SWPPP Design Guidance

NYC DEP BEPA PERM

Part I: April 2025
Part II: May 2025

Objective

To provide an overview of design methodology that can be used on projects that require a Stormwater Construction Permit and stormwater management practices (SMPs).

- Using a case study for reference, this presentation is intended to communicate the appropriate design methodology for establishing and complying with stormwater management permit requirements.

- The presentation will also refer to supporting documentation and calculations that are key to the design process.

- This presentation was given in two parts, as listed below:
  - SWPPP Design Workshop Part I took place on April 29, 2025.
  - SWPPP Design Workshop Part II took place on May 27, 2025.

  Published slides have been compiled into a single deck for clarity.

Overview

1. **Introduction**
2. **SWPPP Design Process (Part I)**
   - Permit Applicability
   - Criteria Applicability
   - Geotechnical Planning
   - SMP Siting
3. **SWPPP Design Process (Part II)**
   - Tier 1 & 2 SMP Design
   - Tier 3 SMP Design *(CSS Only)*
   - Confirming all Requirement are Met
4. **Questions**

NYC Environmental Protection

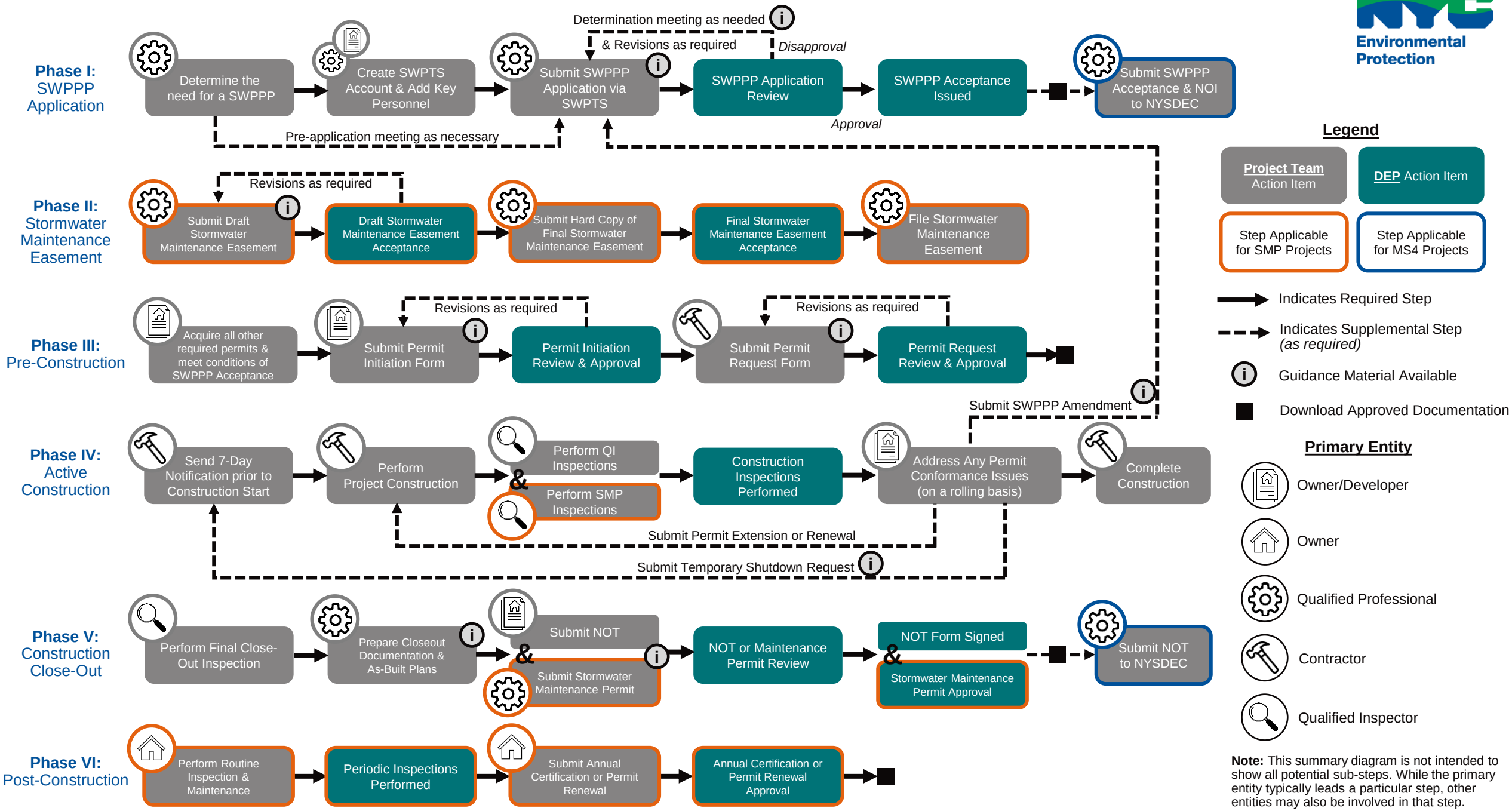
Introduction
& Case Study Overview

NYC Environmental Protection

NYC DEP STORMWATER PERMITTING PROCESS SUMMARY DIAGRAM

Version: March 21, 2025

NYC Environmental Protection



Legend

- **Project Team** Action Item
- **DEP** Action Item
- Step Applicable for SMP Projects
- Step Applicable for MS4 Projects
- Indicates Required Step
- Indicates Supplemental Step *(as required)*
- Guidance Material Available
- Download Approved Documentation

Primary Entity

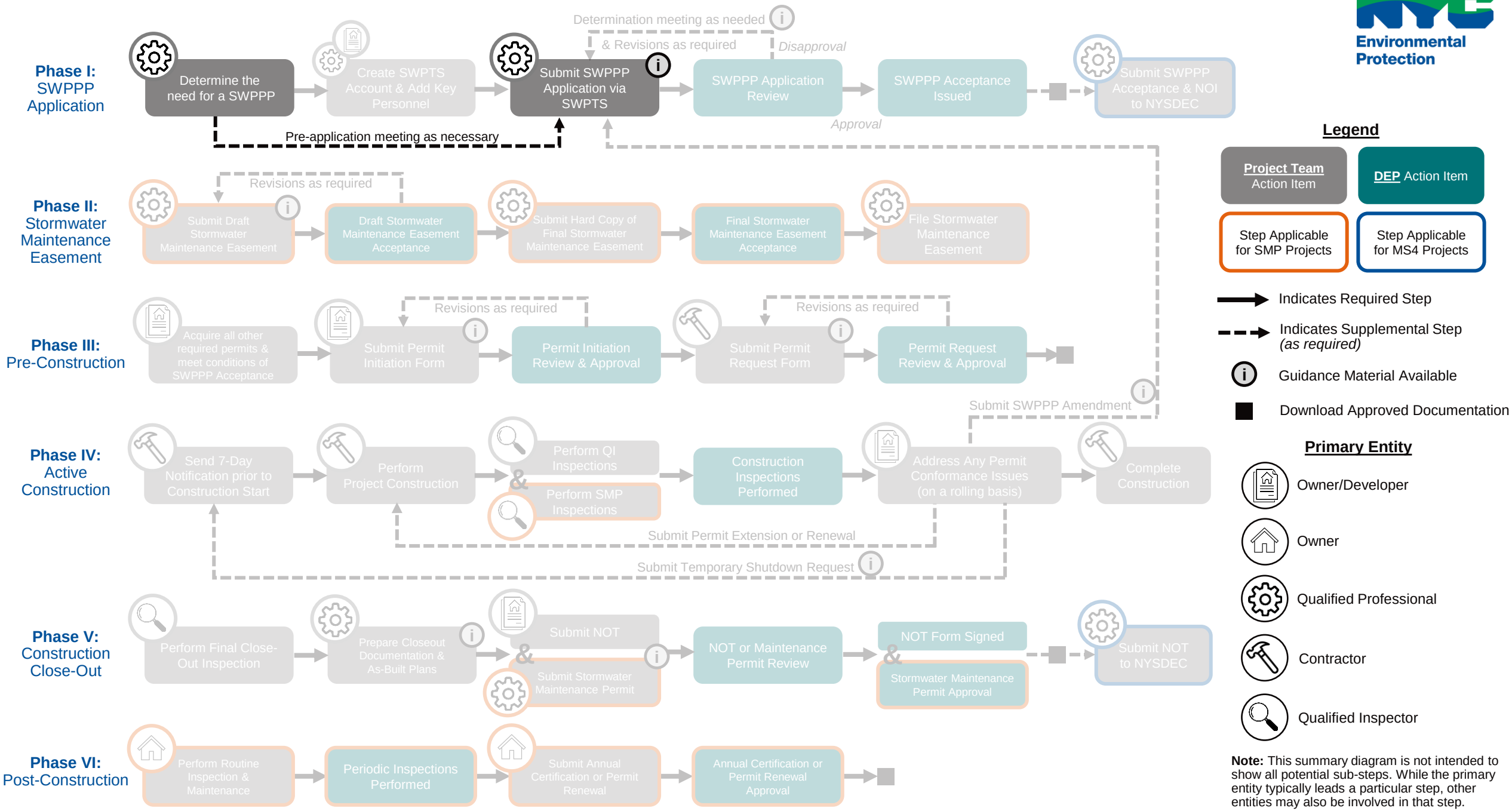
- Owner/Developer
- Owner
- Qualified Professional
- Contractor
- Qualified Inspector

Note: This summary diagram is not intended to show all potential sub-steps. While the primary entity typically leads a particular step, other entities may also be involved in that step.

NYC DEP STORMWATER PERMITTING PROCESS SUMMARY DIAGRAM

Version: March 21, 2025

NYC Environmental Protection



Legend

- **Project Team** Action Item
- **DEP** Action Item
- Step Applicable for SMP Projects
- Step Applicable for MS4 Projects
- Indicates Required Step
- Indicates Supplemental Step *(as required)*
- Guidance Material Available
- Download Approved Documentation

Primary Entity

- Owner/Developer
- Owner
- Qualified Professional
- Contractor
- Qualified Inspector

Note: This summary diagram is not intended to show all potential sub-steps. While the primary entity typically leads a particular step, other entities may also be involved in that step.

Introduction

Overview of Case Study Scope

Counseling center on a lot that drains to Combined Sewer System (CSS) is expanding to include in-patient services

***Concept Map**: Existing Site*

***Concept Map:** Proposed Development*

Introduction

Important Notes

The SWPPP Design process is highly nuanced and project-specific.

This workshop discusses applicability triggered by the following case study parameters:

- ✓ Disturbance occurs both on-site and in the ROW
- ✓ New impervious area is proposed
- ✓ Development activity modifies site hydrology
- ✓ Project discharges to a combined sewer system

This workshop is <u>not</u> intended to:

- ✗ Represent all possible design scenarios
- ✗ Cover all regulated elements of the NYC DEP Stormwater Permitting Program
- ✗ List all required supporting documentation

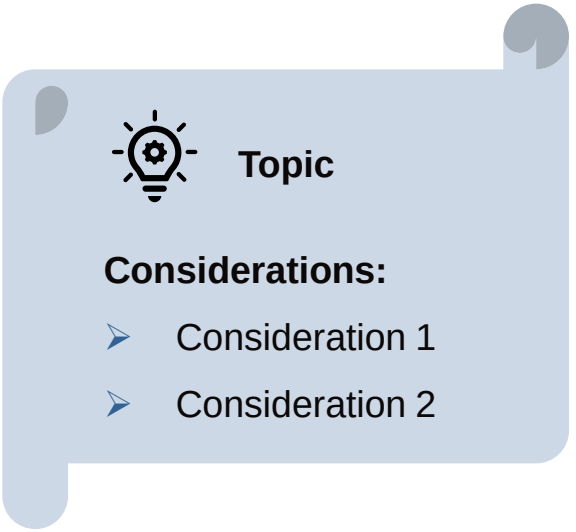
Introduction

Important Notes

The SWPPP Design process is highly nuanced and project-specific.

"Considerations" slides were added for various topics throughout the presentation to:

- Help communicate nuances in the design process
- Provide general guidance on elements that may be outside the scope of the case study

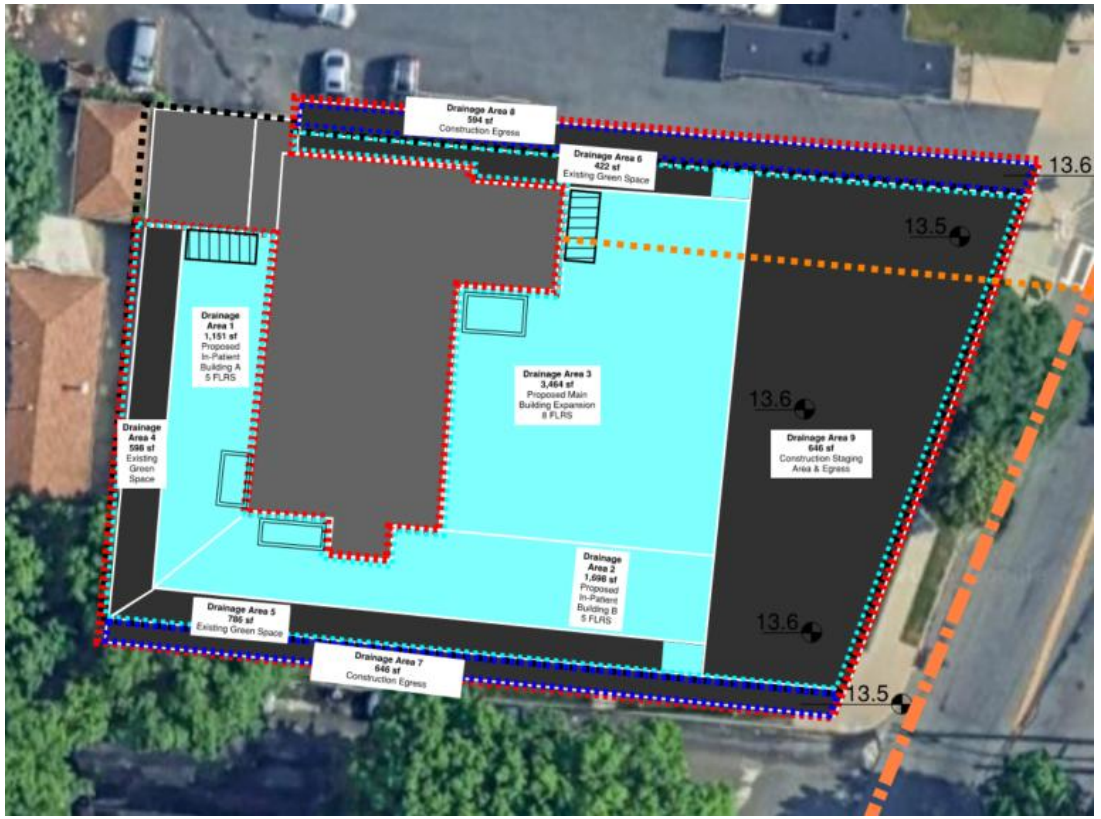


Introduction

Visual Examples

Throughout this workshop, example **Concept Maps** will be used to communicate a design concept visually.

- Contents inform SWPPP design components, including drawings, calculations, and construction processes
- Representations of design elements are schematic
- Maps are tagged with the term “Preliminary” when the plan will change throughout the design process



Concept Map: *Site Contributing Area (Preliminary)*

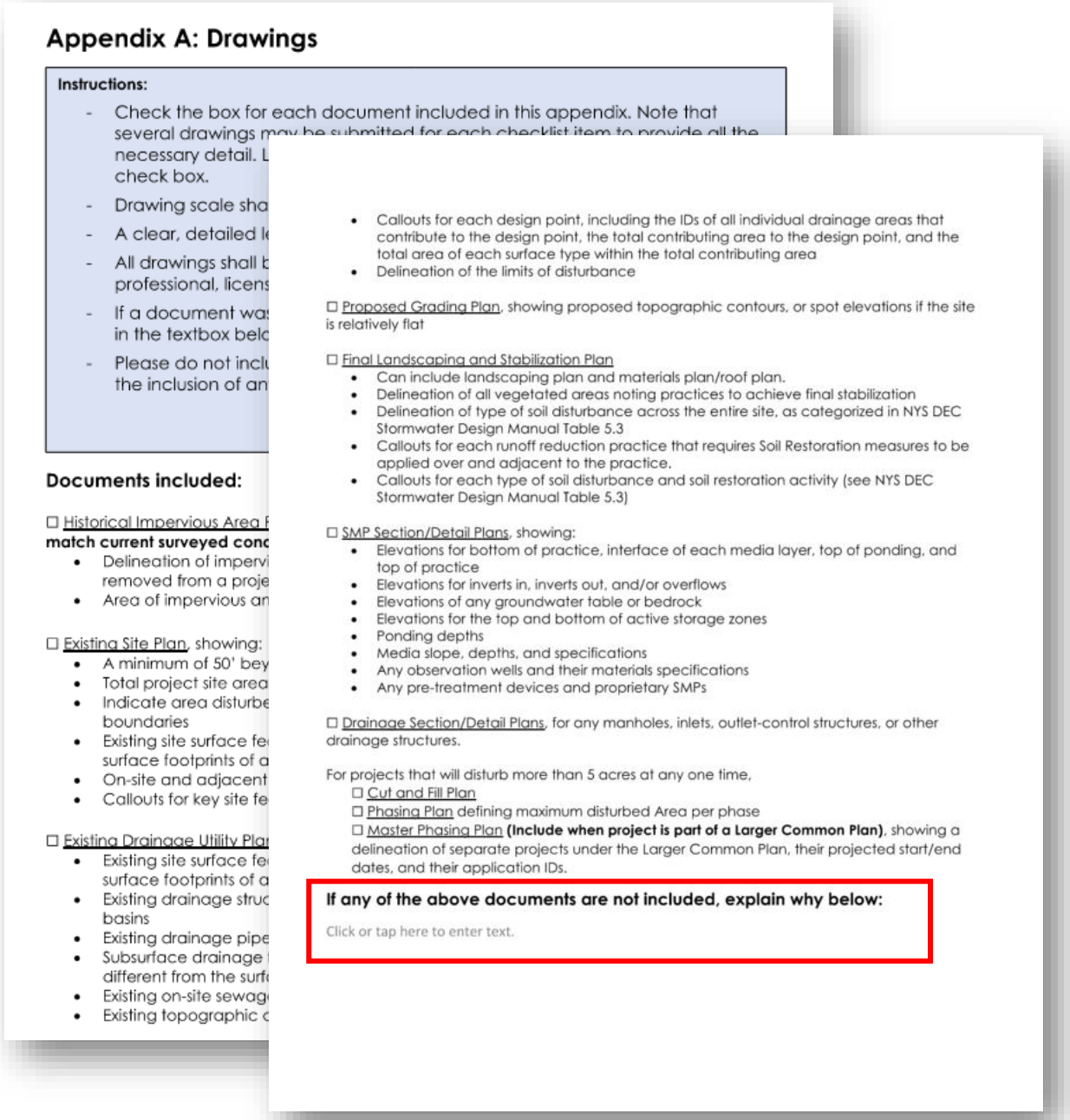
Introduction

Visual Examples

The **Concept Maps** shown throughout this presentation do not include the level of detail required in SWPPP submissions.

SWPPP submissions must include:

- All documents listed in Appendix A of the SWPPP template, in the form of engineering drawings that include all contents listed in bullets under each plan.
- If a plan was not included, a justification that states the reason it is not necessary



Appendix A: Drawings

Instructions:

- Check the box for each document included in this appendix. Note that several drawings may be submitted for each checklist item to provide all the necessary detail. L
check box.
- Drawing scale sha
- A clear, detailed l
- All drawings shall b
professional, licens
- If a document wa
in the textbox belo
- Please do not incl
the inclusion of an

Documents included:

☐ Historical Impervious Area
match current surveyed cond
- Delineation of imperv
removed from a proje
- Area of impervious ar

☐ Existing Site Plan, showing:
- A minimum of 50' bey
- Total project site area
- Indicate area disturbe
boundaries
- Existing site surface fe
surface footprints of a
- On-site and adjacent
- Callouts for key site fe

☐ Existing Drainage Utility Plan
- Existing site surface fe
surface footprints of a
- Existing drainage struc
basins
- Existing drainage pipe
- Subsurface drainage
different from the surf
- Existing on-site sewag
- Existing topographic c

- Callouts for each design point, including the IDs of all individual drainage areas that contribute to the design point, the total contributing area to the design point, and the total area of each surface type within the total contributing area
- Delineation of the limits of disturbance

☐ Proposed Grading Plan, showing proposed topographic contours, or spot elevations if the site is relatively flat

☐ Final Landscaping and Stabilization Plan
- Can include landscaping plan and materials plan/roof plan.
- Delineation of all vegetated areas noting practices to achieve final stabilization
- Delineation of type of soil disturbance across the entire site, as categorized in NYS DEC Stormwater Design Manual Table 5.3
- Callouts for each runoff reduction practice that requires Soil Restoration measures to be applied over and adjacent to the practice.
- Callouts for each type of soil disturbance and soil restoration activity (see NYS DEC Stormwater Design Manual Table 5.3)

☐ SMP Section/Detail Plans, showing:
- Elevations for bottom of practice, interface of each media layer, top of ponding, and top of practice
- Elevations for inverts in, inverts out, and/or overflows
- Elevations of any groundwater table or bedrock
- Elevations for the top and bottom of active storage zones
- Ponding depths
- Media slope, depths, and specifications
- Any observation wells and their materials specifications
- Any pre-treatment devices and proprietary SMPs

☐ Drainage Section/Detail Plans, for any manholes, inlets, outlet-control structures, or other drainage structures.

For projects that will disturb more than 5 acres at any one time,
☐ Cut and Fill Plan
☐ Phasing Plan defining maximum disturbed Area per phase
☐ Master Phasing Plan **(Include when project is part of a Larger Common Plan)**, showing a delineation of separate projects under the Larger Common Plan, their projected start/end dates, and their application IDs.

If any of the above documents are not included, explain why below:

Click or tap here to enter text.

Design Process

NYC Environmental Protection

Permit Applicability

Permit Applicability

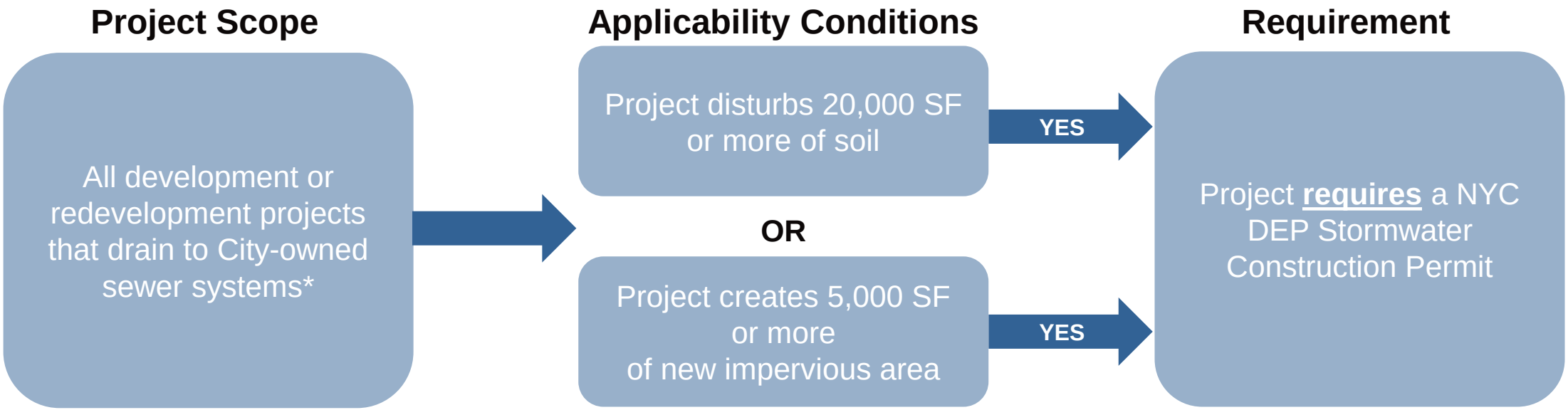
<u>Goal:</u> Determine whether a project needs a Stormwater Construction Permit

Key Questions

- Can the development project drain to an NYC-owned sewer system?
- How much soil is disturbed?
- How much new impervious cover is created?

Permit Applicability

Stormwater Construction Permit Applicability Flow Chart



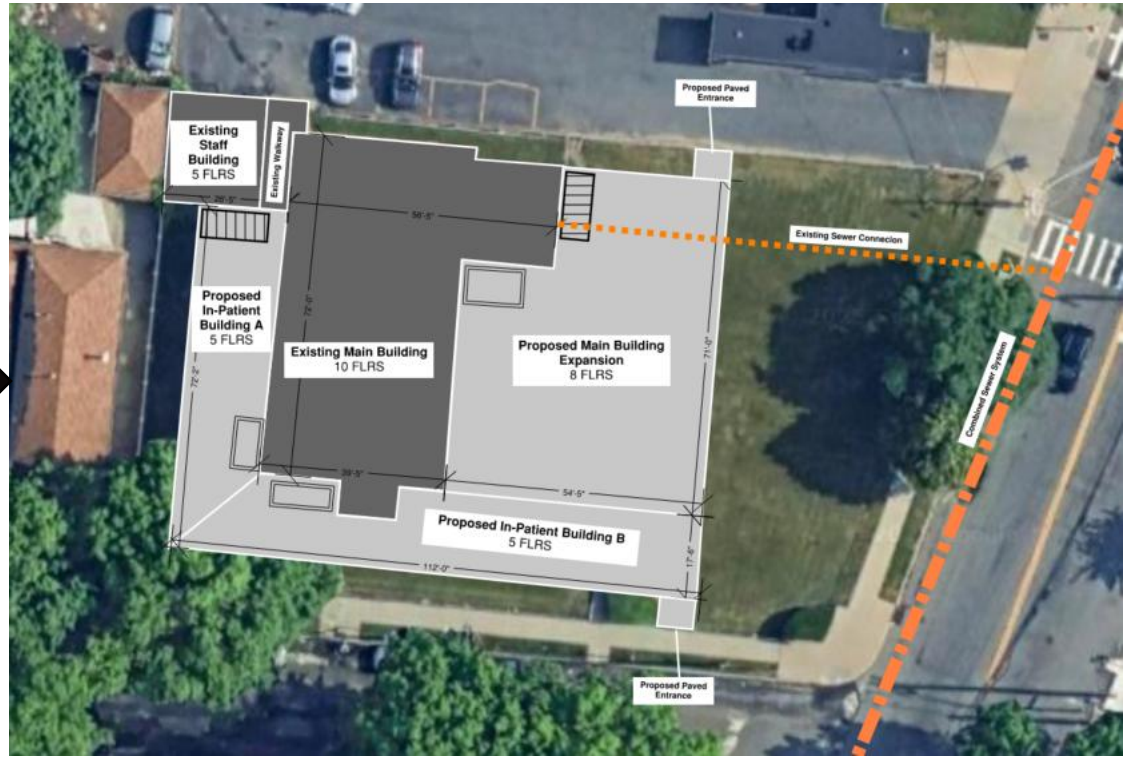
**Direct discharges to Waters of the State of New York from or through NYC-Owned properties may also be considered covered development projects that require a Stormwater Construction Permit.*

Permit Applicability

Can the development project drain to an NYC-owned sewer system?

Counseling center on a lot that drains to Combined Sewer System (CSS) is expanding to include in-patient services

***Concept Map**: Existing Site*



***Concept Map:** Proposed Development & Existing Sewer Connection*

Permit Applicability

How much soil is disturbed?

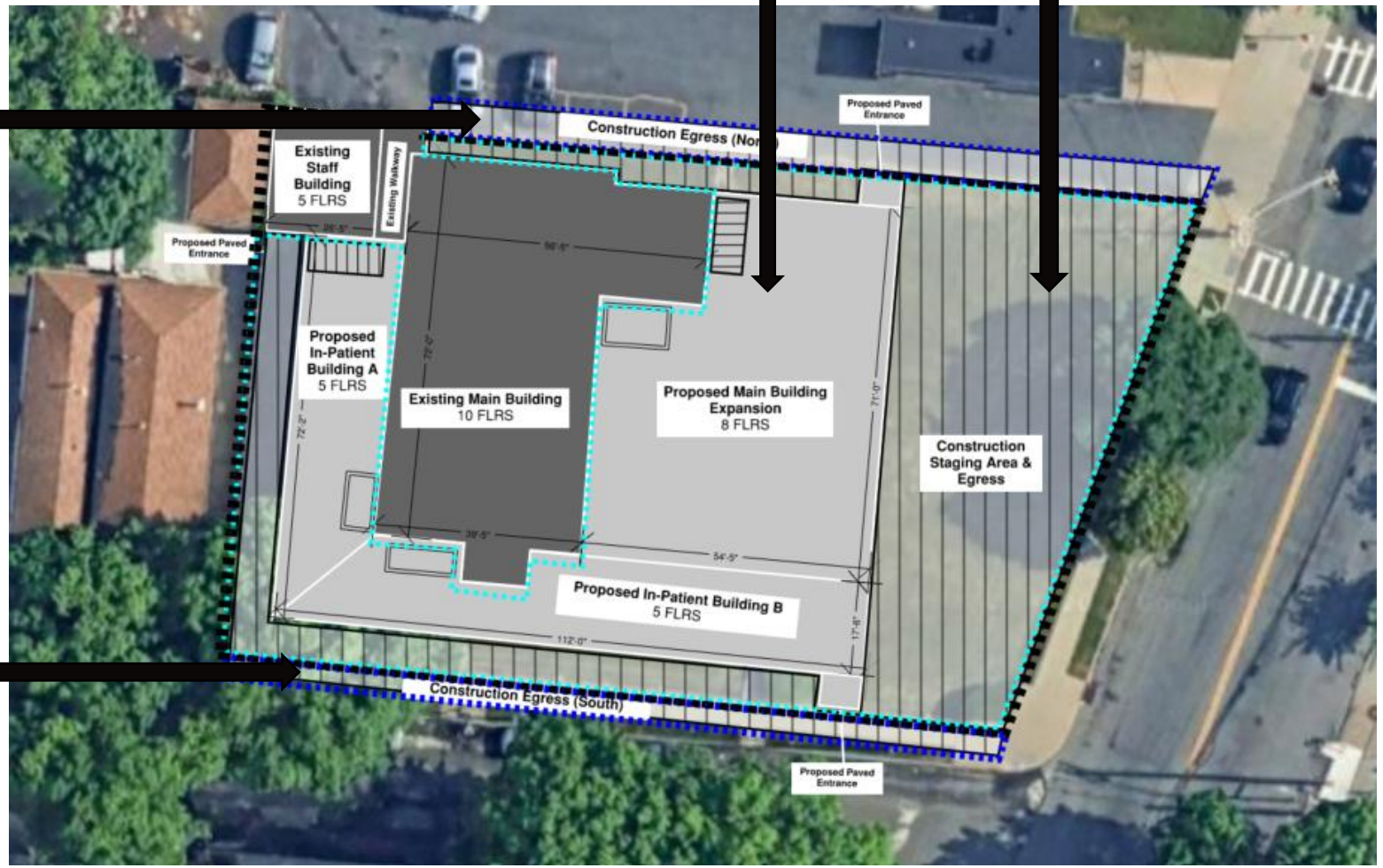
Disturbed areas are characterized as soil disturbed by development activities such as clearing, grading, excavation, demolition & construction

Disturbed areas include construction support activities, such as construction staging areas, stockpiling, egress, etc.

Disturbance extending outside of the property boundary (within an easement or the right-of-way) must be accounted for in overall disturbance value.

LEGEND

- Property Limits: *15,900 sf*
- Existing Structures
- Proposed Structures
- Construction Staging & Egress Areas
- On-Site Disturbance: *11,996 sf*
- Off-Site Disturbance: *1,241 sf*



Concept Map: *Proposed Development, Construction Activities, and Disturbance Delineations*

Permit Applicability

How much soil is disturbed?

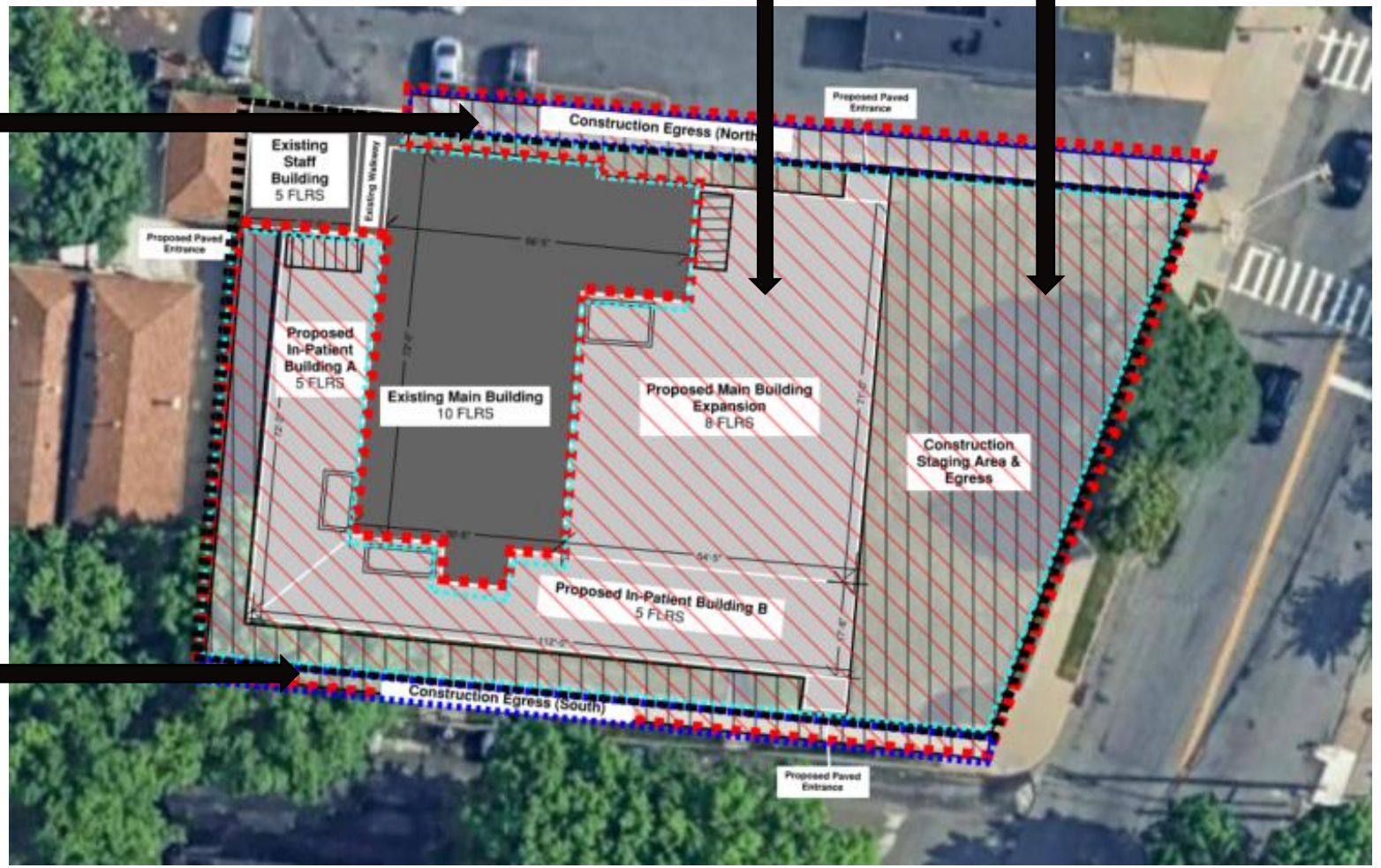
Disturbed areas are characterized as soil disturbed by development activities such as clearing, grading, excavation, demolition & construction

Disturbed areas include construction support activities, such as construction staging areas, stockpiling, egress, etc.

Disturbance extending outside of the property boundary (within an easement or the right-of-way) must be accounted for in overall disturbance value.

LEGEND

- Property Limits: *15,900 sf*
- Existing Structures
- Proposed Structures
- Construction Staging & Egress Areas
- On-Site Disturbance: *11,996 sf*
- Off-Site Disturbance: *1,241 sf*
- Limit of Disturbance: *13,237 sf*



Concept Map: *Soil Disturbance*

Permit Applicability

How much soil is disturbed?

Estimating Soil Disturbance

Considerations:

- To avoid delays and costs associated with SWPPP amendments, estimate soil disturbance conservatively
- Planned limits of work itself, as well as construction support activities.
- In some cases, all areas within the contract limit lines should be included if the contractor is likely to disturb as part of construction support.
- Projects that are close to the 20,000-sf threshold should consider submitting a SWPPP to avoid significant delays if the contractor disturbs more than anticipated.

Permit Applicability

How much new impervious cover is created?

Impervious area are hard surfaces that cannot effectively infiltrate rainfall, such as rooftops, pavements, sidewalks, and driveways.

LEGEND

- Property Limits: *15,900 sf*
- Existing Structures
- Proposed Structures

Concept Map: *Proposed Development Activities*

Permit Applicability

How much new impervious cover is created?

Change in impervious cover is calculated from pre- to post- development conditions for the disturbed area.

***Concept Map**: Existing Site*

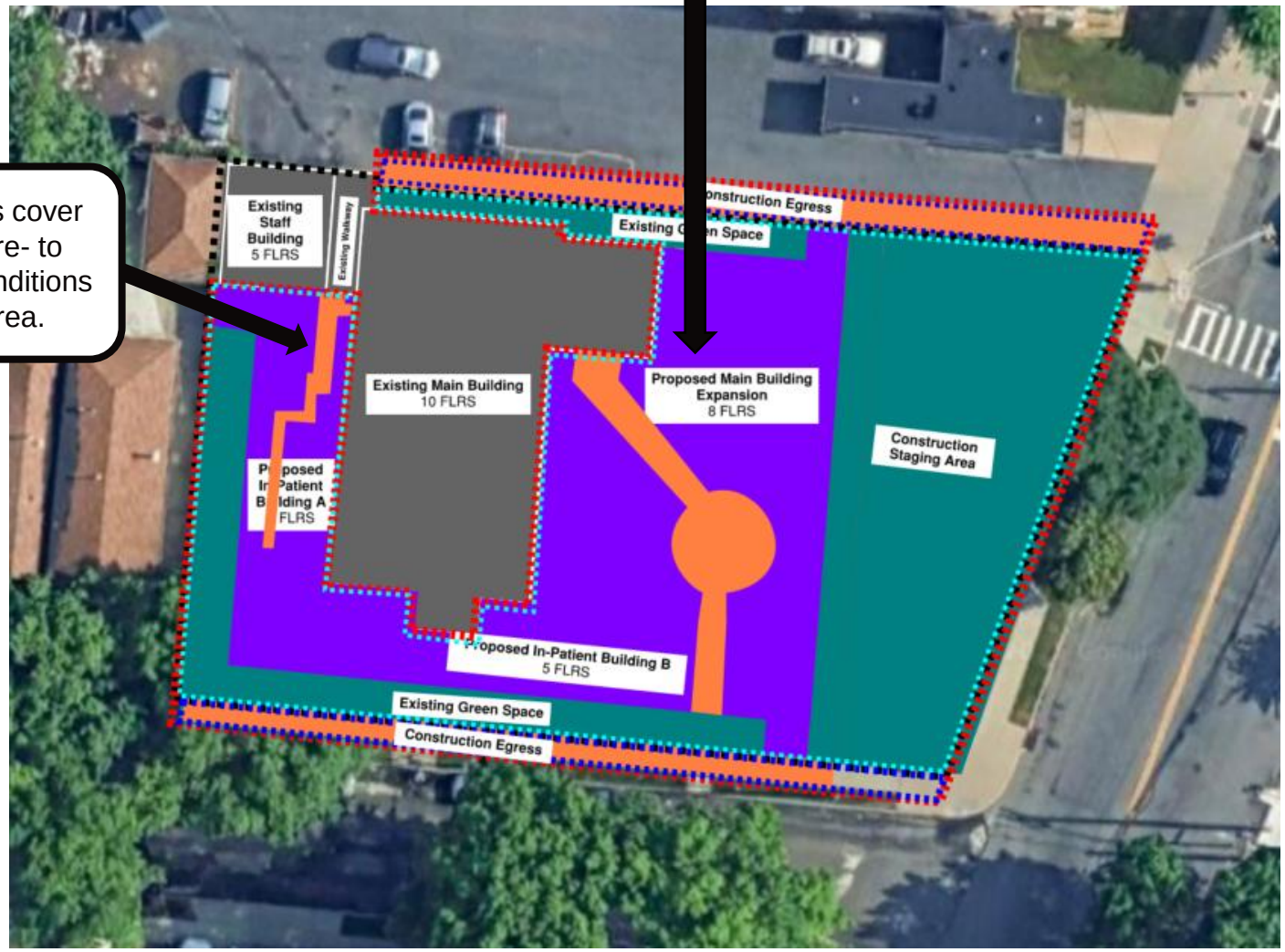
***Concept Map:** Proposed Development*

Permit Applicability

How much new impervious cover is created?

Impervious area are hard surfaces that cannot effectively infiltrate rainfall, such as rooftops, pavements, sidewalks, and driveways.

Change in impervious cover is calculated from pre- to post- development conditions for the disturbed area.



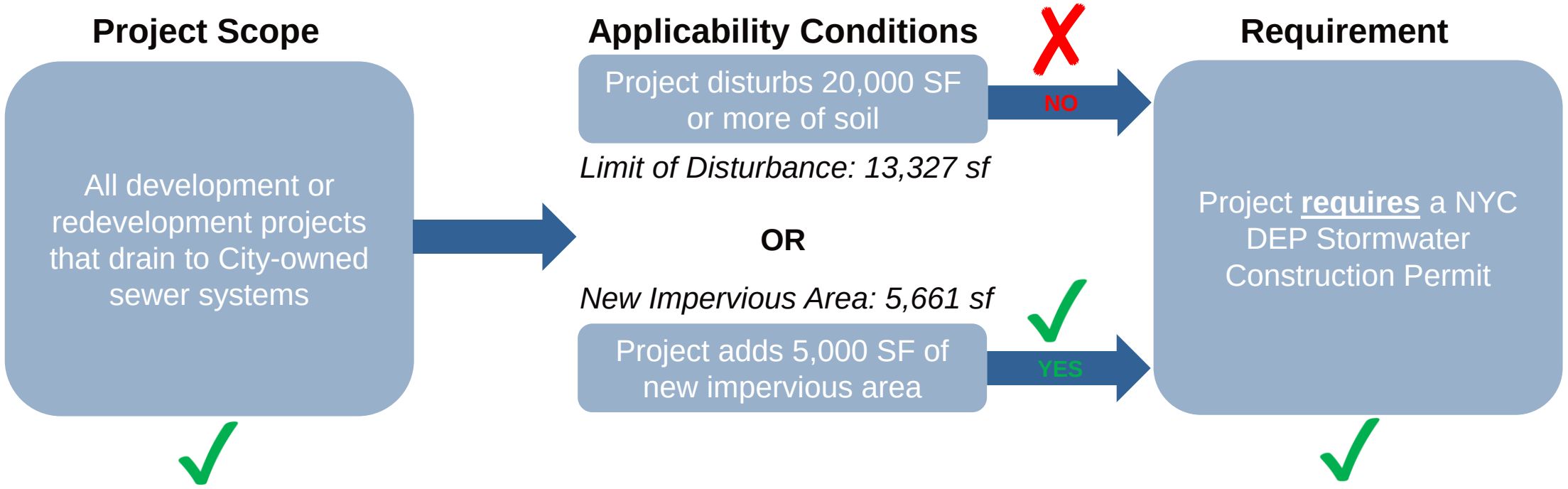
LEGEND

- Property Limits: *15,900 sf*
- Total Disturbance: *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- Right-of-Way Disturbance: *1,241 sf*
- Existing Structures (Undisturbed)
- Existing Pervious in Disturbed Area: *5,916 sf*
- Existing Impervious in Disturbed Area: *1,987 sf*
- New Impervious in Disturbed Area: *5,662 sf*

Concept Map: *Change in Impervious Area*

Permit Applicability

Stormwater Construction Permit Applicability Flow Chart



Counseling center that drains to Combined Sewer System (CSS) is expanding their building to include in-patient services

A Stormwater Construction Permit is required

Permit Applicability

<u>Goal:</u> Determine whether a project needs a Stormwater Construction Permit

Key Questions

- Can the development project drain to an NYC-owned sewer system?
- How much soil is disturbed?
- How much new impervious cover is created?

A Stormwater Construction Permit is required for this project.

Criteria Applicability

Criteria Applicability

<u>Goal:</u> Establish which stormwater management criteria apply to my project

Key Questions

- Are Erosion & Sediment Controls required?
- Are long-term SMPs required?
- Do any MS4-Only criteria apply?

CSS & MS4 | MS4 Only

Criteria Applicability

Criteria Regulated under Stormwater Construction Permits

When a Stormwater Construction Permit is applicable, a Stormwater Pollution Prevention Plan (SWPPP) **must** be prepared. The contents of the SWPPP will depend on which of the following criteria apply:

During Construction

Erosion & Sediment Control (ESC)

Goal: Designed to minimize discharge of pollutants during construction activities

Post-Construction

Water Quality (WQ)

Goal: Aims to manage runoff from small, frequent storm events that can impact water quality

Runoff Reduction (RR)

Goal: Aims to preserve natural hydrologic functions

Sewer Operations (V_V & Q_{DRR})

Goal: Aims to manage runoff from larger storm events to maintain optimal flow rates in the City sewer system

No-Net Increase (NNI)

Goal: Aims to reduce pollutants of concern in MS4 areas that discharge to an impaired waterbody

Channel Protection (Cp_V)

Goal: To protect stream channels from erosion and prevent flooding

Overbank and Extreme Flood Control (Q_P & Q_F)

Goal: To prevent an increase in the frequency and magnitude floods

ESC | WQ_V | RR_V | V_V Q_{DRR} | NNI | Cp_V | Q_P Q_F

Criteria Applicability

Are Erosion & Sediment Controls required?

Erosion and Sediment Control criteria are **always** required.

ESC | WQ_V | RR_V | V_V Q_{DRR} | NNI | Cp_V | Q_P Q_F

Criteria Applicability

Are long-term SMPs required?

NYC SWM Table 2.2 lists covered development projects that only require the implementation of ESC during construction, and therefore “ESC-Only” SWPPP.

If **any** proposed activities on a project are not listed within this table, long-term stormwater management is required as well as ESC. In this case, an “ESC&SMP” SWPPP must be prepared.

Notes:

Projects should cross reference this table with the 2025 CGP Appendix B Table 1.

Table 2.2. Covered development projects that require the preparation of a SWPPP that includes only erosion and sediment control (ESC) requirements.

Covered Development Activity
Installation of underground, linear utilities such as gas lines, fiber-optic cable, cable TV electric, telephone, sewer mains, and water mains
Environmental enhancement projects, such as wetland mitigation projects, stormwater retrofits and stream restoration projects
Pond construction
Linear bike paths running through areas with vegetative cover, including bike paths surfaced with an impervious cover
Cross-country ski trails and walking/hiking trails
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are not park of residential, commercial or institutional development
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that include incidental shoulder or curb work along an existing highway to support construction of the sidewalk, bike path or walking path
Slope stabilization projects
Slope flattening that changes the grade of the site, but does not significantly change the runoff characteristics
Spoil areas that will be covered with vegetation
Vegetated open space projects (i.e. recreational parks, lawns, meadows, fields, downhill ski trails) excluding projects that alter hydrology from pre- to post-development conditions
Athletic fields (natural grass) that do not include the construction or reconstruction of impervious area and do not alter hydrology from pre to post development conditions
Demolition project where vegetation will be established, and no redevelopment is planned
Overhead electric transmission line project that does not include the construction of permanent access roads or parking areas surfaced with impervious cover
Temporary access roads, median crossovers, detour roads, lanes, or other temporary impervious areas that will be restored to pre construction conditions once the construction activity is complete
Road reconstruction projects where the total soil disturbance from all activities is less than 1-acre

ESC | WQ_V | RR_V | V_V Q_{DRR} | NNI | Cp_V | Q_P Q_F

Criteria Applicability

Are long-term SMPs required?

NYC SWM Table 2.3 is a non-exhaustive list of covered development projects that require long-term stormwater management, as well as ESC.

These projects require an “ESC&SMP” SWPPP.

Notes:

Projects should cross reference this table with the 2025 CGP Appendix B Table 2.

Table 2.3. Covered development projects that require the preparation of a SWPPP that includes ESC requirements, as well as WQ and RR requirements.

Covered Development Activity
Single family home directly discharging to one of the impaired segments listed in Appendix 2 of the MS4 Permit
Single family home that disturbs five (5) or more acres of land
Single family residential subdivisions directly discharging to one of the impaired segments listed in Appendix 2 of the MS4 Permit
Single family residential subdivisions Multi-family residential developments; includes duplexes, townhomes, condominiums, senior housing complexes, apartment complexes, and mobile home parks
Airports
Amusement parks
Breweries, cideries, and wineries, including establishments constructed on agricultural land
Cemeteries that include the construction or reconstruction of impervious area (>5% of disturbed area) or alter that hydrology from pre to post development conditions
Commercial developments
Churches and other places of worship
Golf courses
Institutional development; includes hospitals, prisons, schools, and colleges
Industrial facilities; include industrial parks
Athletic fields with artificial turf
Permanent access roads, parking areas, substations, compressor stations and well drilling pads, surface with impervious cover, and constructed as part of an over-head electric transmission line project, wind-power project, call tower project, oil or gas well drilling project, sewer or water main project or other linear utility project
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a residential, commercial, or institutional development
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a highway construction or reconstruction project
All other covered development projects that include the construction or reconstruction of impervious area or alter the hydrology from pre and post development conditions, and are not listed in Table 2.2

ESC | WQ_V | RR_V | V_V Q_{DRR} | NNI | Cp_V | Q_P Q_F

Criteria Applicability

Are long-term SMPs required?

Case Study Scope: Counseling center is expanding to include in-patient services

✗ Not listed in NYC SWM Table 2.2

✓

Table 2.2. Covered development projects that require the preparation of a SWPPP that includes only erosion and sediment control (ESC) requirements.

Covered Development Activity
Installation of underground, linear utilities such as gas lines, fiber-optic cable, cable TV electric, telephone, sewer mains, and water mains
Environmental enhancement projects, such as wetland mitigation projects, stormwater retrofits and stream restoration projects
Pond construction
Linear bike paths running through areas with vegetative cover, including bike paths surfaced with an impervious cover
Cross-country ski trails and walking/hiking trails
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are not park of residential, commercial or institutional development
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that include incidental shoulder or curb work along an existing highway to support construction of the sidewalk, bike path or walking path
Slope stabilization projects
Slope flattening that changes the grade of the site, but does not significantly change the runoff characteristics
Spoil areas that will be covered with vegetation
Vegetated open space projects (i.e. recreational parks, lawns, meadows, fields, downhill ski trails) excluding projects that alter hydrology from pre- to post-development conditions
Athletic fields (natural grass) that do not include the construction or reconstruction of impervious area and do not alter hydrology from pre to post development conditions
Demolition project where vegetation will be established, and no redevelopment is planned
Overhead electric transmission line project that does not include the construction of permanent access roads or parking areas surfaced with impervious cover
Temporary access roads, median crossovers, detour roads, lanes, or other temporary impervious areas that will be restored to pre construction conditions once the construction activity is complete
Road reconstruction projects where the total soil disturbance from all activities is less than 1-acre

ESC | WQ_V | RR_V | V_V Q_{DRR} | NNI | Cp_V | Q_P Q_F

Criteria Applicability

Are long-term SMPs required?

✓

Case Study Scope: Counseling center is expanding to include in-patient services

✗ Not listed in NYC SWM Table 2.2

&

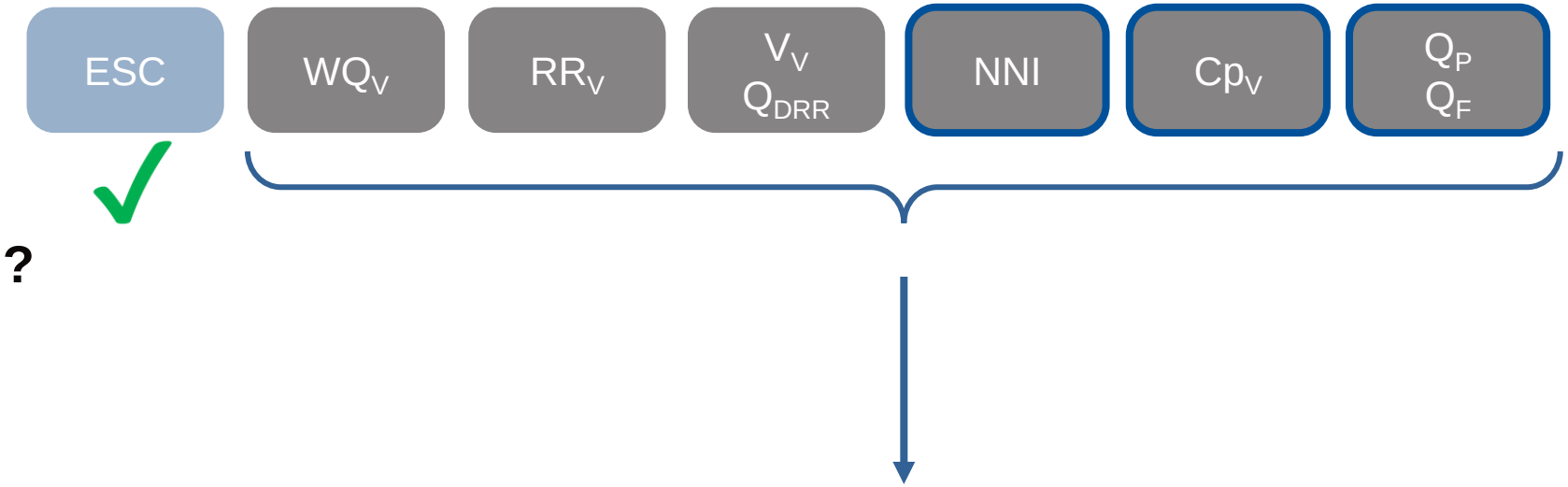
✓ Listed in NYC SWM Table 2.3

Table 2.3. Covered development projects that require the preparation of a SWPPP that includes ESC requirements, as well as WQ and RR requirements.

Covered Development Activity
Single family home directly discharging to one of the impaired segments listed in Appendix 2 of the MS4 Permit
Single family home that disturbs five (5) or more acres of land
Single family residential subdivisions directly discharging to one of the impaired segments listed in Appendix 2 of the MS4 Permit
Single family residential subdivisions Multi-family residential developments; includes duplexes, townhomes, condominiums, senior housing complexes, apartment complexes, and mobile home parks
Airports
Amusement parks
Breweries, cideries, and wineries, including establishments constructed on agricultural land
Cemeteries that include the construction or reconstruction of impervious area (>5% of disturbed area) or alter that hydrology from pre to post development conditions
Commercial developments
Churches and other places of worship
Golf courses
Institutional development; includes hospitals, prisons, schools, and colleges
Industrial facilities; include industrial parks
⫽
Athletic fields with artificial turf
Permanent access roads, parking areas, substations, compressor stations and well drilling pads, surface with impervious cover, and constructed as part of an over-head electric transmission line project, wind-power project, call tower project, oil or gas well drilling project, sewer or water main project or other linear utility project
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a residential, commercial, or institutional development
Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a highway construction or reconstruction project
All other covered development projects that include the construction or reconstruction of impervious area or alter the hydrology from pre and post development conditions, and are not listed in Table 2.2

Criteria Applicability

Are long-term SMPs required?



Case Study Scope: Counseling center is expanding to include in-patient services

✗ Not listed in NYC SWM Table 2.2

&

✓ Listed in NYC SWM Table 2.3

Project requires an "ESC&SMP" SWPPP.

Once this is established, projects must check for the applicability of each of the long-term stormwater management criteria.

Criteria Applicability

Are long-term SMPs required?

WQv and RRv apply to **all** projects that require long-term stormwater management, and therefore an "**ESC&SMP" SWPPP.**

Criteria Applicability

Are long-term SMPs required?

Sewer Operations criteria apply when a site discharges to City sewers.

ESC ✓ | WQ_V ✓ | RR_V ✓ | V_V Q_{DRR} ✓ | NNI | Cp_V | Q_P Q_F

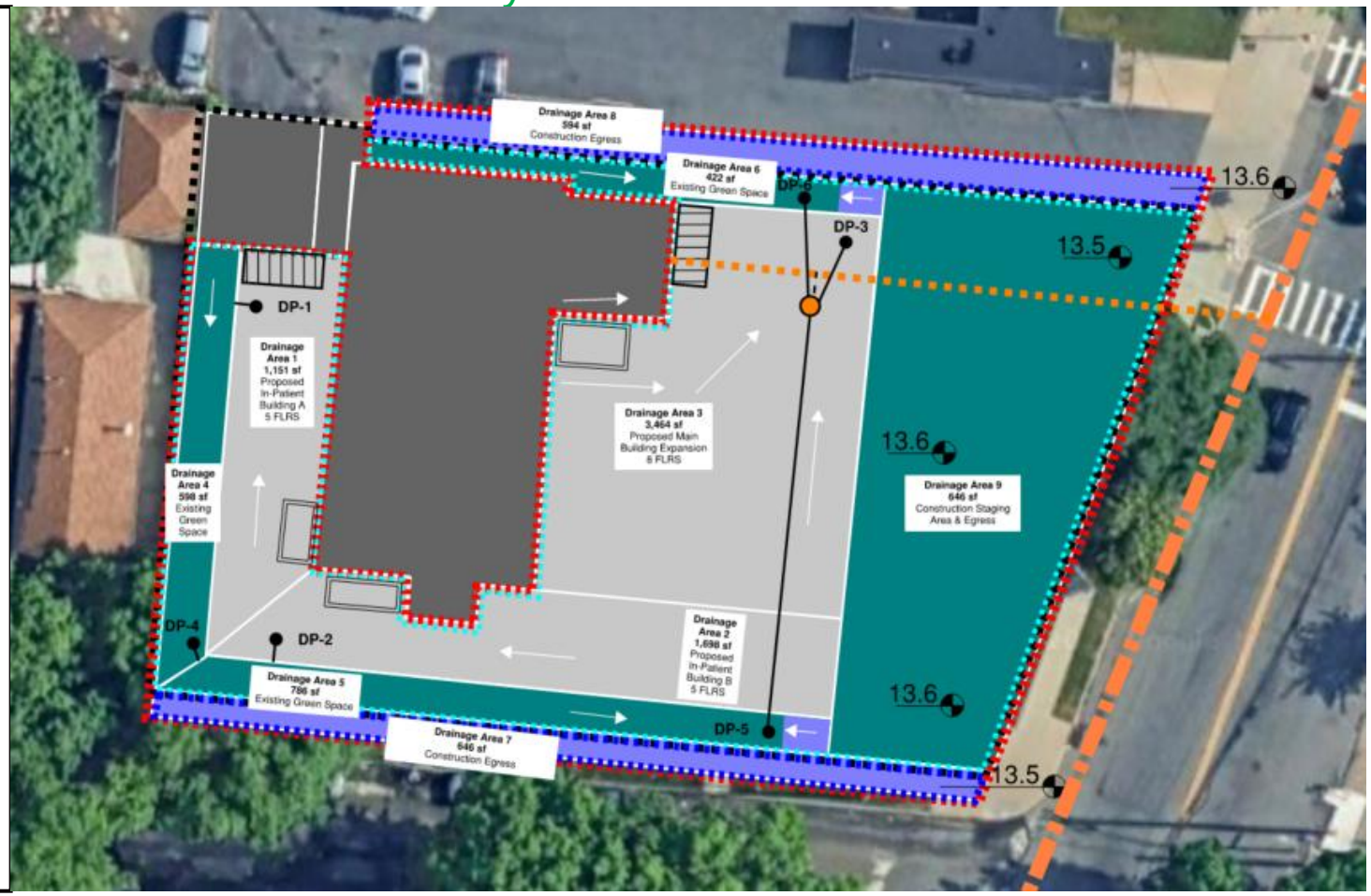
Criteria Applicability

Are long-term SMPs required?

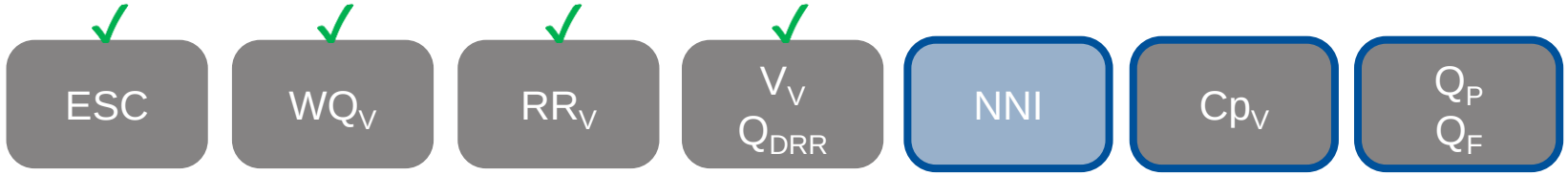
Apply when project discharges to a City-owned sewer

LEGEND

- Property Lot: *15,900 sf*
- Total Disturbance: *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Existing Structures
- Landscaped Area
- Proposed Building Roof Areas
- Paved Areas
- DP- # Drainage Point and ID
- Proposed Inlet
- Proposed Internal Drainage
- Existing Sewer Connection
- NYC Combined Sewer System
- Proposed Site Sewer Connection
- Flow Control Structure
- ##.# Spot Elevations (FT EL.)



Concept Map: *Proposed Cover and Contributing Area Drainage (Preliminary)*

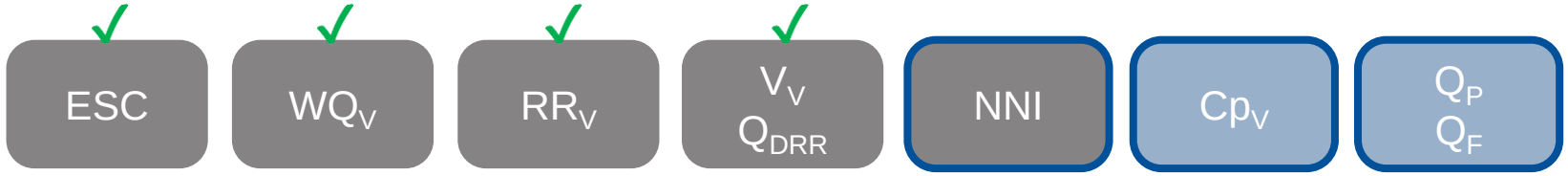


Criteria Requirements

Do any MS4-Only criteria apply?

No-Net-Increase criteria apply when a project meets **all** of the following conditions:

1. Project disturbs 20,000 SF or more of soil, or creates 5,000 sf or more of new impervious area ✓
2. Project increases site imperviousness ✓
3. Project discharges to MS4 system → Must be confirmed.
4. Project discharges to an impaired waterbody



Criteria Requirements

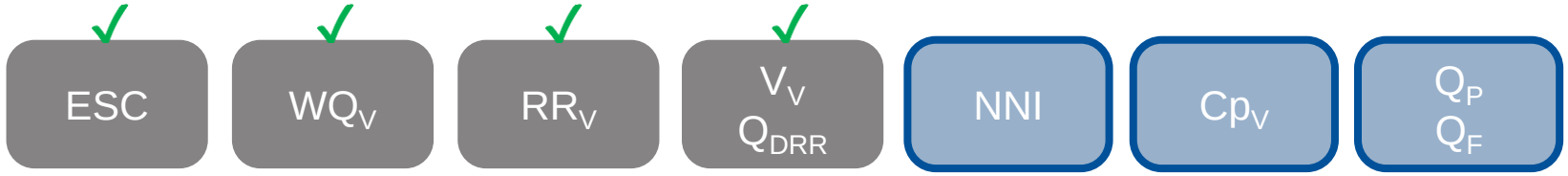
Do any MS4-Only criteria apply?

Channel Protection, Overbank Flood Control, and Extreme Flood Control criteria apply when a project meets **all** of the following conditions:

1. Project disturbs 20,000 sf or more of soil, or creates 5,000 sf or more of new impervious area ✓
2. Project discharges to MS4 system → Must be confirmed.
3. Site discharges to non-tidal waters. ✗

Notes:

Channel protection, overbank flood control, and extreme flood control requirements are not common in NYC projects. However, Designers must review the applicability criteria in the New York State Construction General Permit (2025 CGP Part II.C.2.a.iii) to confirm applicability.



Criteria Requirements

Do any MS4-Only criteria apply?

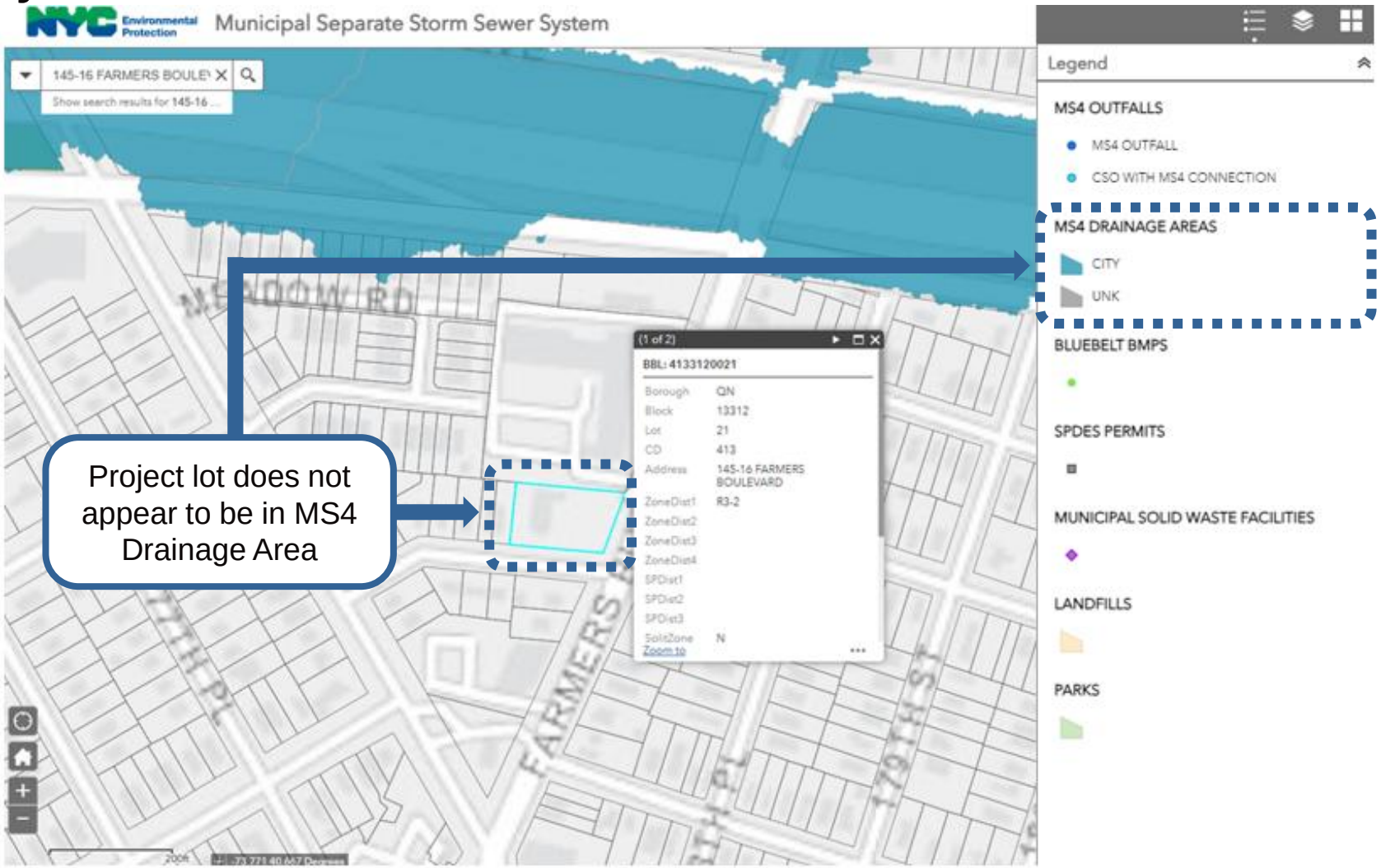
The following steps may be used to determine the sewershed type:

1. Locate project on NYC DEP MS4 Interactive Map
2. Confirm findings by requesting official record via NYC DEP PARIS
3. Resolve any inconsistencies by requesting a Pre-Application Meeting with DEP (as needed)

Criteria Requirements

Do any MS4-Only criteria apply?

1. Locate project on [NYC DEP MS4 Interactive Map]



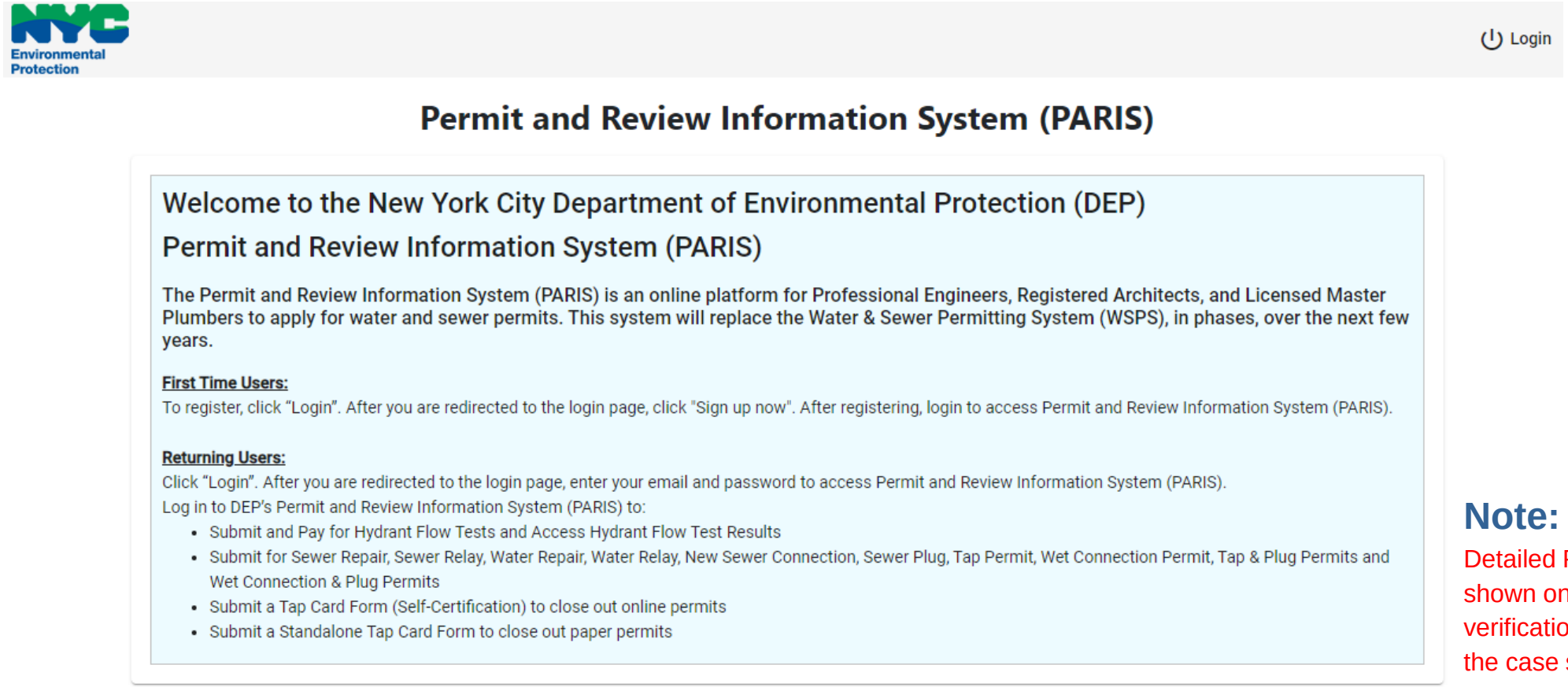
Notes:

- MS4 Interactive Map provides approximate boundaries for areas discharging to MS4 system and impaired waterbodies.
- It is helpful in determining an MS4 area's receiving waterbody and impairment.
- In some cases, the ownership and discharge area is inaccurate or unknown and must be verified separately.

Criteria Requirements

Do any MS4-Only criteria apply?

2. Confirm findings by requesting official record via NYC DEP PARIS



Note:

Detailed PARIS steps are not shown on this slide, but verification was completed for the case study.

Criteria Requirements

Do any MS4-Only criteria apply?

3. Resolve any inconsistencies by requesting a Pre-Application Meeting with DEP via the Stormwater Permit Inquiry Form (as needed)

NYC Environmental Protection

Stormwater Permits Inquiry

You can reach out to the Stormwater Permits Team by submitting your contact information and inquiry below. Be sure to have look at the Stormwater Permit FAQs before submitting your inquiry.

Name *

First Last

Email *

Phone Number

####

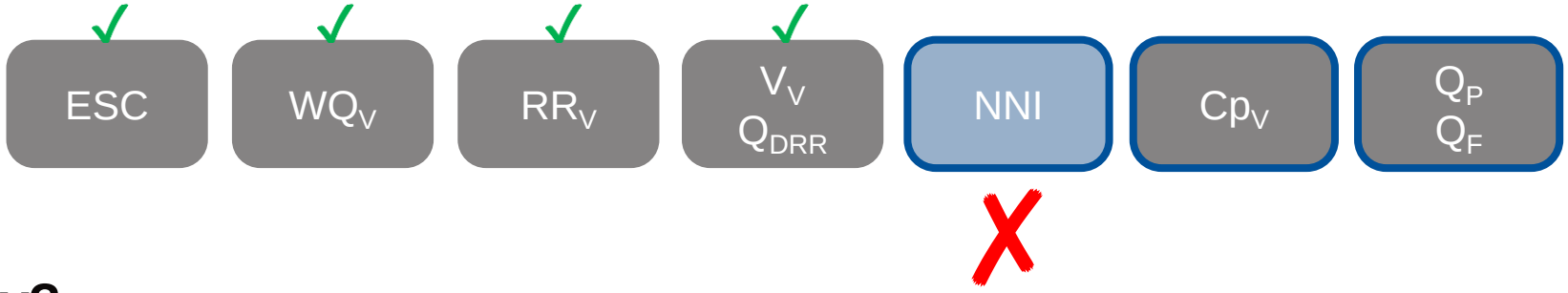
Subject *

Requesting a SWPPP Pre-Application Meeting

If you have questions related to multiple subjects, please submit a separate form for each subject.

Submit

This site is protected by reCAPTCHA Enterprise and the Google Privacy Policy and Terms of Service apply.

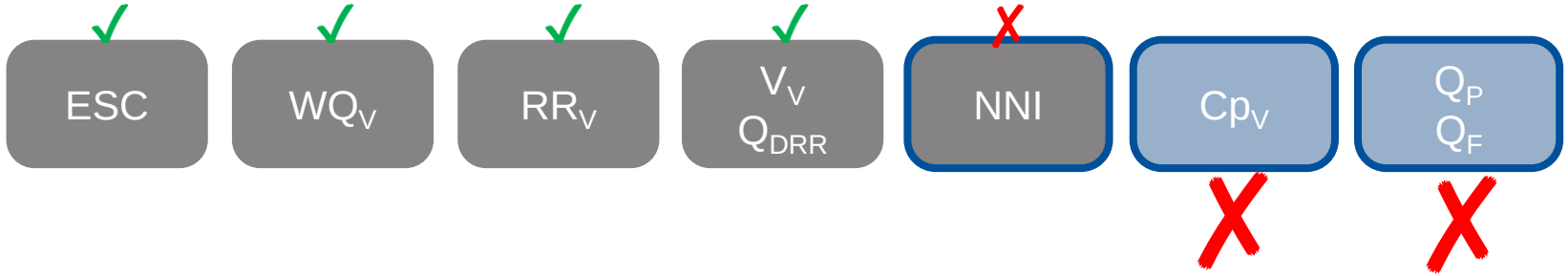


Criteria Requirements

Do any MS4-Only criteria apply?

No-Net-Increase criteria apply when a project meets **all** of the following conditions:

1. Project disturbs 20,000 SF or more of soil, or creates 5,000 sf or more of new impervious area ✓
2. Project increases site imperviousness ✓
3. Project discharges to MS4 system ✗
4. Project discharges to an impaired waterbody ✗



Criteria Requirements

Do any MS4-Only criteria apply?

Channel Protection, Overbank Flood Control, and Extreme Flood Control criteria apply when a project meets **all** of the following conditions:

1. Project disturbs 20,000 sf or more of soil, or creates 5,000 sf or more of new impervious area ✓
2. Project discharges to MS4 system ✗
3. Site discharges to non-tidal waters. ✗

Notes:

Channel protection, overbank flood control, and extreme flood control requirements are not common in NYC projects. However, Designers must review the applicability criteria in the New York State Construction General Permit (2025 CGP Part II.C.2.a.iii) to confirm applicability.

Criteria Applicability

<u>Goal:</u> Establish which stormwater management criteria apply to my project

Key Questions

- Are Erosion & Sediment Controls required?
- Are long-term SMPs required?
- Do any MS4-Only criteria apply?

The following criteria apply:

- ✓ Erosion and Sediment Control (ESC)
- ✓ Water Quality Volume (WQ_V)
- ✓ Runoff Reduction Volume (RR_V)
- ✓ Sewer Operations Volume (V_V) & Maximum Release Rate (Q_{DRR})

Geotechnical Planning

Geotechnical Planning

<u>Goal:</u> Develop and Implement a Geotechnical Investigation Plan

Key Questions

- What site constraints limit the geotechnical testing area?
- Where should boring and permeability tests be conducted?
- What are the infiltration rates on site?
- Was groundwater or bedrock discovered?

Geotechnical Planning

Applicability

On-site geotechnical investigations are **required*** when a stormwater management practices (SMP) is proposed to comply with the NYC DEP Stormwater Construction Permit.

Note:

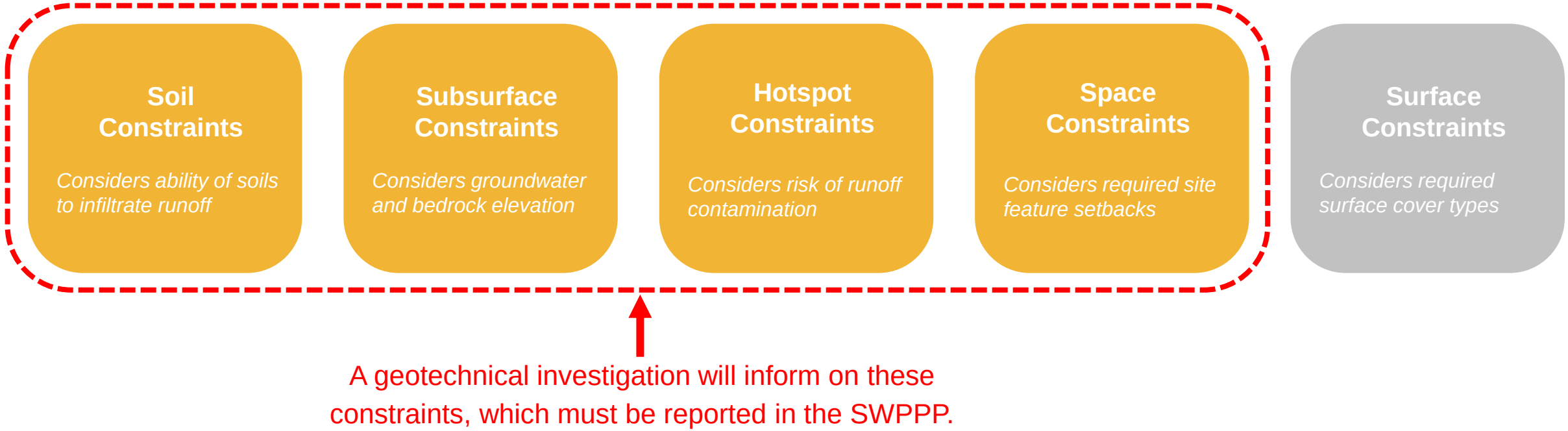
* Geotechnical investigations are not required when a lot line building is proposed that does not increase impervious surface.

Geotechnical Planning

Purpose

The type of proposed SMP should be determined based on a constraints analysis.

The SWPPP **must** document constraints analyzed that impact SMP selection.



Geotechnical Planning

What site constraints limit the geotechnical testing area?

Surface Constraints:

- ✓ Parking lot in adjacent property
- ✓ Paved building access pathways
- ✓ Sidewalk requirement in ROW

Space Constraints:

- ✓ 10 ft Setback from Building Foundations
- ✓ 5 ft Setback from Property Line

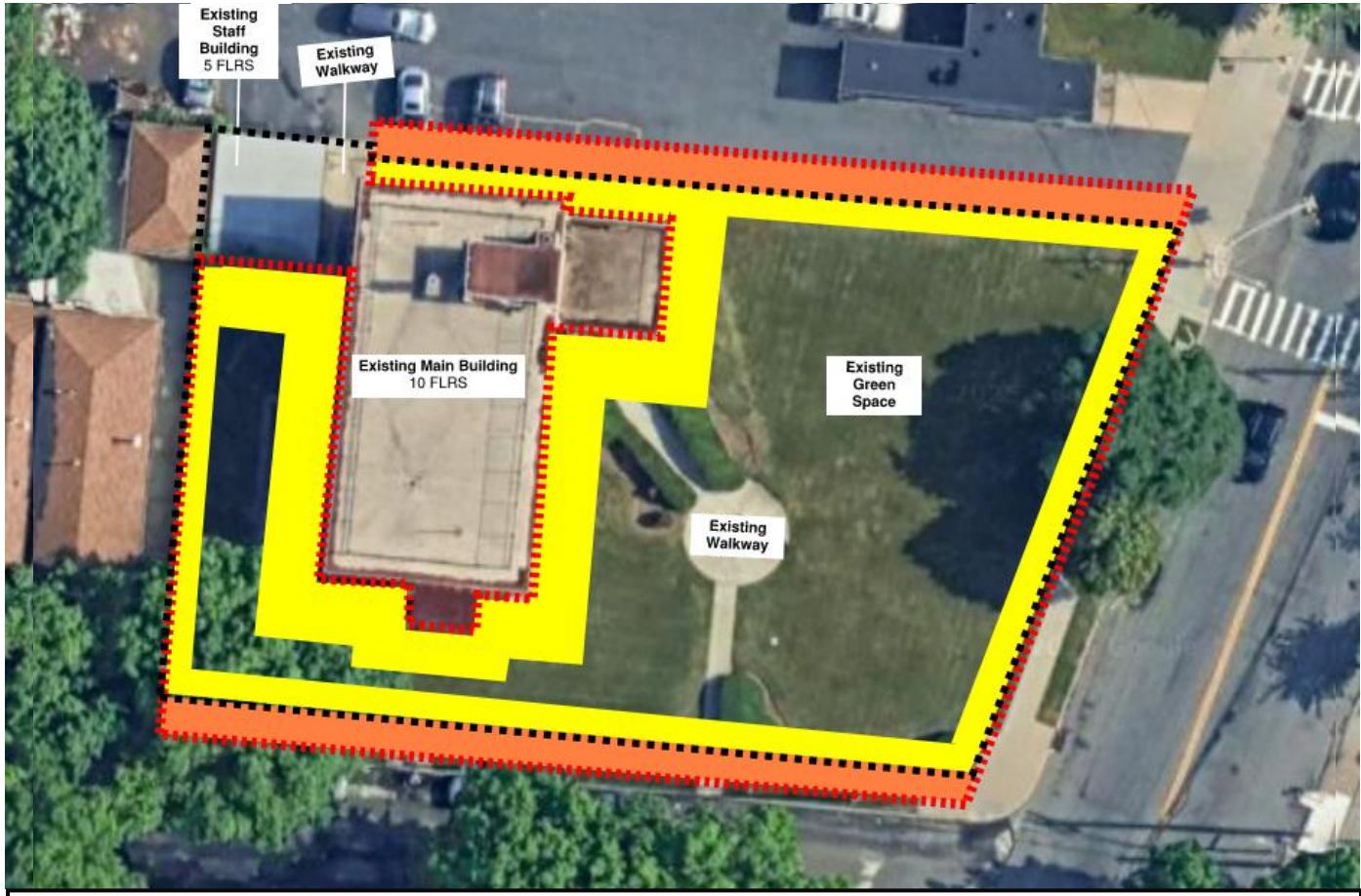
Other Potential Constraints:

- ✓ Areas of contamination
- ✓ Areas of historical high groundwater or bedrock

References:

1. *NYC Stormwater Manual Appendix C*

Concept Map: *Geotechnical Testing Constraints*



Geotechnical Planning

Where should boring and permeability tests be conducted?

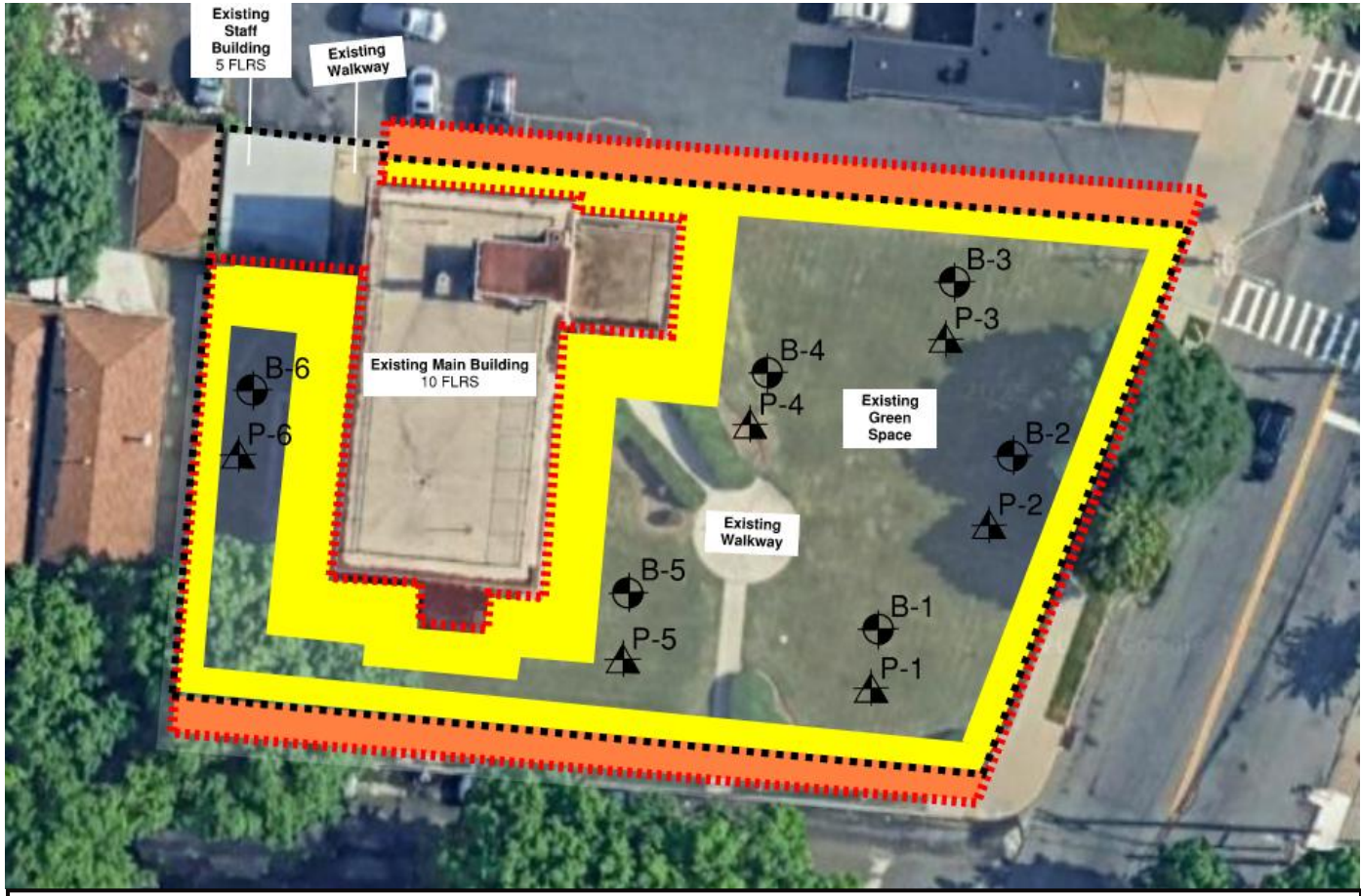
Select testing locations based on:

- ✓ **Desktop analysis**
  of existing site conditions
- ✓ **Review regulatory guidance**
  that may impact SMP location & design
- ✓ **Create a preliminary constraints map**
  to determine where SMPs cannot be located
- ✓ **Create a preliminary boring plan**
  to ensure the minimum number of tests will be performed at all feasible SMP locations
- ✓ **Review results as they are performed**
  to confirm current investigation is consistent with historic borings

References:

1. *NYS DEC Stormwater Management Design Manual – Appendix D*
2. *BEPA PERM Geotech Investigation Workshop*

Concept Map: *Boring Plan*



Geotechnical Planning

How many boring and permeability tests should be conducted?

Geotechnical Investigation Planning

Considerations:

- Project may choose to conduct geotechnical testing in two rounds—first to confirm hydrologic soil groups and constraints across the site, then to confirm suitable soil conditions for each proposed infiltration practice.
- Alternatively, projects could choose to conduct one round of more comprehensive testing to avoid a second geotechnical mobilization. This more comprehensive testing may also help eliminate additional geotechnical work if practices are found to be infeasible during construction.
- In all cases, DEP recommends having the geotechnical professional communicate closely with the design professional during geotechnical investigation testing in order to effectively alter the testing plan based on site conditions and design requirements.

Geotechnical Planning

Results Analysis

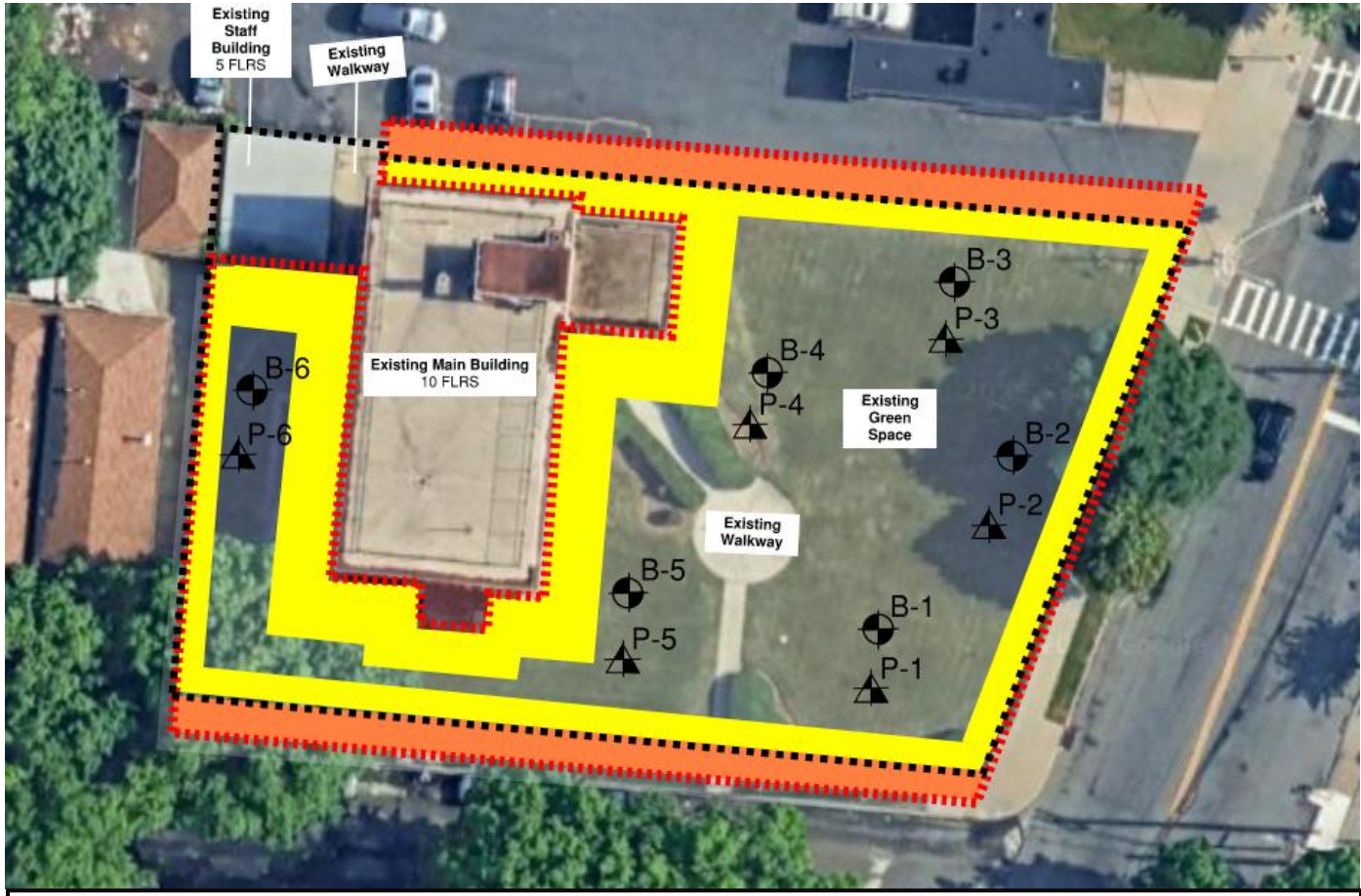
Refer to the Geotechnical Investigation Workshop for additional guidance on reviewing and interpreting results from a geotechnical investigation.

Geotechnical Planning

What are the infiltration rates on site?

All permeability tests found infiltration rates below 0.5 in/hr.

Concept Map: *Boring Plan*



LEGEND

- Property Line
- Limit of Disturbance
- Surface Constraints
- Space Constraints
- B-# Boring Log
- P-# Permeability Test

References:

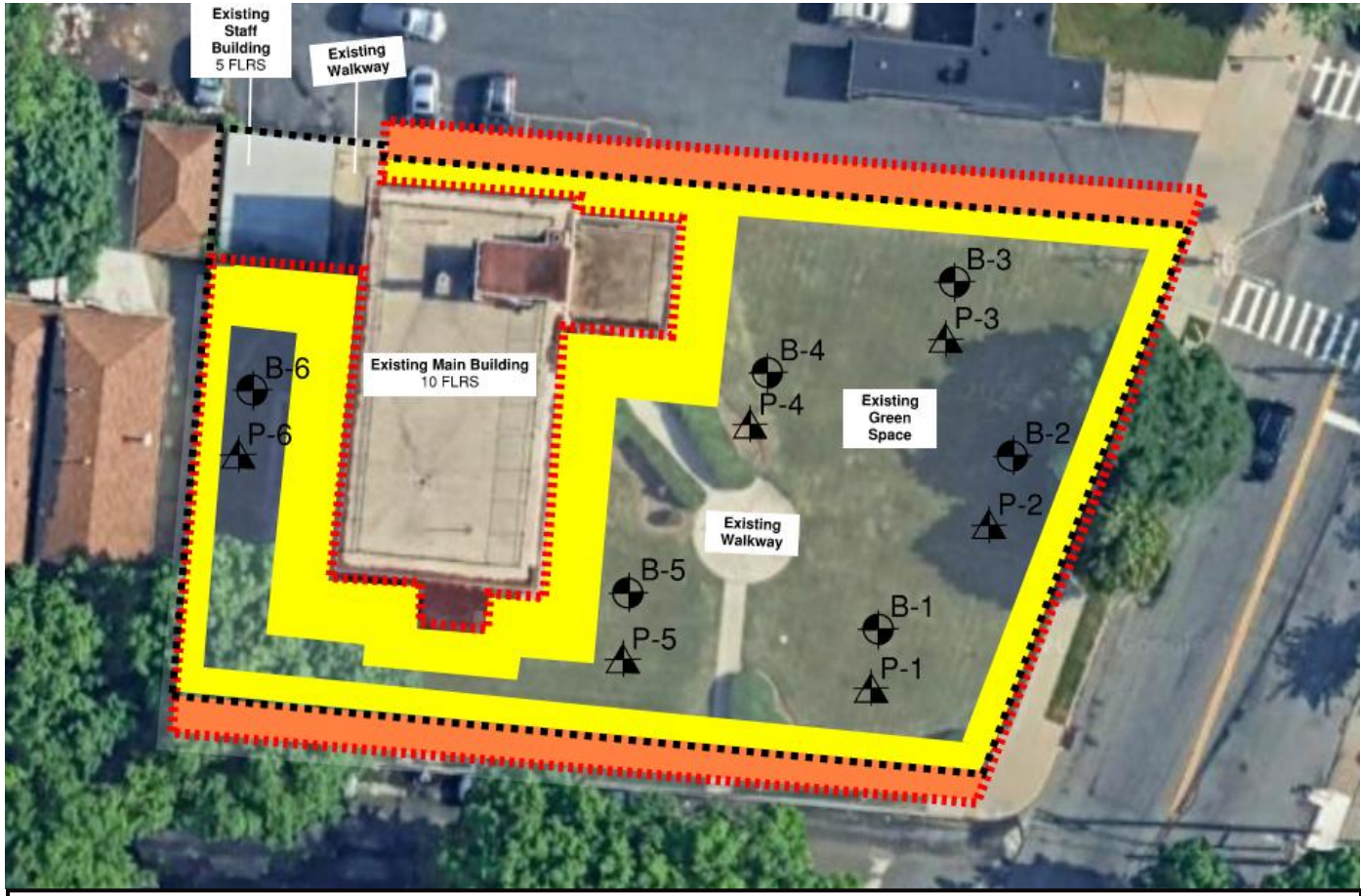
1. *NYS DEC Stormwater Management Design Manual – Appendix D*
2. *BEPA PERM Geotech Investigation Workshop*

Geotechnical Planning

Was groundwater or bedrock discovered?

Boring tests did not discover groundwater or bedrock.

Concept Map: *Boring Plan*



LEGEND

- Property Line
- Limit of Disturbance
- Surface Constraints
- Space Constraints
- B-# Boring Log
- P-# Permeability Test

References:

1. *NYS DEC Stormwater Management Design Manual – Appendix D*
2. *BEPA PERM Geotech Investigation Workshop*

Geotechnical Planning

<u>Goal:</u> Develop and Implement a Geotechnical Investigation Plan

Key Questions

- What site constraints limit the geotechnical testing area?
- Where should boring and permeability tests be conducted?
- What are the infiltration rates on site?
- Was groundwater or bedrock discovered?

Geotechnical Investigation results:

- ✓ Infiltration rate < 0.5 in/hr across site
- ✓ No shallow groundwater or bedrock

SMP Siting

SMP Siting

Goal: Establish Potential SMP Types & Locations

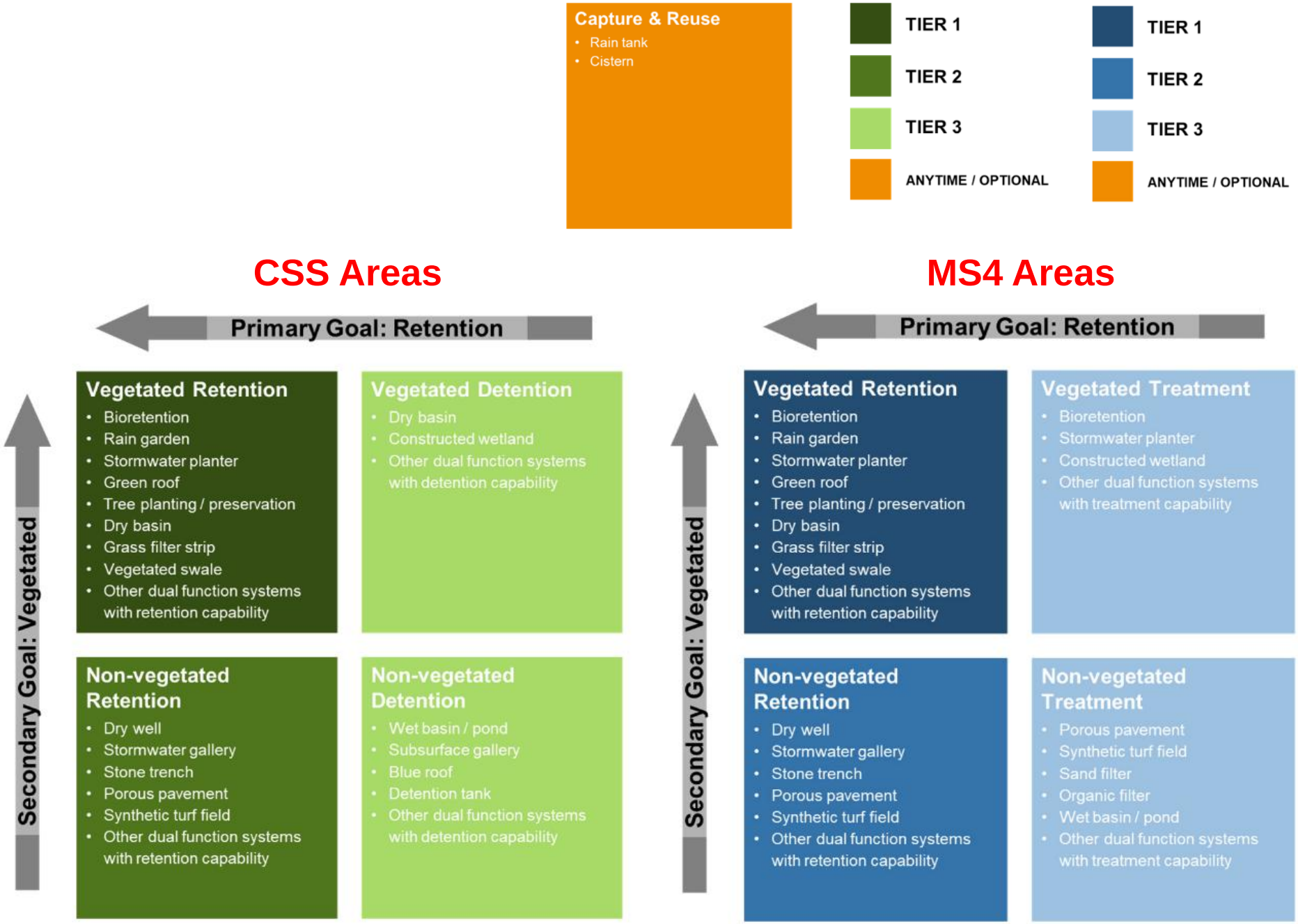
Key Questions

- What soil, subsurface, and hotspot constraints are present?
- What space and subsurface constraints are present?
- Which Tier 1 SMPs are feasible?
- Where can I site Tier 1 SMPs?

SMP Siting

SMP Hierarchy

- The SMP hierarchy creates clear and consistent approach for the selection of SMPs.
- Designers must assess and implement SMPs in higher tiers to the maximum extent practicable before moving to lower tier systems.
- Tiers for SMPs are intended to guide designs towards SMPs most effective at meeting NYC goals.



SMP Siting

Constraints

Projects **must** document constraints that limit the use of Tier 1 or Tier 2 practices when lower tier practices are used:

Soil Constraints

Considers ability of soils to infiltrate runoff

Subsurface Constraints

Considers groundwater and bedrock elevation

Hotspot Constraints

Considers risk of runoff contamination

Surface Constraints

Considers required surface cover types

Space Constraints

Considers required site feature setbacks

Soil | Subsurface | Hotspot | Surface | Space

Legend: ✓ Constraint evaluated does not limit use of SMP function
✕ Constraint evaluated limits use of SMP function

SMP Siting

What soil, subsurface, and hotspot constraints are present?

- **Soil:** Areas where permeability tests indicate soil infiltration rates <0.5 in/hr
- **Subsurface:** Areas where boring tests indicate that the bottom of the SMP would be <3 ft from groundwater or bedrock, or <4 ft for sole source aquifers.
- **Hotspot:** Areas where land use, soil conditions, or other factors pose risk of contaminating infiltration

Constraint Impact on SMP Siting*

Tier 1:

✓ Vegetated Evapotranspiration SMPs
✕ Vegetated Infiltration SMPs

Tier 2:

✕ Non-Vegetated Infiltration SMPs

*Guidance is generalized; designer must comply with NYC SWM Section 4.2 when siting practices.

SMP Siting

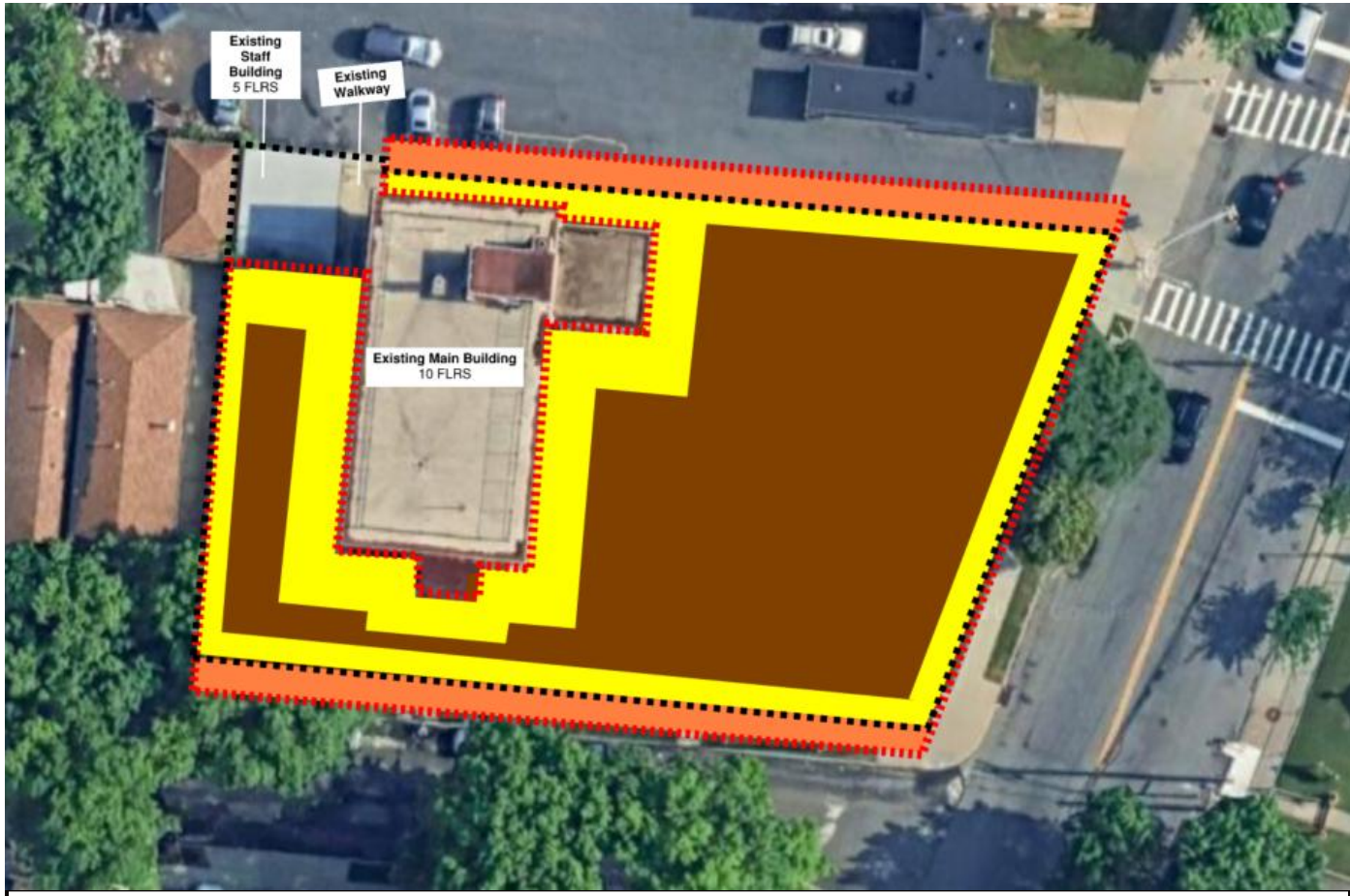
What soil, subsurface, and hotspot constraints are present?

<u>Soil, Subsurface, and Hotspot Constraint Plan</u> must be included in the SWPPP submission when these constraints impact the use of SMPs.

Notes:

- The constraints plan shown was simplified for clarity.
- SWPPP submissions should include notes with justification of each constraint and references to supporting documentation

Concept Map: *Soil, Subsurface and Hotspot Constraints*



Soil | Subsurface | Hotspot | **Surface** | Space

Legend: ✓ Constraint evaluated does not limit use of SMP function
✗ Constraint evaluated limits use of SMP function

SMP Siting

What surface and space constraints are present?

- **Surface:** Areas where regulations require the use of paved surfaces

Constraint Impact on SMP Siting*

Tier 1:

- ✗ Vegetated Evapotranspiration SMPs
- ✗ Vegetated Infiltration SMPs

Tier 2:

- ✓ Non-Vegetated Infiltration SMPs

*Guidance is generalized; designer must comply with NYC SWM Section 4.2 when siting practices.

Soil | Subsurface | Hotspot | Surface | **Space**

Legend: ✓ Constraint evaluated does not limit use of SMP function
✕ Constraint evaluated limits use of SMP function

SMP Siting

What surface and space constraints are present?

- **Space:** Areas where regulations require setbacks from structures, utilities, property lines, existing trees, or other site features

Constraint Impact on SMP Siting*

Tier 1:

- ✓ Vegetated Evapotranspiration SMPs
- ✕ Vegetated Infiltration SMPs

Tier 2:

- ✕ Non-Vegetated Infiltration SMPs

*Guidance is generalized; designer must comply with NYC SWM Section 4.2 when siting practices.

SMP Siting

What surface and space constraints are present?

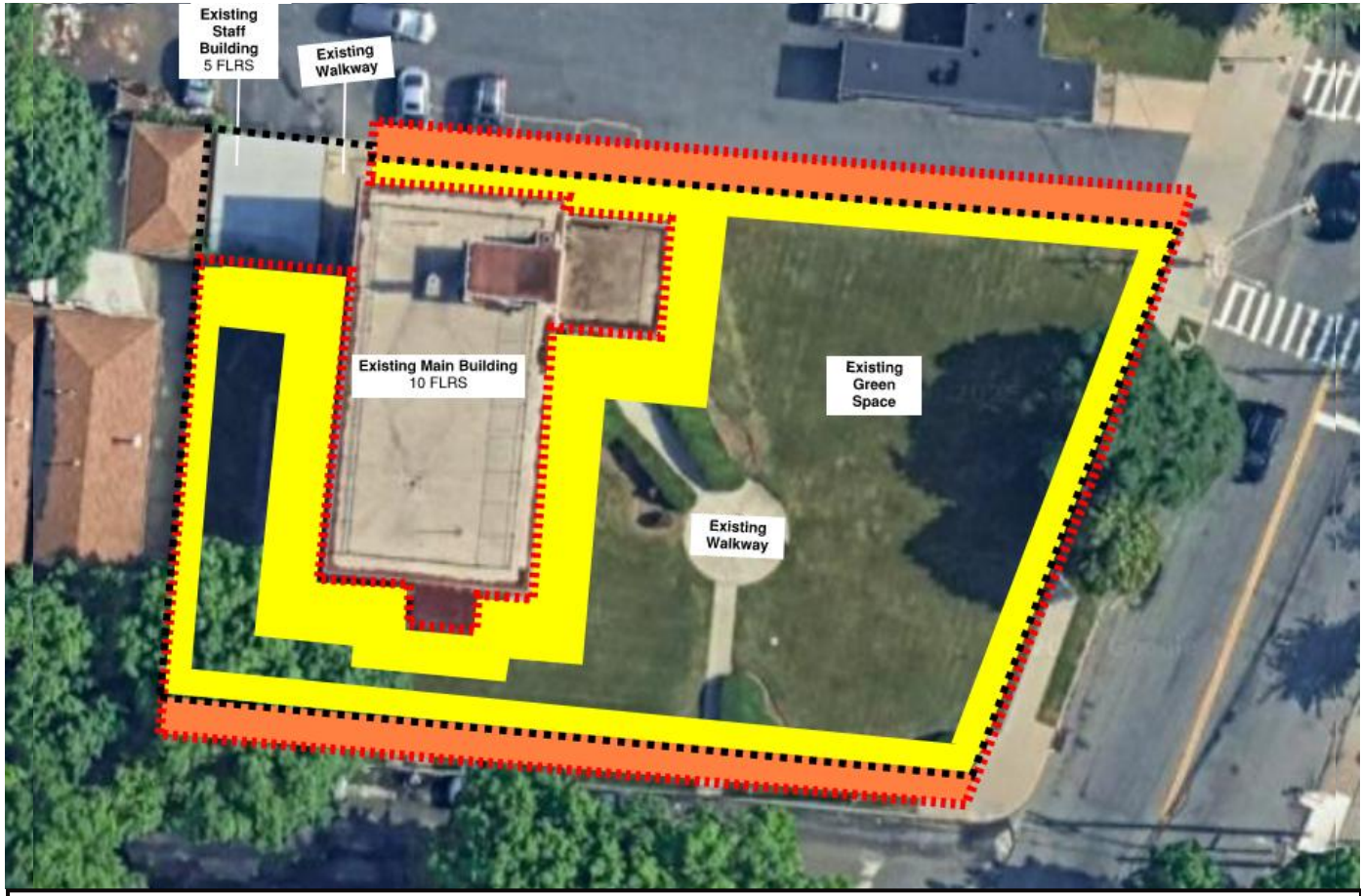
Surface Constraints:

- ✓ Parking lot in adjacent property
- ✓ Paved building access pathways
- ✓ Sidewalk requirement in ROW

Space Constraints *(At Grade)*:

- ✓ 10 ft Setback from Building Foundations
- ✓ 5 ft Setback from Property Line

Concept Map: *Constraints at Grade*



LEGEND

- Limit of Property
- Limit of Disturbance
- Surface Constraints
- Space Constraints

SMP Siting

What surface and space constraints are present?

Surface Constraints:

- ✓ Parking lot in adjacent property
- ✓ Paved building access pathways
- ✓ Sidewalk requirement in ROW

Space Constraints *(At Grade)*:

- ✓ 10 ft Setback from Building Foundations
- ✓ 5 ft Setback from Property Line

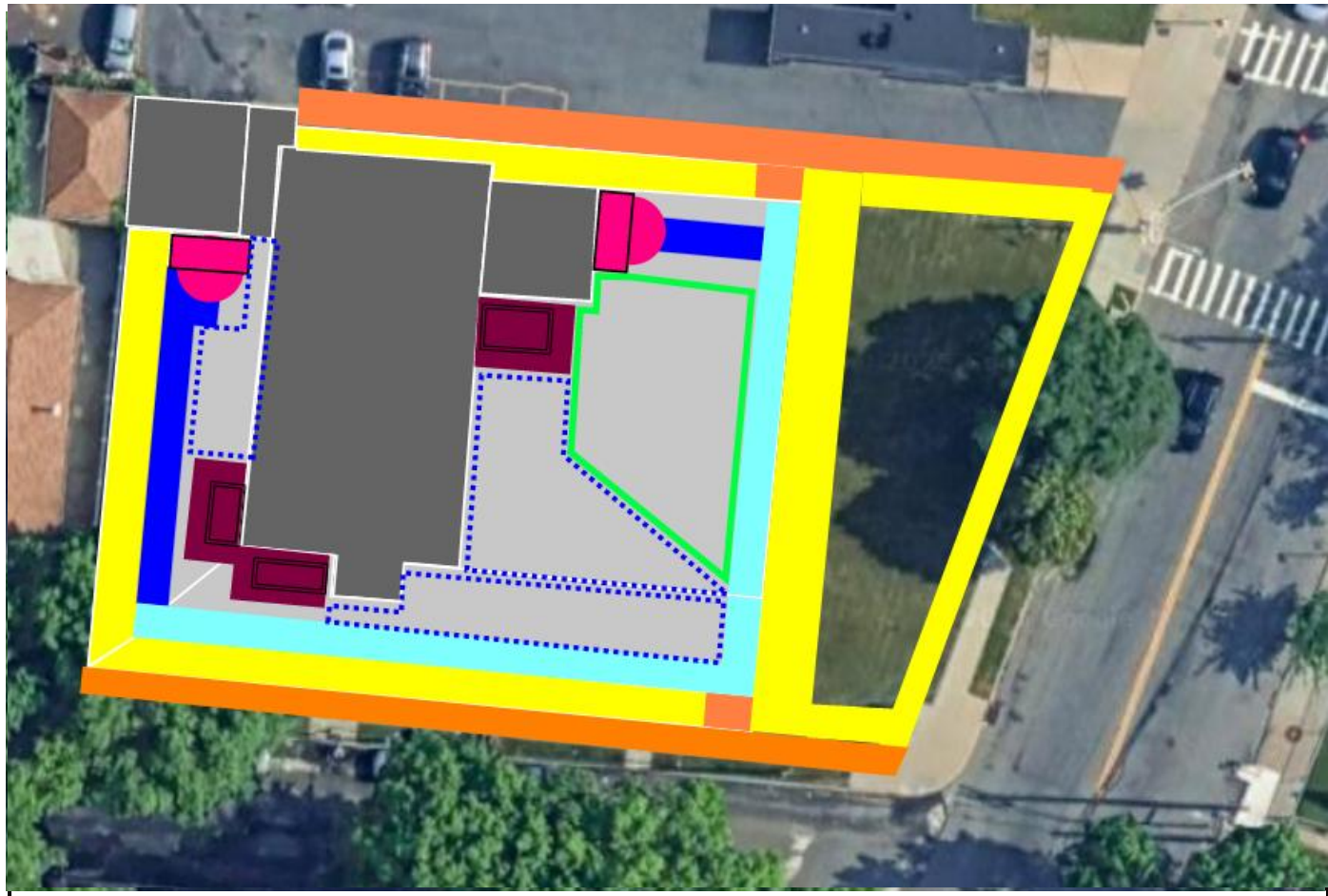
Space Constraints *(Roof Only)*:

- ✓ 6 ft Perimeter Access on Building Frontage
- ✓ 3 ft Radius Clearance from Roof Door
- ✓ 6 ft Clear Paths every 100 ft
- ✓ 3 ft clearance from Mechanical Equipment

References:

1. *RCNY Chapter 5, FDNY Requirements Section 504.4*
2. *Local Laws 92/94: Solar & Green Roofs*
3. *FDNY Clearances Presentation*

***Concept Map:** Constraints at Grade and on Roof*



LEGEND

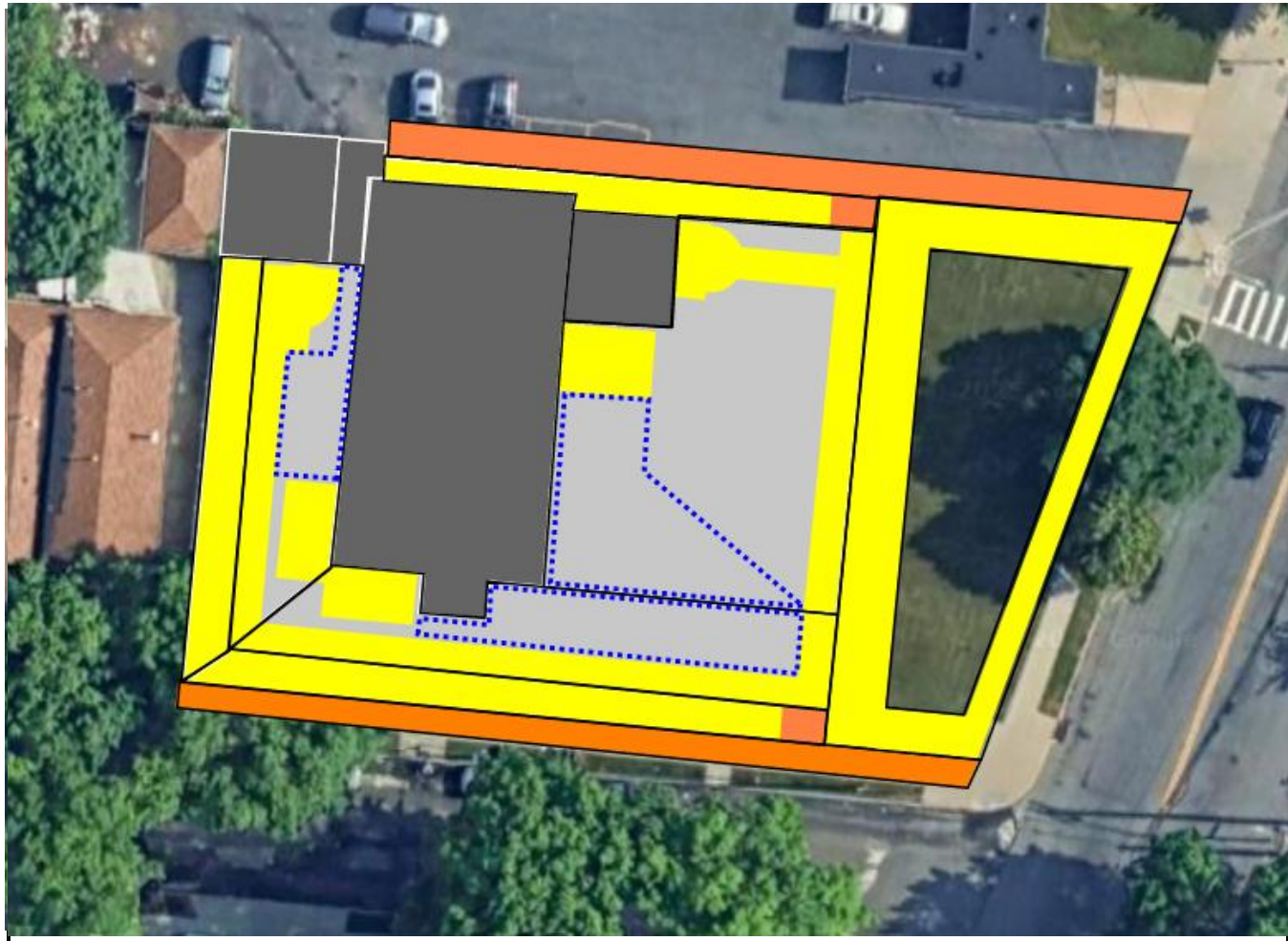
- Existing Structures
- Proposed Structures Roof Area
- Surface Constraints
- Space Constraints at Grade
- Perimeter Access Clearance
- Clear Path
- Roof Access Structure & Door Clearance
- Mechanical Equipment clearance
- Proposed Recreational Area (*not a constraint*)
- Sustainable Roofing Zone

SMP Siting

What surface and space constraints are present?

Surface and Space Constraint Plan must be included in the SWPPP submission when these constraints impact the use of SMPs.

Concept Map: *Surface and Space Constraints Plan*



Notes:

- The constraints plan shown was simplified for clarity.
- Constraints plans submitted with the SWPPP may be separated or combined as needed for clarity.
- SWPPP submissions should include notes with justification of each constraint and references to supporting documentation

References:

1. *NYC DEP SWPPP Template – Appendix A*

SMP Siting

What Tier 1 SMPs are feasible?

This project has surface, space, soil constraints.

Feasible Tier 1 SMPs are all Evapotranspiration Practices

SMP HIERARCHY CHECKLIST - CSS AREAS			Percent of SMP volume applied[a]			Site constraints that limit SMP feasibility[b]				
Tier[c]	Function Type[d]	Practice Type[e]	WQv	RRv	Vv	Soil	Subsurface	Hotspot	Surfaces	Space
Tier 1	Infiltration (Vegetated)	Bioretention	100	100	100	X	X	X	X	X
		Rain garden	100	100	100	X	X	X	X	X
		Stormwater planter	100	100	100	X	X	X	X	X
		Tree planting / preservation	SC	SC	0					
		Dry basin	100	100	100	X	X	X	X	X
		Grass filter strip	SC	SC	0	X	X	X	X	X
		Vegetated swale	SC	SC	0	X	X	X	X	X
	Evapotranspiration[f]	Rain garden	100	100	0		X		X	X
		Stormwater planter	100	100	0				X	
		Tree planting / preservation	SC	SC	0					
		Green roof	100	100	0					
Tier 2	Infiltration (Non-vegetated)	Dry well	100	100	100	X	X	X		X
		Stormwater gallery	100	100	100	X	X	X		X
		Stone trench	100	100	100	X	X	X	X	X
		Porous pavement	100	100	100	X	X	X		X
		Synthetic turf field	100	100	100	X	X	X	X	X
Anytime / Optional	Reuse	Rain tank	100	100	SC					
		Cistern	100	100	SC					
Tier 3	Detention[g,h,i]	Dry basin	100	0	100		X		X	X
		Constructed wetland	100	0	100		X		X	X
		Wet basin / pond	100	0	100		X		X	X
		Stormwater gallery	100	0	100		X			X
		Blue roof	100	0	100					
		Detention tank	100	0	100					

References:

1. *NYS DEC Stormwater Management Design Manual – Appendix A*

SMP Siting

Where Can I Site Tier 1 SMPs?

Concept Map: *Tier 1 SMP Feasibility*

Evapotranspiration Practices can be sited:

- ✓ On all unconstrained roof areas
- ✓ On space constraints at property lines and building foundations
- ✓ On unconstrained spaces outside the planned development area (if needed)

SMP Siting

Where Can I Site Tier 1 SMPs?

Prioritizing Vegetated Retention Practices

Considerations:

- 15 RCNY Chapter 19.1 requires projects to maximize the use of vegetated retention practices, defined in NYC SWM as “Tier 1”.
- Projects are required to site Tier 1 practices to the maximum extent practicable first. Once Tier 1 SMPs have been sited, projects must then revisit their constraints plan to evaluate the feasibility of Tier 2 SMPs, then and Tier 3 SMPs, progressively.
- Recreational areas excluded in the Sustainable Roofing Zone may still be feasible for stormwater management requirements; they are not considered a valid constraint.

SMP Siting

Goal: Establish Potential SMP Types & Locations

Key Questions

- What soil, subsurface, and hotspot constraints are present?
- What space and subsurface constraints are present?
- Where can I site SMPs?

This project has surface, space, soil constraints.

Feasible vegetated retention SMPs (Tier 1) include:

- ✓ Green Roofs
- ✓ Stormwater Planters
- ✓ Rain Gardens

Tier 1 & 2 SMP Design

Tier 1 & 2 SMP Design

<u>Goal:</u> Design SMPs to Meet the Applicable Tier 1 & 2 Stormwater Management Criteria

Key Questions

- What is the site-wide WQ_V and RR_V?
- What are the Tier 1 SMP design requirements?
- What are the Tier 2 SMP design requirements?
- Are all requirements met?

SMP Design

Numerical Criteria

Designers must use technical guidance in NYC SWM Chapter 2 to calculate numerical requirements for the applicable criteria:

- ✓ Water Quality Volume (WQ_V)
- ✓ Runoff Reduction Volume (RR_V)
- ✓ Sewer Operations Volume (V_V)
- ✓ Maximum Release Rate (Q_{DRR})

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Calculating Site WQv:

- **Step 1:** Identify Equation
- **Step 2:** Identify Site Contributing Area
- **Step 3:** Calculate Runoff Coefficient
- **Step 4:** Complete Site-Wide Calculation

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

WQ_V Step 1: Identify Equation

Use NYC SWM Eq. 2.1 to calculate WQ_V

EQ 2.1

$$WQ_V = \frac{1.5"}{12} * A * R_V$$

where:

WQ_V: water quality volume (cf)

A: contributing area (sf)

R_V: runoff coefficient relating total rainfall and runoff

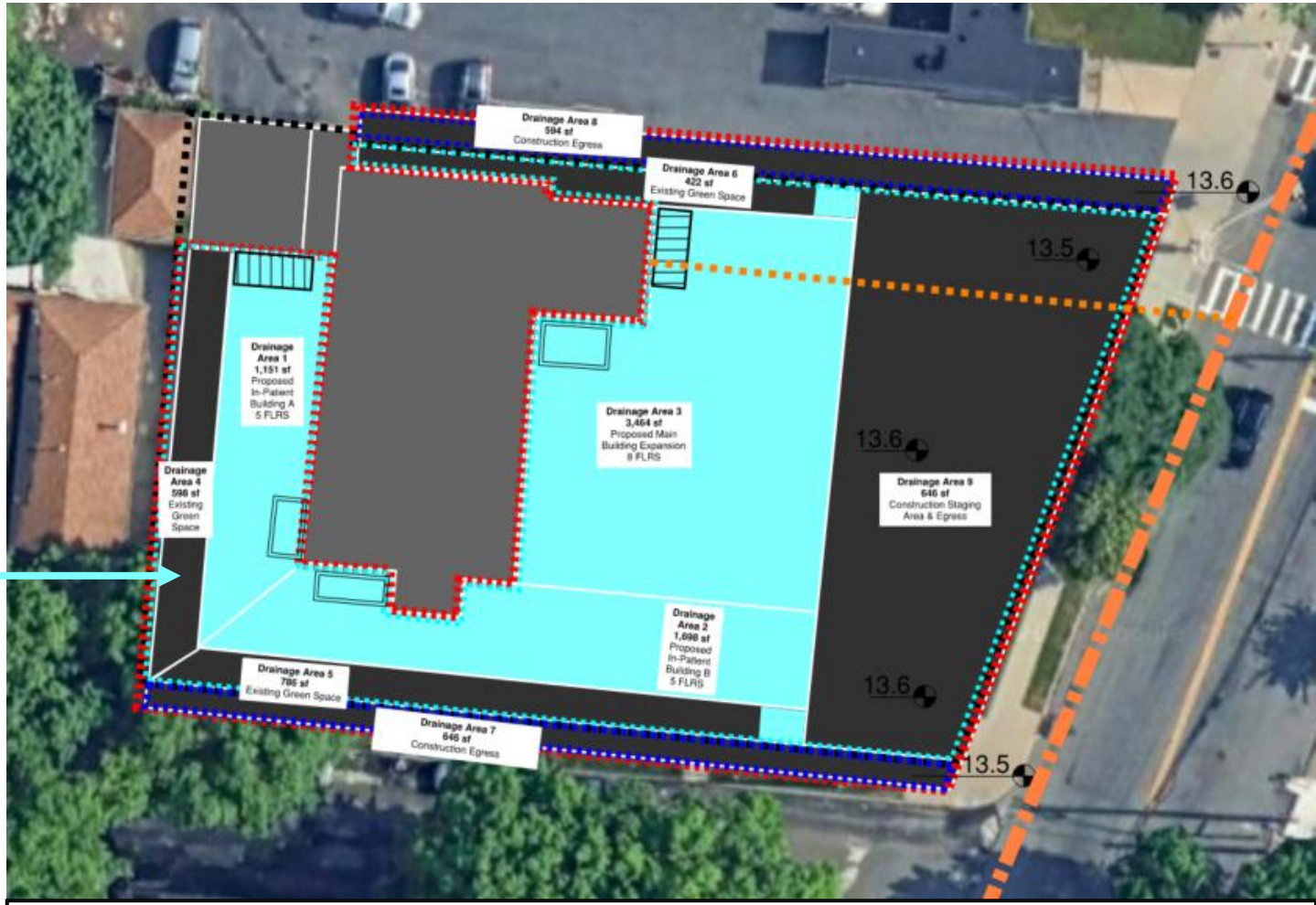
R_V: 0.05 + 0.009(I),

I: percent impervious cover

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Concept Map: *Site Contributing Area (Preliminary)*



WQ_V Step 2: Identify Site Contributing Area

The Contributing Area (A) includes all areas within the Limit of Disturbance that are listed in NYC SWM Table 2.3, as well as areas outside the Limit of Disturbance that drain to those areas.

$$A_{Site} = 6{,}408\ sf$$

LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Establishing the Contributing Area

Considerations:

- Areas disturbed for construction support that are restored to pervious conditions and do not drain to developed areas are typically not included in the site Contributing Area (A), except in cases where DEP determines that these areas pose significant pollution risks
- Areas disturbed by activities listed in NYC SWM Table 2.2 must be included in the site Contributing Area (A) if they drain to portions of the site that have development activities listed in NYC SWM Table 2.3.
- Areas outside the Limit of Disturbance or Property Line that drain to portions of the site that have development activities listed in NYC SWM Table 2.3 must be included in the site Contributing Area (A).

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

WQ_V Step 3: Calculate Runoff Coefficient

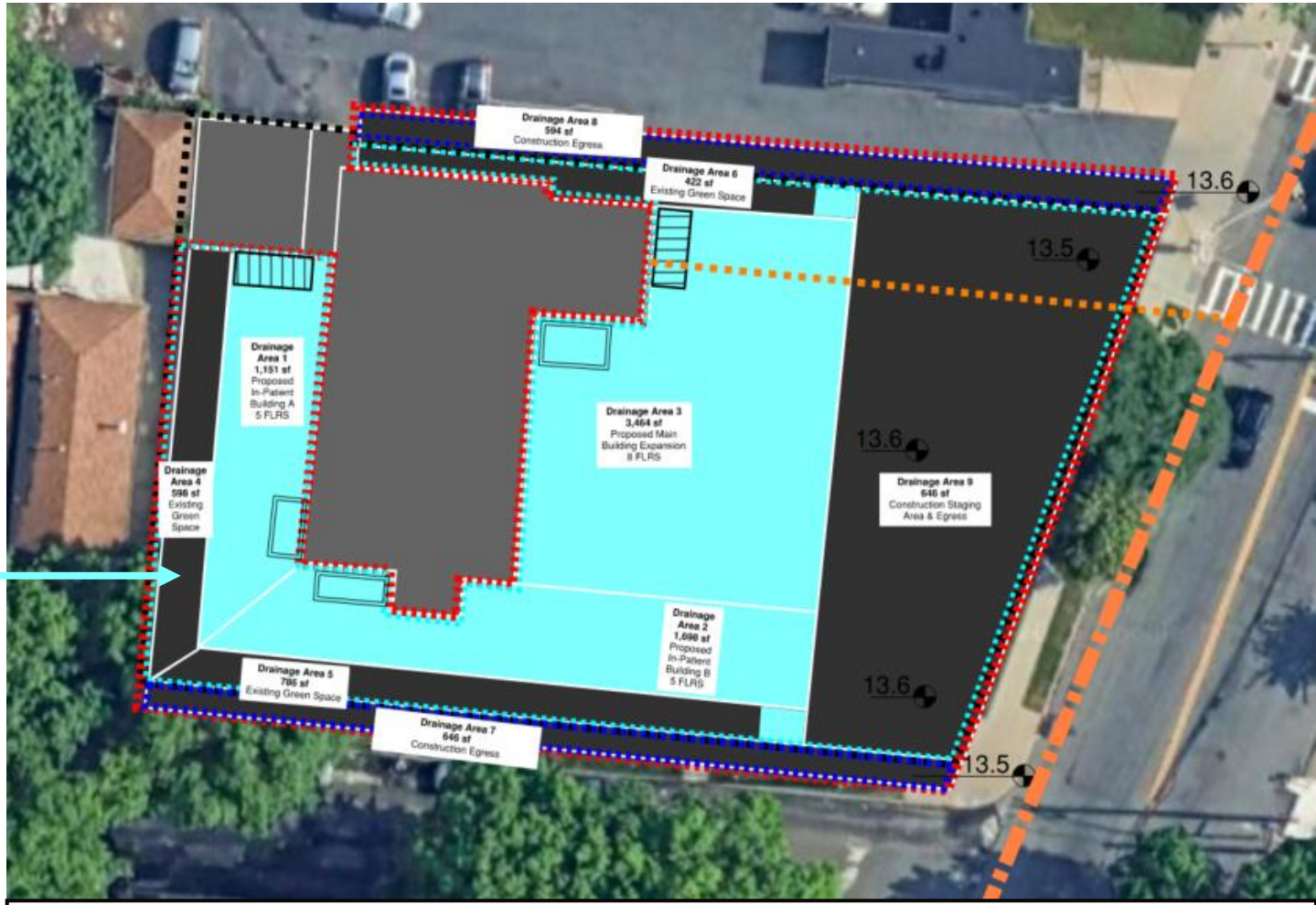
This coefficient relates the total rainfall to runoff on the project site and is based on the percent impervious cover (I) in the proposed condition.

$$R_V = 0.05 + 0.009(I)$$

$$I = 100\%$$

$$R_V = 0.05 + 0.009(100) = 0.95$$

Concept Map: *Site Contributing Area (Preliminary)*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD

SMP Design

What are the site-wide WQ_V and RR_V?

WQ_V Step 4: Complete Site-Wide Calculation

Use NYC SWM Eq. 2.1 to calculate WQ_V

$$WQ_V = \frac{1.5"}{12} * A * R_V$$

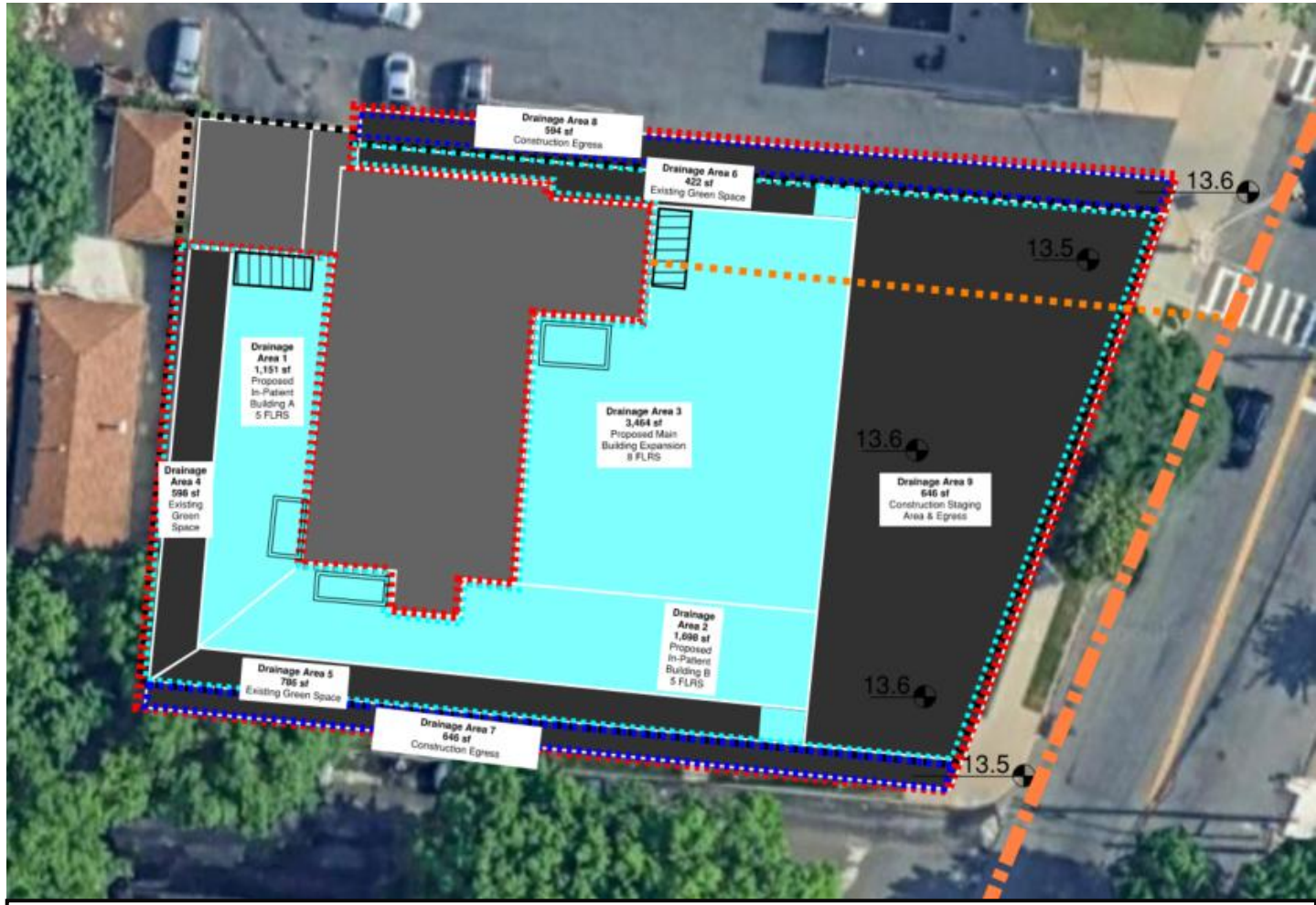
$$A_{Site} = 6{,}408\ sf$$

$$R_{V,Site} = 0.05 + 0.009(100) = 0.95$$

$$WQ_{V,Site} = \frac{1.5"}{12} * 6{,}408 * 0.95$$

$$\boldsymbol{WQ_{V,Site} = 761\ cf}$$

Concept Map: *Site Contributing Area (Preliminary)*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Calculating Site WQv:

- **Step 1:** Identify Equation
- **Step 2:** Identify Site Contributing Area
- **Step 3:** Calculate Runoff Coefficient
- **Step 4:** Complete Site-Wide Calculation

$$WQ_{V,Site} = 761\ cf$$

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Calculating Target RR_V and Minimum RR_V:

- **Step 1:** Establish Target RR_V
- **Step 2:** Identify Minimum RR_V Equation
- **Step 3:** Establish New Impervious Area Proposed
- **Step 4:** Calculate the Specific Reduction Factor
- **Step 5:** Complete Site-Wide Minimum RR_V Calculation

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 1: Establish Target RR_V

15 RCNY Chapter 19.1 requires the use of vegetated retention practices to the maximum extent practicable. Therefore, projects should always aim to reduce the entire WQ_V using Tier 1 practices.

Target RR_V is met when the site WQ_V is managed using Tier 1 and Tier 2 practices.

$$\boldsymbol{Target\ RR_V = WQ_{V,Site} = 761\ cf}$$

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 2: Identify Minimum RR_V Equation

Use NYC SWM Eq. 2.2 to calculate Minimum RR_V

Minimum RR_V must be met for all projects, without exception.

Meeting Minimum RR_V does not exempt projects from having to demonstrate that they have met Target RR_V to the maximum extent practicable.

EQ 2.2

$$^{*}RR_V = \frac{1.5"}{12} * 0.95 * Aic * S$$

$^{*}\ Min$

where:

Aic: total area of new impervious cover (sf)

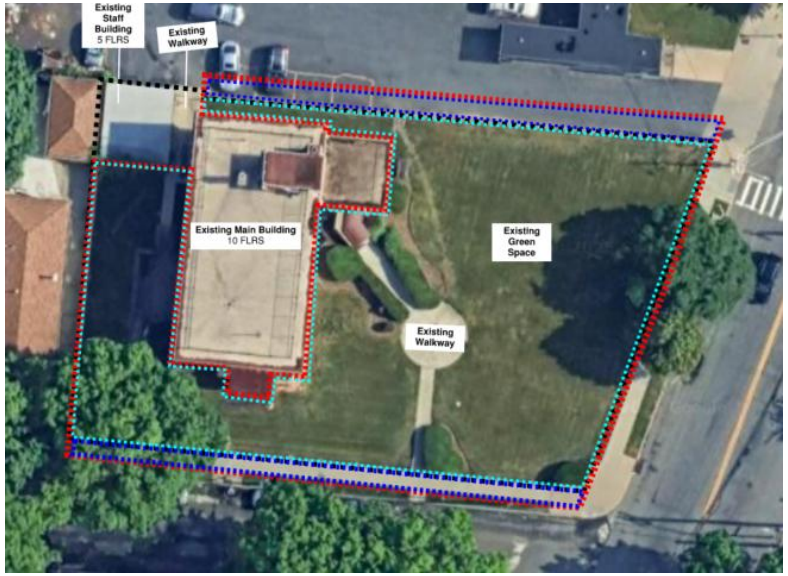
S: specific reduction factor, see Table 2.5

Tier 1 & 2 SMP Design

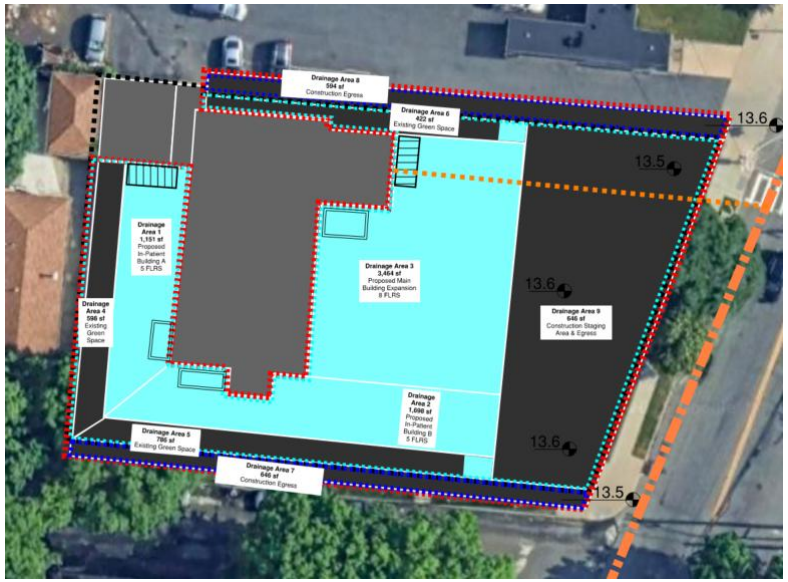
What are the site-wide WQ_V and RR_V?

RR_V Step 3: Establish New Impervious Area Proposed

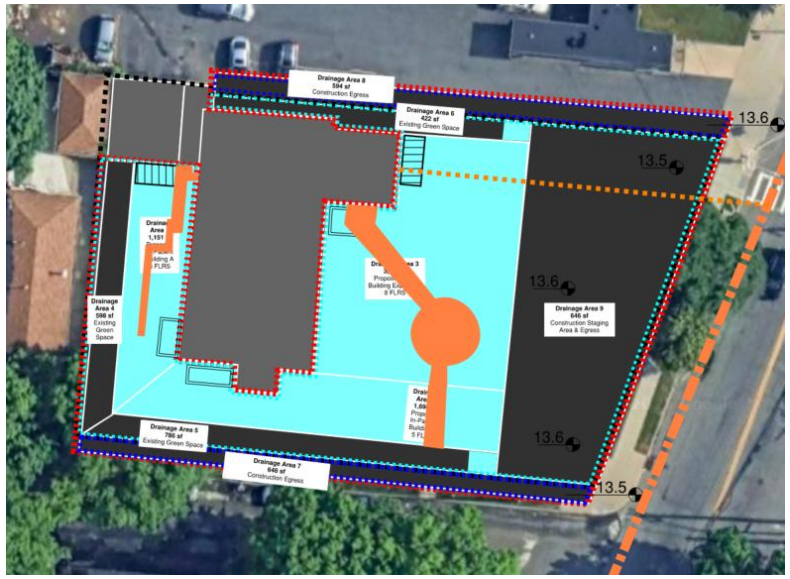
Compare pre- and post-development site plans to determine how much new impervious area is proposed in the developed area.



Concept Map: *Existing Site*



Concept Map: *Site Contributing Area (Preliminary)*



Concept Map: *Site Contributing Area & Existing Impervious Area*

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 3: Establish New Impervious Area Proposed

Compare pre- and post-development site plans to determine how much new impervious area is proposed in the developed area.

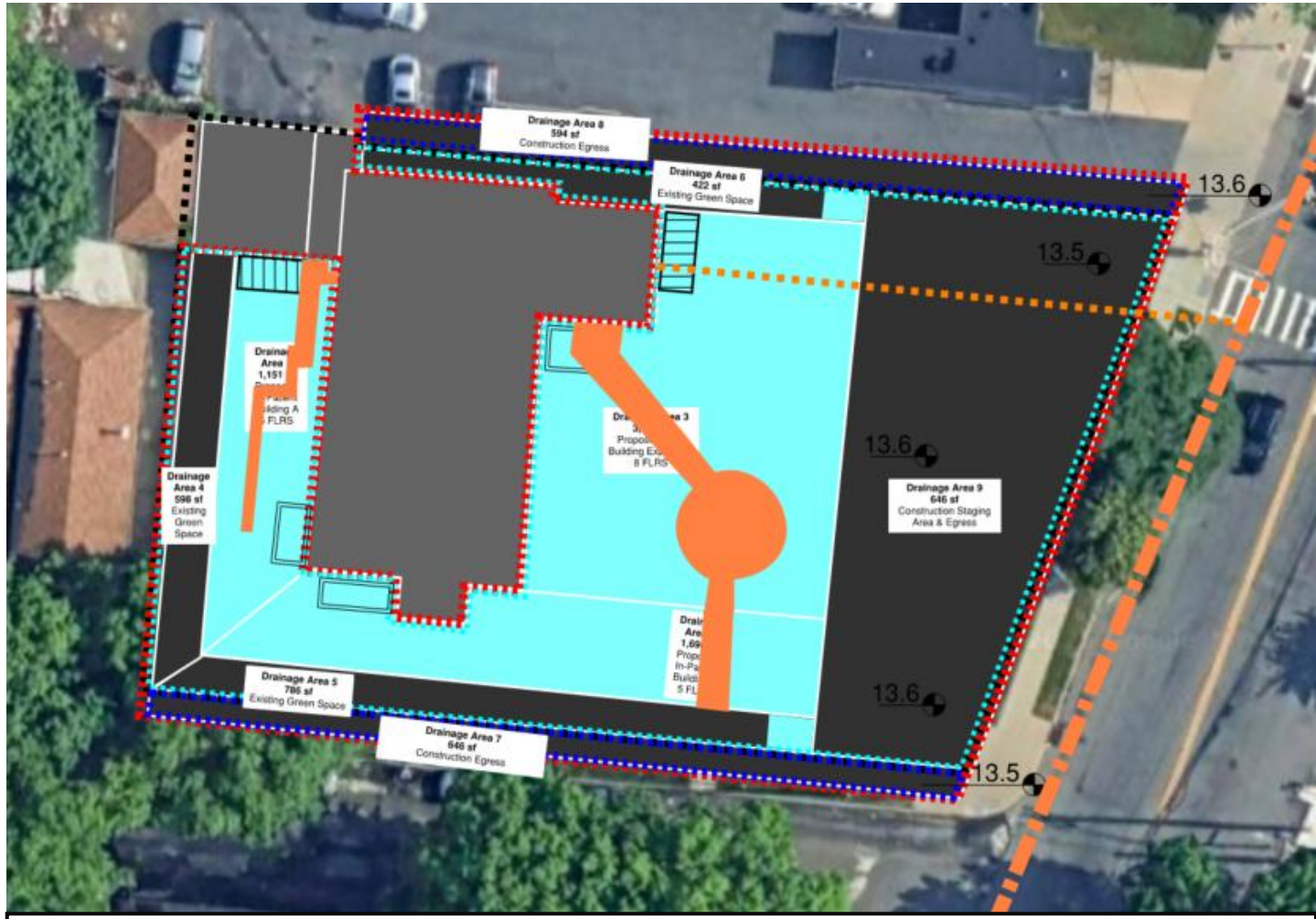
$$A_{Site} = 6{,}408\ sf$$

$$Aic_{Existing} = 747\ sf$$

$$Aic = 6{,}408 - 747 = 5{,}661\ sf$$

$$\boldsymbol{Aic = 5{,}661\ sf}$$

Concept Map: *Site Contributing Area & Existing Impervious Area*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD
- Existing Impervious in Contributing Area: *747 sf*

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 4: Calculate the Specific Reduction Factor

This value depends on the soils on the project site and can be calculated as follows:

- *Establish Hydrologic Soil Groups (HSG) on the project site.*

Hydrologic Soil Group and Surface Runoff–Queens County, New York			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
UFA—Urban land-Flatbush complex, 0 to 3 percent slopes			
Urban land, outwash substratum	75	Very high	—
Flatbush	12	Low	B
Greenbelt	5	Low	B
Riverhead	3	Very low	A
Bigapple, non-dredge material	2	Very low	A
Centralpark	1	Very low	A
Laguardia	1	Low	C
North meadow, outwash substratum	1	Low	C

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Queens County, New York

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Establishing Hydrologic Soil Groups

Considerations:

- Projects may use their own geotechnical tests or the USGS Web Soil Survey Map to establish HSG on their site.
- Unranked soils should be classified per the USDA NRCS Part 630 National Engineering Handbook Ch. 7. Otherwise, the soil should assume the properties of HSG-A for the Minimum RR_V requirement.

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 4: Calculate the Specific Reduction Factor

This value depends on the soils on the project site and can be calculated as follows:

- *Establish Hydrologic Soil Groups (HSG) on the project site.*
- *Refer to NYC SWM Table 2.5 to identify reduction factors for each HSG*

Table 2.5. Specific reduction factors based on hydrologic soil group (HSG).

S	Description
0.55	HSG-A
0.40	HSG-B
0.30	HSG-C
0.20	HSG-D

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 4: Calculate the Specific Reduction Factor

This value depends on the soils on the project site and can be calculated as follows:

- *Establish Hydrologic Soil Groups (HSG) on the project site.*
- *Refer to NYC SWM Table 2.5 to identify reduction factors for each HSG.*
- *Calculate the Specific Reduction Factor based on findings.*

HSG	Reduction Factor	% of Map Unit (NRCS WSS Report)	Specific Reduction Factors
HSG-A	0.55	81%	0.446
HSG-B	0.40	17%	0.068
HSG-C	0.30	2%	0.006
HSG-D	0.20	0%	0
Specific Reduction Factor S			**0.52**

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

RR_V Step 5: Calculate Site-Wide Minimum RR_V Calculation

Use NYC SWM Eq. 2.2 to calculate Minimum RR_V

$$Min\ RR_V = \frac{1.5"}{12} * 0.95 * Aic * S$$

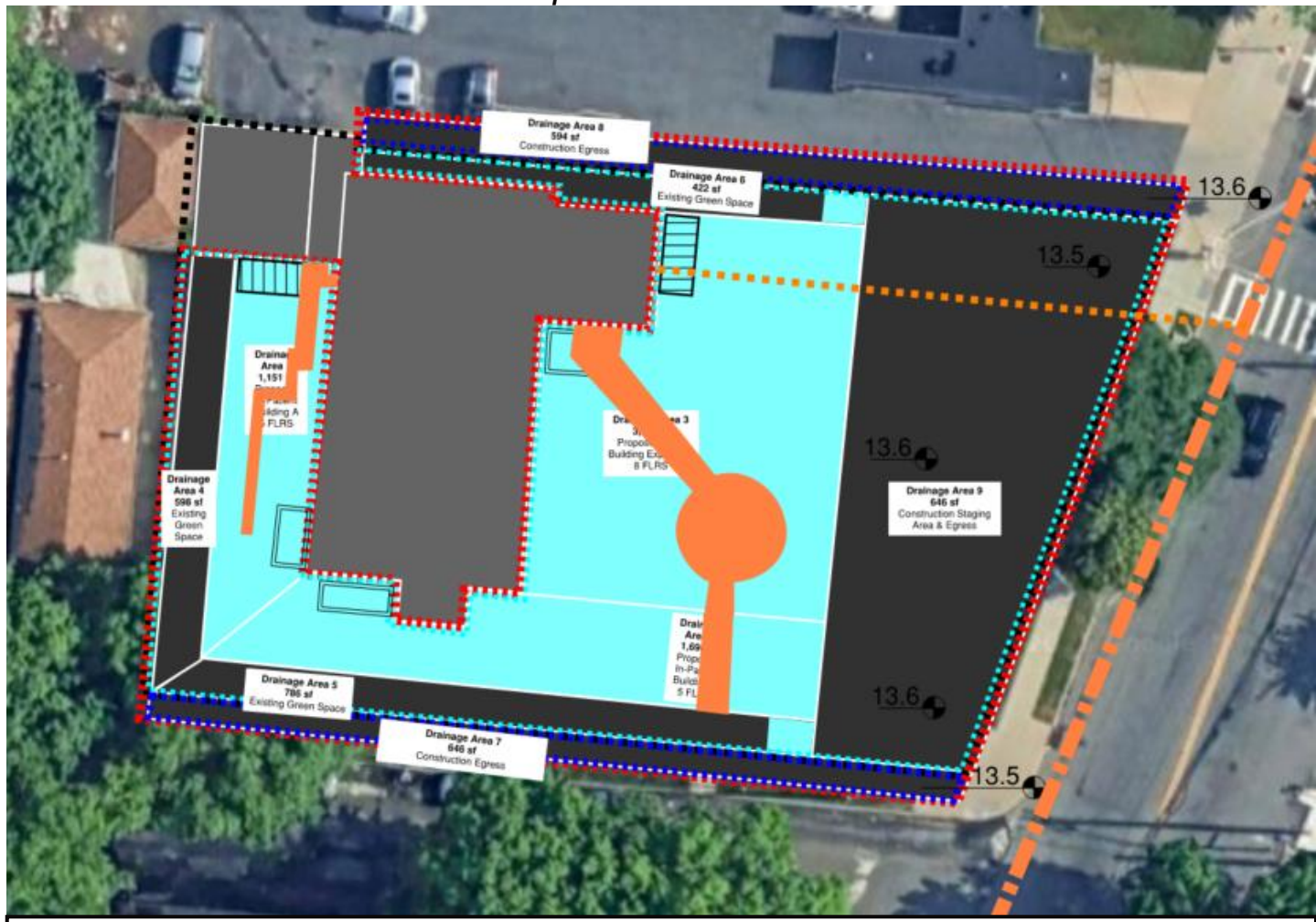
$$Aic = 5{,}661\ sf$$

$$S = 0.52$$

$$Min\ RR_V = \frac{1.5"}{12} * 0.95 * 5{,}661 * 0.52$$

$$\boldsymbol{Min\ RR_V = 350\ cf}$$

Conceptual Preliminary Site Contributing Area Plan with Existing Impervious Areas



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD
- Existing Impervious in Contributing Area: *747 sf*

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Calculating Site WQv:

- **Step 1:** Identify Equation
- **Step 2:** Identify Site Contributing Area
- **Step 3:** Calculate Runoff Coefficient
- **Step 4:** Complete Site-Wide Calculation

Calculating Target RR_V and Minimum RR_V:

- **Step 1:** Establish Target RR_V
- **Step 2:** Identify Minimum RR_V Equation
- **Step 3:** Establish New Impervious Area Proposed
- **Step 4:** Calculate the Specific Reduction Factor
- **Step 5:** Complete Site-Wide Minimum RR_V Calculation

$$WQ_{V,Site} = 761\ cf$$

$$Target\ RR_V = 761\ cf$$

$$Min\ RR_V = 350\ cf$$

Tier 1 & 2 SMP Design

Practice-Based Requirements

In addition to Site-Wide Requirements, Designers must calculate the practice-based WQ_V for each SMP using the *practice* contributing area.

SMP design consists of establishing:

- ✓ **Required $WQ_{V,SMP}$**
  This is the volumetric requirement that each SMP must meet, based on its contributing area.
- ✓ **V_{SMP}**
  This is the storage volume that the SMP is designed to provide.
- ✓ **Provided WQ_V, RR_V, V_V**
  These are the contributions that the SMP makes to each requirement, based on its V_{SMP} and function.

Tier 1 & 2 SMP Design

What are the Tier 1 SMP design requirements?

SMPs Design Steps:

- **Step 1:** Review Drainage Areas & Constraints
- **Step 2:** Site SMP Footprint
- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$
- **Step 7:** Check SMP Contributions to Site-Wide Requirements

Iterate process until all requirements are met

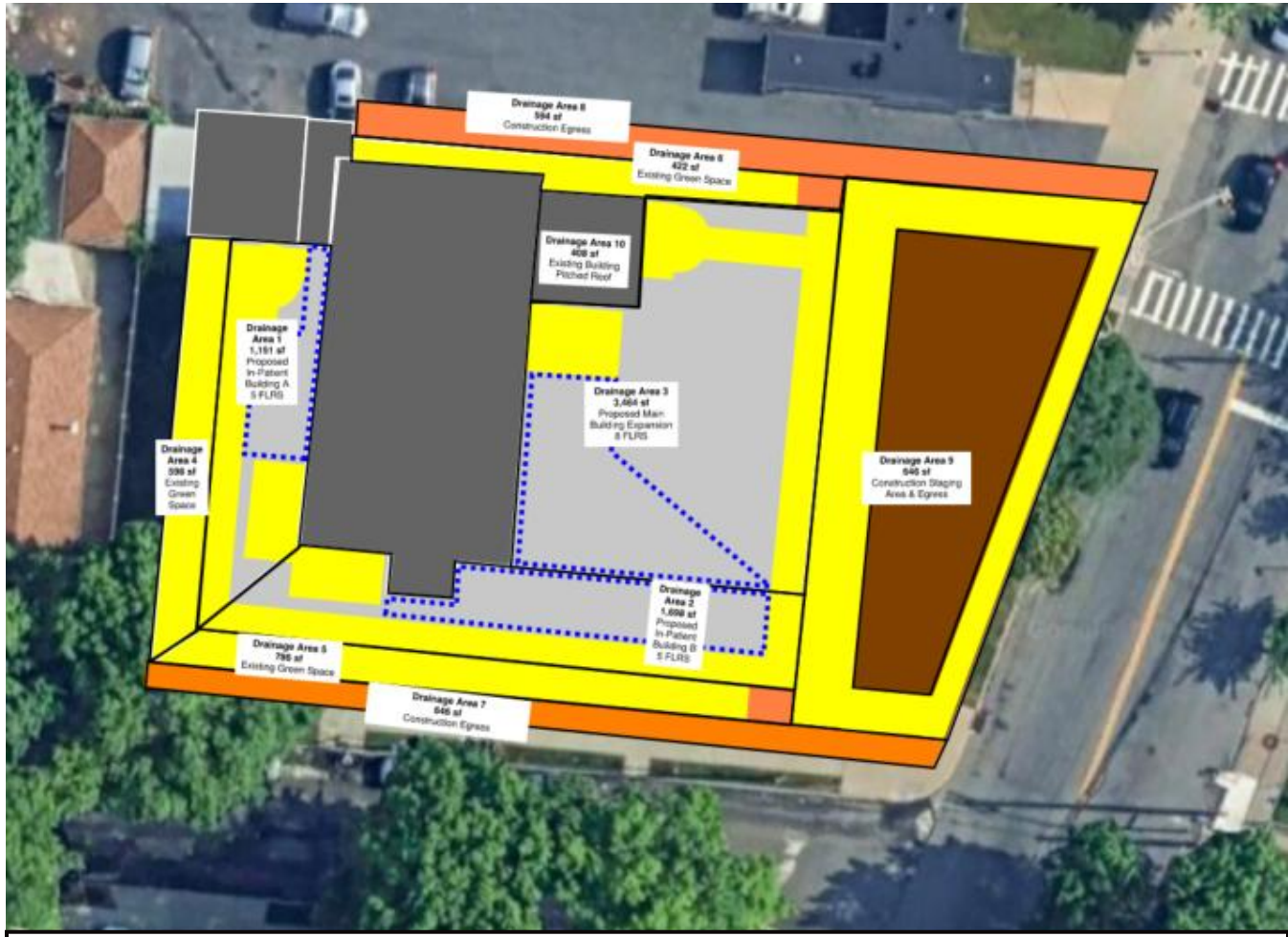
Tier 1 & 2 SMP Design

What are the Tier 1 SMP WQ_V requirements?

SMP Step 1: Review Drainage Areas & Constraints

Constraints may be limited to one portion of the site. It is helpful to evaluate constraints within individual, non-overlapping drainage areas to site SMPs.

Concept Map: *Constraints and Drainage Area Delineation*



LEGEND

- Existing Structures
- Proposed Structures Roof Area
- Surface Constraints
- Space Constraints
- Soil Constraint
- Sustainable Roofing Zone
- Drainage Area Delineation

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 2: Site SMP Footprint

Site Tier 1 practices on unconstrained areas to the maximum extent practicable, based on site constraints.

Notes:

- The sustainable roofing zone definition allows the exclusion of recreational spaces that are integral to the principal use of the building. However, they are not considered a constraints under 15 RCNY Chapter 19.1.
- Meeting the stormwater management requirements outlined in 15 RCNY Chapter 19.1 takes precedence over Local Laws 92/94.

SMP ID	SMP Footprint (sf)
GR-1	371
GR-2	643
GR-3	891

Concept Map: *Proposed Tier 1 SMPs (Preliminary)*

Tier 1 & 2 SMP Design

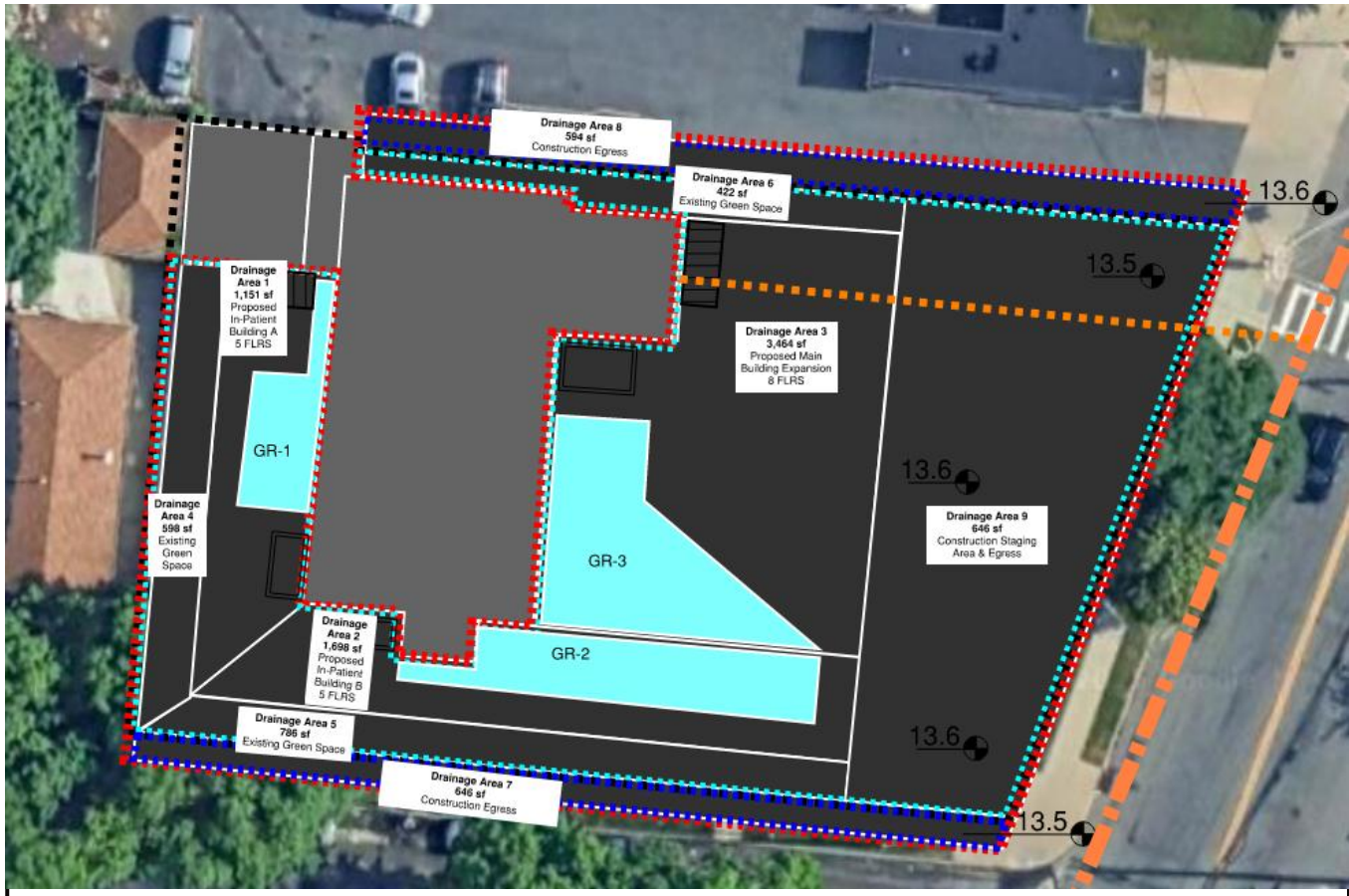
What are the Tier 1 SMP requirements?

SMP Step 3: Determine SMP Contributing Area

Refer to NYC SWM Design Table 4.3 to identify any limits to SMP loading ratio or contributing area for ET SMPs.

SMP ID	SMP Footprint (sf)	SMP Contributing Area, A (sf)
GR-1	371	371
GR-2	643	643
GR-3	891	891

Concept Map: *Green Roof Contributing Areas (Preliminary)*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- SMP Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD

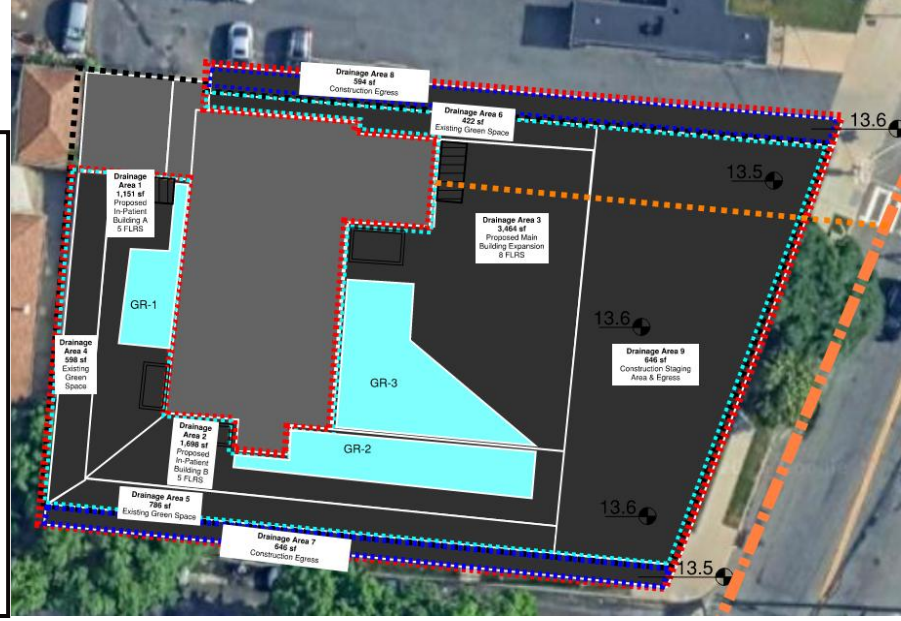
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Green Roof Contributing Areas (Preliminary)*

LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD



SMP Step 4: Determine Runoff Coefficient of SMP Contributing Area

This coefficient relates the total rainfall to runoff on the project site and is based on the percent impervious cover (I) in the proposed condition.

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Contributing Area, A (sf)	Percent Impervious Cover, I (%)	Runoff Coefficient, R_V (-)
GR-1	371	371	100	0.95
GR-2	643	643	100	0.95
GR-3	891	891	100	0.95

Note: When calculating WQ_V for a vegetated SMP, the SMP footprint should be considered 100% impervious in order for the practice to manage itself.

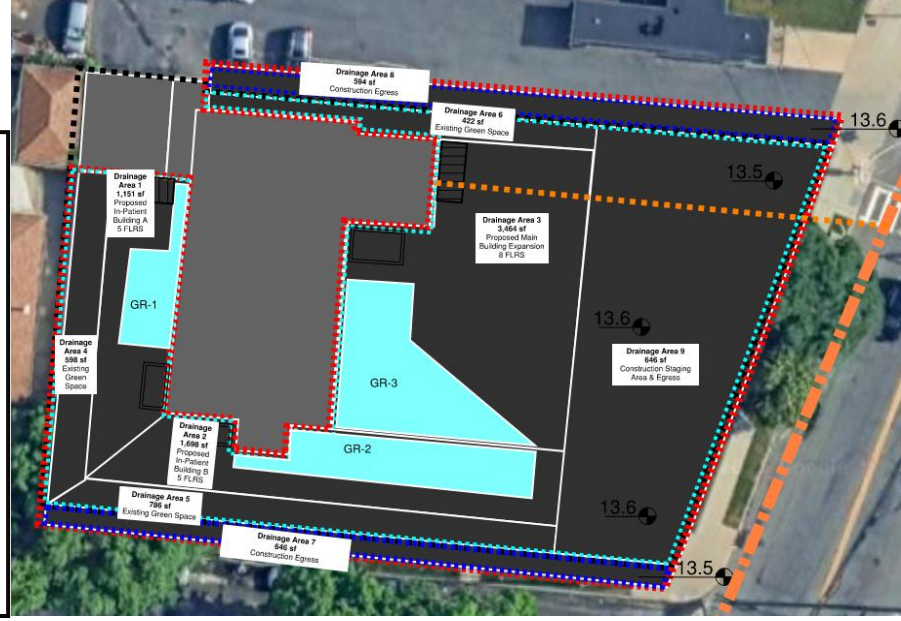
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Green Roof Contributing Areas (Preliminary)*

LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total $WQ_{V,SMP}$ is based on the entire contributing area to a practice*

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Contributing Area, A (sf)	Percent Impervious Cover, I (%)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)
GR-1	371	371	100	0.95	44
GR-2	643	643	100	0.95	76
GR-3	891	891	100	0.95	106

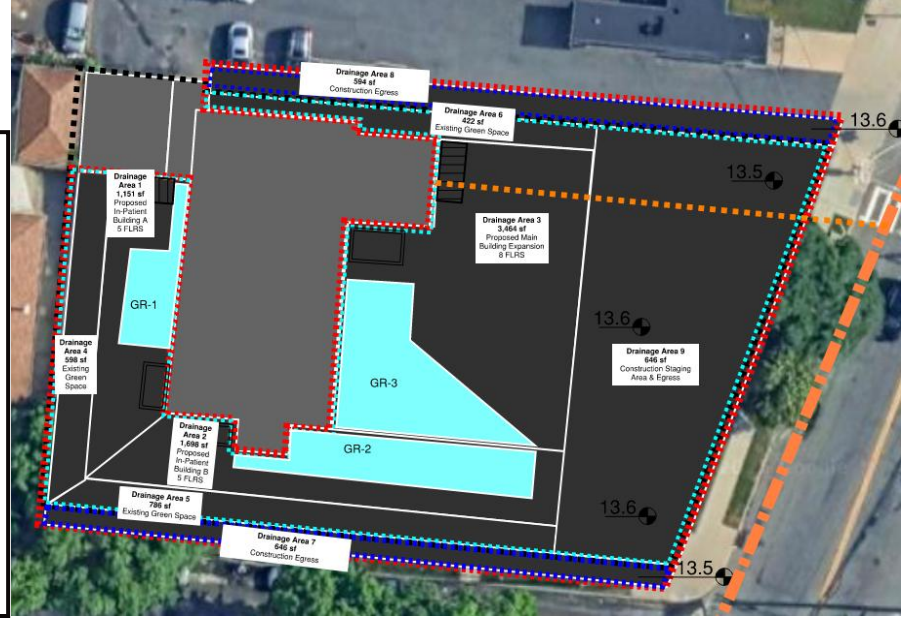
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Green Roof Contributing Areas (Preliminary)*

LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total* $WQ_{V,SMP}$ *is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total* $WQ_{V,SMP}$ *to establish the practice's Required* $WQ_{V,SMP}$

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Contributing Area, A (sf)	Percent Impervious Cover, I (%)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)	Volume Managed by Upstream SMPs	Required $WQ_{V,SMP}$ (cf)
GR-1	371	371	100	0.95	44	-	44
GR-2	643	643	100	0.95	76	-	76
GR-3	891	891	100	0.95	106	-	106

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

EQ 4.1

$$V_{SMP} = V_P + V_S + V_I + V_D$$

where:

V_{SMP} = storage volume of SMP (cf)

V_P = volume of surface ponding (cf)

V_S = volume of voids in the soil media layer (cf)

V_I = volume of voids created by internal structures such as chambers or pipes (cf)

V_D = volume of voids in the drainage media (cf)

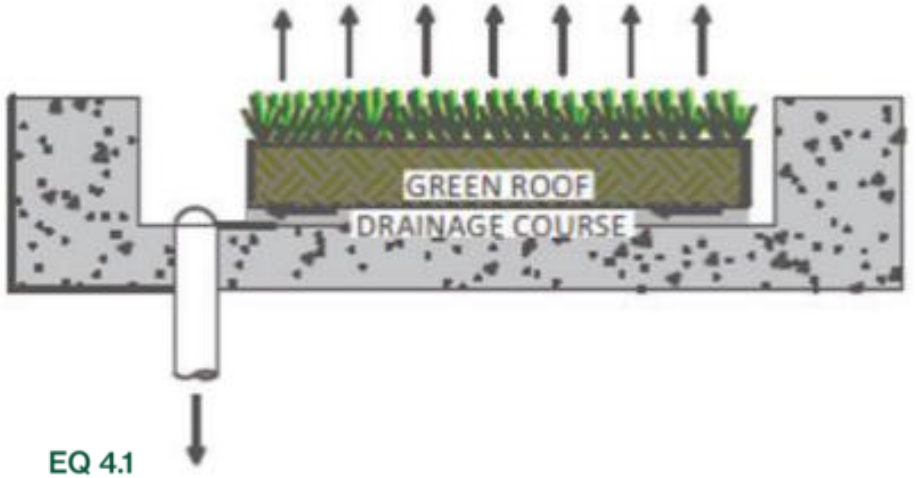
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

- *Determine Applicable Volume Parameters for each SMP type*



EQ 4.1

$$V_{SMP} = V_P + V_S + V_I + V_D$$

where:

V_{SMP} = storage volume of SMP (cf)

V_P = volume of surface ponding (cf)

V_S = volume of voids in the soil media layer (cf)

V_I = volume of voids created by internal structures such as chambers or pipes (cf)

V_D = volume of voids in the drainage media (cf)

$$\boldsymbol{V_{SMP,GR} = V_{S,GR}}$$

- V_P is not applicable → GR cannot pond
- V_S is applicable
- V_I is not applicable → GR do not have internal storage structures
- V_D is not applicable → GR drainage media cannot store water

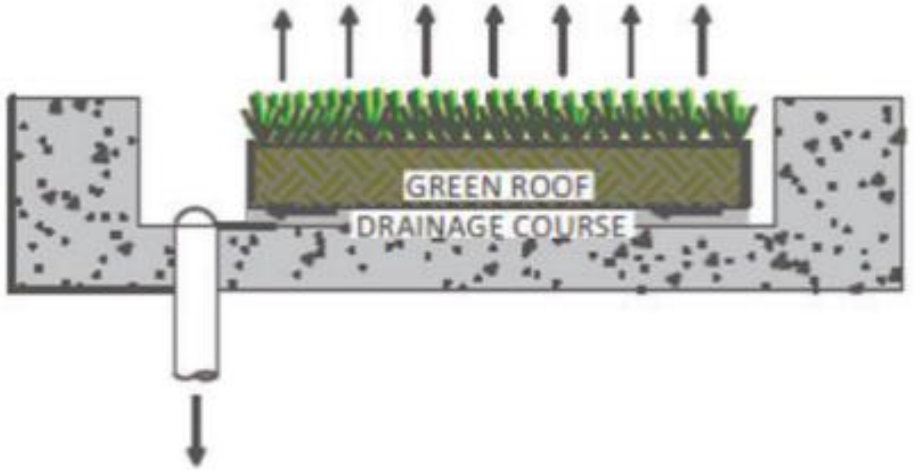
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

- *Determine Applicable Volume Parameters for each SMP type*
- *Refer to the appropriate equations in NYC SWM Section 4.2 to calculate the storage volume provided by each applicable parameter*



EQ 4.4

$$V_S = A_{SMP} * D_S * n_S$$

where:

V_S = volume of voids in the soil media layer (cf)

A_{SMP} = area of the SMP (sf)

D_S = depth of soil media layer (ft)

n_S = available porosity of soil media (cf/cf)

$$\boldsymbol{V_{SMP,GR} = V_{S,GR} = A_{SMP} * D_S * n_S}$$

Tier 1 & 2 SMP Design

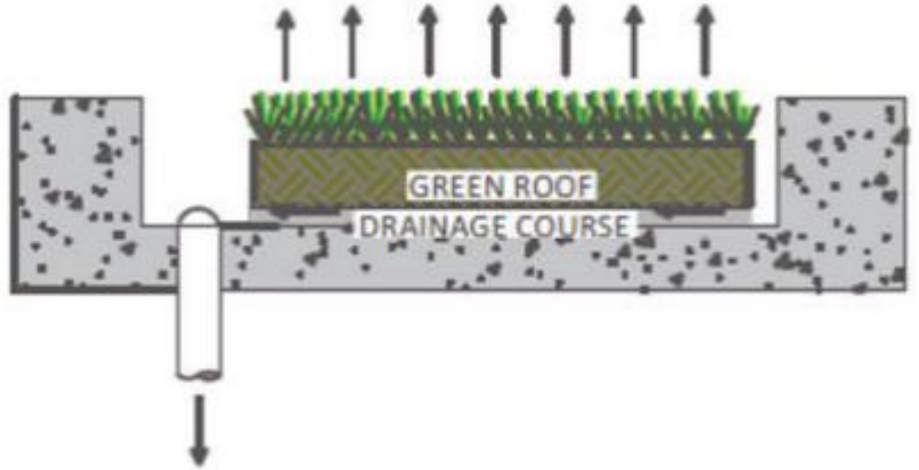
What are the Tier 1 SMP requirements?

SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

- *Determine Applicable Volume Parameters for each SMP type*
- *Refer to the appropriate equations in NYC SWM Section 4.2 to calculate the storage volume provided by each applicable parameter*
- *Refer to NYC SWM Design Table 4.3 to identify design requirements for ET SMPs and complete design calculation.*

SMP ID	A_{SMP} (sf)	D_S (in)	n_S (cf/cf)	$V_S = V_{SMP}$ (cf)
GR-1	371	8	0.2	45
GR-2	643	8	0.2	78
GR-3	891	8	0.2	108



EQ 4.4

$$V_S = A_{SMP} * D_S * n_S$$

where:

V_S = volume of voids in the soil media layer (cf)

A_{SMP} = area of the SMP (sf)

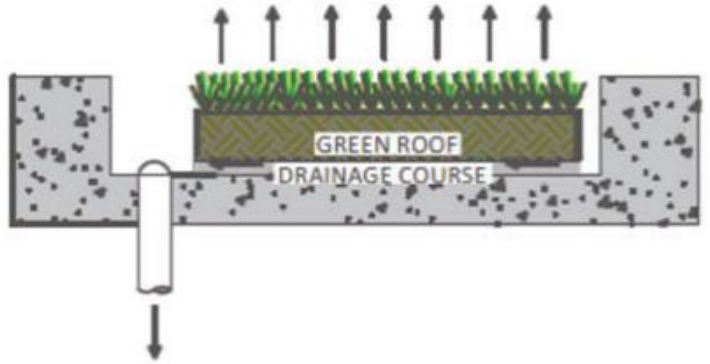
D_S = depth of soil media layer (ft)

n_S = available porosity of soil media (cf/cf)

$$V_{SMP,GR} = V_{S,GR} = A_{SMP} * D_S * n_S$$

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?



SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

- *Determine Applicable Volume Parameters for each SMP type*
- *Refer to the appropriate equations in NYC SWM Section 4.2 to calculate the storage volume provided by each applicable parameter*
- *Refer to NYC SWM Design Table 4.3 to identify design requirements for ET SMPs and complete design calculation.*
- *Confirm that storage volume is sufficient to meet Required $WQ_{V,SMP}$*

$$V_{SMP,GR} = V_{S,GR} = A_{SMP} * D_S * n_S$$

V_S = Volume of voids in the soil media layer [cf]
A_{SMP} = Area of SMP [sf]
D_S = Depth of soil media layer [ft]
n_S = Available porosity of soil media [cf/cf]

SMP ID	A_{SMP} (sf)	D_S (in)	n_S (cf/cf)	$V_S = V_{SMP}$ (cf)		Required $WQ_{V,SMP}$ (cf)	
GR-1	371	8	0.2	45	≥	44	✓
GR-2	643	8	0.2	78	≥	76	✓
GR-3	891	8	0.2	108	≥	106	✓

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Green Roof Depth

Considerations:

- Green roof depth must be greater than 7.5 inches to manage its full water quality volume.
- Green roofs may be designed with smaller depths, but remaining unmanaged volume will need to be routed to downstream practices.

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 7: Check SMP Contributions to Site-Wide Requirements

Use NYC SWM Table 4.1 to determine the percent contributions of each SMP.

SMP ID	Required $WQ_{V,SMP}$ (cf)	V_{SMP} (cf)
GR-1	44	49
GR-2	76	86
GR-3	106	119

Table 4.1. Percent of SMP volume that may be applied to SW management criteria by SMP function.

	Percent of SMP Volume Applied to Requirement (F_A)		
SMP Function	WQv	RRv	Vv
Infiltration	100	100	100
Evapotranspiration	100	100	0
Reuse[A]	100	100	50
Filtration	100[B]	40[C]	0
Detention	100[D]	0	100

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 7: Check SMP Contributions to Site-Wide Requirements

Use NYC SWM Table 4.1 to determine the percent contributions of each SMP.

Table 4.1. Percent of SMP volume that may be applied to SW management criteria by SMP function.

SMP Function	Percent of SMP Volume Applied to Requirement (F_A) WQv	RRv	Vv
Infiltration	100	100	100
Evapotranspiration	100	100	0
Reuse[A]	100	100	50
Filtration	100[B]	40[C]	0
Detention	100[D]	0	100

SMP ID	Required $WQ_{V,SMP}$ (cf)	V_{SMP} (cf)	Provided WQ_V, (cf)	Provided RR_V (cf)	Provided V_V (cf)
GR-1	44	49	44	44	0
GR-2	76	86	76	76	0
GR-3	106	119	106	106	0

Note:

Oversizing an SMP will not increase the volume it receives from a 1.5-in rain event and therefore does not increase its contribution to the Provided WQ_V. Therefore, **when V_{SMP} > Required $WQ_{V,SMP}$, Provided $WQ_{V,SMP} = F_A$ x Required $WQ_{V,SMP}$**

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Table 4.1. Percent of SMP volume that may be applied to SW management criteria by SMP function.

SMP Function	Percent of SMP Volume Applied to Requirement (F_A) WQv	RRv	Vv
Infiltration	100	100	100
Evapotranspiration	100	100	0
Reuse[A]	100	100	50
Filtration	100[B]	40[C]	0
Detention	100[D]	0	100

SMP Step 7: Check SMP Contributions to Site-Wide Requirements

Use NYC SWM Table 4.1 to determine the percent contributions of each SMP.

SMP ID	Required $WQ_{V,SMP}$ (cf)	V_{SMP} (cf)	Provided WQ_V, (cf)	Provided RR_V (cf)	Provided V_V (cf)
GR-1	44	49	44	44	0
GR-2	76	86	76	76	0
GR-3	106	119	106	106	0

The sum of the volumes provided by each SMP should be greater than the site-wide requirements.

Site-Wide Parameters	WQ_V (cf)	RR_V (cf)	V_V (cf)
Total Volume Provided	226	226	0
Total Volume Required	761	350 (*Minimum*)	TBD*
Remaining Volume to be Managed	535	124	TBD*

*The sewer operations volume V_V requirements depends on the site cover types in the proposed conditions. Therefore, it must be calculated after Tier 1 and Tier surface SMPs have been sited.

Tier 1 & 2 SMP Design

What are the Tier 1 SMP design requirements?

SMPs Design Steps:

- **Step 1:** Review Drainage Areas & Constraints
- **Step 2:** Site SMP Footprint
- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$
- **Step 7:** Check SMP Contributions to Site-Wide Requirements

Iterate process until all requirements are met

✗ **Iteration 1:** Three Green Roofs proposed

Note:

Green roofs alone will never meet site-wide WQv requirements because:

1. Their contributing area is always equal to their footprint
2. Roof constraints will always prevent a green roof footprint from covering the full roof area

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Meeting Minimum RRv

Considerations:

- There are no exceptions to meeting Minimum RRv.
- Recreational areas excluded in the Sustainable Roofing Zone may still be feasible for stormwater management requirements.
- To meet Minimum RRv, project must include enough retention practice either on the rooftop or at grade.

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMPs Tier 1 & 2 Design Steps:

- **Step 1:** Review Drainage Areas & Constraints
- **Step 2:** Site SMP Footprint
- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$
- **Step 7:** Check SMP Contributions to Site-Wide Requirements

Iterate process until all requirements are met

✗ **Iteration 1:** Three Green Roofs proposed

- **Iteration 2:** Four Green Roofs and Two Stormwater Planters proposed
  ⇨ *Contributing Area Expanded*

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 1: Review Drainage Areas & Constraints

Constraints may be limited to one portion of the site. It is helpful to evaluate constraints within individual, non-overlapping drainage areas to site SMPs.

Concept Map: *Constraints and Drainage Area Delineation*

Tier 1 & 2 SMP Design

Where Can I Site Tier 1 SMPs?

Concept Map: *Tier 1 SMP Feasibility*

SMP Step 1: Review Drainage Areas & Constraints

Constraints may be limited to one portion of the site. It is helpful to evaluate constraints within individual, non-overlapping drainage areas to site SMPs.

Tier 1 & 2 SMP Design

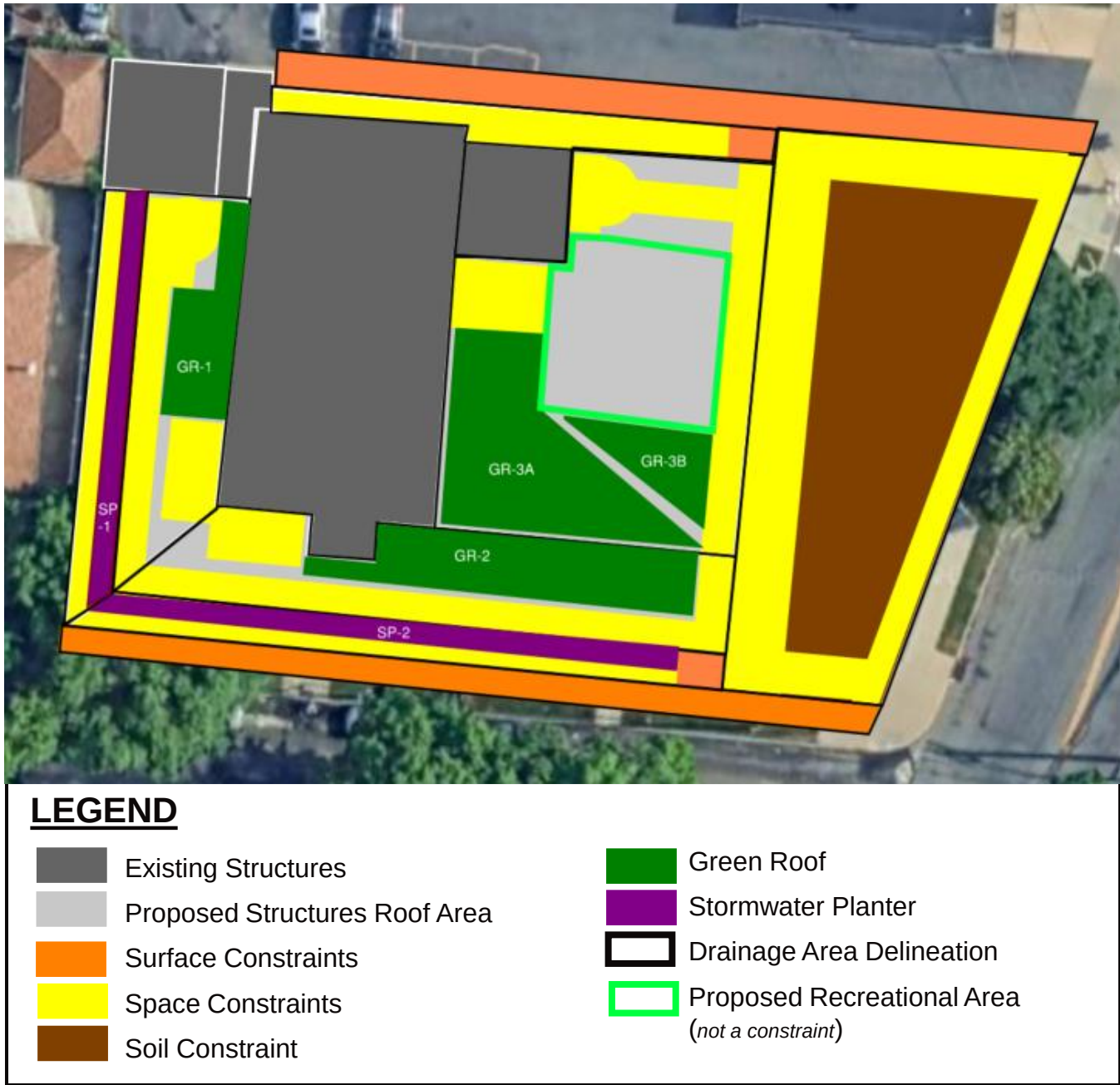
What are the Tier 1 SMP requirements?

SMP Step 2: Site SMP Footprint

Site Tier 1 practices on unconstrained areas to the maximum extent practicable, based on site constraints.

SMP ID	SMP Footprint (sf)
GR-1	371
GR-2	643
GR-3A	891
GR-3B	223
SP-1	371
SP-2	643

Concept Map: *Proposed Tier 1 SMPs (Preliminary)*



Return to Previous Section

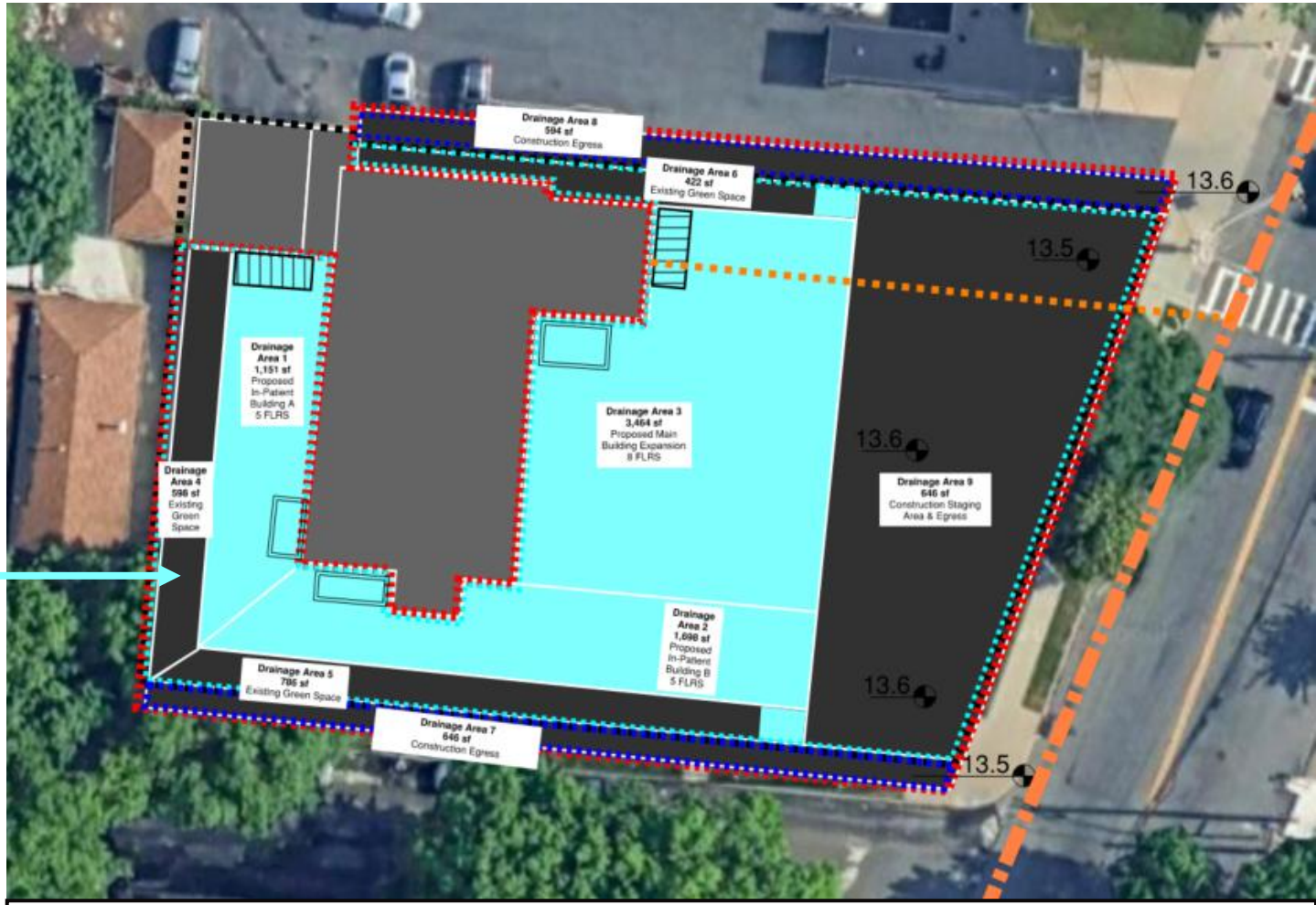
Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

In **WQ_V Step 2**, the Contributing Area (A) was defined as areas within the Limit of Disturbance that are listed in NYC SWM Table 2.3, as well as areas outside the Limit of Disturbance that drain to those areas.

$$A_{Site} = 6{,}408\ sf$$

Concept Map: *Site Contributing Area (Preliminary)*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Contributing Area in LOD: *6,408 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD

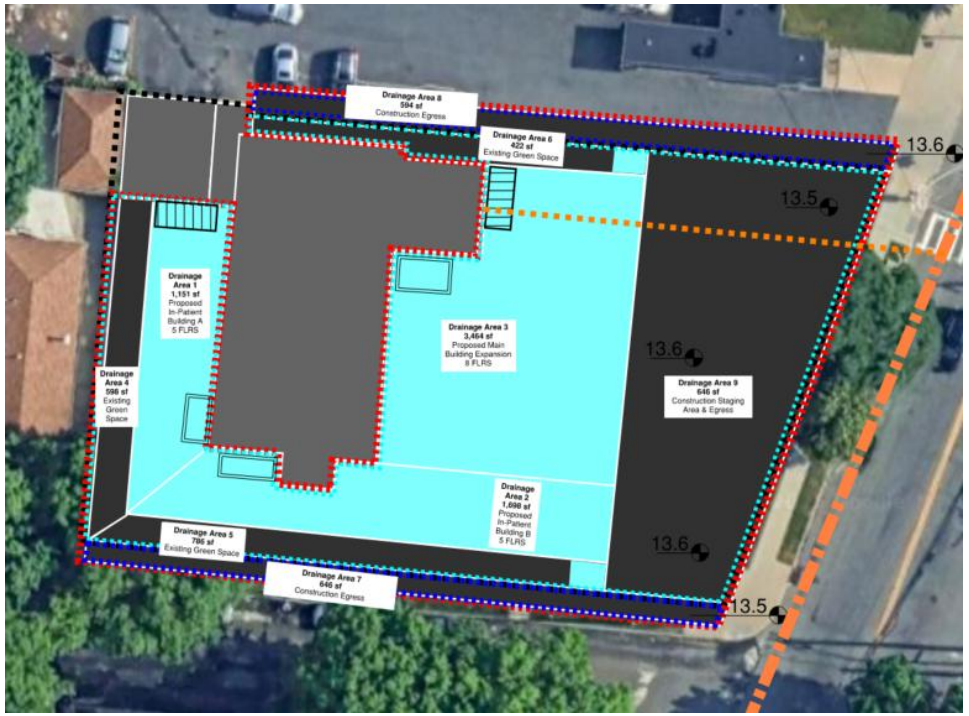
Return to Previous Section

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

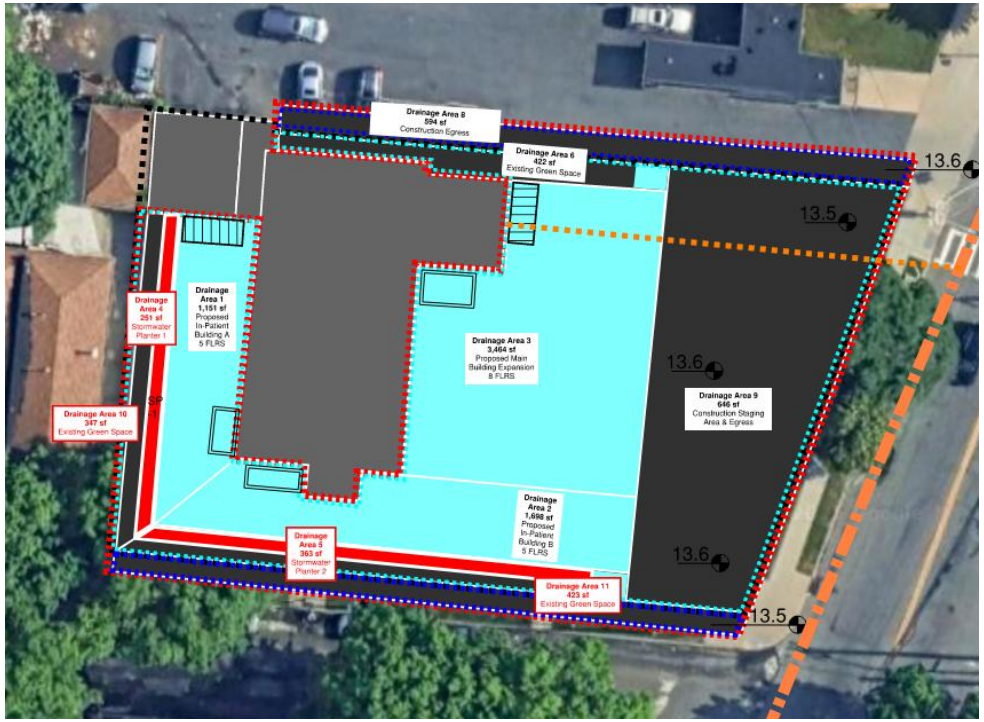
The addition of the two planters at grate expanded the site contributing area (A).

WQ_V and RR_V must be re-calculated.



Concept Map: *Site Contributing Area (Preliminary)*

~~$A_{Site} = 6{,}408\ sf$~~



Concept Map: *Site Contributing Area (Updated)*

$A_{Site} = 7{,}022\ sf$

Return to Previous Section

Tier 1 & 2 SMP Design

What are the site-wide WQ_V and RR_V?

Design steps below were completed but are not shown in detail.

Calculating Site WQv:

- **Step 1:** Identify Equation
- **Step 2:** Identify Site Contributing Area
- **Step 3:** Calculate Runoff Coefficient
- **Step 4:** Complete Site-Wide Calculation

Calculating Target RR_V and Minimum RR_V:

- **Step 1:** Establish Target RR_V
- **Step 2:** Identify Minimum RR_V Equation
- **Step 3:** Establish New Impervious Area Proposed
- **Step 4:** Calculate the Specific Reduction Factor
- **Step 5:** Complete Site-Wide Minimum RR_V Calculation

$$WQ_{V,Site} = 834\ cf$$

$$Target\ RR_V = 834\ cf$$

$$Min\ RR_V = 350\ cf^{*}$$

*The Minimum RR_V requirement does not increase because the stormwater planters (pervious surface) are proposed on an existing pervious surface.

Return to Previous Section

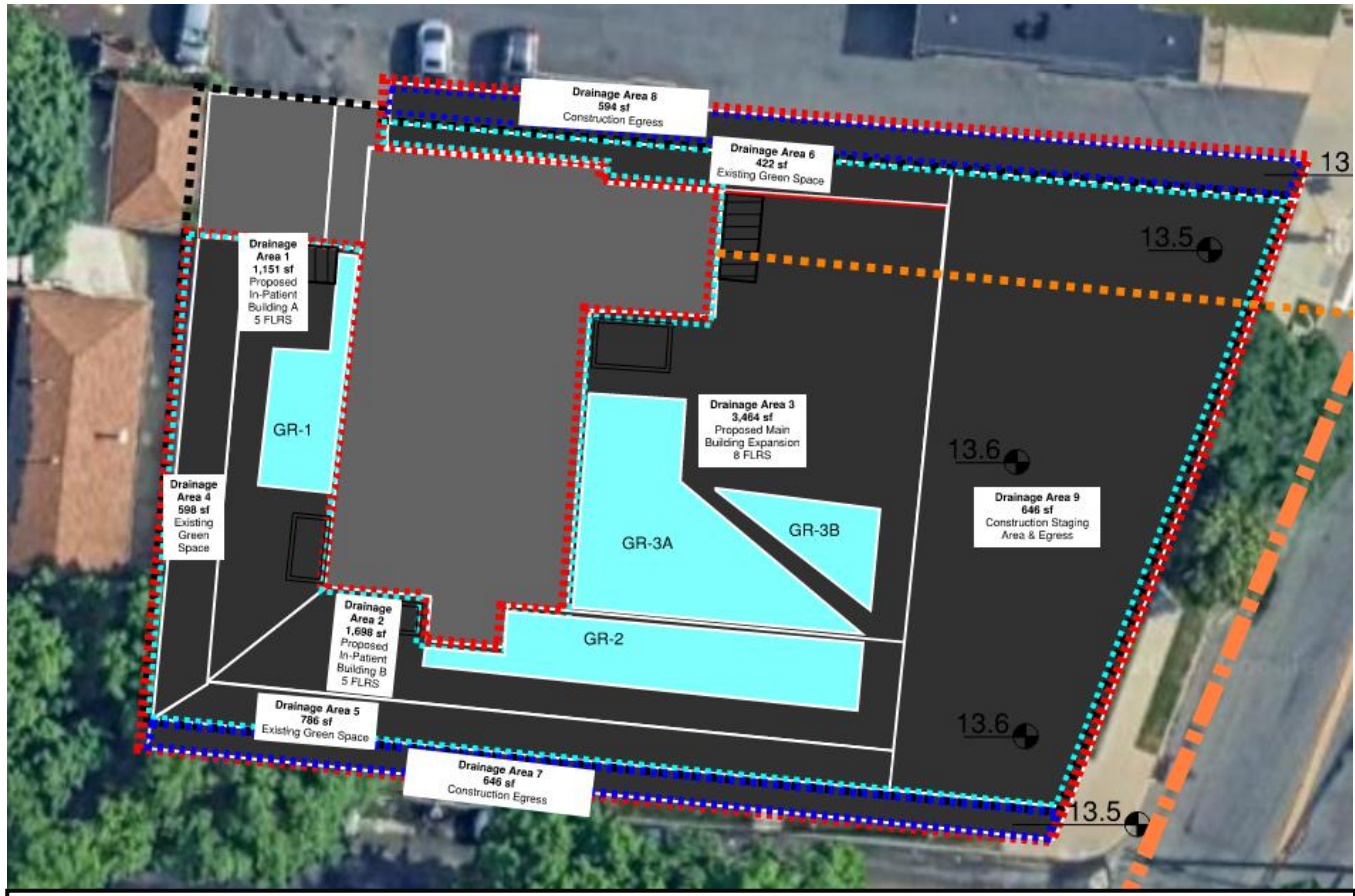
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Design steps completed for GR-3B but not shown:

- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$
- **Step 7:** Check SMP Contributions to Site-Wide Requirements

Concept Map: *Green Roof Contributing Areas (Preliminary)*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- SMP Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD

Resume Stormwater Planter Design

Tier 1 & 2 SMP Design

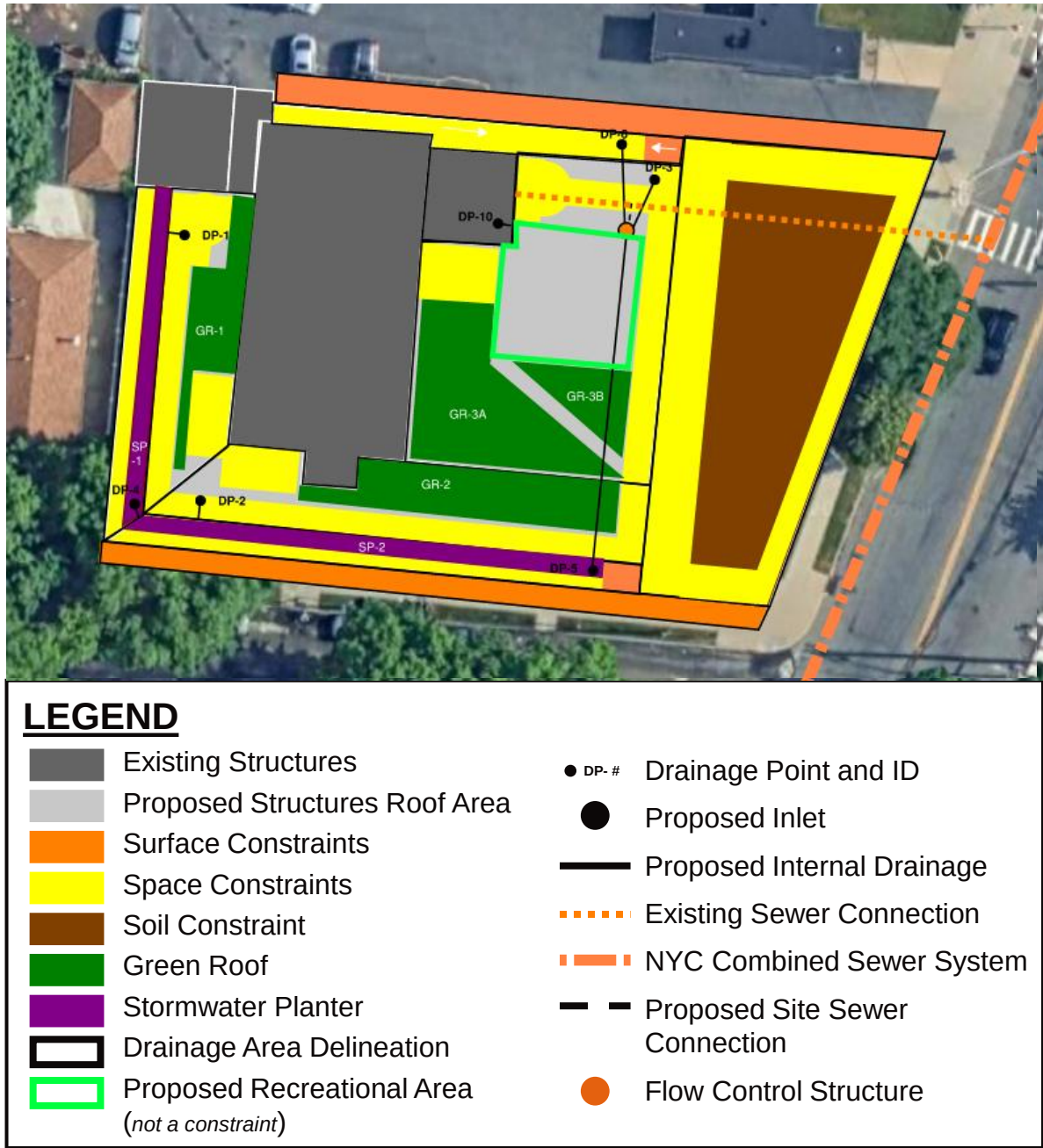
What are the Tier 1 SMP requirements?

SMP Step 2: Site SMP Footprint

Site Tier 1 practices on unconstrained areas to the maximum extent practicable, based on site constraints.

SMP ID	SMP Footprint (sf)
SP-1	371
SP-2	643

Concept Map: *Proposed Tier 1 SMPs (Preliminary)*

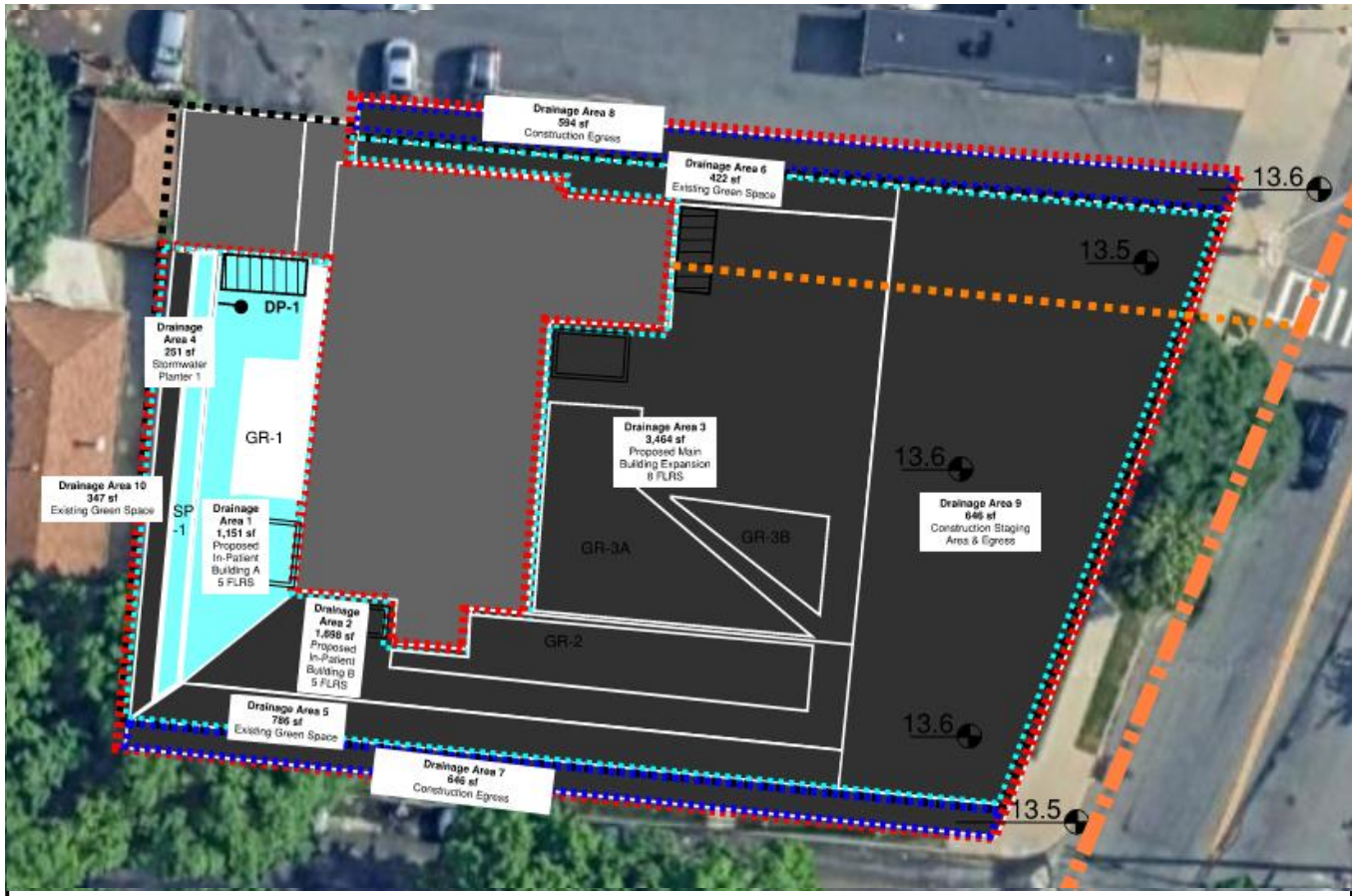


Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

SMP Step 3: Determine SMP Contributing Area

Concept Map: *Stormwater Planter 1 Contributing Area*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- SMP Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Areas Managed Upstream

Notes:

- Multiple green roofs can be designed simultaneously because their contributing areas are restricted to their footprints and independent from each other.
- In cases where SMPs have upstream managed areas, the design must be performed for each practice individually, starting with the upstream-most practice.

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

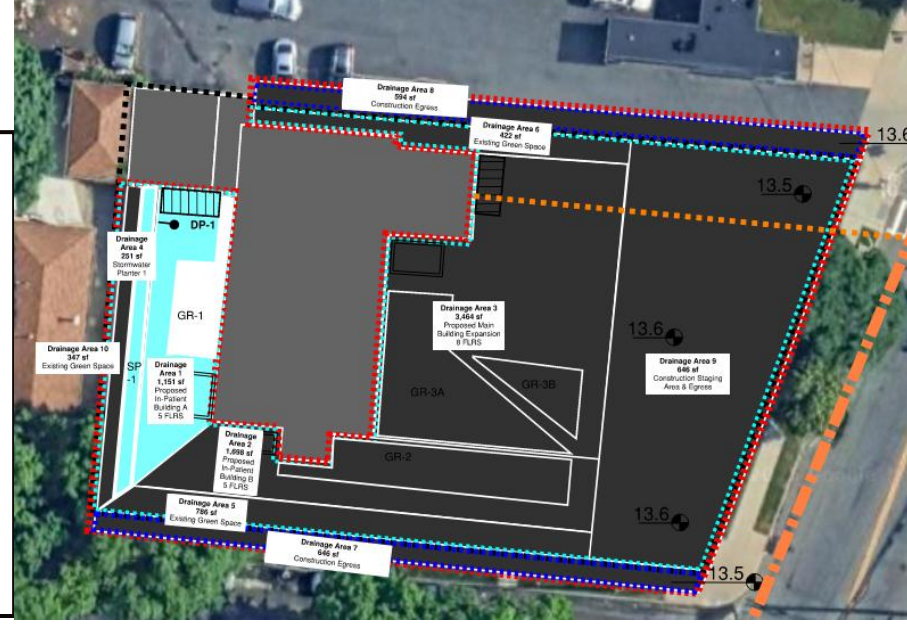
SMP Step 3: Determine SMP Contributing Area

- *Identify the true contributing area to the practice, based on the sum of its drainage areas.*

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)
SP-1	251	1,402

→ Contributing drainage areas to SP-1 are DA-1 & DA-4

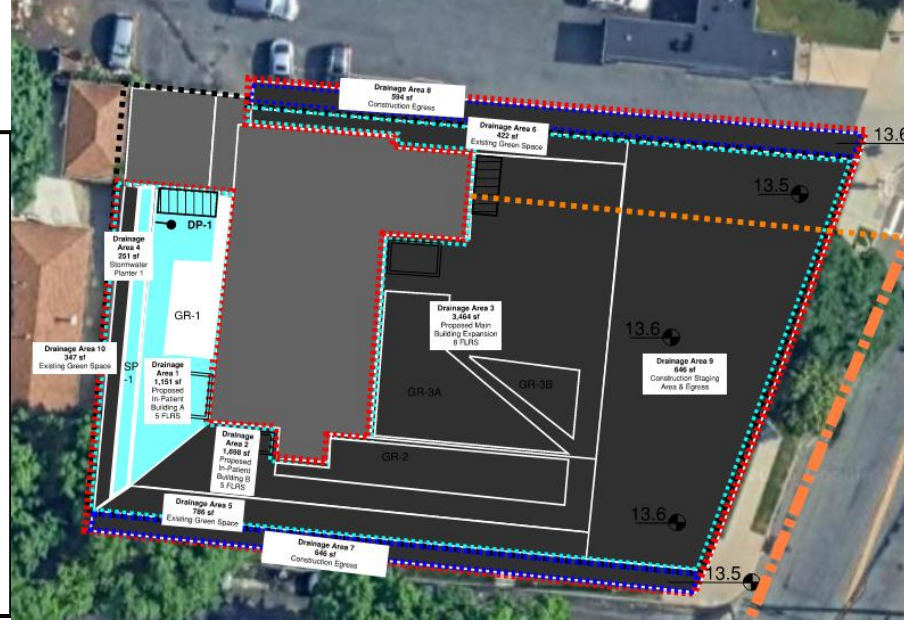
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 3: Determine SMP Contributing Area

- *Identify the true contributing area to the practice, based on the sum of its drainage areas.*
- *Refer to NYC SWM Design Table 4.3 to identify any limits to SMP contributing area or loading ratio for ET SMPs.*

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)
SP-1	251	1,402	1,255

For stormwater planters, the maximum contributing area is the lesser of:

- 15,000 sf
- A 5:1 practice-to-contributing area ratio (i.e. 5x the practice footprint)

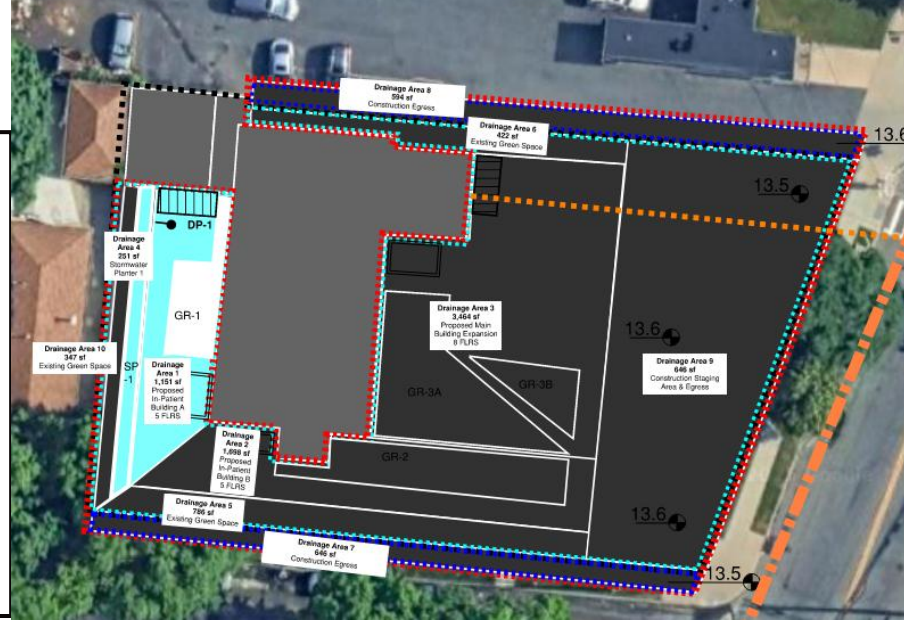
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 4: Determine Runoff Coefficient of SMP Contributing Area

This coefficient relates the total rainfall to runoff on the project site and is based on the percent impervious cover (I) in the proposed condition.

$$R_V = 0.05 + 0.009 * I$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)
SP-1	251	1,402	1,255	0.95

Note: When calculating WQ_V for a vegetated SMP, the SMP footprint should be considered 100% impervious in order for the practice to manage itself.

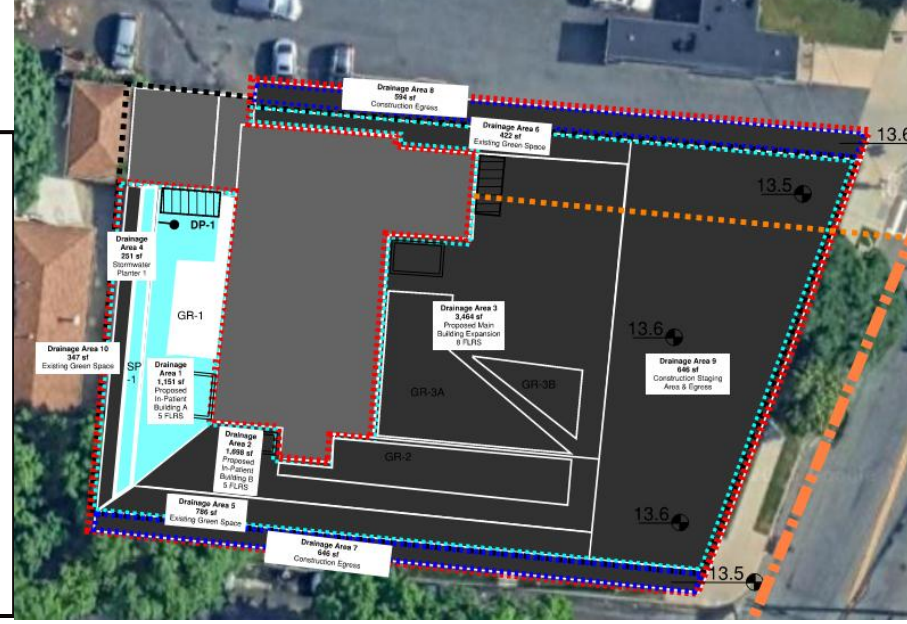
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total $WQ_{V,SMP}$ is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total $WQ_{V,SMP}$ to establish the practice's Required $WQ_{V,SMP}$*

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)
SP-1	251	1,402	1,255	0.95	166

Total $WQ_{V,SMP}$ was calculated based on the SMP Total Contributing Area

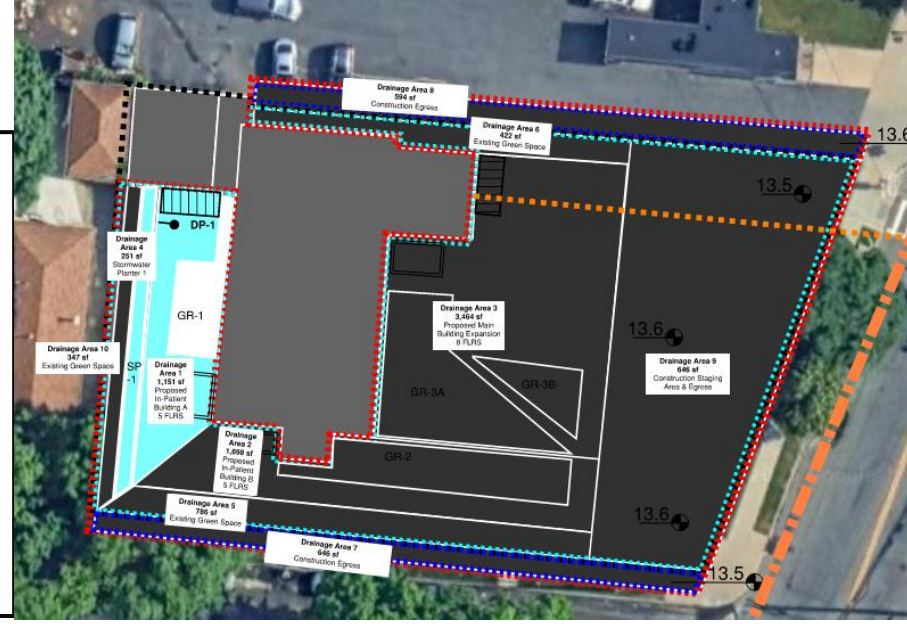
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total $WQ_{V,SMP}$ is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total $WQ_{V,SMP}$ to establish the practice's Required $WQ_{V,SMP}$*

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)	Volume Managed by Upstream SMPs
SP-1	251	1,402	1,255	0.95	166	44

Provided $WQ_{V,SMP}$ of GR-1, which is upstream of SP-1

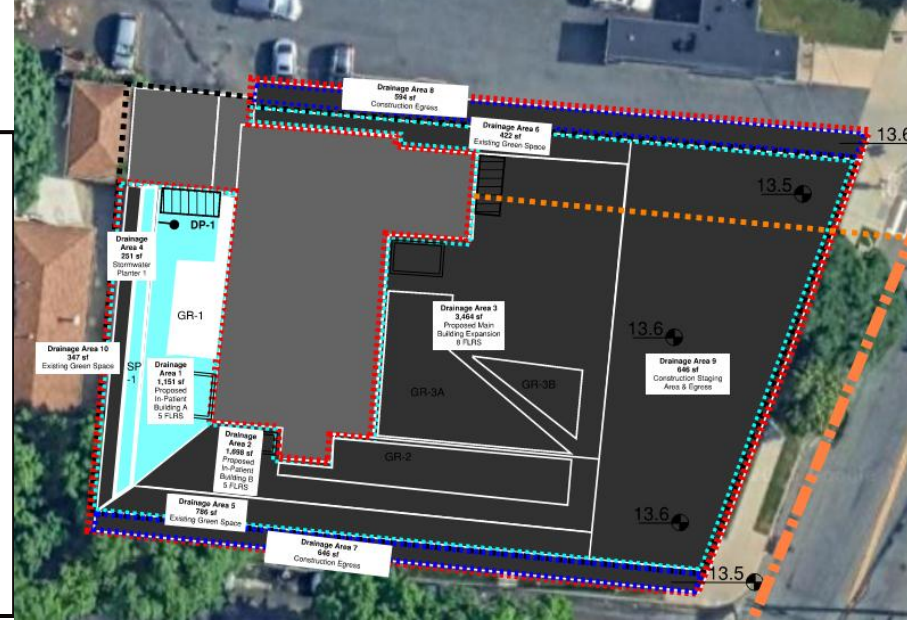
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total $WQ_{V,SMP}$ is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total $WQ_{V,SMP}$ to establish the practice's Required $WQ_{V,SMP}$*

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)		Volume Managed by Upstream SMPs		Required $WQ_{V,SMP}$ (cf)
SP-1	251	1,402	1,255	0.95	(166)	-	(44)	=	(122)

Calculated by subtracting the upstream managed volume from the Total $WQ_{V,SMP}$

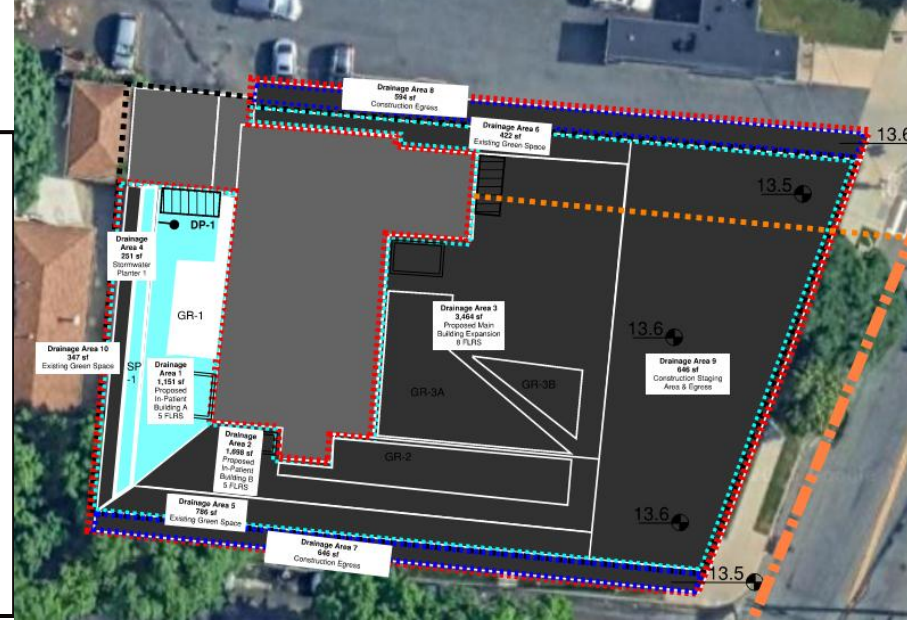
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total* $WQ_{V,SMP}$ *is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total* $WQ_{V,SMP}$ *to establish the practice's Required* $WQ_{V,SMP}$

$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)	Volume Managed by Upstream SMPs	Required $WQ_{V,SMP}$ (cf)	Max. $WQ_{V,SMP}$ (cf)
SP-1	251	1,402	1,255	0.95	166	44	122	149

The Required $WQ_{V,SMP}$ *Required may not exceed that Max.* $WQ_{V,SMP}$

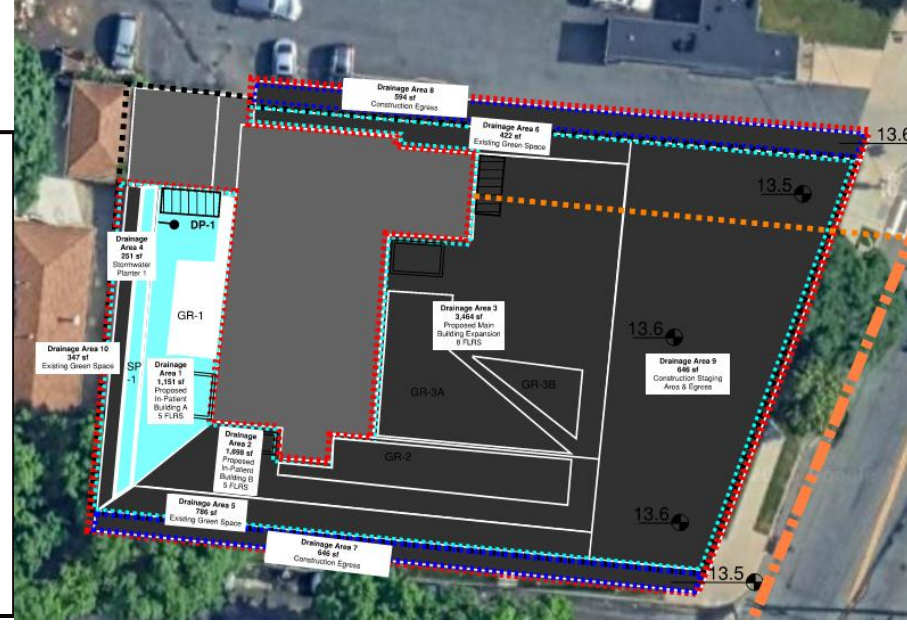
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Concept Map: *Stormwater Planter 1 Contributing Area*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- Practice-Based Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Upstream Contributing Areas



SMP Step 5: Calculate SMP Required $WQ_{V,SMP}$

Use NYC SWM Eq. 2.1 to calculate WQ_V

- *The Total* $WQ_{V,SMP}$ *is based on the entire contributing area to a practice*
- *When upstream practices are present, the volume they managed must be subtracted from the Total* $WQ_{V,SMP}$ *to establish the practice's Required* $WQ_{V,SMP}$

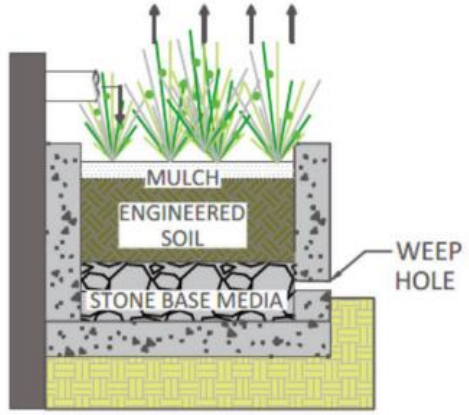
$$WQ_{V,SMP} = \frac{1.5"}{12} * A_{SMP} * R_V$$

SMP ID	SMP Footprint (sf)	SMP Total Contributing Area (sf)	Max. Contributing Area (sf)	Runoff Coefficient, R_V (-)	Total $WQ_{V,SMP}$ (cf)	Volume Managed by Upstream SMPs	Required $WQ_{V,SMP}$ (cf)		Max. $WQ_{V,SMP}$ (cf)	
SP-1	251	1,402	1,255	0.95	166	44	122	≤	149	✓

The Required $WQ_{V,SMP}$ *Required may not exceed that Max.* $WQ_{V,SMP}$

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?



SMP Step 6: Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Use NYC SWM Eq. 4.3 to calculate V_{SMP}

- *Determine Applicable Volume Parameters for each SMP type*
- *Refer to the appropriate equations in NYC SWM Section 4.2 to calculate the storage volume provided by each applicable parameter*
- *Refer to NYC SWM Design Table 4.3 to identify design requirements for ET SMPs and complete design calculation.*

$$V_{SMP} = V_P + V_S + V_I + V_D$$

$$V_{SMP,SP} = V_{P,SP} + V_{S,SP}$$

$$V_{SMP,SP} = (A_{SMP} * D_P) + (A_{SMP} * D_S * n_S)$$

SMP ID	A_{SMP} (sf)	D_P (ft)	V_P (cf)	D_S (ft)	n_S (cf/cf)	V_S (cf)	V_{SMP} (cf)		Required SMP WQ_V (cf)	
SP-1	251	0.25	62.75	1.5	0.2	75.3	138	≥	122	✓

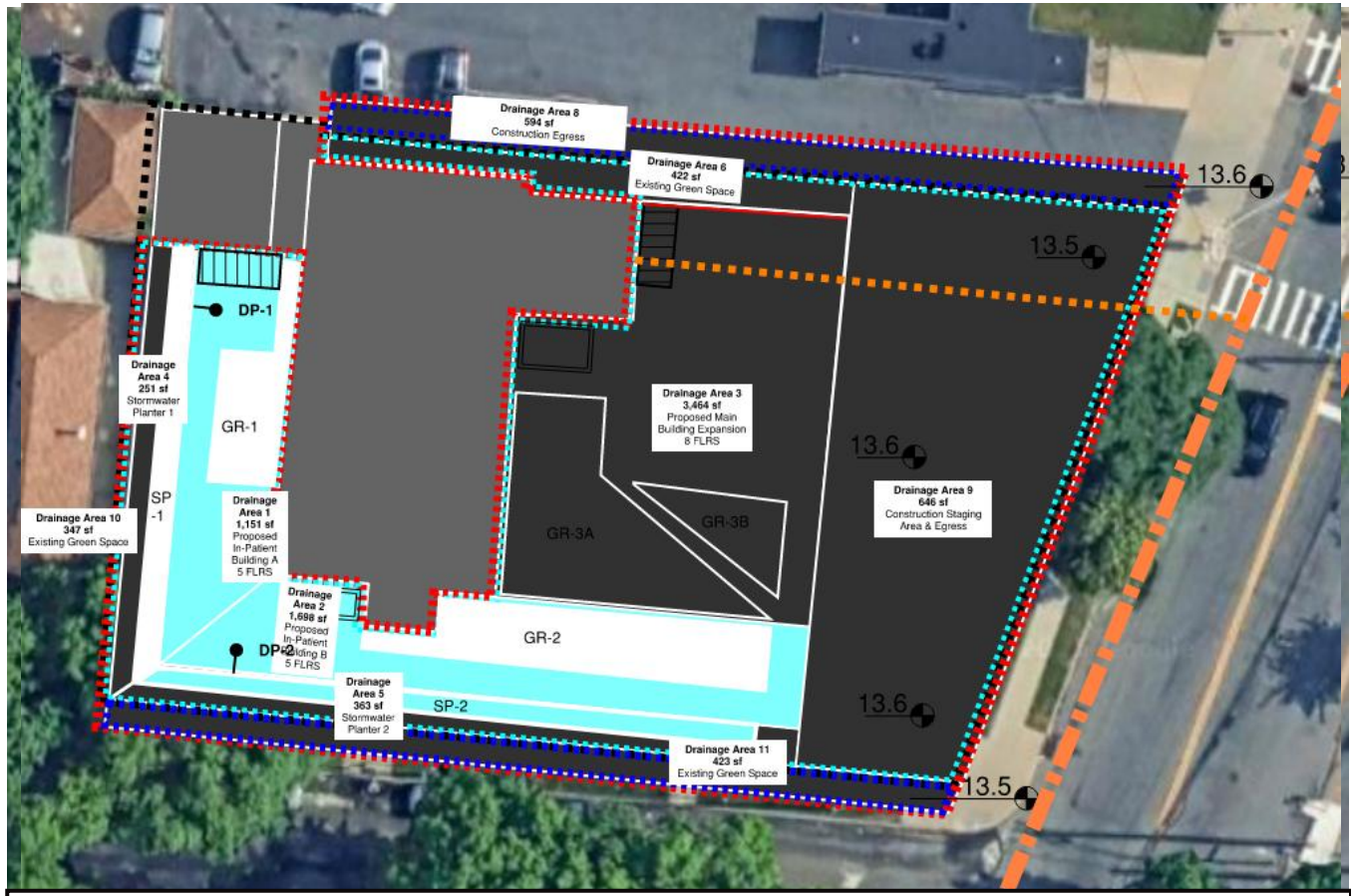
Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Design steps completed for SP-2 but not shown:

- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$

Concept Map: *Stormwater Planter 2 Contributing Area*



LEGEND

- Limit of Property: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- On-Site Disturbance: *11,996 sf*
- ROW Disturbance: *1,241 sf*
- SMP Contributing Areas
- Non-Contributing Areas
- Non-Contributing Areas outside LOD
- Areas Managed Upstream

Tier 1 & 2 SMP Design

What are the Tier 1 SMP requirements?

Table 4.1. Percent of SMP volume that may be applied to SW management criteria by SMP function.

SMP Function	Percent of SMP Volume Applied to Requirement (F_A) WQv	RRv	Vv
Infiltration	100	100	100
Evapotranspiration	100	100	0
Reuse[A]	100	100	50
Filtration	100[B]	40[C]	0
Detention	100[D]	0	100

SMP Step 7: Check SMP Contributions to Site-Wide Requirements

Use NYC SWM Table 4.1 to determine the percent contributions of each SMP.

SMP ID	Required $WQ_{V,SMP}$ (cf)	V_{SMP} (cf)	Provided WQ_V, (cf)	Provided RR_V (cf)	Provided V_V (cf)
GR-1	44	49	44	44	0
GR-2	76	86	76	76	0
GR-3A	106	119	106	106	0
GR-3B	27	30	27	27	0
SP-1	122	138	122	122	0
SP-2	169	200	169	169	0

Site-Wide Parameters	WQ_V (cf)	RR_V (cf)	V_V (cf)
Total Volume Provided	544	544	0
Total Volume Required	834	350 (*Minimum*)	TBD*
Remaining Volume to be Managed	290	0	TBD*

Tier 1 & 2 SMP Design

What are the Tier 1 SMP design requirements?

SMPs Tier 1 and 2 Design Steps:

- **Step 1:** Review Drainage Areas & Constraints
- **Step 2:** Site SMP Footprint
- **Step 3:** Determine SMP Contributing Area
- **Step 4:** Determine Runoff Coefficient of SMP Contributing Area
- **Step 5:** Calculate SMP Required $WQ_{V,SMP}$
- **Step 6:** Design SMP V_{SMP} to Meet Required $WQ_{V,SMP}$
- **Step 7:** Check SMP Contributions to Site-Wide Requirements

Iterate process until all requirements are met

✗ **Iteration 1:** Three Green Roofs proposed

✗ **Iteration 2:** Four Green Roofs and Two Stormwater Planters proposed
⇨ *Contributing Area Expanded*

Tier 1 & 2 SMP Design

What are the Tier 2 SMP requirements?

Tier 2 SMPs are not feasible because:

- Soil, Surface, and Space constraints prevent the project from using them
- Space that would have been available was used to site Tier 1 Practices

SMP HIERARCHY CHECKLIST - CSS AREAS

			Percent of SMP volume applied[a]			Site constraints that limit SMP feasibility[b]				
Tier[c]	Function Type[d]	Practice Type[e]	WQv	RRv	Vv	Soil	Subsurface	Hotspot	Surfaces	Space
Tier 1	Infiltration (Vegetated)	Bioretention	100	100	100	X	X	X	X	X
		Rain garden	100	100	100	X	X	X	X	X
		Stormwater planter	100	100	100	X	X	X	X	X
		Tree planting / preservation	SC	SC	0					
		Dry basin	100	100	100	X	X	X	X	X
		Grass filter strip	SC	SC	0	X	X	X	X	X
		Vegetated swale	SC	SC	0	X	X	X	X	X
	Evapotranspiration[f]	Rain garden	100	100	0		X		X	X
		Stormwater planter	100	100	0				X	
		Tree planting / preservation	SC	SC	0					
		Green roof	100	100	0					
Tier 2	Infiltration (Non-vegetated)	Dry well	100	100	100	X	X	X		X
		Stormwater gallery	100	100	100	X	X	X		X
		Stone trench	100	100	100	X	X	X	X	X
		Porous pavement	100	100	100	X	X	X		X
		Synthetic turf field	100	100	100	X	X	X	X	X
Anytime / Optional	Reuse	Rain tank	100	100	SC					
		Cistern	100	100	SC					
Tier 3	Detention[g,h,i]	Dry basin	100	0	100		X		X	X
		Constructed wetland	100	0	100		X		X	X
		Wet basin / pond	100	0	100		X		X	X
		Stormwater gallery	100	0	100		X			X
		Blue roof	100	0	100					
		Detention tank	100	0	100					

References:

1. *NYS DEC Stormwater Management Design Manual – Appendix A*

Tier 1 & 2 SMP Design

What are the Tier 2 SMP requirements?

Tier 2 SMPs are not feasible.

Establish detention requirements then move to Tier 3 SMP design

Tier 3 SMP Design *(CSS Only)*

Tier 3 SMP Design *(CSS Only)*

<u>Goal:</u> Design Tier 3 SMPs to Meet the Applicable Stormwater Management Criteria

Key Questions

- Which criteria dictate Tier 3 Design Requirements?
- What are the Tier 3 Design Requirements?
- Can the Tier 3 Design be optimized?

Tier 3 SMP Design *(CSS Only)*

Which criteria dictate Tier 3 SMP requirements?

Tier 3 SMP requirements depend on the applicability of the Sewer Operations volume (V_V) requirement.

If V_V does not apply, detention practices should be sized to meet remaining WQ_V → $\boldsymbol{Site\ WQ_V = 834\ cf}$

$\boldsymbol{Remaining\ WQ_V = 834 - 543 = 291\ cf}$

If V_V applies, detention practices must be sized to meet V_V & Q_{DRR} → $\boldsymbol{V_V = ??}$

$\boldsymbol{Q_{DRR} = ??}$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

SMP Tier 3 Design Steps *[when driven by Sewer Operations Requirements]*:

- **Step 1:** Determine Contributing Areas
- **Step 2:** Calculate Weighted Runoff Coefficient C_W
- **Step 3:** Calculate Sewer Operations Volume V_V
- **Step 4:** Calculate Maximum Release Rate Q_{DRR}
- **Step 5:** Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability
- **Step 6:** Design Detention System to meet V_V & Q_{DRR}

Tier 3 SMP Design *(CSS Only)*

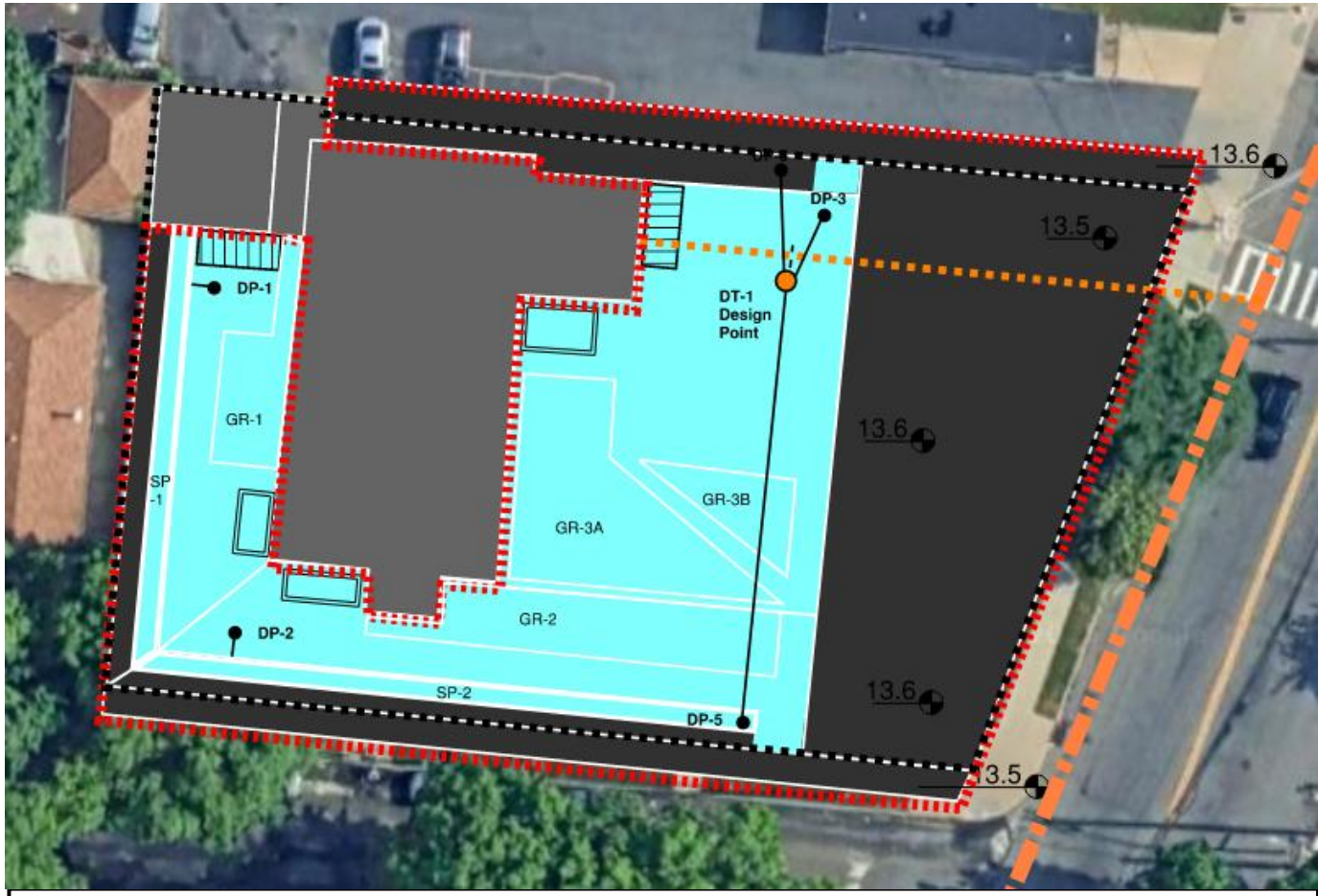
What are the Tier 3 SMP design requirements?

Step 1: Determine Contributing Areas

In this case, all developed areas drain to the detention tank, including overflow from all upstream SMPs

$$A = 7{,}022\ sf$$

Concept Map: *Cover and Contributing Area Drainage Plan*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Contributing Area in LOD: *7,022 sf*
- Non-Contributing Areas in LOD: *6,623 sf*
- Non-Contributing Areas outside LOD
- Detention System Design Point
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 2: Calculate Weighted Runoff Coefficient

- *Complete surface cover design*

The sewer operations volume V_V requirements depends on the site cover types in the proposed condition. Therefore, it must be calculated **after** Tier 1 and Tier 2 surface SMPs have been sited.

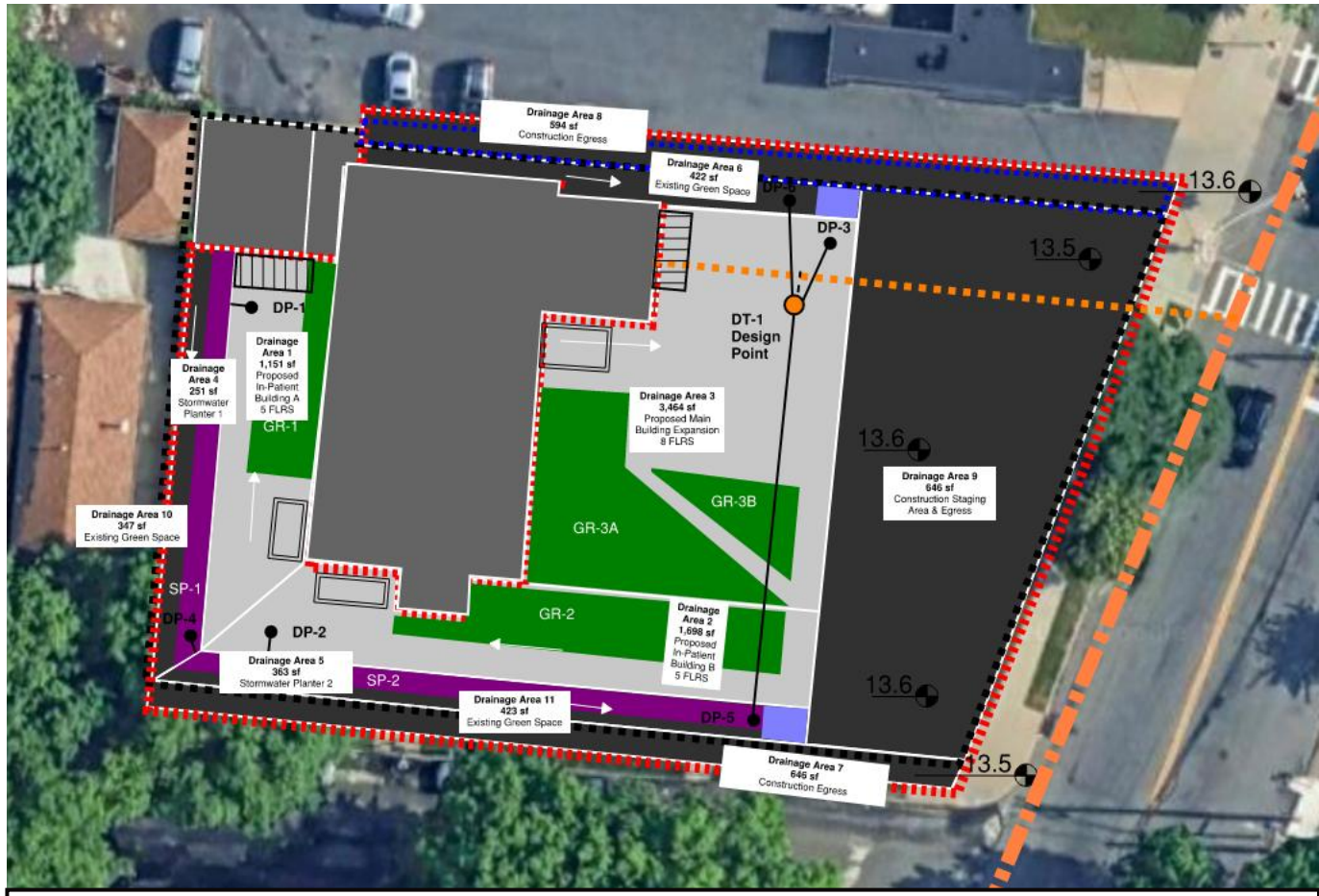
Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 2: Calculate Weighted Runoff Coefficient

- *Complete surface cover design*
- *Establish area of all cover types on the proposed site*

Concept Map: *Cover and Contributing Area Drainage Plan*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Detention System Design Point
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Note:
C values vary by **surface** type, not by pervious or impervious cover which is used for WQv calculations.

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 2: Calculate Weighted Runoff Coefficient

- *Complete surface cover design*
- *Establish area of all cover types on the proposed site*
- *Refer to NYC SWM Table 2.8 to find C values for each surface type.*

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 min. 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.

$A_{Roof} = 4{,}184\ sf$

$A_{Paved} = 96\ sf$

$A_{GR} = 2{,}128\ sf$

$A_{Landscaped} = 614\ sf$

$$C_W = \frac{4{,}184 * 0.95 + 96 * 0.85 + 2{,}128 * 0.70 + 614 * 0.20}{7{,}022}$$

$$C_W = 0.81$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 3: Calculate Sewer Operations Volume V_V

- *Use NYC SWM Eq. 2.3 to calculate V_V*

EQ 2.3

$$V_V = \frac{R_D}{12} * A * C_W$$

where:

V_V: sewer operations volume (cf)

R_D: rainfall depth (in)

A: contributing area (sf)

C_W: weighted runoff coefficient relating peak rate of rainfall and runoff

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 3: Calculate Sewer Operations Volume V_V

- *Use NYC SWM Eq. 2.3 to calculate V_V*
- *Refer to NYC SWM Table 2.7 to establish rainfall depth based on the sewershed type (CSS/MS4) and proposal type for the project (HCP/SCP).*

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

$$R_D = 1.85$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

EQ 2.3

$$V_V = \frac{R_D}{12} * A * C_W$$

where:

V_V: sewer operations volume (cf)

R_D: rainfall depth (in)

A: contributing area (sf)

C_W: weighted runoff coefficient relating peak rate of rainfall and runoff

Step 3: Calculate Sewer Operations Volume V_V

- *Use NYC SWM Eq. 2.3 to calculate V_V*
- *Refer to NYC SWM Table 2.7 to establish rainfall depth based on the sewershed type (CSS/MS4) and proposal type for the project (HCP/SCP).*
- *Finalize calculation using contributing area from Step 1 and weighted runoff coefficient from Step 2.*

$$R_D = 1.85\ in$$
$$A = 7{,}022\ sf$$
$$C_W = 0.81$$

$$V_V = \frac{1.85}{12} * 7{,}022 * 0.81$$

$$\boldsymbol{V_V = 874\ cf}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 4: Calculate maximum release rate Q_{DRR}

- *Use NYC SWM Eq. 2.5 to calculate Q_{DRR} for the tax lot*

EQ 2.5

$$Q_{DRR} = \frac{q\left(\frac{cfs}{acre}\right) * A(sf)}{43560(\frac{sf}{acre})} \; or \; 0.046 \; [whichever \; is \; greater]$$

Q_{DRR}: maximum release rate, site (cfs)
q: maximum release rate, per acre (cfs/acre)
A: contributing area (sf)

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 4: Calculate maximum release rate Q_{DRR}

- *Use NYC SWM Eq. 2.5 to calculate Q_{DRR} for the tax lot*
- *Refer to NYC SWM Table 2.9 to establish max release rate per acre based on the sewershed type.*

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

$$q = 0.1 \frac{cfs}{acre}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 4: Calculate maximum release rate Q_{DRR}

- *Use NYC SWM Eq. 2.5 to calculate Q_{DRR} for the tax lot*
- *Refer to NYC SWM Table 2.9 to establish max release rate per acre based on the sewershed type.*
- *Complete calculation using contributing area from Step 1.*

EQ 2.5

$$Q_{DRR} = \frac{q\left(\frac{cfs}{acre}\right) * A(sf)}{43560(\frac{sf}{acre})} \; or \; 0.046 \; [whichever \; is \; greater]$$

Q_{DRR}: maximum release rate, site (cfs)
q: maximum release rate, per acre (cfs/acre)
A: contributing area (sf)

$$q = 0.1\frac{cfs}{acre}$$

$$A_{Site} = 7{,}022 \; sf$$

$$Q_{DRR,Calc} = \frac{0.1\frac{cfs}{acre} * 7{,}022 \; sf}{43560\frac{sf}{acre}}$$

$$\boldsymbol{Q_{DRR,Calc} = 0.016 \; cfs}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 4: Calculate maximum release rate Q_{DRR}

- *Use NYC SWM Eq. 2.5 to calculate Q_{DRR} for the tax lot*
- *Refer to NYC SWM Table 2.9 to establish max release rate per acre based on the sewershed type.*
- *Complete calculation using contributing area from Step 1.*
- *Select the appropriate Q_{DRR} for the tax lot*

EQ 2.5

$$Q_{DRR} = \frac{q\left(\frac{cfs}{acre}\right) * A(sf)}{43560(\frac{sf}{acre})} \; or \; 0.046 \; [whichever \; is \; greater]$$

Q_{DRR}: maximum release rate, site (cfs)
q: maximum release rate, per acre (cfs/acre)
A: contributing area (sf)

~~$Q_{DRR,Calc} = 0.016 \; cfs$~~

$0.016 \; cfs < 0.046 \; cfs$

$\boldsymbol{Q_{DRR,TaxLot} = 0.046 \; cfs}$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 4: Calculate maximum release rate Q_{DRR}

- *Use NYC SWM Eq. 2.5 to calculate Q_{DRR} for the tax lot*
- *Refer to NYC SWM Table 2.9 to establish max release rate per acre based on the sewershed type.*
- *Complete calculation using contributing area from Step 1.*
- *Select the appropriate Q_{DRR} for the tax lot*
- *Adjust the Max Release Rate as applicable for the site*

$$Q_{DRR,Site} = Q_{DRR,TaxLot} * \frac{Managed\ Area}{Tax\ Lot\ Area}$$

$$= 0.046 * \frac{7{,}022\ sf}{15{,}900\ sf}$$

$$\boldsymbol{Q_{DRR,Site} = 0.020\ cfs}$$

Concept Map: *Area Managed by Detention System (preliminary)*

LEGEND

- Property (Tax) Lot: *15,900 sf*
- Managed Area in Tax Lot: *7,022 sf*
- Unmanaged Area in Tax Lot: *8,878 sf*
- Detention Tank Design Point
- DP-# Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Note:

When the contributing area is less than the total lot area, multiply the max. release rate by the ratio of the altered area to the total site area (15 RCNY § 31-03(a)(3)).

Tier 3 SMP Design

What are the Tier 3 SMP requirements?

If the developed flow (Q_{DEV}) is greater than the maximum release rate (Q_{DRR}),

Designer must design detention practices in accordance with Chapter 4 of the NYC SWM to ensure that the maximum release rate for the site is not exceeded.

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 5: Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability

- *Refer to NYC SWM p. 2-18 to calculate Q_{Dev}*

$$Q_{Dev} = \frac{C_{WS} A_S}{7{,}320}$$

where:
Q_{Dev} = the developed site average storm runoff rate of flow in cfs, based on a rainfall event with a 5 yr. return period, and a 6 minute (min.) time of concentration
C_{WS} = the weighted runoff coefficient for the site
A_S = the site area in ft^2
7,320 = 43,560 ft^2/ac divided by 5.95 inches per hour (in/hr), the average rainfall intensity for the event with a 5 yr. return period and a 6 min. time of concentration

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 5: Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability

- *Refer to NYC SWM p. 2-18 to calculate Q_{Dev}*
- *Complete calculation using contributing area from Step 1 and weighted runoff coefficient from Step 2.*

$$Q_{Dev} = \frac{C_{WS} A_S}{7{,}320}$$

$$Q_{Dev} = \frac{0.8073 * 7{,}022}{7{,}320}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP design requirements?

Step 5: Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability

- *Refer to NYC SWM p. 2-18 to calculate Q_{Dev}*
- *Complete calculation using contributing area from Step 1 and weighted runoff coefficient from Step 2.*
- *Confirm whether Q_{DRR} Applies*

$$Q_{Dev} = \frac{C_{WS} A_S}{7{,}320}$$

$$Q_{Dev} = \frac{0.8073 * 7{,}022}{7{,}320}$$

$$\boldsymbol{Q_{Dev} = 0.7744\ cfs} \quad > \quad Q_{DRR,Site} = 0.020\ cfs$$

Since $Q_{Dev} > Q_{DRR}$ the detention system must be designed to meet Q_{DRR}

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Select Tier 3 SMPs to meet remaining site requirements:

- ✓ *In this case, a detention tank may be used to meet all remaining requirements.*
- ✓ *The detention tank must be sized to meet the full Vv, which will also manage remaining WQv.*

SMP HIERARCHY CHECKLIST - CSS AREAS			Percent of SMP volume applied[a]			Site constraints that limit SMP feasibility[b]				
Tier[c]	Function Type[d]	Practice Type[e]	WQv	RRv	Vv	Soil	Subsurface	Hotspot	Surfaces	Space
Tier 1	Infiltration (Vegetated)	Bioretention	100	100	100	X	X	X	X	X
		Rain garden	100	100	100	X	X	X	X	X
		Stormwater planter	100	100	100	X	X	X	X	X
		Tree planting / preservation	SC	SC	0					
		Dry basin	100	100	100	X	X	X	X	X
		Grass filter strip	SC	SC	0	X	X	X	X	X
		Vegetated swale	SC	SC	0	X	X	X	X	X
	Evapotranspiration[f]	Rain garden	100	100	0		X		X	X
		Stormwater planter	100	100	0				X	
		Tree planting / preservation	SC	SC	0					
		Green roof	100	100	0					
Tier 2	Infiltration (Non-vegetated)	Dry well	100	100	100	X	X	X		X
		Stormwater gallery	100	100	100	X	X	X		X
		Stone trench	100	100	100	X	X	X	X	X
		Porous pavement	100	100	100	X	X	X		X
		Synthetic turf field	100	100	100	X	X	X	X	X
Anytime / Optional	Reuse	Rain tank	100	100	SC					
		Cistern	100	100	SC					
Tier 3	Detention[g,h,i]	Dry basin	100	0	100		X		X	X
		Constructed wetland	100	0	100		X		X	X
		Wet basin / pond	100	0	100		X		X	X
		Stormwater gallery	100	0	100		X			X
		Blue roof	100	0	100					
		Detention tank	100	0	100					

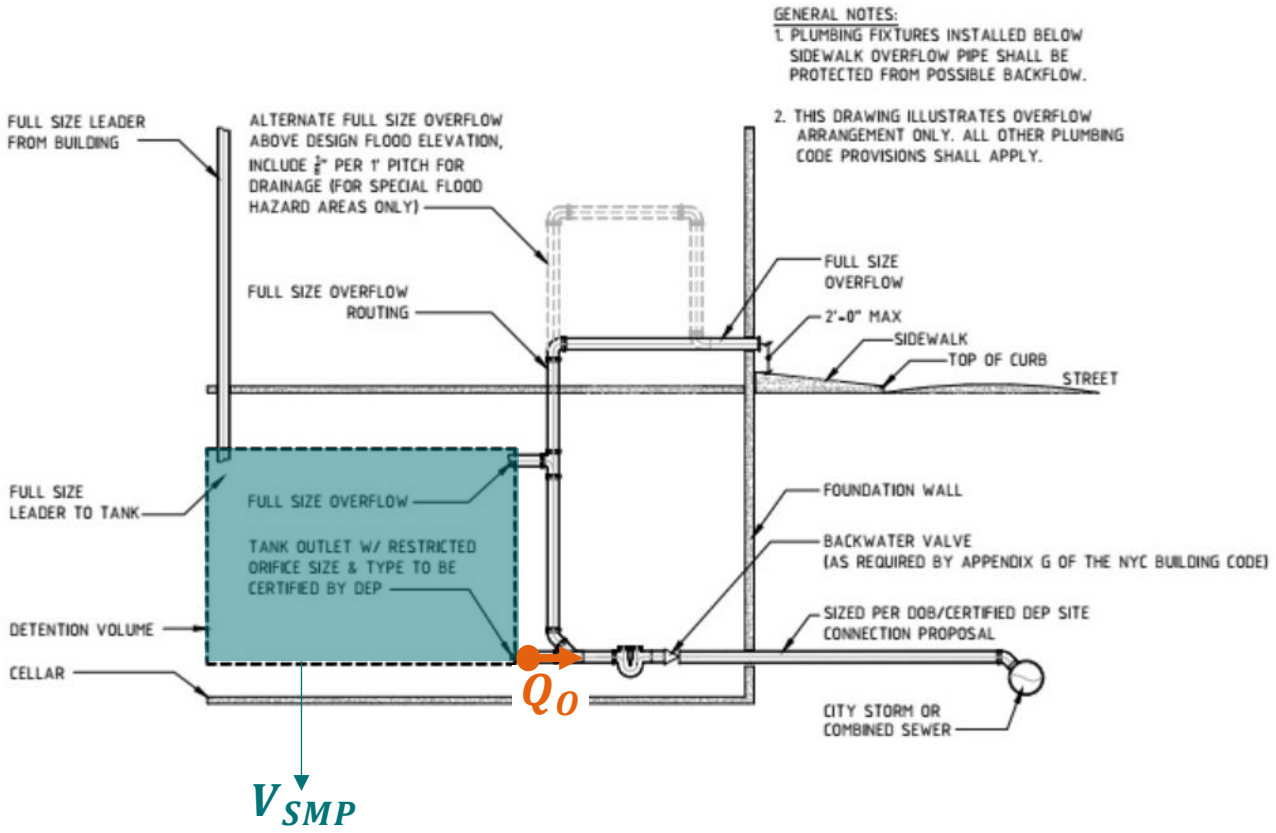
Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

When sewer operations requirements apply, detention SMP design consists of ensuring:

- ✓ **$V_{SMP} > V_V$**
  The SMP active storage volume must exceed the Required Sewer Operations Volume

- ✓ **$Q_O < Q_{DRR}$**
  The release rate from the SMP controlled-flow device (Q_O) must not exceed the Maximum Release Rate (Q_{DRR}) for the contributing area when the 10-year detention volume is being provided (V_V).



(Active Storage Zone)

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*

Design Decisions for Case Study:

- ✓ Detention tank has a re-entrant orifice tube outlet
- ✓ Smallest allowable orifice diameter set in NYC Stormwater Manual is 1 inch
- ✓ Utilizing the smallest orifice diameter will minimize the SMP footprint by allowing a greater S_{DR}
- ✓ Therefore, the Case Study's controlled-flow orifice size is **set to the minimum of 1 inch**

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*
- *Use NYC SWM Eq. 4.16 to calculate the maximum detention storage depth for a re-entrant orifice tube outlet, based on the maximum release rate and orifice diameter*

EQ 4.16

$$S_{DR} = 1{,}930(Q_{DRR})^2/(d_O)^4 + d_O/24$$

where:

S_{DR} = the maximum storage depth in ft. for a Re-entrant orifice tube outlet

Q_{DRR} = the detention facility maximum release rate in cfs

d_O = the nominal dia. of the orifice tube outlet in in.

$$\boldsymbol{S_{DR} = \frac{1{,}930 * {Q_{DRR}}^2}{{d_O}^4} + \frac{d_O}{24}}$$

$$\boldsymbol{S_{DR} = \frac{1{,}930 * 0.020^2}{1^4} + \frac{1}{24}}$$

$$\boldsymbol{S_{DR} = 0.827ft}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*
- *Use NYC SWM Eq. 4.16 to calculate the maximum detention storage depth for a re-entrant orifice tube outlet, based on the maximum release rate and orifice diameter*
- *Establish the required SMP footprint to meet volumetric requirements*

$$S_{DR} = 0.827\ ft$$

$$V_V = S_{DR} * A_{SMP}$$

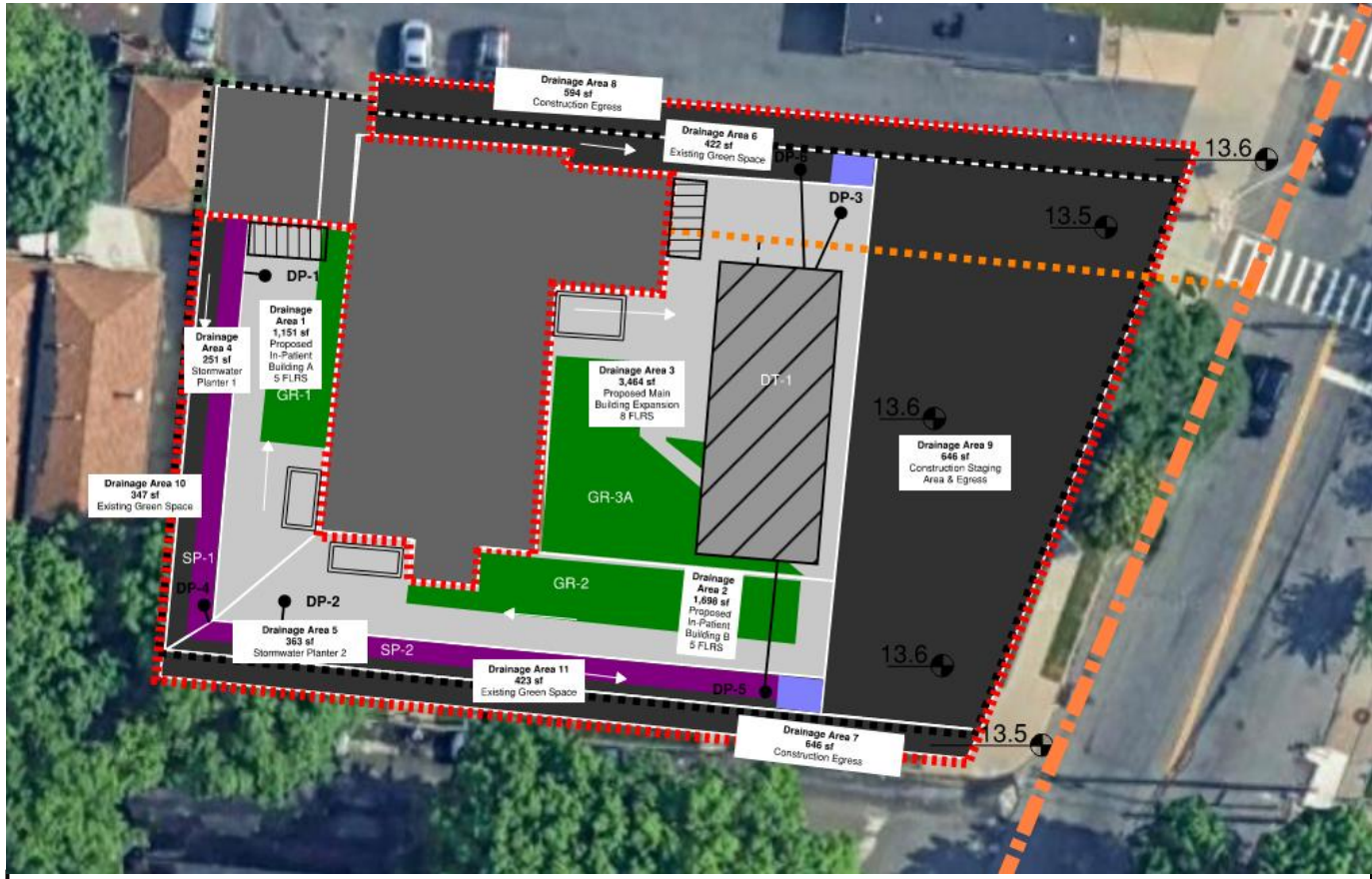
$$\boldsymbol{A_{SMP} = \frac{874\ cf}{0.827 ft} = 1{,}056\ sf}$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

DT-1 Proposed Dimensions:
- 9 in Depth
- 53 ft W x 22 ft L Footprint

***Concept Map**: Detention Tank Footprint (Preliminary)*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Detention Tank: *2,128 sf*
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Tier 3 SMP Design

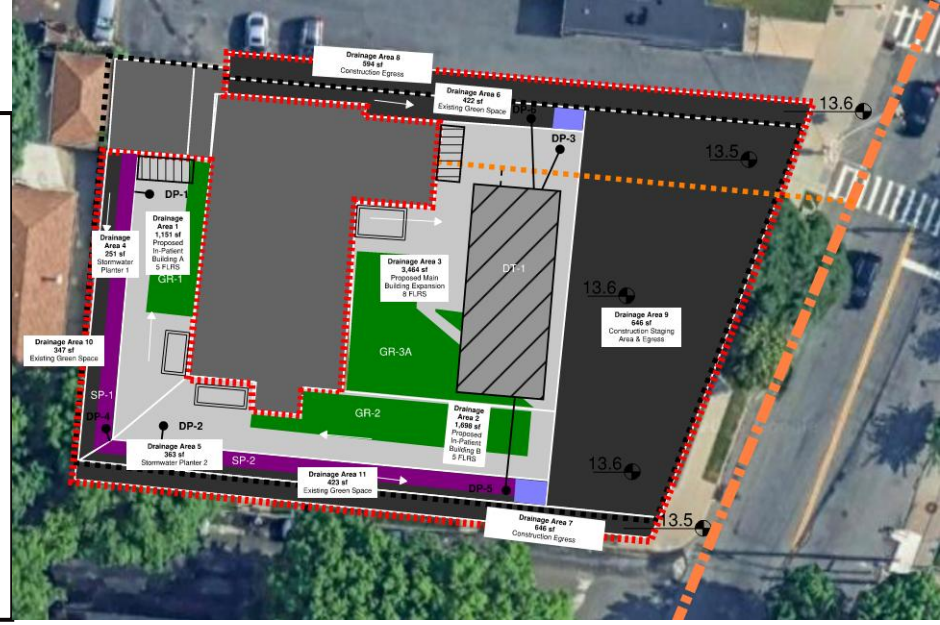
(CSS Only)

What are the Tier 3 SMP requirements?

***Concept Map**: Detention Tank Design (Preliminary)*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Detention Tank: *1,166 sf*
- Paved Area: *48 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD: *3,264 sf*



Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*
- *Use NYC SWM Eq. 4.16 to calculate the required area of the orifice, based on the maximum release rate.*
- *Establish the required SMP footprint to meet volumetric requirements*
- *Design detention tank active storage zone dimensions to meet volumetric requirements.*

EQ 4.5

$$V_I = V_M * N_M$$

where:

V_I = volume of voids created by internal structure (cf)

V_M = interior volume of one modular structure (cf)

N_M = number of modular structures (unit less)

$$V_{SMP} = V_P + V_S + V_I + V_D$$

$$V_{SMP,DT} = V_{I,DT} = V_M * N_M$$

$$V_{SMP,DT} = V_{I,DT} = \left(\frac{9}{12}\right) * 53 * 22 * 1$$

$$V_{SMP,DT} = 875\ cf \quad \geq \quad V_V = 874\ cfs$$ ✓

Tier 3 SMP Design

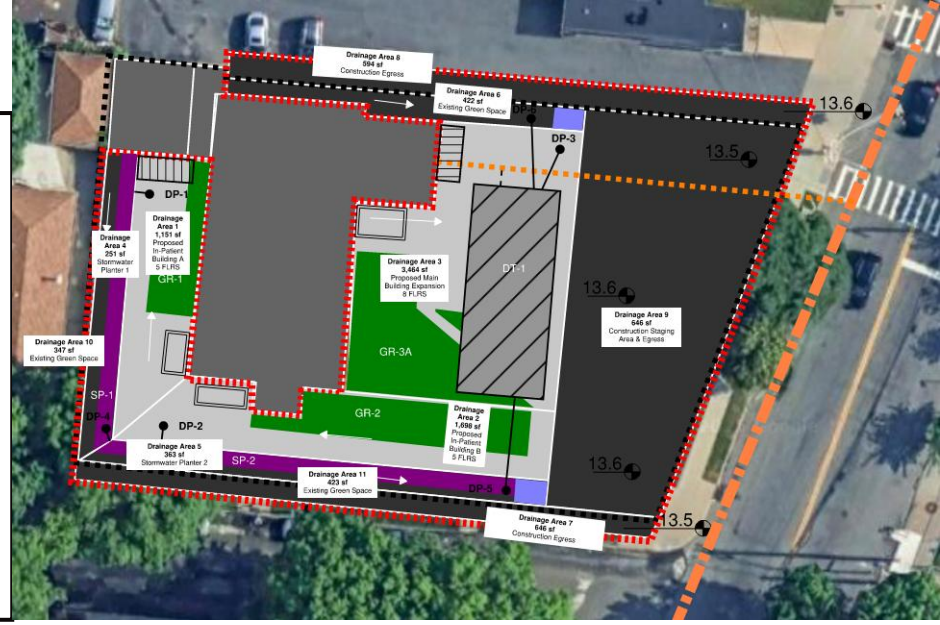
(CSS Only)

What are the Tier 3 SMP requirements?

***Concept Map**: Detention Tank Design (Preliminary)*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Detention Tank: *1,166 sf*
- Paved Area: *48 sf*
- Non-Contributing Areas in LOD: *7,237 sf*
- Non-Contributing Areas outside LOD: *3,264 sf*



Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*
- *Use NYC SWM Eq. 4.16 to calculate the required area of the orifice, based on the maximum release rate.*
- *Establish the required SMP footprint to meet volumetric requirements*
- *Design detention tank active storage zone dimensions to meet volumetric requirements.*
- *Use to NYC SWM Eq. 4.15 to confirm that the maximum release rate is not exceeded.*

EQ 4.15

$$Q_O = C_D * A_o * \sqrt{2gH}$$

where:
QO = maximum release rate of orifice (cfs)
CD = coefficient of discharge; 0.61 (flush), 0.52 (re-entrant)
AO = area of orifice (ft2)
g = acceleration due to gravity, 32.2 (ft/s2)
H = maximum hydraulic head above the centerline of the orifice (ft)

$$C_D = 0.52$$

$$A_O = \frac{\pi}{4} * {D_0}^2 = \frac{\pi}{4} * \left(1in * \frac{1\,ft}{12\,in}\right)^2 = 0.00545\,ft^2$$

$$H = 9in * \frac{1\,ft}{12\,in} = 0.75\,ft$$

$$Q_O = 0.52 * 0.00545\,ft^2 * \sqrt{2 * 32.2 \frac{ft}{s^2} * 0.75ft}$$

$$Q_O = 0.019\,cfs \leq \mathbf{Q_{DRR} = 0.020\,cfs}$$

Tier 3 SMP Design *(CSS Only)*

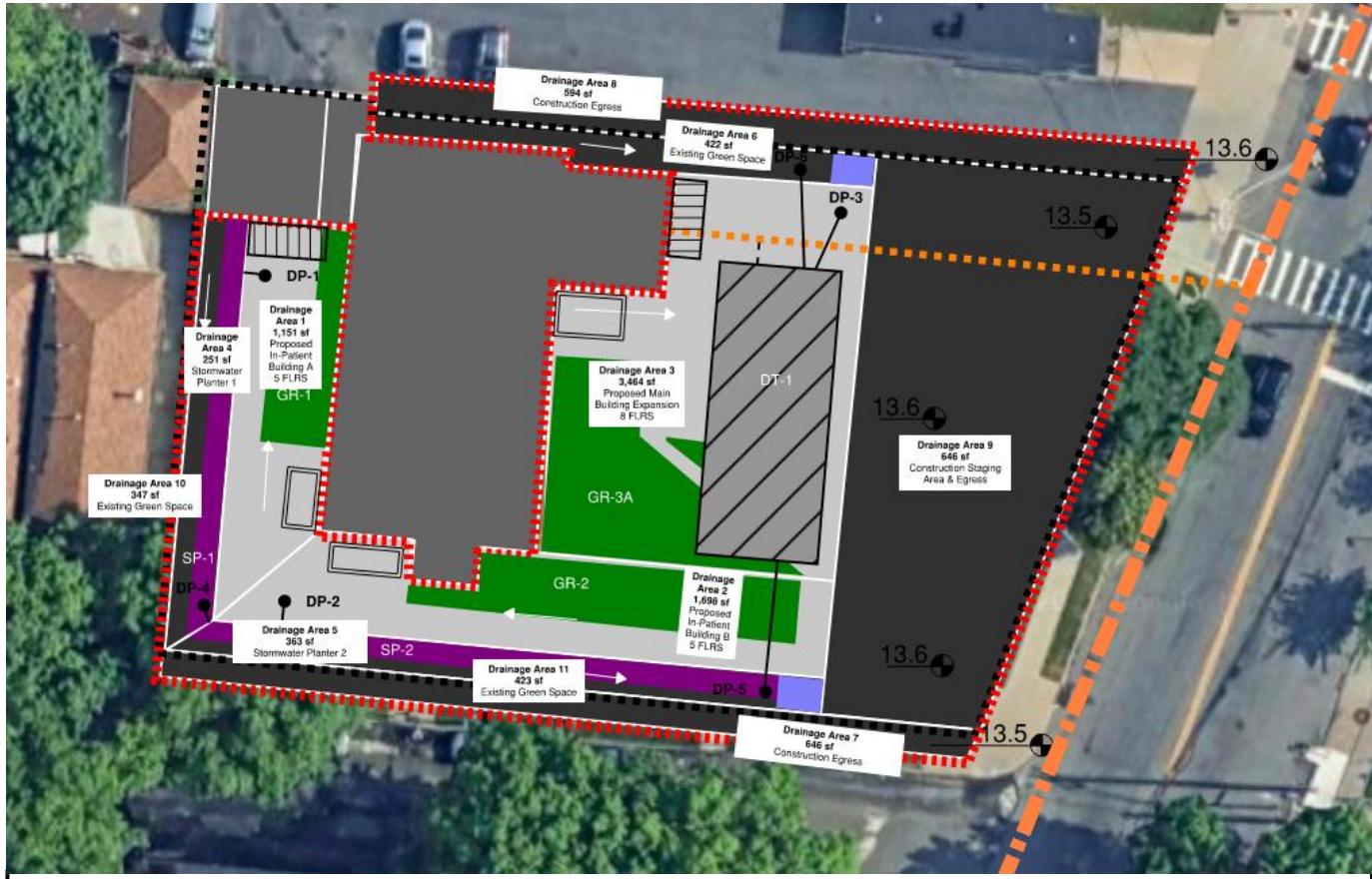
What are the Tier 3 SMP requirements?

DT-1 Proposed Dimensions:
- 9 in Depth
- 53 ft W x 22 ft L Footprint

$$V_{SMP,DT} = 875\ cf \geq V_V = 874\ cfs$$ ✓

$$Q_O = 0.019\ cfs \leq Q_{DRR} = 0.020\ cfs$$ ✓

***Concept Map**: Detention Tank Footprint (Preliminary)*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Detention Tank: *2,128 sf*
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Tier 3 SMP Design *(CSS Only)*

Can the Tier 3 Design be optimized?

Approach 1: Manage a larger portion of the lot

Since the Maximum Release Rate for a site is a function of the proportion of the site that is developed, managing a larger area will increase the allowable Q_{DRR}, and as a result, increase the allowable detention tank depth

Approach 2: Add upstream detention systems

Adding detention in series allows you to reduce the downstream site runoff coefficients, resulting in lower downstream V_V requirements

Tier 3 SMP Design *(CSS Only)*

Can the Tier 3 Design be optimized?

SMP Tier 3 Design Steps *[when driven by Sewer Operations Requirements]*:

- **Step 1:** Determine Contributing Areas
- **Step 2:** Calculate Weighted Runoff Coefficient C_W
- **Step 3:** Calculate Sewer Operations Volume V_V
- **Step 4:** Calculate Maximum Release Rate Q_{DRR}
- **Step 5:** Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability
- **Step 6:** Design Detention System

Approach 1: Manage a larger portion of the lot

Base Design: Manage only developed areas

Tier 3 SMP Design *(CSS Only)*

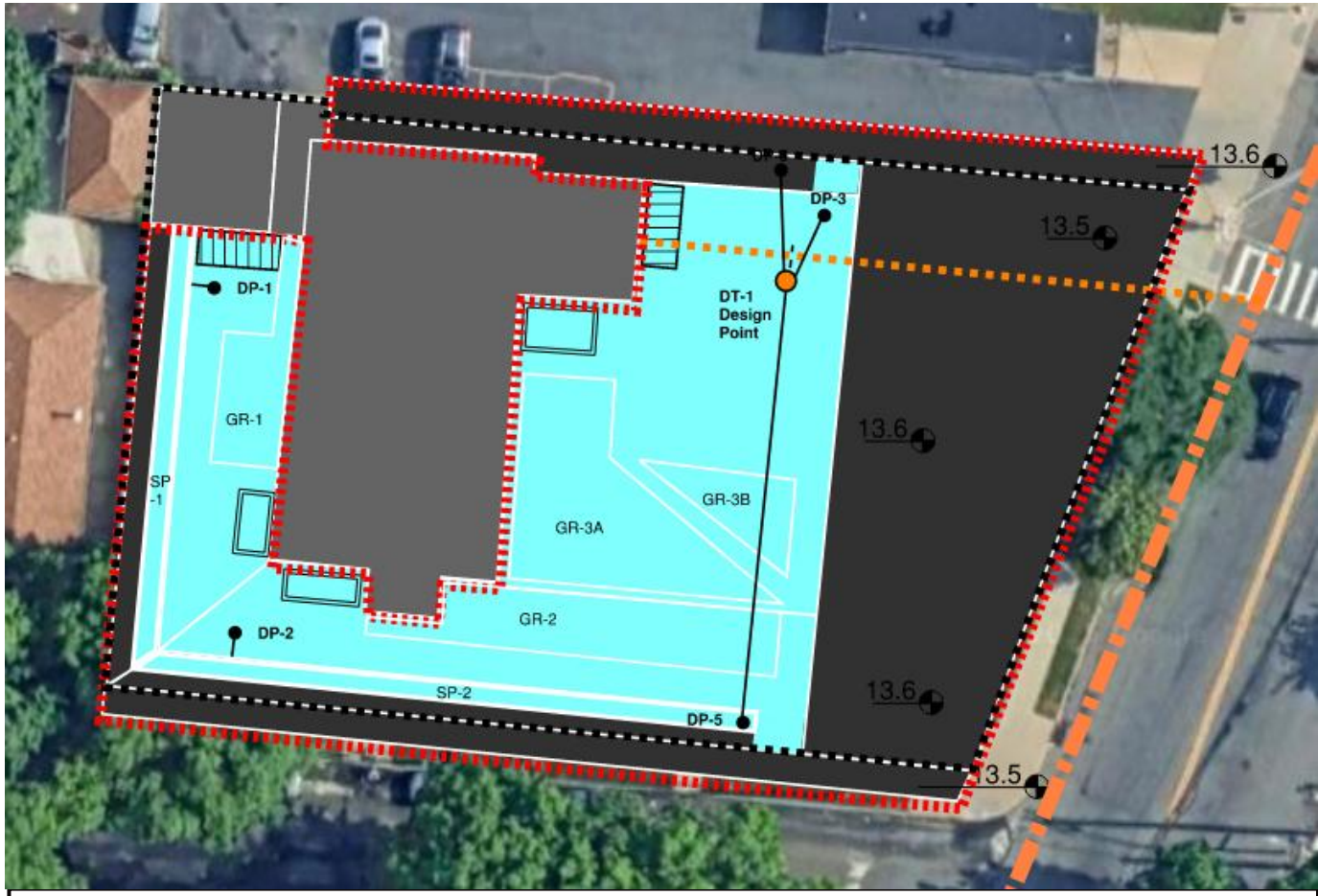
What are the Tier 3 SMP requirements?

Step 1: Determine Contributing Areas

In the base detention design, all developed areas drain to the detention tank, including overflow from all upstream SMPs

$$A_{Site} = 7{,}022\ sf$$

Concept Map: *Area Managed by Detention System (Preliminary)*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Contributing Area in LOD: *7,022 sf*
- Non-Contributing Areas in LOD: *6,623 sf*
- Non-Contributing Areas outside LOD
- Detention System Design Point
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Approach 1: Manage a larger portion of the lot

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 1: Determine Site Contributing Area

In Approach 1, rather than connecting to the existing sewer, the detention system will be built in line with the existing sewer. As a result, it will manage:

- *All developed areas within the LOD*
- *The existing building outside the LOD*

$$A_{Site} = 7{,}022\ sf + 3264\ sf$$

$$A_{Site} = 10{,}286\ sf$$

Concept Map: *Area Managed by Detention System (Preliminary)*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Contributing Area in LOD: *7,022 sf*
- Contributing Areas outside LOD: *3,264 sf*
- Non-Contributing Areas outside LOD: *626 sf*
- Non-Contributing Areas within LOD: *7,237 sf*
- Detention System Design Point
- DP-# Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Approach 1: Manage a larger portion of the lot

Note:
C values vary by **surface** type, not by pervious or impervious cover which is used for WQv calculations.

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 2: Calculate Weighted Runoff Coefficient

- *Complete surface cover design*
- *Establish area of all cover types on the proposed site*
  - *In this case, the roof area and site area both increase as a result of Adjustment 1.*
- *Refer to NYC SWM Table 2.8 to find C values for each surface type.*

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 min. 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.

$A_{Roof} = 4{,}184\ sf + 3264\ sf$

$A_{Paved} = 96\ sf$

$A_{GR} = 2{,}128\ sf$

$A_{Landscaped} = 614\ sf$

$$C_W = \frac{(4{,}184 + 3264) * 0.95 + 96 * 0.85 + 2{,}128 * 0.70 + 614 * 0.20}{7{,}022 + 3264}$$

$$C_W = 0.85$$

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 3: Calculate Sewer Operations Volume V_V

- *Recalculate using the updated contributing area from Step 1 and weighted runoff coefficient from Step 2*

$$V_V = 1,352\ cf$$

+478 cf relative to initial design

Step 4: Calculate Maximum Release Rate Q_{DRR}

- *Recalculate using the updated contributing area from Step 1*

$$Q_{DRR} = 0.030\ cfs$$

+0.01 cfs relative to initial design

Step 5: Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability

- *Recalculate using the updated contributing area from Step 1 and weighted runoff coefficient from Step 2*

$$Q_{Dev} = 1.198\ cfs$$

+0.424 cfs relative to initial design

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 6: Design Detention System

- *Refer to NYC SWM Section 4.10 for guidance on designing SMP components*
- *Select the orifice type and diameter for the detention SMP*
- *Use NYC SWM Eq. 4.16 to calculate the maximum detention storage depth for a re-entrant orifice tube outlet, based on the maximum release rate and orifice diameter*
- *Establish the required SMP footprint to meet volumetric requirements*

$$S_{DR} = \frac{1{,}930 * Q_{DRR}^{\uparrow 2}}{d_O^{\,4}} + \frac{d_O}{24}$$

$$S_{DR}^{\uparrow} = 1.727 ft$$

+11-in relative to initial design

$$V_V^{\uparrow} = S_{DR}^{\uparrow} * A_{SMP}^{\downarrow}$$

$$A_{SMP}^{\downarrow} = \frac{1{,}352\ cf}{1.727\ ft} = 784\ sf$$

-247 sf relative to initial design

Approach 1: Manage a larger portion of the lot

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

DT-1 Proposed Dimensions:

- 20 in Depth
- 37 ft W x 22 ft L Footprint

$$V_{SMP,DT} = 1,357\ cf \geq V_V = 1,352\ cfs$$ ✓

$$Q_O = 0.029\ cfs \leq Q_{DRR} = 0.030\ cfs$$ ✓

***Concept Map**: Detention Tank Footprint (Preliminary)*

LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Detention Tank: *2,128 sf*
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Tier 3 SMP Design *(CSS Only)*

Can the Tier 3 Design be optimized?

SMP Tier 3 Design Steps *[when driven by Sewer Operations Requirements]*:

- **Step 1:** Determine Contributing Areas
- **Step 2:** Calculate Weighted Runoff Coefficient C_W
- **Step 3:** Calculate Sewer Operations Volume V_V
- **Step 4:** Calculate Maximum Release Rate Q_{DRR}
- **Step 5:** Calculate Developed Flow Q_{DEV} to Confirm Q_{DRR} Applicability
- **Step 6:** Design Detention System

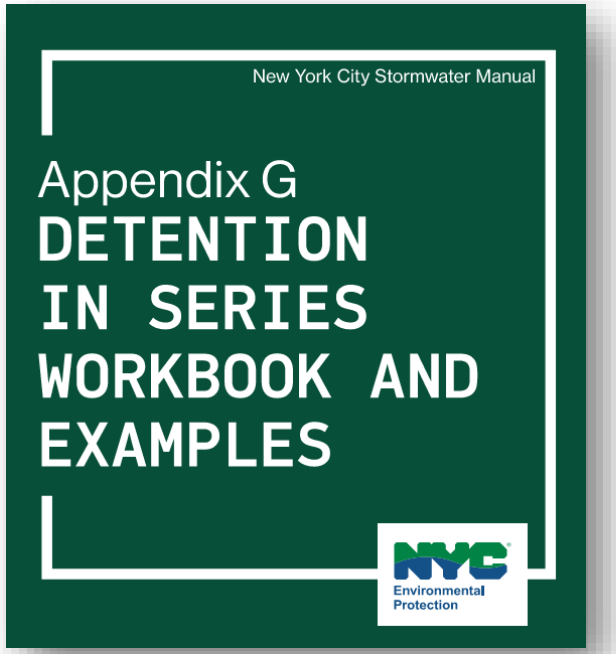
Approach 2: Add upstream detention

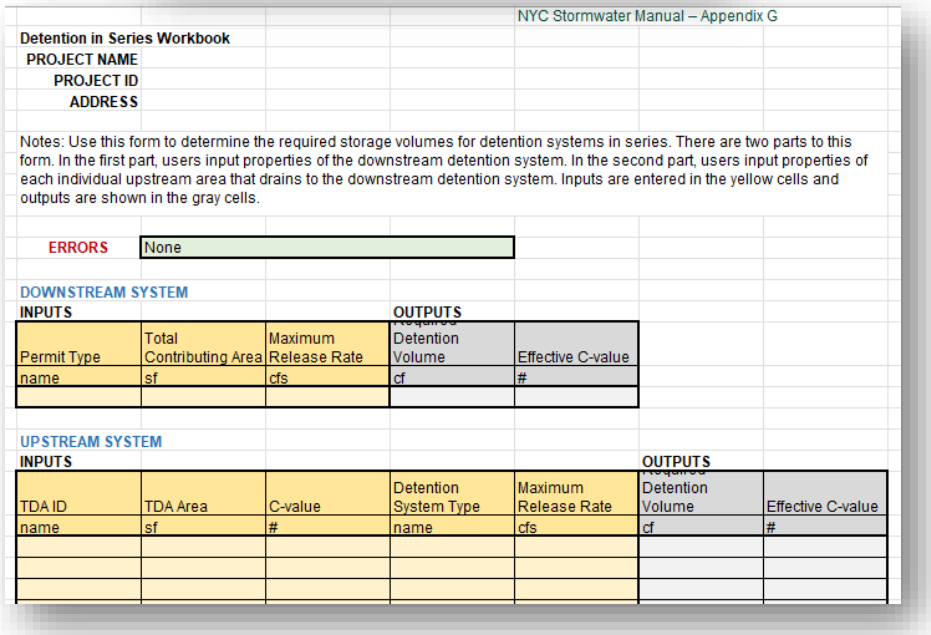
Tier 3 SMP Design *(CSS Only)*

Can the Tier 3 Design be optimized?

Adding blue roofs upstream of the detention tank reduces the effective weighted runoff coefficient of the proposed building roof. As a result, the sewer operations volume required in the downstream detention system will be reduced.

Refer to NYC SWM Appendix G for guidance on detention-in-series design processes.





NYC Stormwater Manual – Appendix G

Detention in Series Workbook

PROJECT NAME
PROJECT ID
ADDRESS

Notes: Use this form to determine the required storage volumes for detention systems in series. There are two parts to this form. In the first part, users input properties of the downstream detention system. In the second part, users input properties of each individual upstream area that drains to the downstream detention system. Inputs are entered in the yellow cells and outputs are shown in the gray cells.

ERRORS: None

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Detention Volume	Effective C-value
name	sf	cfs	cf	#

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

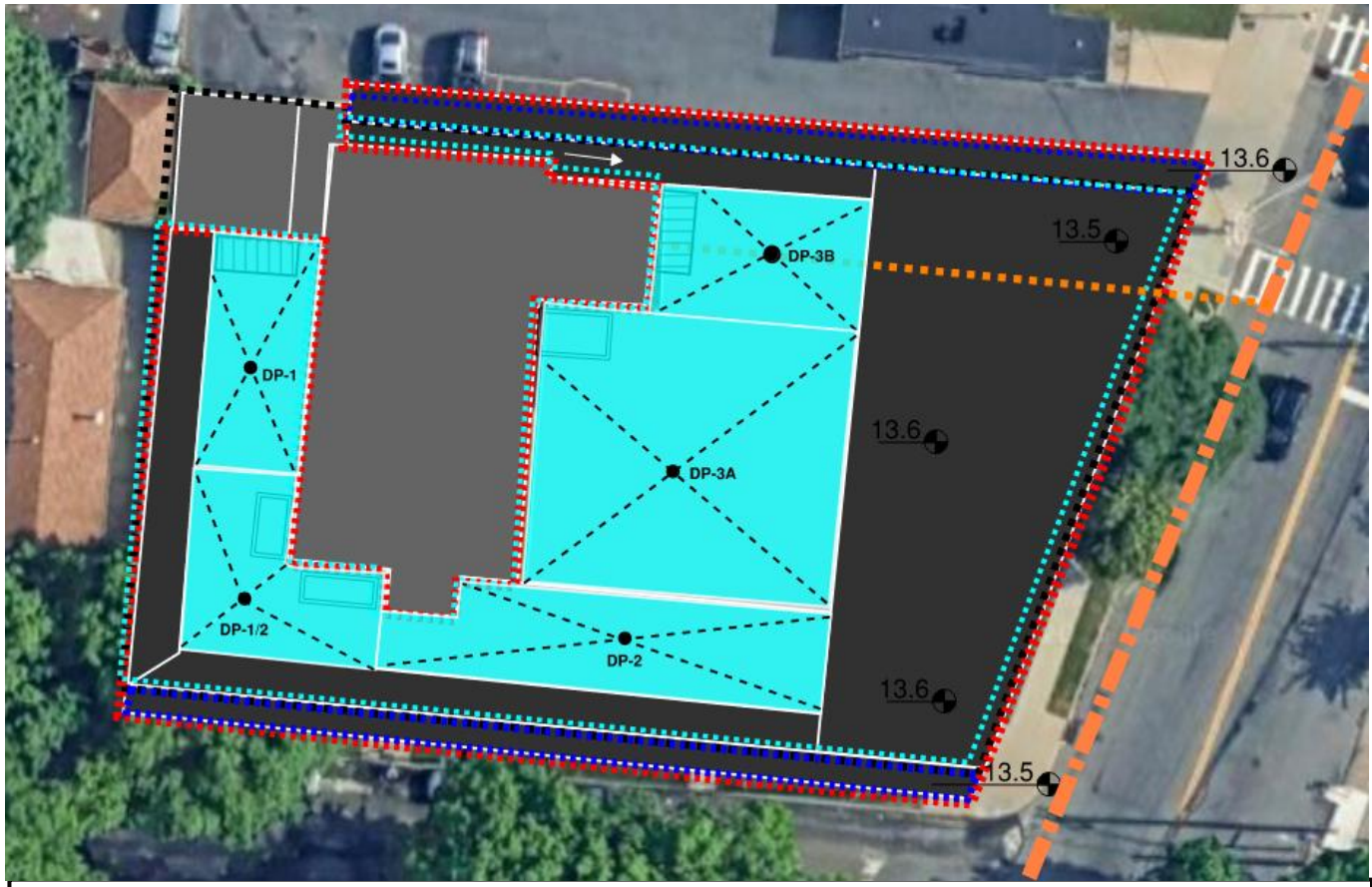
What are the Tier 3 SMP requirements?

Step 1: Determine Contributing Areas

- *In this case, all proposed buildings are converted into blue roofs.*

$$A_{BlueRoof} = 6{,}311\ Sf$$

Concept Map: *Blue Roof Contributing Area Plan*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Contributing Area in LOD: *6,311 sf*
- Non-Contributing Areas in LOD: *6,623 sf*
- Non-Contributing Areas outside LOD
- DP-# Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 1: Determine Contributing Areas

- *In this case, all proposed buildings are converted into blue roofs.*
- *Input upstream & downstream contributing areas into the Appendix G spreadsheet*

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286			

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311		Blue Roof			
AllOthers	3975		None			

Downstream Detention Tank $A_{Site} = 10{,}286\ sf$

Upstream Blue Roof $A_{BlueRoof} = 6{,}311\ sf$

Upstream Undetained Areas $A_{Non-BlueRoof} = 3{,}975\ sf$

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*
3. *DOB Plumbing Code (2022)*
4. *BWSO Criteria for Detention Facility Design*

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

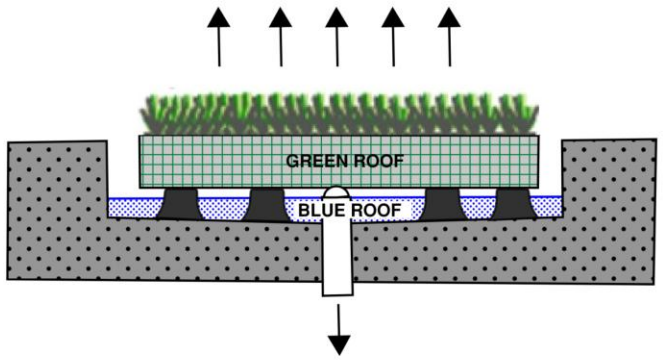
What are the Tier 3 SMP requirements?

Step 2: Calculate Weighted Runoff Coefficient

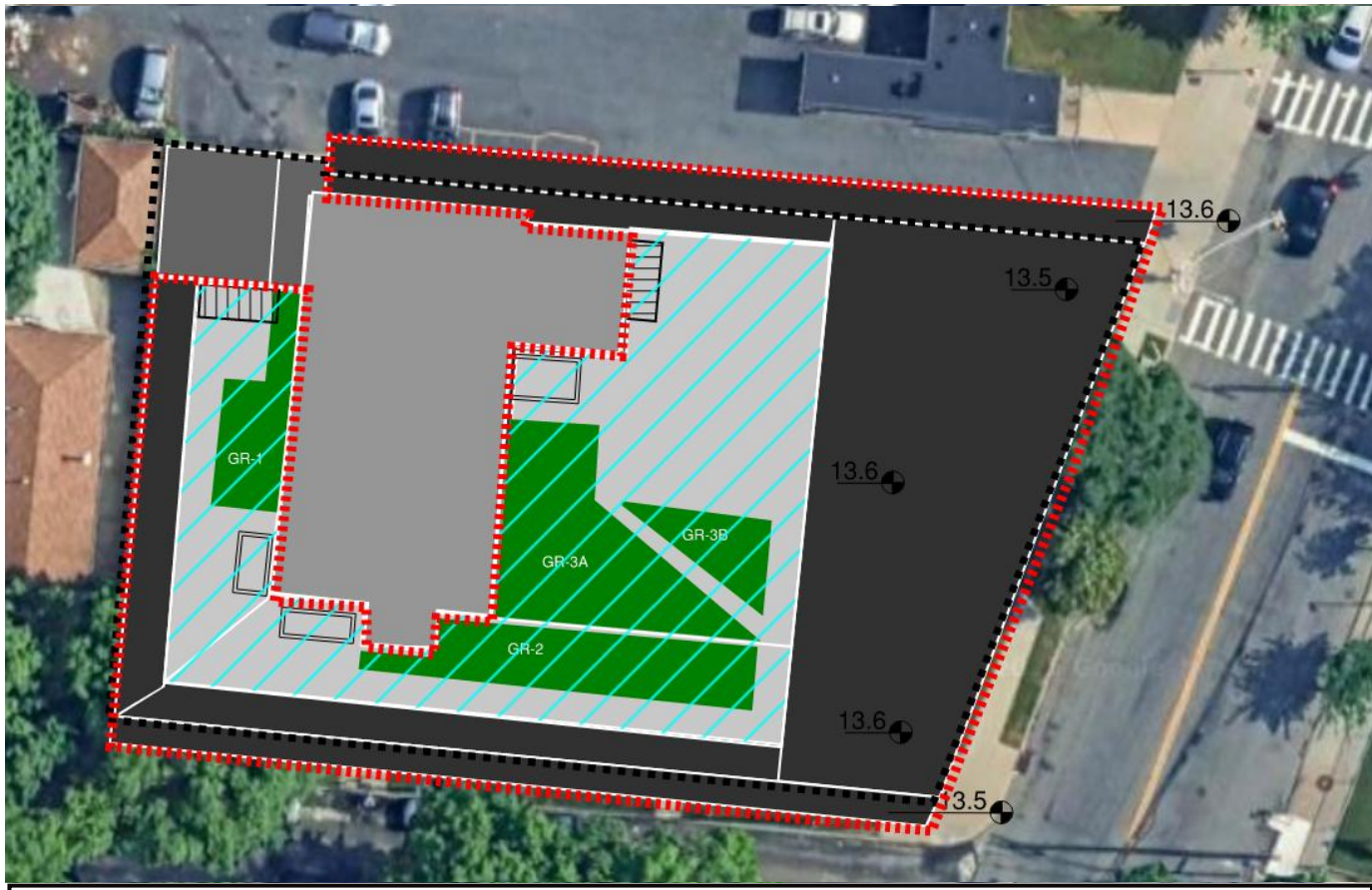
- *Re-calculate Weighted Runoff Coefficients for the Downstream Systems*
- *Calculations must be updated based on the cover types in each contributing area*

$$C_{W,BlueRoof} = \frac{4148 * 0.95 + 2128 * 0.7}{4148 + 2128} = 0.865$$

Blue Roof located beneath Green Roof



Concept Map: *Blue Roof Weighted Runoff Coefficient Areas*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Non-Contributing Areas in LOD
- Non-Contributing Areas outside LOD
- Contributing Areas *9,576 sf*

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

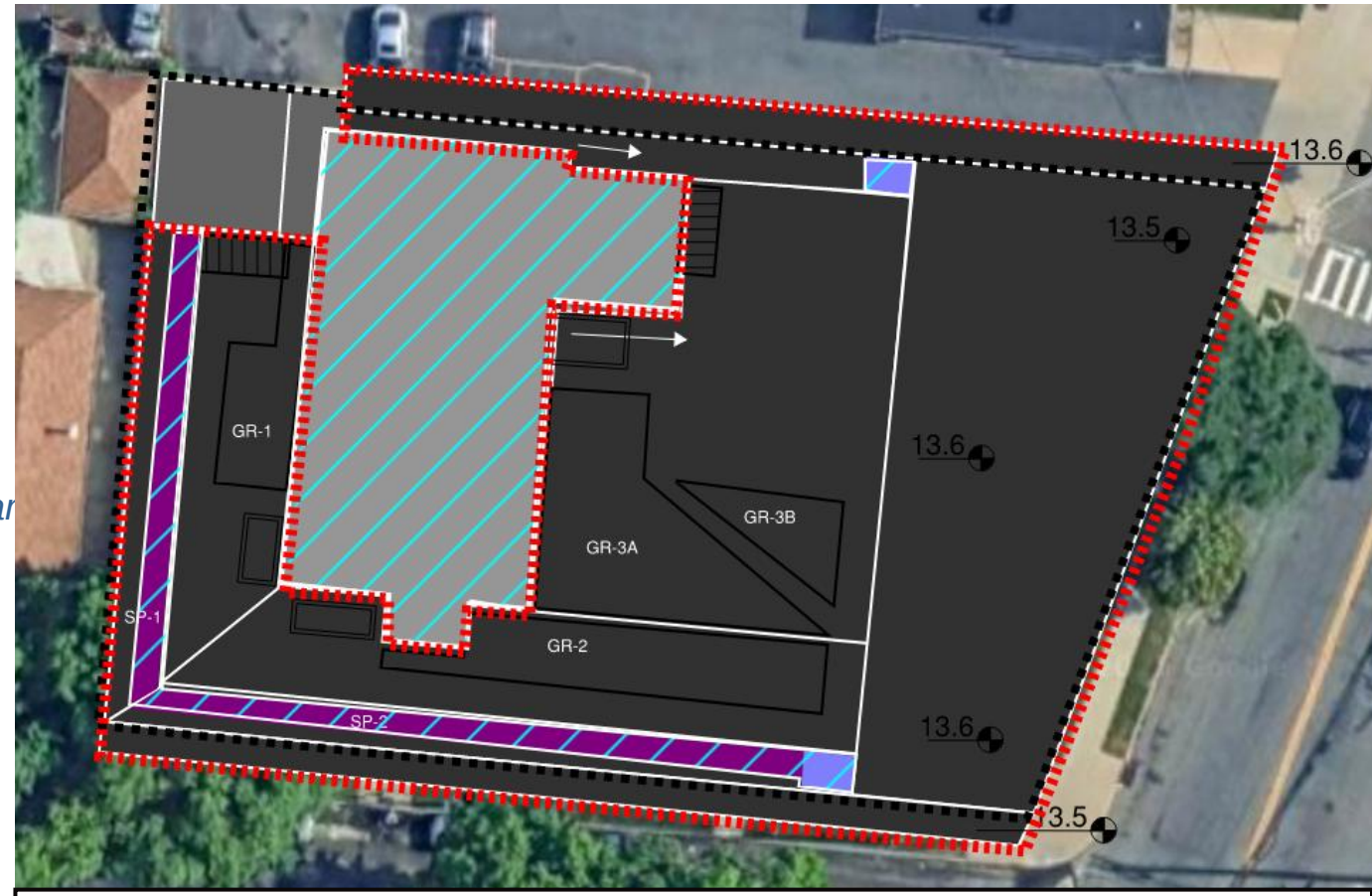
Step 2: Calculate Weighted Runoff Coefficient

- *Re-calculate Weighted Runoff Coefficients for the Downstrear Systems*
- *Calculations must be updated based on the cover types in each contributing area*

$$C_{W,Non-BlueRoof} = \frac{3264 * 0.95 + 96 * 0.85 + 614 * 0.2}{3264 + 96 + 614}$$

$$C_{W,Non-BlueRoof} = 0.832$$

Concept Map: *Non-Blue Roof Weighted Runoff Coefficient Areas*



LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *3,264 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Non-Contributing Areas in LOD
- Non-Contributing Areas outside LOD
- Contributing Areas *9,576 sf*

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Note:

*The downstream weighted runoff coefficient for the detention tank is calculated automatically by the Appendix G spreadsheet, once all other inputs are entered. Refer to the Appendix G guidance for detailed equations use at each step.

Step 2: Calculate Weighted Runoff Coefficient

- *Re-calculate Weighted Runoff Coefficients for the Downstream Systems*
- *Calculations must be updated based on the cover types in each contributing area*

Downstream Detention Tank $C_{W,Site} = ??^{*}$

Upstream Blue Roof $C_{W,BlueRoof} = 0.865$

Upstream Undetained Areas $C_{W,Non-BlueRoof} = 0.832$

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286			

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311	0.865	Blue Roof			
AllOthers	3975	0.832	None			0.83

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*
3. *DOB Plumbing Code (2022)*
4. *BWSO Criteria for Detention Facility Design*

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 3: Calculate Sewer Operations Volume V_V

- *The Appendix G spreadsheet is built to calculate upstream and downstream Vv*
- *Return to this step after Step 4.*

Downstream Detention Tank $V_{V,Site} = ??^*$

Upstream Blue Roof $V_{V,BlueRoof} = ??^*$

Upstream Undetained Areas $V_{V,Non-BlueRoof} = N/A$

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286			

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311	0.865	Blue Roof			
AllOthers	3975	0.832	None			0.83

Note:

*The upstream and downstream detention volume requirements are calculated automatically by the Appendix G spreadsheet, once all other inputs are entered. Refer to the Appendix G guidance for detailed equations use at each step.

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*
3. *DOB Plumbing Code (2022)*
4. *BWSO Criteria for Detention Facility Design*

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 4: Calculate Maximum Release Rate Q_{DRR}

- *The downstream Q_{DRR} does not change relative to that calculated in Approach 1.*

Downstream Detention Tank $Q_{DRR,Site} = 0.030\ cfs$

DOWNSTREAM SYSTEM

INPUTS			**OUTPUTS**	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286	0.030	894	0.56

UPSTREAM SYSTEM

INPUTS					**OUTPUTS**	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311	0.865	Blue Roof	0.161	501	0.39
AllOthers	3975	0.832	None			0.83

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*
3. *DOB Plumbing Code (2022)*
4. *BWSO Criteria for Detention Facility Design*

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 4: Calculate Maximum Release Rate Q_{DRR}

- *The downstream Q_{DRR} does not change relative to that calculated in Approach 1.*
- *The blue roof max release rate Q_{Roof} is a function of the blue roof depth, the number of drains proposed, and the release rate of each drain. See references for additional guidance.*

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286	0.030	894	0.56

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311	0.865	Blue Roof	0.161	501	0.39
AllOthers	3975	0.832	None			0.83

Downstream Detention Tank $Q_{DRR,Site} = 0.030\ cfs$

Upstream Blue Roof $Q_{Roof} = \frac{Q_i * N_{RD} * d_{max}}{499} = \frac{5\frac{gpm}{in} * 5 * 2.90in}{499\frac{gpm}{cfs}} = 0.161cfs$

Upstream Undetained Areas $Q_{Non-BlueRoof} = N/A$

References:

1. NYC SWM Appendix G Workbook
2. NYC SWM Appendix G Examples
3. DOB Plumbing Code (2022)
4. BWSO Criteria for Detention Facility Design

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 3: Calculate Sewer Operations Volume V_V

- *The Appendix G spreadsheet is built to calculate upstream and downstream Vv.*
- *Continue to Step 6 to design detention systems.*

DOWNSTREAM SYSTEM

INPUTS			OUTPUTS	
Permit Type	Total Contributing Area	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	cfs	cf	#
CSS - SCP	10286	0.030	894	0.56

UPSTREAM SYSTEM

INPUTS					OUTPUTS	
TDA ID	TDA Area	C-value	Detention System Type	Maximum Release Rate	Required Detention Volume	Effective C-value
name	sf	#	name	cfs	cf	#
BlueRoofZones	6311	0.865	Blue Roof	0.161	501	0.39
AllOthers	3975	0.832	None			0.83

Downstream Detention Tank $V_{V,Site} = 894\ cf$

Upstream Blue Roof $V_{V,BlueRoof} = 501\ cf$

Upstream Undetained Areas $V_{V,Non-BlueRoof} = N/A$

References:

1. *NYC SWM Appendix G Workbook*
2. *NYC SWM Appendix G Examples*
3. *DOB Plumbing Code (2022)*
4. *BWSO Criteria for Detention Facility Design*

Tier 3 SMP Design *(CSS Only)*

What are the Tier 3 SMP requirements?

Step 6: Design Detention System

- *Design blue roofs to manage their required detention volume*
  - *Exclude roof areas where mechanical equipment and parapets are provided from the SMP footprint*
  - *Account for sloped roofs in V_{SMP} calculation*
- *Design downstream detention tank to manage remaining volume*

Upstream Blue Roof

$$A_{SMP,BR} = 1{,}016\ sf$$

$$d_{SMP,BR} = 2.90\ in$$

Downstream Detention Tank

$$S_{DR} = 1.727 ft$$

+11-in relative to initial design

+0-in relative to Approach 1

$$V_{V,DT} = 894\ cf$$

+20-cf relative to initial design

-458-cf relative to Approach 1

$$V_V \downarrow = S_{DR} * A_{SMP} \downarrow$$

$$A_{SMP} \downarrow = \frac{893\ cf}{1.727\ ft} = 517\ sf$$

-539 sf relative to initial design

-266 sf relative to Approach 1

Approach 2: Add upstream detention

Tier 3 SMP Design *(CSS Only)*

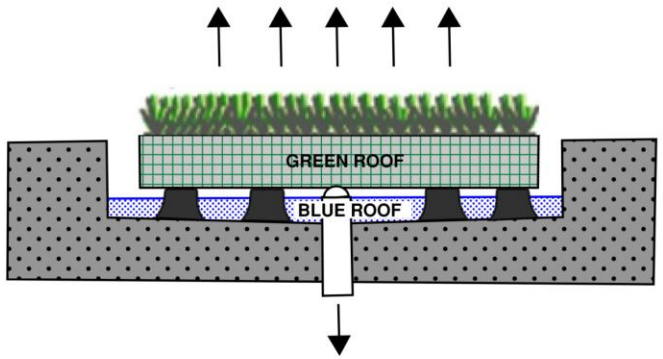
What are the Tier 3 SMP requirements?

DT-1 Proposed Dimensions:
- 20 in Depth
- 25 ft W x 22 ft L Footprint

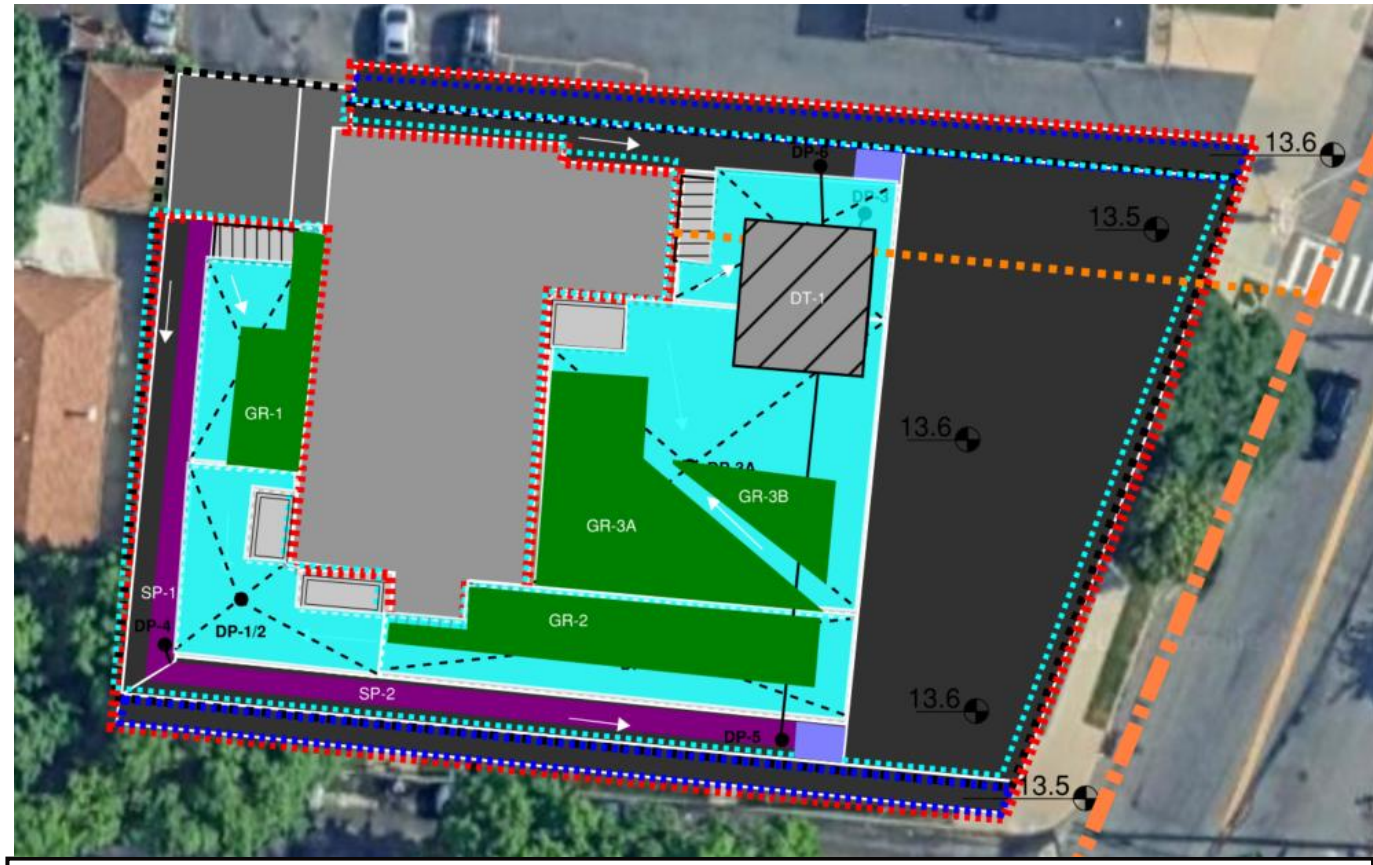
$V_{SMP,DT} = 917\ cf \quad \geq \quad V_V = 894\ cf$ ✓

$Q_O = 0.029\ cfs \quad \leq \quad Q_{DRR} = 0.030\ cfs$ ✓

Blue Roof located beneath Green Roof



***Concept Map**: Detention Tank Footprint (Preliminary)*

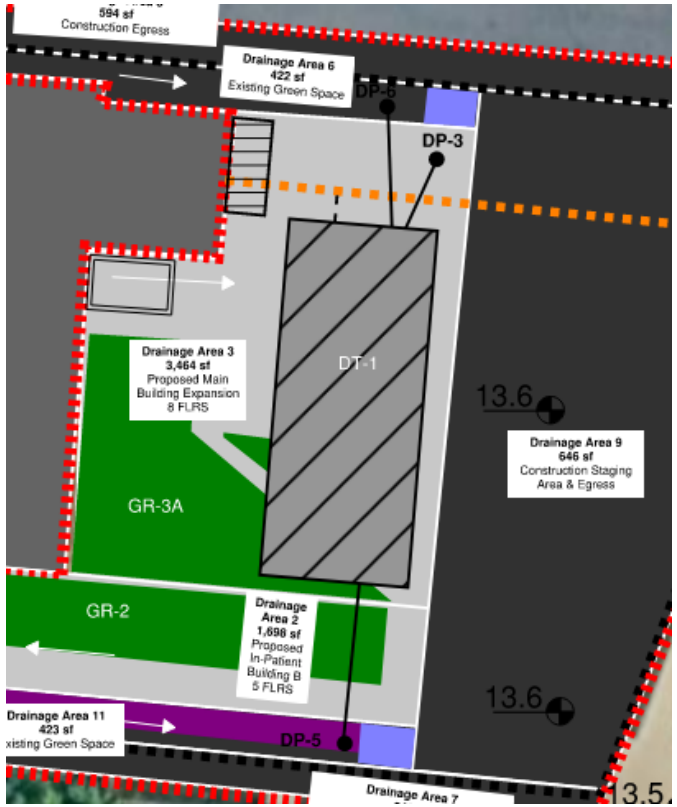


LEGEND

- Property Lot: *15,900 sf*
- Limit of Disturbance (LOD): *13,237 sf*
- Roof Area: *4,184 sf*
- Green Roof Area: *2,128 sf*
- Stormwater Planter Area: *614 sf*
- Paved Area: *96 sf*
- Blue Roof Area
- Detention Tank: *2,128 sf*
- DP- # Drainage Point and ID
- Schematic Inlet & Internal Drainage
- Proposed Site Sewer Connection
- Existing Sewer Connection
- NYC Combined Sewer System

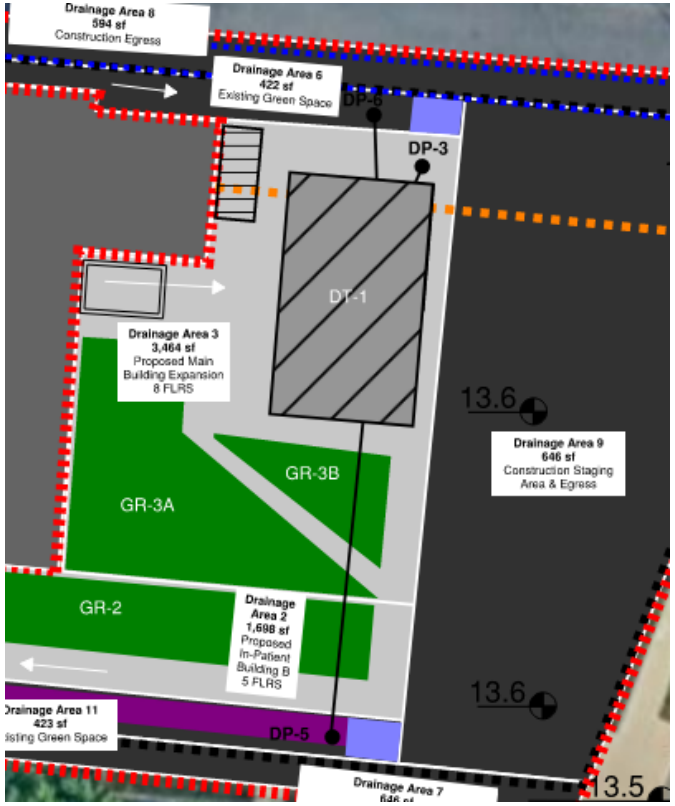
Tier 3 SMP Design

Can the Tier 3 Design be optimized?



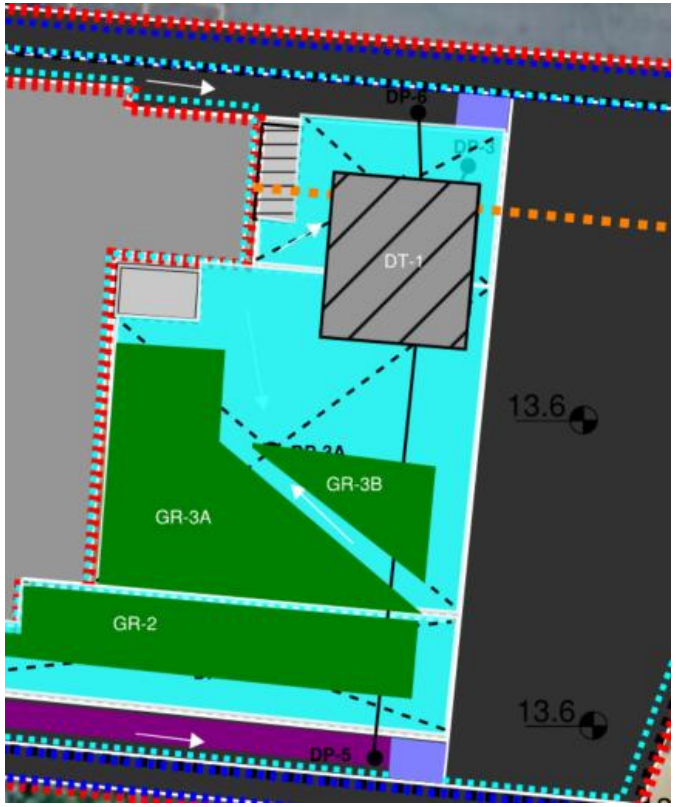
Original Design

DT-1 Proposed Dimensions:
- 9 in Depth
- 53 ft W x 22 ft L Footprint



Approach 1: Manage a larger portion of the lot

DT-1 Proposed Dimensions:
- 20 in Depth
- 37 ft W x 22 ft L Footprint



Approach 2: Add upstream detention systems

DT-1 Proposed Dimensions:
- 20 in Depth
- 25 ft W x 22 ft L Footprint

Confirming all Requirement are Met

Confirming All Requirements Were Met

Are all requirements met?

SMP ID	Required $WQ_{V,SMP}$ (cf)	V_{SMP} (cf)	Provided $WQ_{V,}$ (cf)	Provided RR_V (cf)	Provided V_V (cf)
GR-1	44	49	44	44	0
GR-2	76	86	76	76	0
GR-3A	106	119	106	106	0
GR-3B	27	30	27	27	0
SP-1	122	138	122	122	0
SP-2	169	200	169	169	0
BR-1	501*	618	290	0	501
DT-1	894*	917	0	0	894

Site-Wide Parameters	WQ_V (cf)	RR_V (cf)	V_V (cf)
Total Volume Provided	834	544	894
Total Volume Required	834	406 (*Minimum*)	894
Remaining Volume to be Managed	0	0	0
	✓	✓	✓

*Requirement is driven by V_V in this case, not WQ_V

Questions

NYC Environmental Protection