credit

In addition to complying with the previous rules and regulations, Green Infrastructure measures could potentially earn credits for the Green Schools Guide (GSG). SCA and DOE require all applicable projects to be certified under this system. The GSG was developed to encourage sustainable design for public construction projects in New York City. Based upon the LEED rating system of certification, the GSG system requires the same 40 credits needed to meet the LEED certification, as well as a list of other credits that are both required (R), and "Required if Feasible" (RIF). For the last category, explanations must be provided for not meeting those criteria. Green Infrastructure can fulfill the following credits:

- Open Space (RIF)
- Green Infrastructure Assessment (LEED Requirements)
- Rainwater Management (RIF)
- Heat Island Reduction (RIF)

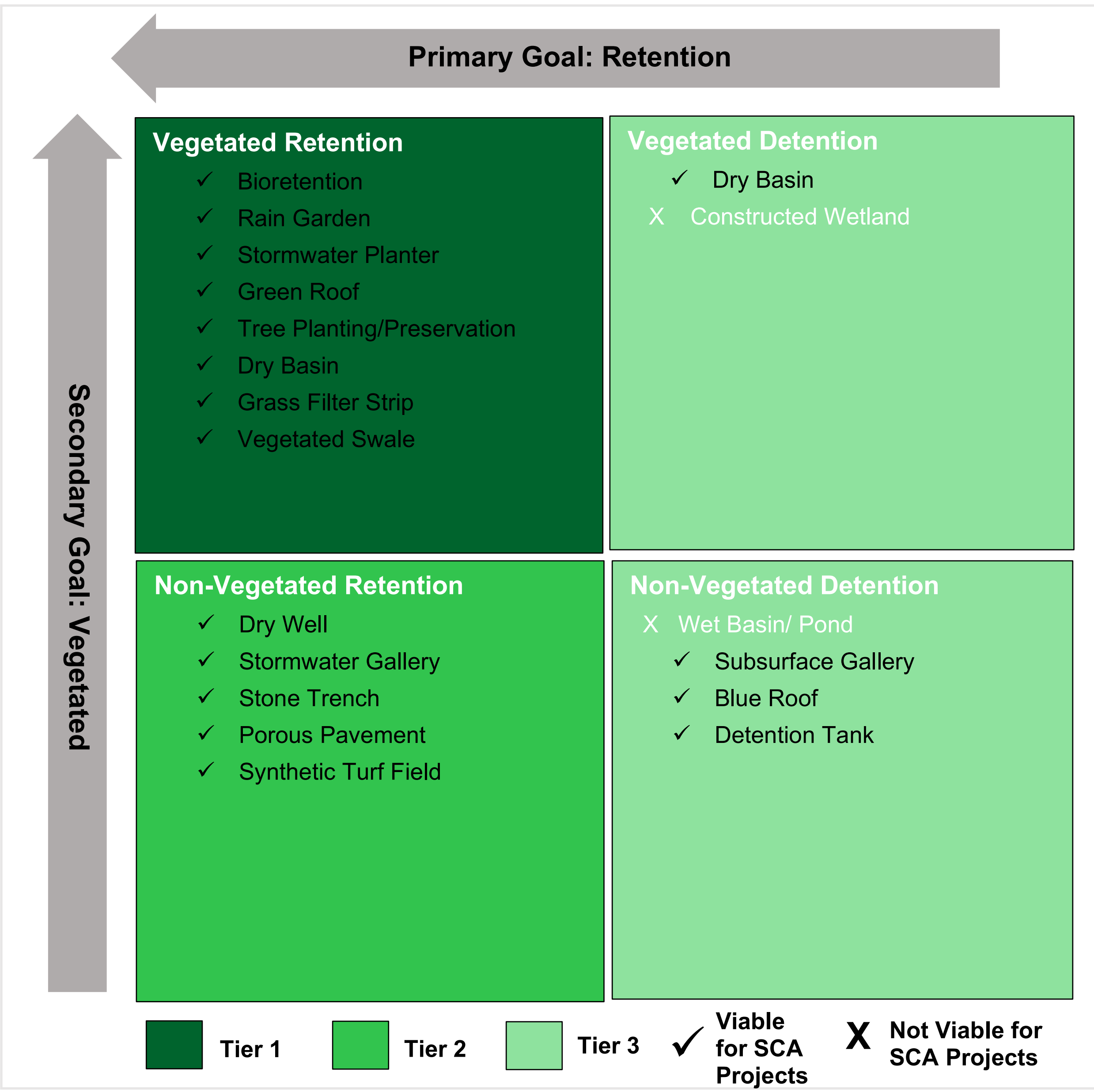
SECTION 3 | CSS and MS4 Tier Charts

- 3.1 Combined Sewer System (CSS)
- 3.2 Municipal Separate Sewer System (MS4)

SECTION 3 | CSS and MS4 Tier Charts

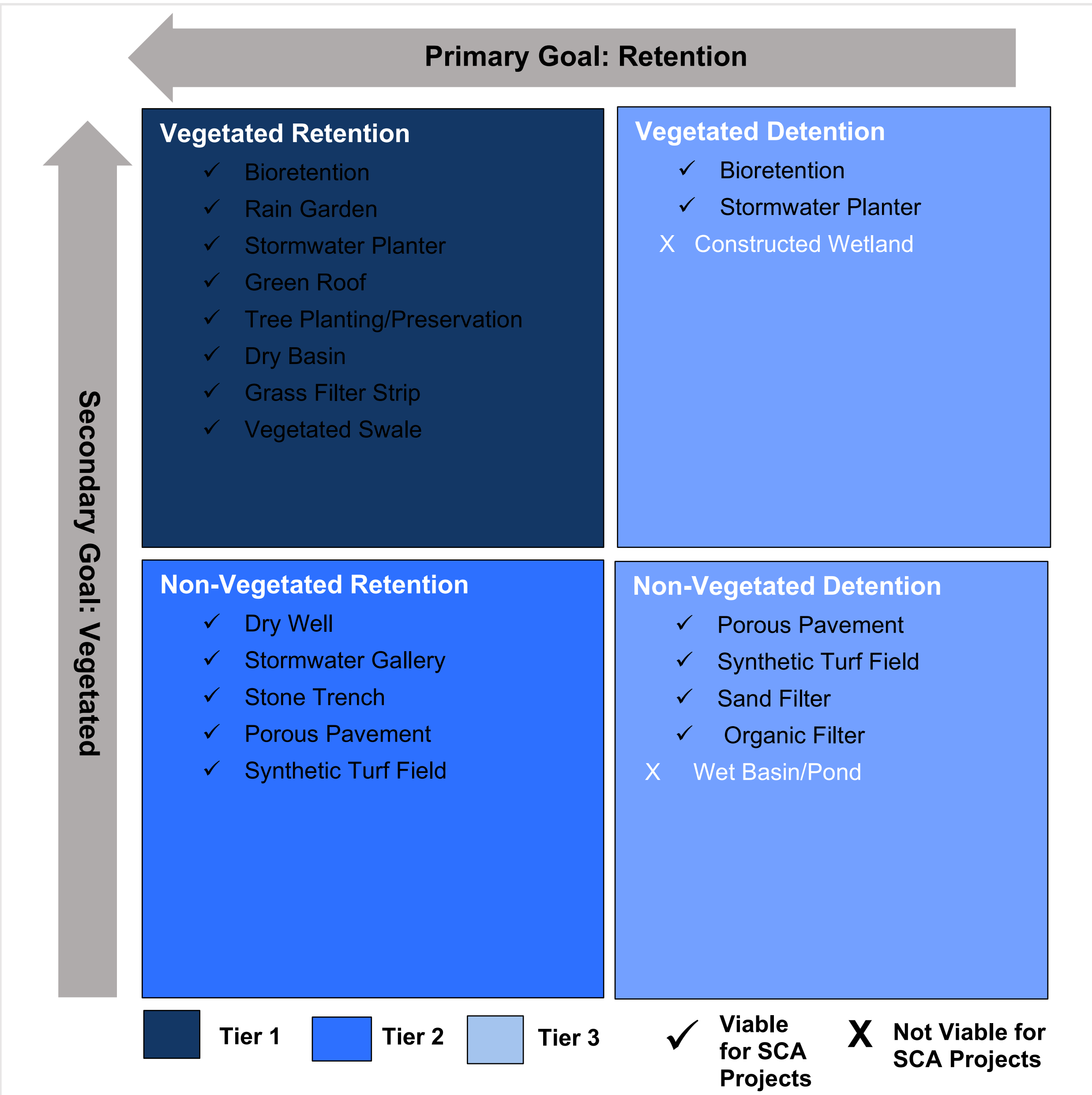
3.1 Combined Sewer System (CSS)

A combined sewer system (CSS) collects rainwater runoff, domestic sewage, and industrial wastewater into one pipe. Under normal conditions, it transports all the wastewater it collects to a sewage treatment plant for treatment, then discharges to a water body. The following graphic shows the NYC USWR-defined SMP hierarchy chart. The chart indicates SMPs that could be used with a CSS. Descriptions of these SMPs are on the following pages.



3.2 Municipal Separate Sewer System (MS4)

A Municipal Separate Storm Sewer System (MS4) is a conveyance or system of conveyances owned or operated by a municipality that carries stormwater that ultimately discharges to waters. The MS4 includes pipes, curbs, gutters, ditches, manmade channels, storm drains, catch basins, municipal streets, basins (surface/subsurface) or roads with drainage systems that are not combined sewers and are not part of a publicly owned treatment works. The following graphic shows the NYC USWR defined SMP hierarchy chart. The chart indicates SMPs that could be used in an MS4 system. Descriptions of these SMPs are on the following pages.



SECTION 4 | Stormwater Management Practices

Viable Stormwater Management Practices

- 4.1 Bioretention
- 4.2 Rain Garden
- 4.3 Stormwater Planter
- 4.4 Green Roof
- 4.5 Tree Planting/Preservation
- 4.6 Dry Basin
- 4.7 Grass Filter Strip
- 4.8 Vegetated Swale
- 4.9 Dry Well
- 4.10 Stormwater Gallery
- 4.11 Stone Trench
- 4.12 Porous Pavement
- 4.13 Synthetic Turf Field
- 4.14 Subsurface Gallery
- 4.15 Blue Roof
- 4.16 Detention Tank
- 4.17 Sand Filter
- 4.18 Organic Filter

Non-Viable Stormwater Management Practices

- 4.19 Constructed Wetland
- 4.20 Wet Basin/Pond

SECTION 4 | Stormwater Management Practices

General Guidelines

For standard details of each green infrastructure practice, please review NYC DEP's Standard Designs and Guidelines for Green Infrastructure Practices at:
https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/green-infrastructure-standard-designs.pdf

For a glossary of terms, please visit: https://www.nyc.gov/assets/dep/downloads/pdf/water/stormwater/green-infrastructure/nyc-green-infrastructure-onsite-design-manual-v2.pdf

For vegetated SMPs, please refer to The Native Species Planting Guide for New York City (https://static.nycgovparks.org/images/pagefiles/144/Native-Plant-Guide-2019-Final-CC__5dbb1a8b1bc6a.pdf), which provides suggestions for native plantings suitable for New York City.

For all measures:
Provide sizing based on the USWR Manual's max loading ratio and max contributing area.

Viable Stormwater Management Practices

4.1 Bioretention

4.1.1 Definition

A Bioretention basin is a shallow landscaped area that captures water runoff for large sites. Typically, there is a ponding area with mulch, soil, vegetation, and a stone base. This practice can be constructed on permeable soils to be used primarily as an infiltration practice, while evapotranspiration accounts for a smaller portion of managed runoff. Alternatively, if the infiltration rate of soil is below 0.5 in/hr, it can be used as a filtration practice that sends filtered water to the sewer system via an outlet pipe. This practice is commonly used in urban areas. The vegetation provided by this practice can help improve air quality and mitigate heat island effects.

4.1.2 Feasibility for SCA Projects

Area and Sizing: Bioretention basins are very efficient at treating large areas. If the size of the site allows, they could be a viable option for SCA projects. For an area of one acre, a bioretention basin needs to be 2,178 square feet to be effective. In some situations, a basin may require more space than what is available on the average SCA site. Additionally, bioretention basins can abut buildings with no below grade space, and they can abut raised buildings if they are properly graded so that the runoff drains to the basin. If a building has a below grade space such as a basement, the basin will need to adhere to a 10 ft offset from the building to avoid potential flooding of the underground space. In many cases, that may be far more space than what is available.

Drainage: If the existing soil cannot provide a satisfactory infiltration rate, installing an outlet pipe that connects to the existing sewer would be necessary to drain the area and prevent ponding over long periods. The designer of this system is responsible for sizing the outlet pipe. Underdrains are installed below the soil to connect with existing sewer systems, which would require excavation and future contractor maintenance.

Standing Water: To avoid standing water and mosquito risks, ponding areas such as bioretention basins must have a drawdown time within 24 hours. If a basin is being built in an area where the minimum infiltration rate of underlying soil is 0.5in/hr, the size and depth of the basin must be adjusted to avoid water standing for longer than 24 hours.

4.1.3 Pros and Cons

PROS	CONS
Can be mostly maintained by custodial staff. Vegetation should only require basic weeding and trash removal.	Requires ground level space that may not be available on zero lot line projects.
Can sustain native plant life. Regular watering and fertilizing of the soil is minimal after plant life is established.	During extensive drought, occasional watering may be needed to maintain plant life.
Some excavation required for construction.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Highly effective at treating large areas of runoff. Can reduce both volume and rate of runoff.	If the soils are not permeable and infiltration methods cannot be used, installing an outlet pipe on the bioretention basin would require more in-depth construction and maintenance
Improves air quality.	Requires inspections only when windblown trash and debris are an issue on site.
Can utilize infiltration, evapotranspiration or filtration methods of stormwater management.	If a building has a below grade space such as a basement, it requires 10 feet offset from any building structures to prevent flooding to underground spaces.

Can mitigate heat island effects.	Not suitable for steeply sloped sites. Steep slopes would not allow for proper infiltration into the soil. Water would simply run off. Sites with steep slopes would need to regrade the area or choose a different SMP.
Can be integrated into a project as a landscape feature.	
Flexible layout, can be retrofitted into an existing landscape.	

4.1.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment. For all vegetated SMPs, note that more frequent (3x/week) irrigation is required during the first 3 months after planting.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mulching:** Mulching of planting beds.
- ✓ **Vegetation Management:** Cutting and trimming of detrital herbaceous vegetation from the previous growing season to four to six inches above the ground.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping, if applicable.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and/or baskets, if applicable.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods, if applicable.
- ✓ **Outlet Cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging, if applicable.
- ✓ **Erosion Control:** Stabilization of eroded soil areas with vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life, insufficient drainage of the area and damage to the underlying drainage system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.1.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			+			+			+			+
Mulching			+									
Vegetation Management		+										
Debris and Sediment Removal				+						+		
Pipe Cleaning		As warranted based on video inspections every 3 years.										
Inlet Filter Cleaning			+			+			+			+
Inlet Cleaning							+					
Outlet Cleaning							+					
Erosion Control	As warranted based on visual inspection.											

4.1.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.
- ✓ Approximately $1,000 monthly.

4.1.7 Lifecycle Information

The lifecycle of a bioretention basin can range from 10-40 years. Throughout its lifecycle, the bioretention basin should be examined for necessary repairs, replacement and/or replanting.

4.2 Rain Garden

4.2.1 Definition

A Rain Garden is a small, landscaped section that consists of a surface ponding area, mulch layer, soil layer, vegetation layer, and a stone base. It is like a bioretention basin, but it is a much smaller practice intended to treat smaller areas via infiltration and evapotranspiration. Alternatively, if the infiltration rate of soil is below 0.5 in/hr, it can also be used as a filtration practice that sends filtered water to the sewer system via an underdrain and outlet pipe. The vegetation provided by this practice can help improve air quality and mitigate heat island effects.

4.2.2 Feasibility for SCA

Area and Sizing: Rain gardens can be used in most situations in conjunction with other practices and can be easily implemented in most SCA projects as they do not take up a significant amount of space. However, because they are smaller in size, a site will either require multiple rain gardens or additional SMPs to meet the stormwater management requirements. Rain gardens are normally 200 square feet in size (based on the USWR Manual's maximum loading ratio of 1:5 and maximum contributing area of 1,000 SF per rain garden). 44 rain gardens of this size are needed to manage the runoff for 1 acre of land.

4.2.3 Pros and Cons

PROS	CONS
Can be maintained by custodial staff. Vegetation should only require basic weeding and trash removal.	Requires ground level space that may not be available on zero lot line projects.
Can sustain native plant life. Regular watering and fertilizing of the soil would not be necessary after plant life is established.	During extensive drought, occasional watering may be needed to maintain plant life.
Requires minimal excavation.	Designed for smaller areas, may not be sufficient for all drainage needs.
Improves air quality.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Can mitigate heat island effects.	Requires daily visual inspections to remove trash and debris.
Flexible layout, can be retrofitted into an existing landscape.	Must be at least 10 feet away from buildings with below grade space and 5 feet away from lot lines as per building codes.
Can serve as a visual aesthetic/landscape feature.	May not be suitable for steeply sloped sites. Steep slopes would not allow for proper infiltration into the soil. Water would simply run off. Sites with steep slopes would need to regrade the area or choose a different SMP.

4.2.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment. For all vegetated SMPs, note that more frequent (3x/week) irrigation is required during the first 3 months after planting.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mulching:** Mulching of planting beds.
- ✓ **Vegetation Management:** Cutting and trimming of detrital herbaceous vegetation from the previous growing season to four to six inches above the ground.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and/or baskets.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.
- ✓ **Erosion Control:** Stabilization of eroded soil areas with vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life, insufficient drainage of the area and damage to the underlying drainage system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.2.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			✚			✚			✚			✚
Mulching			✚									
Vegetation Management		✚										
Debris and Sediment Removal				✚						✚		
Pipe Cleaning		As warranted based on video inspections every 3 years.										
Inlet Filter Cleaning			✚			✚			✚			✚
Inlet Cleaning							✚					
Outlet Cleaning							✚					
Erosion Control		As warranted based on ongoing inspections.										

4.2.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.
- ✓ Approximately $1,000 monthly. Price is approximated under the assumption that this SMP alone is treating 1 acre of land. The amount of rain gardens that would be needed to treat 1 acre of land (44 rain gardens at a typical size of 200 square feet) would require more labor than one bioretention basin would require due to the separation of units.

4.2.7 Lifecycle Information

The lifecycle of a rain garden can range from 10-40 years. At the end of this term, the rain garden will require replacement and replanting.

4.3 Stormwater Planter

4.3.1 Definition

A Stormwater Planter is a planter box that consists of a surface ponding area, mulch layer, engineered soil with vegetation and a stone base. These planters have permeable bottoms and there are often more than one in an area. This practice can be constructed on permeable soils to be used as an infiltration and evapotranspiration practice. Alternatively, it can be used as a filtration practice that sends filtered water to the sewer system via an underdrain and outlet pipe if the infiltration rate of soil is below 0.5 in/hr. They are meant to treat smaller areas of runoff from roofs or elevated pavement areas. The vegetation provided by this practice can help improve air quality and mitigate heat island effects.

4.3.2 Feasibility for SCA

Stormwater planters can be used in most situations in conjunction with other practices. They can be easily implemented into most SCA projects. However, because they are smaller in size, a site will either require multiple planters or additional SMPs to meet the stormwater management requirements.

4.3.3 Pros and Cons

PROS	CONS
Can be maintained by custodial staff. Vegetation should only require basic weeding and trash removal.	During extensive drought, occasional watering may be needed to maintain plant life.
Can sustain native plant life. Regular watering and fertilizing of the soil would not be necessary after plant life is established.	Designed for smaller areas, will not be sufficient for drainage needs of an entire site.
Requires no excavation.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Improves air quality.	Must be at least 10 feet away from buildings and 5 feet away from lot lines.
Can mitigate heat island effects.	
Can be integrated into a project as a landscape feature.	
Flexible layout, can be retrofitted into an existing landscape.	

4.3.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment. For all vegetated SMPs, note that more frequent (3x/week) irrigation is required during the first 3 months after planting. Note that this practice is likely to require more frequent watering due to the small volume of soil which is likely to dry out.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mulching:** Mulching of planting beds.
- ✓ **Vegetation Management:** Cutting and trimming of detrital herbaceous vegetation from the previous growing season to four to six inches above the ground.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Erosion Control:** Minimal erosion is expected if the SMP is contained within an above-grade planter.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life, insufficient drainage of the area and damage to the underlying drainage system.

4.3.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			✚			✚			✚			✚
Mulching			✚									
Vegetation Management		✚										
Debris and Sediment Removal				✚						✚		
Erosion Control		As warranted based on ongoing inspections.										

4.3.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.
- ✓ Approximately $1,000 monthly.

4.3.7 Lifecycle Information

The lifecycle of a stormwater planter can range from 10-40 years. At the end of this term, a stormwater planter will require replacement and replanting.

4.4 Green Roof

4.4.1 Definition

A Green Roof is a stormwater management practice that usually consists of lightweight soil, vegetation, filtration and detention components placed on the rooftop of a building. This is primarily an evapotranspiration method, meaning that water is captured by the roof media and it is either absorbed by plant life or it is evaporated back into the atmosphere. Roof drains are provided for excess runoff to be drained into a sewer or other water storage structure after being filtered by the roof media. The vegetation provided by this practice can help improve air quality, mitigate heat island effects and reduce outside air intake temperatures during the cooling season.

4.4.2 Green Roof with Retention

Green roofs can manage stormwater runoff as an evapotranspiration SMP for runoff reduction and filtration. Retention for green roofs involves water getting stored in the soil and plants. That water is absorbed by the plants or it evaporates back into the air. This reduces the overall water that is released into the streets and sewer systems; however, a green roof is not usually sufficient as a standalone measure to handle all the stormwater runoff on a site. See appendix for calculations to determine any supplemental practices that are needed.

Detention is when water is temporarily stored and is slowly released into the street or sewer. A Blue Roof (see page 48) uses detention methods to slow the flow of water. Combining a green roof with blue roof practices to create a Blue-Green Roof could be an option to reap the benefits of retention and detention. Permavoid Blue-Green Roof and ACO RoofBloxx Blue/Green Roof are two companies that are currently offering products which combine these two SMPs.

4.4.3 Feasibility for SCA Projects

<u>Area and Sizing</u>: In many SCA projects, especially existing sites, finding a space at grade that is large enough to allocate towards green infrastructure will be the biggest hurdle. Green roofs can solve that issue due to their application.

<u>Maintenance</u>: The warranties offered for green roofs will vary among manufacturers. Different types of common warrantees offered with green roofs include a waterproofing warranty, a plan warranty and warranties for the entire system. Waterproofing warranties typically last between 10-20 years based

on market research. Overburden removal warranties typically cover a duration of 1 to 2 years and cover the cost of removing and replacing the green roof layers if a leak needs to be repaired. This should only be considered for green roofs on existing buildings without a new membrane. If repairs are required for the underlayment, only the vegetation located atop the affected area needs to be temporarily removed. With proper care, the removed vegetation can be reintegrated after the repairs are completed.

4.4.4 Pros and Cons

PROS	CONS
Can be mostly maintained by custodial staff. Vegetation should only require basic weeding and trash removal.	May require roof reinforcement on existing structures to support the increased load of growing media and water detention.
Would not require at grade land.	Takes away available space for PV Panels. PVs help schools meet sustainability requirements and save substantially on electricity bills.
Does not need to be offset from the building or from the lot line.	Will require contractor maintenance for more in-depth repairs.
Lower utility cost impact can occur if existing roof is poorly insulated.	May require weekly inspections to remove trash and debris.
No excavation required.	May require watering to maintain plant life if rainfall is insufficient.
Improves air quality.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Can mitigate heat island effects.	Freeze-proof hose bibs are required for green roofs.
Can be installed within FDNY access landings and paths, if vegetation is less than 12" high and a level grade is provided.	

4.4.5 Field Assessment – M041 Manhattan

During a field visit to M041 in Manhattan to assess green infrastructure on the school grounds, the green roof was thoroughly evaluated. The green roof consisted of roof pavers and modular trays of plants, as well as a few PV panels. The green roof was beautifully maintained, mostly due to the school incorporating the vegetation into the science curriculum. The roof is also a popular place for after-school events. Because stormwater management needs were taken care of by the green roof, no additional measures were needed.

For this school, a professional green roof company is contracted to come in several times a year for general maintenance. Maintenance like this can be expensive depending on what company is hired. It is also not always possible for schools to incorporate outdoor activities into their science curriculum. Without student and staff involvement, the green roof would require routine maintenance from custodial staff.

4.4.6 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment. For all vegetated SMPs, note that more frequent (3x/week) irrigation is required during the first 3 months after planting.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Vegetation Management:** Removal of detrital herbaceous vegetation from the previous growing season.
- ✓ **Fertilization:** Use of slow-release fertilization capsules to supply plant nutrients as needed.
- ✓ **Outlet Cleaning:** Removal of sediment from drain outlets including rooftops drains, gutters, downspouts and secondary overflows.
- ✓ **Erosion Control:** Stabilization of eroded soil areas after heavy storms or high winds via vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life, insufficient drainage of the area, roof leaks, roof damage and damage to the underlying drainage system.

4.4.7 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than 2 times a week in dry conditions.										
Weeding			✚			✚			✚			
Vegetation Management				✚								
Fertilization	As necessary based on visual observation of plant health or soil fertility testing.											
Outlet Cleaning							✚			✚		
Erosion Control	During growing season and based on visual observation after heavy storms and strong winds.											

4.4.8 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.
- ✓ Approximately $3,000/year

4.4.9 Lifecycle Information

The lifecycle of a green roof can range from 10-40 years. However, life cycle expectations should be limited to that of the roof warranty. At the end of this term, a green roof will require replacement and replanting.

4.5 Tree Planting/Preservation

4.5.1 Definition

Tree Planting/Preservation is a stormwater management practice where existing trees are preserved and new trees are planted to reduce the amount of impervious area on a site. These trees will have a shallow ponding area and a topsoil layer. When new trees are planted, they may also contain a drainage layer in their soil. Tree planting and preservation utilizes both infiltration and evapotranspiration methods of stormwater runoff control. The vegetation provided by this practice can help to improve air quality.

4.5.2 Feasibility for SCA Projects

Tree planting/preservation can be used in most situations in conjunction with other practices. It could be easily implemented into most SCA projects. The only potential issue would be ensuring that there is an offset from any surrounding buildings and from lot lines as required by regulatory authorities. There is also a concern with tree roots impacting/damaging foundation walls. Therefore, offsets should be increased. This offset would prevent the ponded water from the tree pit subbase from leaking into basement walls or from flooding the sidewalks. Additionally, trees planted in tree pits without surrounding permeable block paving will not grow as quickly or as large as trees planted within paved areas (i.e., playgrounds or sidewalks) surrounded by permeable block paving, which have a shared layer of growing media and drainage underneath. Additionally, these trees are more likely to fill the tree pits and intrude into pavements and utilities in search of water. Another design consideration pertains to tree preservation. Tree preservation on active construction sites requires protection, which should cover the entire root zone (where feasible) to prevent soil compaction. It should also be noted that tree planting/preservation is often required for the street frontages of new buildings as per NYC zoning requirements.

4.5.3 Pros and Cons

PROS	CONS
Can be maintained by the custodial staff.	Requires ground level space that may not be available on zero lot line projects.
Usually consists of native plant life (however, street trees must conform to NYC DOT requirements and the NYC DPR's Native Planting Guide).	New trees will require watering and especially when rainfall is insufficient.
Minimal excavation.	Planting new trees and vegetation would require care such as fertilizing and watering while they establish roots.
Preservation of existing mature trees.	Weekly or biweekly visual inspections are required to remove trash and debris and maintain tree health.
Improves air quality.	Must maintain an offset from buildings and from lot lines.
Can mitigate heat island effects.	Potential hazard from falling branches or untamable roots from existing large trees.
Minimal maintenance.	Required offsets from underground plumbing utilities must be maintained to prevent root intrusion.

4.5.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment. "Treegator" type temporary watering systems are recommended during the first 3-6 months for newly planted or established trees.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mulching:** Mulching of planting beds.
- ✓ **Pruning (Small):** Removal of dead, damaged or diseased wood under 2" diameter.
- ✓ **Pruning (Large):** Removal of dead branches over 2" in diameter or selective removal for proper form.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life, insufficient drainage of the area and potential danger from falling branches of trees.

4.5.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering												
Weeding	Quarterly as minimum during the growing season or more frequently based on ongoing inspections.											
Mulching		Minimum annually or as needed based on ongoing inspections.										
Pruning (Small)												
Pruning (Large)												
Debris and Sediment Removal	Twice per year or more frequently if needed based on ongoing inspections. (note: leaves and other natural materials can be left in place if they do not impede conveyance)											

4.5.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors.
- ✓ Up to $1,000 annually, including the costs of pruning. However, after the trees are established, watering and pruning may decrease in frequency, resulting in lower costs.

4.5.7 Lifecycle Information

The lifecycle of tree planting can be indefinite. Trees being preserved should not need replacement unless they are damaged or dying, which is unlikely to occur if they are maintained as described in this report.

4.6 Dry Basin

4.6.1 Definition

A Dry Basin is a depression in the ground that is planted with grass. It can act as a large ponding area, and it does not require any special drainage methods other than natural infiltration. It can have controlled flow devices and outlet pipes if necessary for overflow. This practice treats a large area and because it is vegetated it does improve air quality.

4.6.2 Feasibility for SCA

Dry basins are rarely viable for SCA projects. This can only be implemented for projects where extra-large sites are allocated. Additionally, building codes require an offset of 10 feet from any buildings and 5 feet from the lot line for SMPs to avoid flooding basements or public sidewalks. These offsets may already eliminate any extra space on an average site. If the soil is not permeable and infiltration methods cannot be used, installing an outlet pipe on the dry basin would require more in-depth construction and maintenance. Outlet pipes are required for overflow unless soils drain quickly. It is possible for dry basins to also function as a recreational facility. However, multi-purpose basin designs often need a larger area to comply with the sports field size requirement. Additionally, note that the maximum surface water drawdown time for dry basins is 48 hours.

4.6.3 Pros and Cons

PROS	CONS
Can be maintained by the custodial staff.	Requires ground level space that may not be available on zero lot line projects.
Usually consists of native grass	May require watering if rainfall is insufficient to maintain green grass.
Improves air quality.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Can mitigate heat island effects.	Requires daily visual inspections to remove trash and debris.
Can be used as a multi-purpose basin and sports field depending upon the slope of the land. This would meet stormwater management needs and allow for sports program space.	Must be at least 10 feet away from buildings and 5 feet away from lot lines.
Inexpensive because they take advantage of existing conditions. They do not usually involve the addition of engineered soils.	Excavation may be necessary for overflow drainage pipes. Excavation may also be necessary if this practice is not a natural basin.

4.6.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mowing/Trimming:** Mowing and/or trimming of detrital herbaceous material to four to six inches above the ground. Mowing frequency will depend on the allowable height for tick control.
- ✓ **Vegetation Management:** Dethatching and soil conditioning for turf grasses. Vegetation should be reviewed for its tolerance to flooding, as certain turf grasses that are non-native to NYC create a relatively impermeable root mat. A mix of alternative grasses and sedges is recommended, although these are less amenable to active recreation.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping if installed.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and baskets.
- ✓ **Inlet Cleaning:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hood.
- ✓ **Outlet Cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.
- ✓ **Erosion Control:** Stabilization of eroded soil areas with vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life and insufficient drainage of the area.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.6.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			+			+			+			+
Mowing/Trimming		Monthly during the growing season.										
Vegetation Management				+								
Pipe Cleaning		As warranted based on inspections every three years.										
Debris and Sediment Removal	+						+					
Outlet Cleaning												
Erosion Control		During growing season or as warranted based on inspections.										

4.6.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.

4.6.7 Lifecycle Information

Dry basins have a lifecycle of 50 years with proper maintenance.

4.7 Grass Filter Strip

4.7.1 Definition

A Grass Filter Strip is a length of area that consists of topsoil planted with short grasses that allow for the infiltration of stormwater runoff, like a swale. It is an otherwise unusable collection ditch or flat lawn. This grass can cover a large area and because it is vegetated with grass, it will improve air quality. Grass filter strips are solely an infiltration method.

4.7.2 Feasibility for SCA

Grass filter strips could be a viable option for SCA projects, space permitting. However, they may in some situations require more space than what is available on the average SCA site that must also incorporate a playground as its primary use. Grass filter strips are used for filtration with minimal or no infiltration. They consist of a short, evenly graded slope down from the edge of a field or parking area. If the soil is not permeable and infiltration methods cannot be used, installing an outlet pipe on the grass filter strip would require more in-depth construction and maintenance. A grass filter strip would require approximately 8,000 cubic feet of permeable material to effectively treat 1 acre of land. Alternatively, a smaller strip could be used in conjunction with other SMPs on one site.

Grass filter strips can manage 100% of the water quality volume of a site if the slopes are 0% to 8% for 50 feet of width, 8% to 12% for 75 feet of width, or 12% to 15% for 100 feet of width, according to section 4.11 of the NYC Stormwater Manual.

.

4.7.3 Pros and Cons

PROS	CONS
Can be maintained by the custodial staff.	Requires ground level space that may not be available on zero lot line projects.
Usually consists of native grass.	May require watering if rainfall is insufficient to maintain green grass.
Improves air quality.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Can mitigate heat island effects.	Requires daily visual inspections to remove trash and debris.
Can be integrated into parking lots and fields.	May not be suitable for steeply sloped sites. Steep slopes would not allow for proper infiltration into the soil. Water would simply run off.

4.7.4 Maintenance Tasks

- ✓ **Watering:** Watering of new planting during the first two years of establishment.
- ✓ **Weeding:** Removal of non-native or undesirable vegetation.
- ✓ **Mowing/Trimming:** Mowing and/or trimming of detrital herbaceous material to four to six inches above the ground.
- ✓ **Vegetation Management:** Dethatching and soil conditioning for turf grasses.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Erosion Control:** Stabilization of eroded soil areas with vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life and insufficient drainage of the area.

4.7.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			+			+			+			+
Mowing/Trimming		Monthly during the growing season.										
Vegetation Management				+								
Debris and Sediment Removal	+						+					
Erosion Control		During growing season or as warranted based on inspections.										

4.7.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors.

4.7.7 Lifecycle Information

Grass filter strips have a lifecycle of 10 years with proper maintenance.

4.8 Vegetated Swale

4.8.1 Definition

A Vegetated Swale is a shallow channel with vegetation and dams that control the flow of runoff. This practice can cover large areas, and it also improves air quality. Vegetated swales can be solely an infiltration practice or they can have an optional outlet pipe. Vegetated swales will always have an overflow outlet, unless they are designed to overflow into another SMP such as a bioretention basin.

4.8.2 Feasibility for SCA

Area and Sizing: Vegetated swales could be a viable option for SCA projects, space permitting. However, they may in some situations require more space than what is available on the average SCA site. Building codes require an offset of 10 feet from any buildings and 5 feet from the lot line for SMPs to avoid flooding basements or public sidewalks. These offsets may already eliminate any extra space on an average site.

Site Conditions: Unlike a rain garden, a swale channels stormwater downslope to a single outlet or another stormwater management practice, and may require plants to withstand moving water. Therefore, swales are most likely to be used on large SCA sites with significant grade changes.

Permeability: If the soils are not permeable and infiltration methods cannot be used, installing an outlet pipe on the dry basin would require more in-depth construction and maintenance.

.

4.8.3 Pros and Cons

PROS	CONS
Can be maintained by the custodial staff.	Requires a large area that may not be available on an average SCA site.
Usually consists of native plantings/grass	May require watering if rainfall is insufficient.
Improves air quality.	Planting new vegetation would require care such as fertilizing and watering while they establish roots.
Can mitigate heat island effects.	Requires frequent visual inspections to remove trash and debris.
This practice does not have a maximum loading ratio under the USWR Manual.	Must be at least 10 feet away from buildings and 5 feet away from lot lines.

4.8.4 Maintenance Tasks

Watering: Watering of new planting during the first two years of establishment. For all vegetated SMPs, note that more frequent (3x/week) irrigation is required during the first 3 months after planting.

Weeding: Removal of non-native or undesirable vegetation.

Mowing/Trimming: Mowing and/or trimming of detrital herbaceous material to four to six inches above the ground.

Vegetation Management: Dethatching and soil conditioning for turf grasses.

Debris and Sediment Removal: Removal of accumulated sediment and debris from practice areas.

Pipe Cleaning: Hydraulic cleaning of inflow, outflow and underdrain piping.

Outlet Cleaning: Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

Erosion Control: Stabilization of eroded soil areas with vegetative or mechanical means.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in unhealthy or dying plant life and insufficient drainage of the area.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.8.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Watering		As needed. Not less than weekly in dry conditions.										
Weeding			+			+			+			+
Mowing/Trimming				+								
Vegetation Management				+								
Pipe Cleaning		As warranted based on inspections every three years.										
Debris and Sediment Removal	+						+					
Outlet Cleaning												
Erosion Control		During growing season or as warranted based on inspections.										

4.8.6 Maintenance Cost Data

- ✓ Maintenance for vegetation can be done by custodial staff or contractors. Maintenance for draining systems must be done by contractors.
- ✓ Approximately $1,000 monthly

4.8.7 Lifecycle Information

Vegetated swales have a lifecycle of 20-50 years with proper maintenance.

4.9 Dry well

4.9.1 Definition

A Dry Well is a stone-filled shaft or prefabricated, open-bottom concrete container, typically cylindrical, that is placed underground. These structures typically collect stormwater via pipes from a series of remote inlets and allow it to infiltrate into the surrounding soil. Dry wells can treat large areas of runoff. This practice has no vegetation and is underground, but sometimes pretreatment measures such as grass and vegetation are planted around the opening to the well to minimize sediment and debris entering the system. Subgrade sedimentation chambers that allow impurities to settle out of the water may also be installed nearby to filter the water before it enters the well. Aside from pretreatment measures, dry wells have no impact on air quality.

4.9.2 Feasibility for SCA Projects

Area and Sizing: Dry wells can be a viable option for SCA projects because they are buried underground, and therefore they will not take away from the available above ground space that could be used for playground. They do however have to abide by the building codes that state they cannot be within 10 feet of a building or 5 feet of a lot line. This may limit where they can be placed on smaller sites. For an area of 1 acre, multiple drywells totaling 6,172 cubic feet underground are needed. A typical 6' diameter, 12' deep prefabricated concrete dry well installation holds approximately 300cf with no stone fill.

Infiltration: They are also only viable if the infiltration rate of soil on the site is 0.5 in/hr.

4.9.3 Pros and Cons

PROS	CONS
Would not take away from area that could be used for playground or other construction purposes.	Requires contractor maintenance.
Components, other than the access manhole, are usually underground and out of sight.	Does not mitigate heat island effect.
Treats a large area.	Does not improve air quality.
Does not require sewer connections as a dry well is solely an infiltration practice.	Requires 10 feet offset from any building structures and 5 feet from lot line as per building codes.
This practice does not have a maximum loading ratio under the USWR Manual.	Is not viable if surrounding soils do not have an adequate infiltration rate (0.5 in/hr).
	Requires deeper excavation than vegetated SMPs.

4.9.4 Maintenance Tasks

- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from the sediment chamber. If used, pretreatment areas and sedimentation chambers must also be cleared of debris and sediment.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and/or baskets.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.9.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Debris and Sediment Removal		As warranted based on ongoing inspections.										
Pipe Cleaning		As warranted based on video inspections every 3 years.										
Inlet Filter Cleaning			+			+			+			+
Inlet Cleaning							+					

4.9.6 Maintenance Cost Data

- ✓ Requires Contractor Maintenance.
- ✓ Approximately $1,500 to $2,000 per contractor's annual visit.

4.9.7 Lifecycle Information

The lifecycle of a dry well can last up to 50 years. Even with proper care, the concrete of a dry well will deteriorate over time from repeated exposure to the common chemicals, salts and sulfates in water, rain and soil. At the end of this term, a dry well will require replacement.

4.10 Stormwater Gallery

4.10.1 Definition

A Stormwater Gallery is an area underground filled with a stone base and prefabricated structures, usually made of stone-filled perforated HDPE or concrete pipes or chambers surrounded by additional drainage stone. This retention practice stores rainwater and allows it to infiltrate into the surrounding soil, similar to a dry well. Alternatively, if the infiltration rate of soil is below 0.5 in/hr, this SMP may be used as a detention measure. In this application, a stormwater gallery differs from a detention tank system in its size and configuration. A stormwater gallery can also be a detention practice that stores and does not infiltrate— it is excavated and then filled with stone base and prefabricated structures. Grit chambers may be included to allow sediment to separate from the water before infiltration. These galleries are very large and can treat large areas of runoff. This practice has no vegetation and is underground, therefore it has no impact on air quality.

4.10.2 Feasibility for SCA

Stormwater galleries can be a viable option for SCA projects because they are buried underground, and therefore they will not take away from the available above ground space that could be used for playground.

4.10.3 Pros and Cons

PROS	CONS
Would not take away from area that could be used for playground.	Requires contractor maintenance.
Requires shallower excavation as these galleries are built out horizontally as opposed to straight down.	Requires large areas of excavation.
Treats a large area.	Does not mitigate heat island effect.
Components are always underground and out of sight.	Does not improve air quality.
This practice does not have a maximum loading ratio under the USWR Manual.	Uses significant amounts of plastic or concrete, which have high embodied carbon.

4.10.4 Maintenance Tasks

- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping.
- ✓ **Inlet Grit Chamber Cleaning:** Grit chambers must also be cleared of debris and settlement.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.10.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Debris and Sediment Removal		As warranted based on ongoing inspections.										
Pipe Cleaning		As warranted based on video inspections every 3 years.										
Inlet Grit Chamber Cleaning			+			+			+			+
Inlet Cleaning							+					
Outlet Cleaning							+					

4.10.6 Maintenance Cost Data

- ✓ Requires Contractor Maintenance.
- ✓ Approximately $1,500 to $2,000 per contractor visit. Contractors ideally visit annually but may be called more frequently if there are issues.

4.10.7 Lifecycle Information

The lifecycle of a stormwater gallery is 50 years. At the end of this term, a stormwater gallery will require replacement. Note that, even with proper care, the concrete of additional components (i.e., concrete piping or chambers) will deteriorate over time from repeated exposure to the common chemicals, salts and sulfates in water, rain and soil.

4.11 Stone Trench

4.11.1 Definition

A Stone Trench is an excavated linear area that has a stone layer above, which serves as a holding area and debris filter for rainwater to infiltrate into the soil underneath. This method does not treat very large areas. This practice has no vegetation and is underground, though the surface of this measure is exposed, not buried. Therefore, its surface is covered with pea gravel and/or grates to prevent children from disrupting the rocks. It is a horizontal application that receives stormwater directly from adjacent surfaces rather than from inlets and pipes.

4.11.2 Feasibility for SCA

Stone trenches require very little maintenance, and they can be placed in a variety of places. Stone trenches are a possible option for SCA projects, but they may not be viable as the sole stormwater management practice of a site. It would require 600 cubic feet to treat an acre of runoff, which may not be readily available on many SCA sites. Other practices may need to be implemented in conjunction with trenches to meet stormwater management requirements.

4.11.3 Pros and Cons

PROS	CONS
Once installed, requires virtually no maintenance.	Fails without warning.
Flexible layout, can be retrofitted into an existing landscape.	Requires excavation.
Requires shallower excavation as these trenches are built out horizontally as opposed to straight down.	Requires regular visual maintenance for the clearing of trash and debris, especially if a covering is used over the stone.
	Does not mitigate heat island effect.
This practice does not have a maximum loading ratio under the USWR Manual.	Does not improve air quality.
	Requires at grade level space.

	Components are exposed and visible.
	Only suitable where infiltration rate is 0.5 in/hr or more.
	Unlike other practices, this practice does not accommodate prefilters and is therefore more vulnerable to sedimentation.
	Surface is walkable but not suitable for recreation.

4.11.4 Maintenance Tasks

- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment from permeable surface.

  If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in clogging and insufficient drainage of the area. This would require intensive repairs or a possible full replacement of the system.

4.11.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Debris and Sediment Removal	✚						✚					

4.11.6 Maintenance Cost Data

- ✓ Virtually no maintenance except for annual cleaning by contractors if necessary or if failure occurs.
- ✓ Approximately $1,500 annually.

4.11.7 Lifecycle Information

The lifecycle of a stone trench is 50 years. At the end of this term, a stone trench will require replacement.

4.12 Porous Pavement

4.12.1 Definition

Porous Pavement is concrete or asphalt pavement that has holes or seams in it to allow water to infiltrate the underlying ground. There are commonly layers underneath such as a leveling course or stone base. If the underlying soil does not have a satisfactory infiltration rate (at least 0.5in/hr), then underdrain methods may be installed to handle excess runoff. This makes porous pavement both an infiltration and filtration practice that can be used on large areas. This practice has no vegetation; therefore, it has no impact on air quality. Note that there are two application types: porous or pervious pavement and permeable paver block systems.

4.12.2 Feasibility

Permeable paver block systems are a favorable option for SCA projects because it can provide the necessary drainage for a site without taking away playground space. However, there are maintenance requirements associated with this measure that may limit its applicability. Porous pavement may be better suited for large recreational areas, while permeable pavers can be suited to smaller areas, including pathways, areas near tree pits, etc. Note that porous pavements require vacuuming, while permeable paver block systems require re-setting with replacement of the sand or gravel joints.

4.12.3 Pros and Cons

PROS	CONS
Can be installed almost anywhere, would not take away from potential playground area.	Requires frequent maintenance to maintain quality drainage.
Can be a variety of colors and designs.	Permeable paver block systems can become a tripping hazard if not properly maintained.
Can be maintained by custodial staff.	Does not improve air quality.
Some excavation is required for drainage stone and bedding layers.	May require some excavation if underdrain methods are needed to meet drainage requirements.
	Includes maintenance of vacuuming out debris.

4.12.3.1 Field Inspection - R062 Staten Island Porous Pavement

During a field visit to R062 in Staten Island to assess the green infrastructure on the school grounds, there was quite an abundance of porous pavers. However, there was ponding noted in some areas. This is most likely due to maintenance issues. Porous pavers require very frequent cleaning to maintain their permeability.

4.12.4 Maintenance Tasks

- ✓ **Weeding:** Removal of any vegetation is required for permeable block paver systems. Weeding may only be required during the growing season.
- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment from permeable surface. Both porous pavements and permeable paver block systems should be inspected for sediment removal after the winter, when sweeping may be prevented by snow and ice.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping.
- ✓ **Sweeping**: Removal of accumulated leaves during the Fall season.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

4.12.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Weeding	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚
Debris and Sediment Removal	✚						✚					
Pipe Cleaning												
Sweeping	Regular sweeping at least 3 times a week, daily during Autumn season.											

4.12.6 Maintenance Cost Data

- ✓ Requires contractor maintenance.
- ✓ Approximately $750 semi-annually.

4.12.7 Lifecycle Information

The lifecycle of porous pavement can range from 20-25 years. Note that, even with proper care, concrete will deteriorate over time from repeated exposure to the common chemicals, salts and sulfates in water, rain and soil. At the end of this term, porous pavement will require replacement. Paver blocks are longer lasting, but will need to be re-set with new bedding and joints. Pavements need to be replaced in their entirety.

4.13 Synthetic Turf Field

4.13.1 Definition

A Synthetic Turf Field is a field covered in an artificial grass type fabric, shock absorbing pad, leveling course and stone base. Thermoplastic elastomer (TPE) infill, rubber, coated sand, polymers, lighter-colored turf fibers and organic material like walnuts or cork are common infill options that would minimize heat. These layers allow water runoff to infiltrate the ground below as long as the underlying soil meets the minimum infiltration rate of 0.5in/hr. If the underlying soil does not meet the minimum infiltration rate, then underdrain systems may be necessary to carry the runoff to the nearest sewer system. This infiltration/filtration practice can treat very large areas. However, it has no vegetation, so it has no impact on air quality.

4.13.2 Feasibility for SCA

Synthetic turf is a favorable option for SCA projects because it can provide the necessary drainage for a site without taking away playground space. Turf fields are commonly built atop stormwater galleries for detention if soil conditions do not allow infiltration. However, detention underneath the field will most likely be necessary to meet stormwater management requirements, and the SCA must account for the maintenance necessary to maintain proper drainage if this is the case.

Note that fields used for sports are pitched to shed surface flows to their edges during heavy precipitation, so they will not accept flows from surrounding surfaces.

4.13.3 Pros and Cons

PROS	CONS
Would not take away from potential playground area.	Requires routine maintenance.
Can be primarily maintained by custodial staff.	If there are stormwater galleries or detention tanks underneath, contractor maintenance will be required.

Allows for multiple sports programs.	Increased use of plastic.
Can allow for large below-grade drainage/ filtration systems.	Requires visual maintenance as needed to remove trash and debris.
	Does not mitigate heat island effects.

4.13.3.1 Field Inspection- R062 Synthetic Turf

During a field visit to R062 in Staten Island to assess the green infrastructure on the school grounds, it was noted that the synthetic turf field on the premises was in very good condition. It had been well maintained. It was raining during the field visit, and no ponding was noticed in the area. It provided a large area for sports and recreation while also providing proper drainage.

It should be noted that the detention tanks underneath the turf field can only be maintained via contractors due to the difficult nature of accessing the tanks. While a contractor may only be needed for yearly inspections or as problems arise, these visits can be expensive. This is in addition to the regular maintenance of the field itself. Regular maintenance can be carried out by custodial staff as long as proper equipment is provided to brush and aerate the field. Brushing and aerating the field must be done monthly to maintain proper function of the field.

4.13.4 Maintenance Tasks

- ✓ **Brushing:** Monthly with supplied sweeper.
- ✓ **Refuse removal:** Remove garbage.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow and underdrain piping.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and/or baskets. If grit chambers are used, they must also be cleared of debris and settlement.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system. There is also a potential tripping hazard to students from the carpet of the field lifting or tearing due to insufficient maintenance.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.13.5 Maintenance Frequency

<table>
<tr><th>Frequency / Tasks</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sept</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>Refuse Removal</td><td></td><td></td><td colspan="8">As warranted based on daily visual inspection.</td><td></td><td></td></tr>
<tr><td>Brushing</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td><td>✚</td></tr>
<tr><td>Pipe Cleaning</td><td></td><td colspan="10">As warranted based on video inspections every 3 years.</td><td></td></tr>
<tr><td>Inlet Filter Cleaning</td><td></td><td></td><td>✚</td><td></td><td></td><td>✚</td><td></td><td></td><td>✚</td><td></td><td></td><td>✚</td></tr>
<tr><td>Inlet Cleaning</td><td></td><td></td><td></td><td></td><td></td><td></td><td>✚</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Outlet Cleaning</td><td></td><td></td><td></td><td></td><td></td><td></td><td>✚</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

4.13.6 Maintenance Cost Data

- ✓ Regular refuse removal and brushing can be done by custodial staff. Any maintenance to underground systems will require contractor maintenance.

4.13.7 Lifecycle Information

The lifecycle of a synthetic turf field can range from 7-10 years. At the end of this term, a synthetic turf will require replacement. Note that replacement of the synthetic turf does not necessitate the need to replace the subgrade piping/drainage systems.

4.14 Subsurface Gallery

4.14.1 Definition

A Subsurface Gallery is an underground practice filled with a stone base and prefabricated structures, usually made of concrete, stone chambers, or pipes. This detention practice controls the release of stormwater into the sewer system to avoid overflow. While similar to stormwater galleries, subsurface galleries are detention practices, while stormwater galleries are infiltration practices. This practice can treat large areas of runoff.

4.14.2 Feasibility for SCA

Subsurface galleries can be a viable option for SCA projects because they are buried underground, and therefore they will not take away from playground space.

4.14.3 Pros and Cons

PROS	CONS
Would not take away from potential playground area.	Requires contractor maintenance.
Components are usually underground and out of sight.	Requires extensive excavation.
	Does not mitigate the heat island effect.
	Has no vegetation and is underground, therefore it has no impact on improving air quality.

4.14.4 Maintenance Tasks

- ✓ **Debris and Sediment Removal:** Removal of accumulated sediment and debris from practice areas.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow, and underdrain piping.
- ✓ **Inlet Filter Cleaning:** Emptying of inlet filter bags and/or baskets.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.14.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Debris and Sediment Removal			As warranted based on ongoing inspections.									
Pipe Cleaning		As warranted based on video inspections every 3 years.										
Inlet Filter Cleaning			+			+			+			+
Inlet Cleaning							+					
Outlet Cleaning							+					

4.14.6 Maintenance Cost Data

- ✓ Requires Contractor Maintenance
- ✓ Approximately $1,500 to $2,000 per contractor visit. Contractors ideally visit annually but may be called more frequently if there are issues.

4.14.7 Lifecycle Information

The lifecycle of a subsurface gallery is 25 years. At the end of this term, a subsurface gallery will require replacement.

4.15 Blue Roof

4.15.1 Definition

A Blue Roof is a system that temporarily stores water on the rooftop of a building. This can be done with modular storage units or roof restriction devices. Drain restriction devices with overflows should always be incorporated.

4.15.2 Feasibility for SCA

Blue roofs are a viable option for SCA projects for many of the same reasons green roofs are viable. They do not take away from potential playground space while still providing the necessary stormwater detention. While blue roofs can take advantage of evaporation to reduce flow to the sewer if left uncovered, they are typically covered by pavers which reduces the opportunity for evaporation. However, covering with pavers helps protect the roof membrane from UV and mechanical damage.

4.15.3 Pros and Cons

PROS	CONS
Would not take away available land at grade level.	This practice does not include vegetation, so it has no impact on improving air quality.
Can mitigate heat island effects.	Requires some visual maintenance to remove trash and debris, however the maintenance is the same as that of a standard SCA roof.
	If used, modular storage units add plastic to projects.

4.15.4 Maintenance Tasks

- ✓ **Sediment and Debris Removal:** Removal of sediment and debris from roof storage area(s) and from drain outlets including roof drains, gutters, downspouts, secondary overflows and drain screens.
- ✓ **Ice Removal:** Break-up and removal of ice formations around outlet and overflow structure.
- ✓ **Repair Leaks:** Repair of roofing materials for damages and leaks.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

4.15.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Sediment and Debris Removal	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚	✚
Ice Removal	As warranted based on inspections during the winter.											
Repair Leaks	As warranted based on ongoing inspections.											

4.15.6 Maintenance Cost data

✓ Maintenance can be done by custodial staff.
Should not require significantly more maintenance than a standard SCA roof.

4.15.7 Lifecycle Information

The lifecycle of a blue roof is the same as that of a typical SCA roof.

4.16 Detention Tank

4.16.1 Definition

A Detention Tank is a concrete tank placed underground that captures water runoff and slowly releases it into surrounding sewer systems. This can treat a large area of runoff. This practice has no vegetation and is underground; therefore, it has no impact on air quality.

4.16.2 Feasibility for SCA

Detention tanks are placed underground, so they do not encroach on the available playground space in a site. They can be implemented on almost any site, which makes them a favorable option for SCA projects.

4.16.3 Pros and Cons

PROS	CONS
Would not take away from potential playground area.	Requires contractor maintenance.
Components are underground and out of sight.	Requires intensive excavation.
Requires minimal to no custodial maintenance.	Does not mitigate the heat island effect.
	Does not improve air quality.
	May be difficult to access if placed beneath turf fields or other surfaces that cannot accommodate manholes.

4.16.4 Maintenance Tasks

- ✓ **Debris and Sediment Removal:** Vacuum cleaning of accumulated sediment from primary storage tank.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow and outflow piping.
- ✓ **Outlet Cleaning:** Cleaning of gutters, downspouts and first flush chambers.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment within inlet hoods and sumps.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.16.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Debris and Sediment Removal	As warranted based on annual inspections.											
Pipe Cleaning	As warranted based on video inspections every 3 years.											
Outlet Cleaning				+						+		
Inlet Cleaning	At a minimum annually or more based on inspections.											

4.16.6 Maintenance Cost Data

- ✓ Requires Contractor Maintenance.
- ✓ Approximately $1,500 to $2,000 per contractor visit. Contractors ideally visit annually but may be called more frequently if there are issues.

4.16.7 Lifecycle Information

The lifecycle of a detention tank is 50 years. Even with proper care, the concrete of a detention tank will deteriorate over time from repeated exposure to the common chemicals, salts and sulfates in water, rain and soil. At the end of this term, a detention tank will require replacement.

4.17 Sand Filter

4.17.1 Definition

A Sand Filter is a chamber that is placed underground and contains a filter bed of sand. Water runoff is stored in the chamber and slowly released as it goes through the sand bed. Sediment and debris are filtered through the sand so that it does not enter the sewer system. Some sand filter systems use cartridges of sand filter media. Cartridge systems may be easier to clean/replace than regular sand media, but depending on the company used to supply cartridges, it may be more expensive.

4.17.2 Feasibility for SCA

Sand filters are buried underground. They only require approximately 1,234 square feet to treat an acre of land. They do not take away from potential playground space and can be implemented in most SCA projects. Generally, sand and organic filters are used in series with detention SMPs such as SW galleries and detention tanks, since they provide filtration only. They are only required in MS4 areas.

4.17.3 Pros and Cons

PROS	CONS
Would not take away from potential playground area.	Requires contractor maintenance.
Components are usually underground and out of sight.	Requires extensive excavation.
Requires virtually no custodial maintenance.	Requires regular replacement of the sand filter media. Depending on type of product, may require cartridge replacements as recommended by factory specifications.
	Does not mitigate heat island effect.
	Does not improve air quality.
	If using sand cartridges, price for replacements can vary based on the supplier used.

4.17.4 Maintenance Tasks

- ✓ **Media Raking:** Raking of sand or organic filter media to remove trash and debris from control openings. If using cartridges instead of loose sand, cartridges must be replaced as recommended by factory specifications. Note that the life expectancy of cartridges is dependent on size. Bigger cartridges last longer but are also more expensive. The flow rate of a site and how sediment fills the water also impacts the life expectancy. Lastly, companies have various types of organic fill to choose from, which once again varies the life of a filter. Therefore, cartridge replacement can vary anywhere from once a year to once every 5 years based upon these factors.

- ✓ **Surface Media Replacement:** Removal, cultivation and replenishment of sand or organic filter media to sufficient depths to achieve unclogged media.
- ✓ **Debris and Sediment Removal:** Vacuum cleaning of accumulated sediment from filter bed within sedimentation chambers. If using sand cartridges, then cartridges must be replaced according to factory instructions. Price for replacements can vary based on the supplier.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow, and underdrain piping.
- ✓ Inlet Filter Cleaning: Emptying of inlet filter bags and/or baskets.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet Cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.17.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Media Raking		As warranted based on annual inspections.										
Surface Media Replacement		As warranted based on annual inspections.										
Debris and Sediment Removal		Annually or when accumulation reaches a depth of 6 inches.										
Pipe Cleaning		As warranted based on video pipe inspections every three years.										
Inlet Filter Cleaning			+			+			+			+
Inlet Cleaning							+					

Outlet Cleaning							✚					

4.17.6 Maintenance Cost Data

- ✓ Requires Contractor maintenance.
- ✓ Approximately $1,500 annually. This cost is an average and considers cartridges vs filter beds.

4.17.7 Lifecycle Information

The lifecycle of cartridge and filter bed systems can range from 5-20 years, while the lifecycle of the surrounding concrete structure is 25 years. At the end of this term, a sand filter will require replacement.

4.18 Organic Filter

4.18.1 Definition

An Organic Filter is a chamber underground that contains a bed of organic filter media. Water is temporarily stored as it slowly filters through the organic media, typically sand supplemented with an organic material such as peat. Some organic filter systems use cartridges of organic and sand filter media. Cartridge systems may be easier to clean/replace than regular organic media, but depending on the company used to supply cartridges, it may be more expensive. However, organic filters are widely believed to provide superior pollutant removal and are therefore beneficial for project sites.

4.18.2 Feasibility for SCA

Organic filters are buried underground. They require approximately 2,468 square feet to treat an acre of land. They do not take away potential playground space and can be implemented in most SCA projects.

4.18.3 Pros and Cons

PROS	CONS
Would not take away from at grade land.	Requires contractor maintenance
Components are usually underground and out of sight.	Requires extensive excavation
Requires virtually no custodial maintenance.	Requires regular replacement of the organic filter media. Depending on type of product, may require cartridge replacements as recommended by factory specifications.
	Does not mitigate heat island effect.
	This practice has no vegetation and is underground, therefore it has no impact on air quality.
	If using sand cartridges, price for replacements can vary based on the supplier used.
	While organic filters require twice as much area as sand filters to treat an acre, the enhanced pollutant removal provided by organic filters is typically not needed- therefore, sand filters are an efficient option.

4.18.4 Maintenance Tasks

- ✓ **Media Raking:** Raking of sand or organic filter media to remove trash and debris from control openings. If using cartridges instead of layers of organic media, cartridges must be replaced as recommended by factory specifications. Note that the life expectancy of cartridges is dependent on size. Bigger cartridges last longer but are also more expensive. The flow rate of a site and how sediment fills the water also impacts the life expectancy. Lastly, companies have various types of organic fill to choose from, which once again varies the life of a filter. Therefore, cartridge replacement can vary anywhere from once a year to once every 5 years based upon these factors.
- ✓ **Surface Media Replacement**: Removal, cultivation, and replenishment of sand or organic filter media or cartridges to sufficient depths to achieve unclogged media.
- ✓ **Debris and Sediment Removal:** Vacuum cleaning of accumulated sediment from filter bed within sedimentation chambers. If using organic media cartridges, then cartridges must be replaced according to factory instructions. Price for replacements can vary based on the supplier.
- ✓ **Pipe Cleaning:** Hydraulic cleaning of inflow, outflow, and underdrain piping.
- ✓ Inlet Filter Cleaning: Emptying of inlet filter bags and/or baskets.
- ✓ **Inlet Cleaning*:** Vacuum cleaning of accumulated sediment and debris within inlets sumps and hoods.
- ✓ **Outlet Cleaning:** Removal of accumulated sediment and debris from risers (vacuum cleaning), trash racks, and spillways and clearing sediment from orifices and outlet control structures to prevent clogging.

If the above maintenance tasks are not performed on their scheduled regular basis, there could be issues that result in insufficient drainage of the area and damage to the underlying drainage system that would require intensive repairs or a possible full replacement of the system.

** Note that inlet filters, sumps, hoods and risers are not typical and simpler installations excluding these components should be considered.*

4.18.5 Maintenance Frequency

Frequency / Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Media Raking		As warranted based on annual inspections.										
Surface Media Replacement		As warranted based on annual inspections.										
Debris and Sediment Removal		Annually or when accumulation reaches a depth of 6 inches.										
Pipe Cleaning	As warranted based on video pipe inspections every three years.											

Inlet Filter Cleaning			+			+			+			+
Inlet Cleaning							+					
Outlet Cleaning							+					

4.18.6 Maintenance Cost Data

- ✓ Requires Contractor maintenance.
- ✓ Approximately $1,500 annually. This cost is an average and considers cartridges vs filter beds.

4.18.7 Lifecycle Information

The lifecycle of an organic filter can range from 5-20 years. At the end of this term, an organic filter will require replacement.

Non-Viable Stormwater Management Practices

4.19 Constructed Wetland

4.19.1 Definition

A Constructed Wetland is a wetland that is created with engineered soils and vegetation. There is a permanent pond of water and additional water can be retained so that it can naturally infiltrate surrounding soil or evaporate. This method treats a very large area and because it is highly vegetated it does improve air quality.

4.19.2 Feasibility for SCA

Constructed wetlands require large areas of land to be effective (approx. 10,890 cubic feet). Most SCA jobs will not have that much space available. Therefore, constructed wetlands are not a viable option for SCA projects. Wetlands require significant excavation and intensive landscaping. Moreover, standing bodies of water require fencing to restrict access and wildlife curation or pesticide spraying to manage mosquitos.

4.20 Wet Basin/Pond

4.20.1 Definition

A Wet Basin/Pond is a pool of water that usually has impervious soil or a liner underneath. This system allows for the storage of stormwater runoff. This method treats a large area, and because there is usually vegetation surrounding these ponds, they can improve air quality.

4.20.2 Feasibility for SCA

A wet basin or pond would require a large area to be effective (approx. 10,890 cubic feet). Most SCA jobs will not have that much space available. Therefore, wet basins and ponds are not a viable option for SCA projects.

SECTION 5 | Site Assessment

- 5.1 Site Assessment
- 5.2 Evaluation Checklist
- 5.3 Flood Zone Schools
- 5.4 NYC Stormwater Resiliency Plan
- 5.5 New York City Flood Maps
- 5.6 Flood Risk Assessment Chart for SMPs

SECTION 5 | Site Assessment

5.1 Site Assessment

For most SCA work, an existing site will be provided with proposed updates. The sites must be investigated to determine its needs as far as stormwater management. A geotechnical investigation will classify the characteristics of the existing soil and help the design team to pick the appropriate stormwater management practice. This investigation should include the texture and characteristics of the soil, the depth to groundwater, depth to bedrock, possible contamination concerns, and the infiltration rate of the soil. The designer must be able to determine if additional studies on the soil are needed due to variations on the soil or possible contaminants.

Infiltration rate is a major factor in which SMPs we choose to implement. If water infiltrates too slowly, there is a potential for flooding. However, if water infiltrates too quickly, there is a risk of drying out the soil and destroying plant life. The type of plant life used in a vegetated green infrastructure design is determined by the landscape designer. However, the landscape designer should consult the SCA design requirements for the types of vegetation allowed on SCA projects.

If the site is in an MS4 area, then the SMP will need to meet MS4 requirements. While both CSO and MS4 areas prioritize retention, the secondary priority area for MS4 areas is filtration while the secondary priority for CSO areas is detention.

The design team needs to know the layout of the entire area being worked on, and the exact locations of any major structures within that area. Buildings, playgrounds, existing drainage, sewer connections, and any other major obstacles will need to be located as accurately as possible. From there they can assess how much space is available and which SMPs will meet the stormwater requirements within that allotted space, without interfering with existing nearby structures.

5.2 Evaluation Checklist

There are several items that need to be evaluated before selecting a green infrastructure measure. Below is a checklist that a designer can follow to ensure that every aspect of selecting a GI for an SCA site has been reviewed.

No.	Project Stage	Description	Done
1	**Schematic Design**	**Data collection: SURVEY** Confirm that survey is complete with site features, topographic information, and ASCE Level B as-built underground utilities/structures/building connections. Identify requirements for infiltration practices, such as min. permeability rate, bedrock clearance, groundwater table and soil strata and see if any of these requirements eliminate certain GI practices.	☐
2	**Schematic Design**	**Data collection: MAPS AND INFO** FEMA FIRMETTE Flood Map - For floodplain areas NYCDPR Street Tree Map - For tree quantities, species, sizes Oasis Map – For transit routes, parks, playgrounds, open space Tax Map – For block and lot information Zoning Map – For zoning information (affects BPP-Tree requirements). Sewer System Area – Identify if area is CSS or MS4 NYC Stormwater Flooding Map- for areas of potential flooding due to stormwater.	☐
3	**Schematic Design**	**Data collection: Regulatory Permits** See Section 2 for details	☐
4	**Schematic Design**	**STUDIES & INVESTIGATIONS** Test Fit Study – For general information about the site and its proposed design. Soil Boring Logs – See No. 05. Geotechnical Reports – See No. 05. Stormwater Pollution Prevention Plans (SWPPP) Environmental Reports	☐
5	**Schematic Design**	**Data collection: GEOTECHNICAL** Soil classification, permeability rates, depth of groundwater table, and depth to bedrock of the site.	☐
6	**Design Development & Construction Documents**	**PROPOSED WORK** Architectural Plans showing proposed building, playground, accessibility requirements, foundations, building connections, and other site features.	☐
7	**Design Development & Construction Documents**	**Analysis: FIELD INVESTIGATION** Identify existing surface utilities, drainage flow problems, ponding, grading issues, tree root systems and vegetation that need to remain undisturbed, structures, vaults, and site constraints.	☐
8	**Design Development & Construction Documents**	**Analysis: SURVEY INVESTIGATION AND GRADING DESIGN** Identify and calculate tributary areas, grading, and runoff flow paths for the proposed conditions and how they tie into the surrounding existing site.	☐
9	**Design Development & Construction Documents**	**Analysis: TREES/VEGETATION** Identify trees/vegetation (including trunk size, canopy extents, critical root zones) to remain, be removed, or be installed.	☐

10	**Design Development & Construction Documents**	**Analysis: SITE CONSTRAINTS** Review all site constraints listed below and see if any of these constraints eliminate certain GI practices. ✓ existing features to remain ✓ proposed features to be installed (playground equipment, site grades, stairs, storage areas, etc.) ✓ building foundation ✓ retaining walls ✓ support of excavation ✓ existing transit structures ✓ utility setback requirements ✓ utility tie in points ✓ setback requirements from neighboring properties ✓ available surface footprint	☐
11	**Design Development & Construction Documents**	**Analysis: GI PRACTICES (PROCESS OF ELIMINATION)** After identifying the site constraints, drainage requirements, and sewer area. Review all the viable GI practices and select a few SMPs that would best fit the site.	☐
12	**Design Development & Construction Documents**	**Analysis: MAINTENANCE** Compare the maintenance of all the GIs selected.	☐
13	**Design Development & Construction Documents**	**Analysis: COST** Compare the cost of all the GIs selected.	☐
14	**Design Development & Construction Documents**	**Analysis: COST VS. MAINTENANCE VS. EASE** Compare the maintenance that the school will be required to perform in order to ensure that the GI system works long term with the cost and the benefits of investing in the GI practice. Decide on a GI practice.	☐
15	**Design Development & Construction Documents**	**Analysis: IMPLEMENTATION** Implement the selected GI practice and check if it is the best solution for the SCA site. If not, re-evaluate the GI selection and go through steps 11-14 again.	☐

5.3 Flood Zones and Resiliency Impacts on Green Infrastructure

An additional consideration in these cases will be the issue of resiliency. Both the rainfall and sea level rise impacts need to be addressed early in the design process. The rainfall resiliency would result in larger SMPs being designed to accommodate the additional runoff.

Most green infrastructure would be adversely impacted by being constructed within a flood zone. The main flooding in the city of New York is tidal. As a result, the plants would generally not do well being inundated by saltwater.

5.4 NYC Stormwater Resiliency Plan

NYC has come out with an NYC Stormwater Resiliency Plan. This plan acknowledges the increasing intensity of storms and flooding due to climate change and aims to implement measures that ensure the infrastructure that is built today can withstand the precipitation needs of tomorrow. For a facility to be resilient, it must be designed to withstand changes in climate that are projected to occur by the end of the facility's useful life.

The resiliency guidelines explain which structures are deemed as critical, meaning they are of high importance and must be protected in inclement weather. To protect these structures, the designs must be adaptable over time. This means that the protection level can be assessed and improved easily over time as environmental demands increase.

For the potential of increased precipitation, emphasis is placed on infiltration, retention, and detention to avoid potentially overwhelming the city sewer system. The city is also attempting to expand the capacity of the sewers themselves, but that is not always feasible. Capturing as much water as possible before it enters the sewer system is one of the best ways to prevent urban flooding.

With regards to stormwater management practices, the resiliency guidelines put a focus on designing SMPs for increased flood risks and designing SMPs that will specifically mitigate damage to buildings. The NYC Stormwater Resiliency Plan includes various risk assessment tools to help in the design process.

5.5 New York City Flood Maps

New York City developed a flood map system to illustrate moderate to extreme flooding in the city. These maps can help people be more prepared for these sudden storms. It can also assist engineers in their designs for green infrastructure by showing the worst-case scenarios that need to be accounted for.

Flooding could be very damaging to vegetated SMPs. Flooding deprives the plants of oxygen, and severe floodwaters can contain contaminants like trash, roadway salt, sewage, etc. If an SMP is being implemented in an area with a high flood risk, it will be important to utilize plants that are resistant to flooding. The SMP itself should be designed to handle worst case scenario flooding to get ahead of projected flood patterns. It may even be a strong reason to go with a rooftop option like a green roof or rooftop stormwater planters, so the vegetation will be less likely to be sitting in pools of water and absorb contaminants from the ground. Alternate measures of stormwater management would likely still be needed to handle the heavy flow of water. High flood risk could also be a strong factor in choosing a non-vegetated option, like a detention tank or stormwater gallery to avoid issues with plant life altogether.

5.6 Flood Risk Assessment Chart of SMPs

While stormwater management practices are ideally designed to handle flood conditions, sometimes major storms and floods can overwhelm a system. Major flooding could especially harm the plant life in vegetated measures and may cause plants and soil media in the SMP to need to be completely replaced. If a site is within an area that has a high risk of flooding, it is recommended to consider how safe the SMP is from potential flood damage. Measures that are on the ground level, and especially ones that have vegetation, are high risk. SMPs that are underground or on the rooftop of buildings are low risk. The following chart shows the SMPs in order of risk level.

Stormwater Management Practice	Typical Location	Flood Risk Assessment
Green Roof	Rooftop	Low Risk
Dry Well	Underground	Low Risk
Stormwater Gallery	Underground	Low Risk
Subsurface Gallery	Underground	Low Risk
Blue Roof	Rooftop	Low Risk
Detention Tank	Underground	Low Risk
Sand Filter	Underground	Low Risk
Stormwater Planter	Above Grade	Low Risk
Organic Filter	Underground	Medium Risk
Tree Planting/Preservation	Ground Level	Medium Risk
Grass Filter Strip	Ground Level	Medium Risk
Stone Trench	Ground Level	Medium Risk
Porous Pavement	Ground Level	Medium Risk
Synthetic Turf Field	Ground Level	Medium Risk
Dry Basin	Ground Level	Medium Risk
Bioretention	Ground Level	High Risk
Rain Garden	Ground Level	High Risk
Vegetated Swale	Ground Level	High Risk

SECTION 6 | Design Examples

- 6.1 Example Calculations for Choosing and Sizing Stormwater Management Practices
- 6.2 CSS Area - New School - 6315 14th Avenue, Brooklyn NY
- 6.3 MS4 Area - Addition to Existing School - PS 206 Brooklyn, NY

SECTION 6 | Design Examples

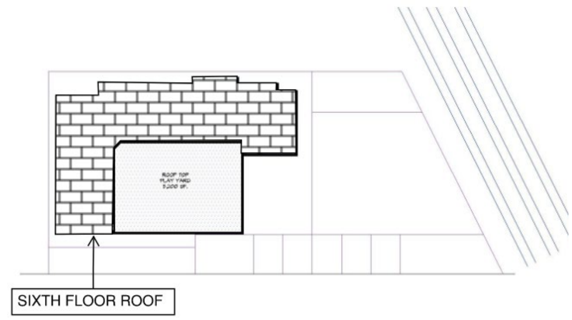
6.1 Example Calculations for Choosing and Sizing Stormwater Management Practices

With the limited amount of land in New York City, there is a unique challenge with regards to the availability of space for green infrastructure. There are regulations that limit how close an SMP can be from a lot line or from the building. Required playground space further limits available area for SMP implementation. Many New York schools already lack sufficient recreational space, so taking away even more of that space to implement an SMP is not ideal.

The following section includes example calculations for selecting and sizing an SMP. The test fit schools selected here represent a few of the common scenarios that the design team will face when working on SCA projects. These are only examples and should be used as a guide. Every new site should be evaluated on the physical site characteristics and unique challenges.

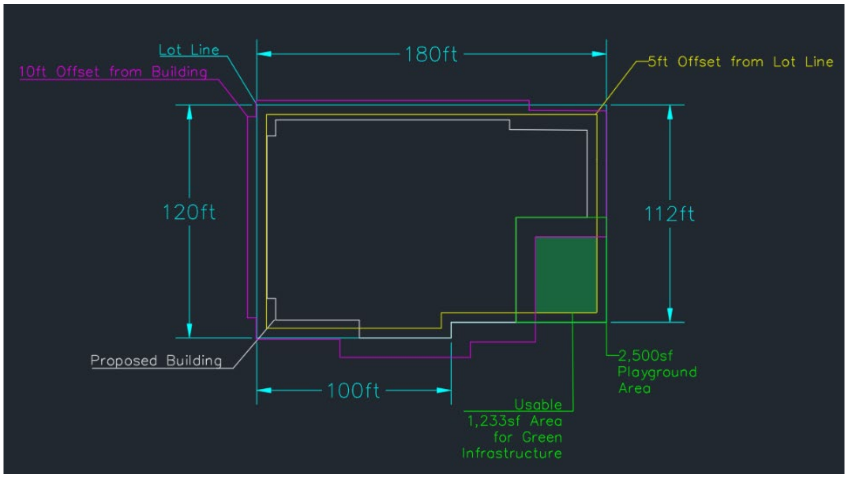
6.2 CSS Area - New School - 6315 14th Avenue, Brooklyn NY

The following example is from 6315 14th Avenue, Brooklyn, NY. This is a new construction site for a primary school located in a CSS zone. SCA provided their test fit information for this site, which includes the location, the block and lot numbers, conceptual plans, tax maps, zoning information, flood maps, and site photographs. The test fit document will be included in the index at the end of this report. This school has a 2,500sf asphalt playground at grade and a 5,200sf rooftop playground, which is 32.27% less than what is targeted in a standard educational program of requirements. For this reason, it is strongly advised to avoid any SMPs that would subtract from the already insufficient play space.



Before beginning the selection and sizing process, the 2012 DEP Guideline for the Design & Construction of Stormwater Management Systems checklist must first be consulted to ensure this site is eligible for a stormwater management practice. A copy of this checklist is included on the first page of the Appendix A. Please see the spreadsheet on page 84 of the appendix, rows to see the answers to this checklist with respect to each test fit school.

Once it is determined that a Green Infrastructure practice is appropriate, we must account for the 5 feet and 10 feet offsets from the lot line and building respectively. In this example, there is only approximately 1,233 square feet of space left, and it is all within the school playground (see CAD drawing below). Assuming we cannot take away any of the playground space, a bioretention basin, and subsequently a rain garden and stormwater planter cannot be used. This makes the project a candidate for green roof, synthetic turf, and detention tanks, as these are all practices that would not detract from the playground space. For this example, we will design a green roof.



6.2.1 Green Roof Calculations

Calculate the Water Quality Volume (WQv). When calculating this value, you must account for all of the contributing areas. In this case, there is both an asphalt play area at grade as well as on the roof. Both must be accounted for by using a Weighted Runoff Coefficient. See Table 2.8 for individual runoff coefficients. Table 2.8 is originally from the 2022 New York City Stormwater Manual.

WQv = water quality volume (cf) WQv = (1.5in/12)*A*Rv	A = Contributing Area = total roof Area and asphalt playground A = 10,031sf Roof, 5,200sf Rooftop Playground and 2,500sf at Grade Asphalt Playground Rv = Runoff Coefficient (See table 2.8 in appendix) Rv Roof = 0.95 Rv Asphalt = 0.85
Cw = Weighted Rv Cw = (C1A1+C2A2+C3A3)/At	Rv Roof = C1 = 0.95 A1= 10,031sf Rv Asphalt = C2 = 0.85 A2=2,500sf Playground at Grade Rv Asphalt = C3 = 0.85 A3=5,200sf Rooftop Playground At= 17,731sf Cw = (0.95*10,031+0.85*2,500+0.85*5,200)/17,731sf = 0.91
WQv = (1.5in/12)*17,731*0.91	WQv = 2016.90cf

Calculate the ASMP

Area is calculated at 60% to account for setbacks and/ or equipment. Setbacks and equipment should be determined on a case-by-case basis.

60% of A = 60% of Area of Roof = 0.6*10,031sf = 6018.6 sf = Round up to 6020sf

Calculate the Volume of Surface Ponding

Vp =0 cf. Green roofs do not typically pond water. Water is retained in the soil and evaporates over time. Water that cannot be retained in the soil runs off the sides of the building or through other drains on the roof. If this were a blue roof or a blue-green roof, water would be detained on the roof itself. In this case however, we are deciding that no water will be detained by this roof. Therefore, there is no ponding.

Calculate the Volume of Voids in the Soil Media Layer

Vs = Volume of Voids Vs = Asmp * Ds* ns	Asmp = 6020sf **Ds = Depth of Soil = 8 in (0.67ft) **Ns = Porosity of soil Media = (cf/cf) = 0.2 cf/cf
Vs = 6020sf*0.67ft*0.2cf/cf	=806.68cf

**The depth of soil (Ds) and the Porosity of Soil Media (Ns) can vary largely from project to project. Ds is often dictated by the vegetation that is planned for an area. Ns can depend on the type of vegetation, the growing media design, and the rate of rainfall in an area. The numbers we have chosen above are common Ds and Ns values.

Calculate the Volume of Voids Created by Internal Structures

Vi = 0 cf. Assume no internal structures.

Calculate the Volume of Voids in the Drainage Layer

Vd = 0 cf. Storage for a Green roof is considered from the soil media up, so the storage volume is 0.

Calculate the Total SMP Volume and Compare to the WQv

Vsmp = Vp+Vs+Vi+Vd	
Vsmp = 0+806.68cf+0+0	= 806.68cf

WQV = 2016.90cf > **Vsmp** = 806.68cf

WATER QUALITY NOT MET. VSMP MUST BE GREATER THAN WQV FOR GREEN ROOF TO MEET ALL REQUIREMENTS

Green roof does not meet all of the requirements for this site. The next viable GI practice should be used to make up for the difference in what the green roof could not cover. The green roof should still be implemented to its maximum capacity, and the next viable SMP, which would be a detention tank, will be designed for the remainder.

6.2.2 Detention Tank Calculations

Step one of sizing a detention tank is to determine the Rainfall Depth (Rd). This is determined by knowing if the area is a CSS or MS4 area, and if the area requires a Site Connection Permit (SCP) or a House Connection Permit (HCP). This school is in a CSS area, and it requires a Site Connection Permit, so the Rd is 1.85in based on table 2.7 in the appendix. Table 2.7 is originally from the 2022 New York City Stormwater Manual.

Calculate Sewer Operations Volume

Vv = Sewer Operations Volume = (Rd/12)*A *Cw	Rd = 1.85 A = Contributing Area = 17,731sf Cw = Weighted Runoff Coefficient = 0.91
Vv = (1.85/12)*17,731sf *0.91	= 2,487.51 cf

Calculate the Release Rate to be Maintained by the Controlled-Flow Orifice

Assume site is connecting to a 15 in. combined sewer. Based on table 2.9 in the appendix, q = 0.1 cfs/acre for a CSS area. Table 2.9 is originally from the 2022 New York City Stormwater Manual.

Qdrr = Maximum release rate for the site (cfs) Qdrr = (q*A)/43560	Q = maximum release rate per acre (cfs/acre) = 0.1 cfs/acre A = Contributing area = 17,731sf
Qdrr = (0.1*17,731) /43560	Qdrr = 0.041, or 0.046 because it is greater.

Use the Controlled-Flow Orifice Equation to Determine an Appropriate Orifice Area by Assuming the Active Storage Depth

Qo = Cd*Ao*√2gH Ao = Area of Orifice (sf)	Qo = maximum release rate of orifice (cfs) = 0.046 Cd = coefficient of discharge = assuming 0.52 for re-entrant orifice H = maximum hydraulic head above the centerline of the orifice (ft) = Assuming 4ft
0.046 = 0.52*Ao*√2*32.2*4	Ao = 0.006

Translate the Area of the Controlled-Flow Orifice (AO) Into a Diameter and Check that it is Greater than the Minimum Diameter of 1 in.

$Ao = [\pi * (Do/2)^2]/144$	Ao = 0.006 Do = Diameter of Orifice (in)
$0.006 = [\pi * (Do/2)^2]/144$	Do = 1.05 in

Do=1.05in > 1in

ORIFICE MUST BE TO THE NEAREST 0.25 IN, ROUNDING DOWN, WITH A MINIMUM OF 1 IN. FOR THIS CASE, WE WILL USE 1 IN.

Confirm the Orifice Area of the Selected Orifice Diameter

$Ao = [\pi * (Do/2)^2] /144$	Ao = Area of Orifice (sf) Do = Diameter of Orifice (in) = 1in
$Ao = [\pi * (1in/2)^2] /144$	Ao = 0.005sf

Confirm the Required Active Storage Depth in the Tank Using the Orifice Area

$Qo = Cd * Ao * \sqrt{2gH}$	Cd = coefficient of discharge = assuming 0.52 for re-entrant orifice Ao = Area of Orifice (sf) = 0.005sf g = acceleration due to gravity = 32.2ft/s^2 H = maximum hydraulic head above centerline of the orifice (ft)
$0.046cfs = 0.52*0.005sf*\sqrt{2*(32.2ft/s^2)*H}$	H = 4.9ft

Use H and Vv to Dimension Detention Tank

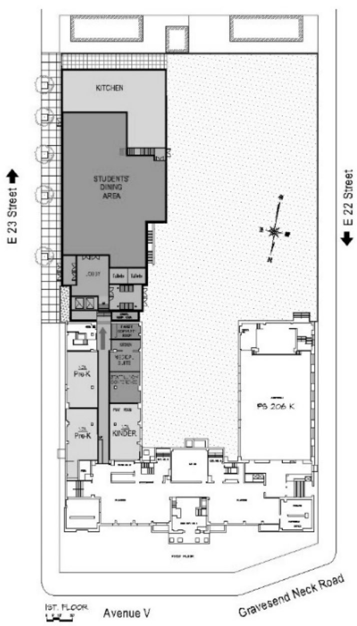
(L*W)*H = Vv	L = Length of Detention Tank W = Width of Detention Tank H = Maximum Hydraulic Head = 4.9 Vv = Sewer Operations Volume = 2,487.51 cf
(L*W)*4.9=2,487.51cf	(L*W) = 507.66sf
Assuming a square tank; L = W = 22.5 feet Round L and W to nearest ft; L = W = 23ft	L*W*H = V 23ft*23ft*4.9ft = 2592.1cf

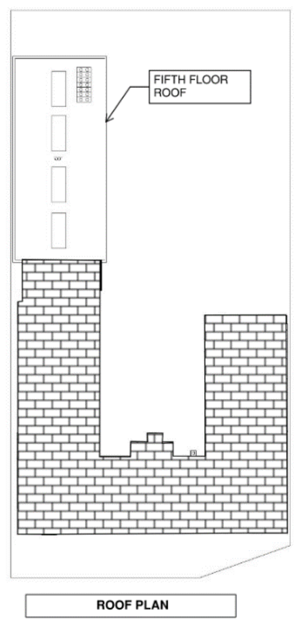
The detention tank as dimensioned will fit within the 1,228 square feet space that is available for green infrastructure. Because detention tanks are underground, the tank can be constructed underneath the at- grade playground without detracting from the playground space. In practice, a design team may consider including the small green roof and using a detention tank to make up the difference in runoff. That would require more in-depth calculations. These examples are meant to show the general way that SMPs are vetted for viability in the beginning stages of design.

6.3 MS4 Area - Addition to Existing School - PS 206 Brooklyn, NY

The following school is different from the first example. Instead of a new school being built on a new site, this is an addition being added to an existing site. The building along the frontage of Gravesend Neck Road and Avenue V is an existing school. The building along E 23 Street is being newly constructed. The test fit document will be included in the index at the end of this report. When an addition is being added to an existing site, the site must be evaluated in two parts. First, the stormwater management needs for the additional area must be addressed alone. Then, the needs of the entire site, including the new area and existing area must be addressed.

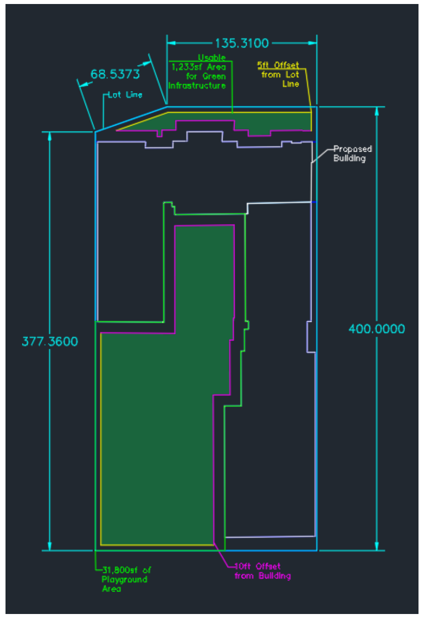
Before beginning the selection and sizing process, the 2012 DEP Guideline for the Design &





Construction of Stormwater Management Systems checklist must first be consulted to ensure this site is eligible for a stormwater management practice. A copy of this checklist will be included on the first page of Appendix A. Please refer to the spreadsheet in the appendix to see the answers to this checklist with respect to each test fit school.

Once it is determined that a Green Infrastructure practice is appropriate, we must account for the 5 feet and 10 feet offsets from the lot line and building respectively. In this example there is only approximately 2,141.77 square feet of space left that is not already being dedicated to playground space (see CAD drawing below).



We will begin by finding a GI practice for the addition alone. Because the only available space in the addition is asphalt playground, we cannot use a bioretention basin for this addition. That makes this building a candidate for green roof, synthetic turf, and detention tanks, as these are all practices that would not detract from the playground space. For this example, a green roof is selected.

Green Roof Calculations

Calculate the Water Quality Volume (WQv). When calculating this value, you must account for all of the contributing areas. In this case, there is both an asphalt play area at grade as well as on the roof. Both must be accounted for by using a Weighted Runoff Coefficient.

WQv = water quality volume (cf) WQv = (1.5in/12)* A * Rv	A = Contributing Area= total roof Area and asphalt playground A = 20,797.14sf Rooftop and 31,800sf Asphalt Playground Rv = Runoff Coefficient (See table 2.8 in appendix) Rv Roof = 0.95 Rv Asphalt = 0.85

Cw = Weighted Rv Cw = (C1A1+C2A2)/At	Rv Roof=C1=0.95 A1=20,797.14sf Rv Asphalt=C2= 0.85 A2=31,800sf Playground at Grade At=52,597.14sf Cw = (0.95*20,797.14sf+0.85*31,800sf)/52,597.14sf = 0.89
WQv = (1.5in/12)* 52,597.14sf *0.89	WQv = 5848.41cf

Calculate the ASMP

Area is calculated at 60% to account for setbacks and/ or equipment.
60% of A= 60% of Area of Roof = 0.6*20,797.14sf = 12478.28sf = Round up to 12,480sf

Calculate the Volume of Surface Ponding

Vp =0 cf. Green roofs do not typically pond water. Water is retained in the soil and evaporates over time. Water that cannot be retained in the soil runs off the sides of the building or through other drains on the roof. If this were a blue roof or a blue-green roof, water would be detained on the roof itself. In this case however, we are deciding that no water will be detained by this roof. Therefore, there is no ponding.

Calculate the Volume of Voids in the Soil Media Layer

Vs = Volume of Voids Vs = Asmp * Ds* ns	Asmp = 12,480sf **Ds = Depth of Soil = 8 in (0.67ft) **Ns = Porosity of soil Media = (cf/cf) = 0.2 cf/cf
Vs = 12,480sf*0.67ft*0.2cf/cf	= 1,672.32cf

**The depth of soil (Ds) and the Porosity of Soil Media (Ns) can vary largely from project to project. Ds is often dictated by the vegetation that is planned for an area. Ns can depend on the type of vegetation and/or the rate of rainfall in an area. The numbers we have chosen above are common Ds and Ns values.

Calculate the Volume of Voids Created by Internal Structures

Vi = 0 cf. Assume no internal structures.

Calculate the Volume of Voids in the Drainage Layer

Vd = 0 cf. Storage for a Green roof is considered from the soil media up, so the storage volume is 0.

Calculate the Total SMP Volume and Compare to the WQv

Vsmp = Vp+Vs+Vi+Vd	
Vsmp = 0+1,672.32cf+0+0	= 1,672.32cf

WQV=5848.41cf > Vsmp = 1,672.32cf

WATER QUALITY NOT MET. VSMP MUST BE GREATER THAN WQV FOR GREEN ROOF TO MEET ALL REQUIREMENTS

Green roof does not meet all of the requirements for this site. The next viable GI practice should be used to make up for the difference in what the green roof could not cover. The green roof should still be implemented to its maximum capacity, and the next viable smp, which would be a detention tank, will be designed for the remainder. Refer to previous example for detention tank calculations. Phase 2, which will determine the GI needs for the entire site, includes both the old and new buildings. There is 1,233 square feet of landscaped area in front of the school that could potentially be used for GI. Let's begin with the calculations for a bioretention basin.

Calculations for a Bioretention Basin

Calculate Water Quality Volume

WQv = water quality volume (cf) WQv = (1.5in/12)* A * Rv	A = Contributing Area= total roof Area, Landscaping, and asphalt playground A = 20,797.14sf Addition Rooftop, 17,691.45sf Existing Rooftop, 5594.76sf Landscaping, and 31,800sf Asphalt Playground Rv = Runoff Coefficient (See table 2.8 in appendix) Rv Roof = 0.95 Rv Asphalt = 0.85 RV Landscaped Area = 0.2
Cw = Weighted Rv Cw = (C1A1+C2A2+C3A3)/At	Rv Roof = C1 = 0.95 A1 = 38,488.59sf Rv Asphalt = C2 = 0.85 A2 = 31,800sf Playground at Grade Rv Landscaped = C3 = 0.2 A = 5,594.76 At = 75,883.35 Cw = (0.95*38,488.59sf+0.85*31,800sf+0.2*5594.76)/ 75,883.35 = 0.85
WQv = (1.5in/12)* 75,883.35sf *0.85	WQv = 8062.61cf

Calculate the ASMP

Asmp = A/20	A = Contributing Area = 75,883.35sf 1:20 = Maximum Loading Ratio for a Bioretention Practice
Asmp = 75,883.35sf/20	Asmp= 3794.1675

Based on this preliminary sizing, a bioretention basin would not be possible. The landscaped area where we would put the bioretention basin is 5,594.76sf, but because of the necessary offsets from the building and the lot line, there is only 1,233 sq. ft. of space for the Bioretention Basin, which is less than our ASMP. From here we would move on to calculating the area of a Green Roof. Refer to previous example for Green Roof calculations.

Conclusion

Design of green infrastructure based on the 2022 New York City Stormwater Manual and DEP stormwater rules requires selection of the appropriate SMP to meet the site requirements. This Guideline has been prepared for identification of the appropriate GI practices to meet both the regulatory requirements and the SCA's ability for long term maintenance. The information in this report is meant to assist in the planning phase of future design projects. However, design engineers should continue to use their professional judgement for unique scenarios that appear in the field to meet the regulations.

The most common issue that design teams will encounter when implementing green infrastructure is space. Planning for GI practices should be considered as early as possible in the programming phase as there is a limited amount of land available for building projects, and the land that is available is occupied by structures or playground. Most SCA schools already lack adequate play area, and many green stormwater management practices would require the remainder of that space to function properly. For this reason, the four SMPs highlighted in this guideline as most commonly applicable are bioretention, green roof, synthetic turf, and detention tank. These have been selected as the most viable for SCA to construct and for DOE to maintain. They are not meant to rule out other practices should the site and building program allow for sufficient space for "green" solutions. The submission to DEP will require details of each practice in the USWR thought its hierarchy and an indication if not technically feasible, which will typically result in the use of a Green Roof. The only SMPs that were determined to be generally unviable are a constructed wetland and wet basin/pond. This is because the minimum tributary area necessary for these two SMPs is larger than what an SCA site has available. This guideline will provide the design team a first step in planning for discussion and final selection of the practice most fitted to each individual site while meeting the commitment by SCA for long term sustainability.

References

Climate Resiliency Design Guidelines
https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/CRDG-4-1-May-2022.pdf

NYC Environmental Protection Stormwater Management
https://www.nyc.gov/site/dep/water/stormwater-management.page

New York City Stormwater Flood Maps
https://experience.arcgis.com/experience/6f4cc60710dc433585790cd2b4b5dd0e

New York City Mayor's Office of Resiliency. (2020, September). *Climate Resiliency Design Guidelines, Version 4.0*. II. Resilient Design, B. Increasing Precipitation. City of New York.

New York State Department of Environmental Conservation. (2015, January). *New York State Stormwater Management Design Manual*. State of New York.

New York State Department of Environmental Conservation. (2016, November). *New York State Standards and Specifications for Erosion and Sediment Control*. State of New York.

New York City Department of Environmental Protection. (2016, June). *Green Infrastructure Performance Metrics Report*. City of New York.

New York City Department of Environmental Protection (2016, July). *New York City Green Infrastructure On-site Design Manual, Version No. 2*. City of New York.

New York City Department of Environmental Protection. (2022, February). *New York City Stormwater Design Manual*. City of New York.

Appendix – Tables and Charts

This abbreviated version of the 2012 DEP Guideline is to be used as a starting point for determining if a site is a candidate for GI. It does not supersede the new DEP rules.

2012 DEP GUIDELINE FOR THE DESIGN & CONSTRUCTION OF STORMWATER MANAGEMENT SYSTEMS
(FLOWCHART BASED ON APPENDICES M & I – TO BE USED TO DETERMINE IF GREEN INFRASTRUCTURE PRACTICE IS APPROPRIATE FOR PROJECT, *EXCEPT* FOR GREEN ROOF PRACTICE)

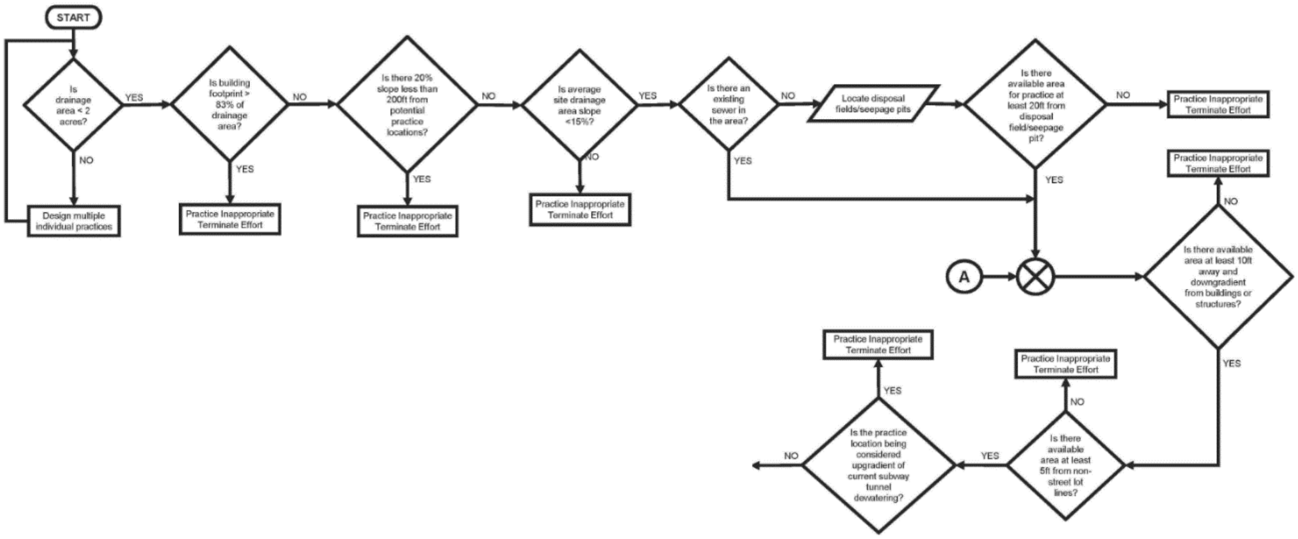


Table 2.8. C values for various surface types.

C	Surface Description
0.95	Roof areas
0.85	Paved areas
0.70	Green roof with 4 in. growing media
0.70	Porous asphalt/Porous Concrete[a]
0.70	Synthetic turf fields[a]
0.65	Gravel parking lot
0.30	Undeveloped areas
0.20	Grass, bio-swales, or landscaped areas

[a] Using a C value of 0.7 for the indicated surface types typically requires the use of an outlet pipe, with approval at the discretion of DEP.

Table 2.7. Applied rainfall depth by sewershed type and connection proposal type.

R_D	Description
1.85	CSS areas with SCP
1.50	CSS areas with HCP
1.50	MS4 areas with SCP
1.10	MS4 areas with HCP

Table 2.9. Maximum release rate per acre (cfs/acre) by sewershed type.

q (cfs/acre)	Description
1.0	MS4 areas
0.1	CSS areas

This table shows the three schools from Section 6 going through the decision matrix on the previous page.

GUIDELINES FOR DESIGN & CONSTRUCTION OF STORMWATER MANAGEMENT SYSTEMS					
			PS206- Brooklyn		6315 14th Avenue, Brooklyn
2012 DEP Guideline Flowchart Questions (Appendix Page 82)	Citation	Units	Addition to Site	Entire Site	Entire Site
Is the area less than 2 acres?	NYC Stormwater Manual. § 2.2 Permit Requirements. Figure 2.3 Flow chart 2-10 Page	Acres	0.53	1.82	0.50
What is the building coverage?	NYC stormwater manual - §6 Right-of-way stormwater management requirements-page 6-1		74%	49%	71%
Is there a 20% slope less than 200ft from the practice?	NYC stormwater manual- appendix c - SMP siting criteria		YES	YES	YES
Is the average site drainage area less than 15% slope?	NYC Manual- §6.3 Technical Requirements- pg 6.3		YES	YES	YES
Is there an existing sewer in the area?	NYC stormwater manual-chapter 1 introduction-01 Introduction-Section 1,1 Background-Page 1-3		YES	YES	YES
Is there an available 10' offset from the building and structures?	N.Y.C. Admin. Code §28-6.01.1114.1.3		YES	YES	YES
Is there an available 5' offset from the lot line?	N.Y.C. Admin. Code §28-6.01.1114.1.3		YES	YES	YES
Is the practice upgradient of a subway tunnel dewatering?	NYC Stormwater manual- § 4 SMP selection and design -- 4-6 Reuse systems		NO	NO	NO
Is the practice upgradient of a groundwater remediation hotspot?	NYC Stormwater Manual- §5.1 Maintenace Procedures		NO	NO	NO
Is the nonbuilding coverage area >17%?	NYC stormwater manual - §6- Right of Way Stormwater management requirements- 6.3 Technical Requirements-page 6-3		YES	YES	YES
Required Playground		Square Feet	40,980		11,370
Proposed Playground		Square Feet	31,800	31,800	2500 At Grade 5,200 Rooftop 7,700 Total
Available Area	NYC stormwater manual - §6 Right-of -way stormwater management requirements-page 6-1	Square Feet	6,177	40,779	6,370

Appendix – SMP Sample Calculations