Stantec

City of Somerville

Municipal Vulnerability Preparedness Grant

Green Stormwater Infrastructure Feasibility Study

June 24, 2019

Prepared for:

City of Somerville, Massachusetts

OVERVIEW

Stantec has studied the feasibility of constructing green stormwater infrastructure (GSI) within the public right-of-way for six neighborhood opportunity areas in the City of Somerville. These study areas were developed in collaboration with the City and represent a range of different street and neighborhood types found throughout the City. Each opportunity area ranges in size from 35 to 90 acres.

To conduct the study, Stantec used the City of Somerville's most up-to-date GIS data to identify locations within the six opportunity areas that may be suitable for implementation of stormwater management practices (SMPs) based on several siting and right-of-way parameters. Once we understood these locations, we determined the drainage area and most appropriate SMP for the site based on a second set of criteria, including available space and street slope.

Based on a combination of parameters surrounding each Stormwater Management Practice (SMP) (drainage area, sidewalk width, SMP type, etc.) we scored and ranked each SMP site. The score is intended to reflect both the impact and relative ease of design and construction of each SMP.

The methodology behind the ranking has been discussed with the City, however, there is the ability to update rankings and the associated parameters in response to the development of the City's green infrastructure program and stakeholder feedback. The result of the scoring and ranking exercise is a sorted list of SMPs and locations from highest to lowest priority.

GIS ANALYSIS

Using a GIS analysis, Stantec identified locations that may be suitable for installing SMPs within each of the six neighborhood opportunity areas. Specifically, we reviewed GIS layers for building footprints, property lines, combined and separate storm and sewer utility mains, fire hydrants, utility poles, street trees, and LiDAR topography. Stantec employed the following horizontal offsets:

- 10' horizontal offset from buildings
- 5' horizontal offset from utility poles and lights
- 3' horizontal offset from utility mains, laterals, and associated valves, hydrants, and manholes
- No horizontal offset from property lines, but used the property line as a hard boundary and removed all area outside of the public right-of-way
- 6' horizontal offset from existing street trees

This analysis identified locations that may be suitable to implement SMPs. It is important to note that the analysis is a high-level review of available surface area and does not account for variable subsurface conditions such as the condition and type of soil or subsurface utilities that are not included in the GIS database.

To give a more realistic depiction of implementation feasibility, we further refined the locations as follows:

- Removed all areas where the street slope exceeded 5 percent
- Removed areas where available width was less than 5 feet

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

The locations remaining after refinement are referred to as the available SMP footprint.

DRAINAGE AREAS AND GREEN INFRASTRUCTURE FOOTPRINTS

In combination with the GIS analysis, we delineated approximate drainage areas to the downstream end of each available SMP footprint based on topography and location of catch basins (inlets). From there we sketched in a conceptual SMP site for each drainage area. The SMP site footprints were set independently of the recommended SMP type, as there are other surface features and site elements that drive this decision – regardless of available footprint.

We applied a 65% impervious cover ratio to the total area. This value corresponds to the land use and type of development seen widely across Somerville, to which City confirmed to be appropriate for this planning exercise. The relationship of impervious drainage area to SMP footprint area is ideally set between 10:1 and 15:1. This is a ratio range that is based on typical thresholds for an infiltrating system to be able to effectively transmit hydraulic loading and to filter runoff pollution (e.g. sediment, nutrients, etc.)

The resulting SMP sites that have been sketched in reflect a layout that may not be inherently obvious based on the available SMP footprint. For example, we did not obtain information regarding utility laterals to homes and buildings, however, understand these would complicate the construction of the SMP system. As such, we avoided placing SMPs directly in front of houses as this would likely conflict with service laterals. In turn, we focused on placing SMPs at the ends of blocks and along side yards to avoid these conflicts. We also avoided breaking up SMP sites into multiple pieces, such as around trees or utility manholes near the curb line.

STORMWATER MANAGEMENT PRACTICE (SMP) DETERMINATION

By understanding site features such as sidewalk width and parking conditions, we were able to determine an appropriate SMP type for each site. For example, a street with parking on either side may be suitable for a stormwater bumpout since the bumpout width is typically the width of the parking lane, while allowing vehicles to travel as they would normally.

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

Given these site specific features, we developed siting parameters that determined which SMP type may be most suitable at each site. The parameters are as follows:

SMP Type	Siting Parameters
Bumpout	• Parking lane present (bumpout width to the limit of parking) • Streets at least 26' wide (to allow for emergency vehicle access)
Planter Box	• Sidewalk width at least 9' wide (3' wide planter with 6' walking zone)
Subsurface Trench	• Available GSI footprint and drainage, but not enough space for a bumpout or planter box
Raingarden	• Outside of public right-of-way • Ability to manage impervious area without impeding on the site's programming (e.g. inhibiting adequate sidewalks or drive aisles within parking lots)
Green Roof	• New construction • Public buildings slated for substantial renovation (including structural upgrades to building)
Porous Pavement	• Outside of public right-of-way • No space to implement surface practice

Bioswales were considered as part of this analysis but were determined to be not feasible given the number and proximity of large trees adjacent to walkways within park areas.

A series of six maps are provided in **Appendix A.** A map is provided for each neighborhood opportunity area depicting the drainage areas, associated SMP site footprints, and SMP types.

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

SMP PRIORITIZATION AND RANKING

Following identification of recommended SMP types, we developed a methodology for ranking each SMP site that reflect either the effectiveness, cost of design and construction, or highly desired SMPs.

Impervious Drainage Area and Loading ratio relate to the effectiveness of the SMP in terms of impervious area managed and the loading of the SMP by that drainage area. Street Slope and Sidewalk Width reflect the relative ease or complexity of design and construction and associated cost. Feasible SMP Type is prioritized based on which kind of SMP is appropriate at a given location – with high priority on vegetated surface expressions.

Several factors were identified and assigned a scoring weight, priority value of 1 to 3, with associated parameter ranges "binned" into High, Medium, and Low priority categories. Scoring weights and priority ranges were determined based both on Stantec's experience working with other communities as well as feedback from the City, and adjusted in order to obtain a diverse spread of scores. Weights and ranges can be adjusted in the future as the City's priorities may change.

The matrix below outlines the ranking methodology:

SMP Site Scoring Matrix				
Factors	**Scoring Weight**	**Lowest Priority (Value = 1)**	**Medium Priority (Value = 2)**	**Highest Priority (Value = 3)**
Impervious Drainage Area	20%	< 15,000 SF	15,000 SF - 25,000 SF	≥ 25,000 SF
Loading Ratio	40%	> 25:1	15:1 to 25:1	≤ 15:1
Street Slope	10%	4% - 5%	2% - 4%	0% - 2%
Sidewalk Width	10%	< 6 ft	6 ft - 9 ft	≥ 9 ft
Feasible SMP Type(s)	20%	Subsurface Trench	Planter Box, Porous Paving	Bumpout, Rain Garden, Green Roof

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

Applying the scoring matrix to each SMP generated a score between 1 and 3, with 1 representing the lowest priority, and 3 the highest. The Excel file provided in **Appendix B** will allow the City of Somerville to change the priority ranges should they desire to do so, which can reflect changing priorities as the green infrastructure program progresses. Each SMP is coded based on the study area and a sequential letter assigned to the SMP within that area. So for the example below, 03_B indicates that it is the second SMP identified within Study Area #3.

An example of the scoring calculation is as follows:

System 03_B			
Factors	**Value**	**Priority**	**Weighted Score**
Impervious Drainage Area	4,216 SF	1	0.2
Loading Ratio	10:1	3	1.2
Street Slope	0.5%	3	0.3
Sidewalk Width	10-ft	3	0.3
Feasible SMP Type	Bumpout	3	0.6
Score	**2.6**		

Running this calculation for each SMP site allowed for us to generate a score for each SMP site and sort the list with the highest priority locations at the top. The table below lists each SMP from highest to lowest score. An asterisk (*) indicates a property outside of the public right-of-way. The scoring matrix was applied slightly different to these sites.

Each SMP outside of the right-of-way received a priority value of 3 in the Sidewalk Width category. This reflects a higher level of opportunity to manage stormwater, as well as an increased relative ease of construction (e.g. outside of the roadway, less traffic maintenance, fewer subsurface utility considerations, etc.). Similarly, these sites receive a score of 3 in the Street Slope category. This is because the impacts that street slope would have on the SMP design and construction would be make simpler for SMPs not located in the roadway. For example, a parking lot that is going to be replaced with porous paving could be re-graded to be flatter and more effective in managing runoff. Or in the case of a green roof, it simply does not apply at all and is therefore a non-factor.

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

Rank	SMP ID	Location	SMP Type	Score
1	03_G	Herbert St Parking Lot*	Raingarden	2.8
2	11_A	Medford St and School St	Bumpout	2.7
3	03_J	City Traffic & Parking Dept*	Green Roof	2.6
4	03_B	Holland St Gorham to Jay	Bumpout	2.6
5	12_I	Tufts St and Glen Parking Lot*	Raingarden	2.6
6	03_I	Davis Square Parking Lot*	Raingarden	2.6
7	08_D	Grant St and Sydney St	Bumpout	2.5
8	11_C	Waldo and Hudson	Bumpout	2.5
9	12_G	Glen St and Fountain	Bumpout	2.5
10	08_E	Grant St and Sewall St	Bumpout	2.5
11	08_F	Jaques St and Temple St	Bumpout	2.5
12	08_A	Sydney St and Taylor St	Bumpout	2.4
13	10_C	Hillsdale Rd and Opland Rd	Bumpout	2.4
14	12_D	Glen St and Fountain	Bumpout	2.4
15	12_J	Fountain Ave and Glen St Parking Lot*	Porous Paving	2.4
16	12_K	Capuano School Vacant Lot*	Porous Paving	2.4
17	03_D	Holland St and Paulina St	Planter	2.4
18	10_B	W Adams St and Chetwynd Rd	Bumpout	2.3
19	03_A	Holland St and Elmwood St	Planter	2.3
20	03_H	Orchard St and Day St	Bumpout	2.2
21	02_B	Bleachery Ct and Somerville Ave	Subsurface Trench	2.2
22	08_B	Grant St and Mystic Ave	Subsurface Trench	2.1
23	11_B	Central St and Willoughby St	Subsurface Trench	2.1
24	10_A	North St and Bailey St	Bumpout	2.1
25	11_D	Waldo and Hudson	Bumpout	2.1
26	12_B	Auburn and Cross	Bumpout	2.1
27	10_E	Conwell Ave and College Hill Rd	Subsurface Trench	2.1
28	02_C	Park St and Somerville Ave	Subsurface Trench	2.0
29	02_E	Properzi Way and Hanson St	Subsurface Trench	2.0
30	02_G	Church St and Somerville Ave	Subsurface Trench	2.0
31	12_A	Auburn and Cross	Subsurface Trench	2.0
32	02_F	Palmacci Playground	Bumpout	2.0
33	12_E	Tufts St and Glen St	Bumpout	2.0
34	12_F	Tufts St and Knowlton St	Bumpout	2.0
35	10_D	Hillsdale Rd and Sunset Rd	Subsurface Trench	2.0

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

Rank	SMP ID	Location	SMP Type	Score
36	03_C	Holland Street at Jay St	Subsurface Trench	2.0
37	10_G	Hillsdale Rd and Conwell Ave	Subsurface Trench	1.9
38	10_J	Chetwynd Rd and Curtis St	Subsurface Trench	1.9
39	10_K	Chetwynd Rd and Curtis St	Subsurface Trench	1.9
40	08_G	Edgar Ave and Heath St	Bumpout	1.9
41	02_D	Washington St and Hanson St	Bumpout	1.9
42	02_A	Kent St and Somerville Ave	Subsurface Trench	1.8
43	12_C	Flint and Rush	Subsurface Trench	1.8
44	12_H	Glen St and Morton St	Bumpout	1.8
45	03_F	Thorndike St and Howard St	Bumpout	1.7
46	08_C	Grant St and Sydney St	Bumpout	1.7
47	10_I	W Adams St and Conwell Ave	Subsurface Trench	1.6
48	03_E	Holland St and Elmwood St	Subsurface Trench	1.5
49	10_H	W Adams St and Conwell Ave	Subsurface Trench	1.5
50	10_F	Conwell Ave and College Hill Rd	Subsurface Trench	1.3

Reference: **Somerville MVP Grant – Green Infrastructure Feasibility Study**

CONCLUSION

There appears to be ample opportunity to implement green infrastructure in the City of Somerville. However, some locations are more favorable than others. The highest ranked sites tend to be those that can capture a high amount of drainage with enough space to construct the SMP. Additionally, the optimum locations for green infrastructure tend to be those that incorporate surface practices, such as bumpouts and raingardens. High value is placed on these sites because not only do they have the ability to manage stormwater, but these areas include incidental benefits such as beautification and pedestrian improvements.

The results of the analysis have been developed with the flexibility to be updated and adapted to the unique needs of Somerville, both as priorities develop and as the City's green infrastructure program develops and stakeholders are engaged.

NEXT STEPS

The identified SMPs will be incorporated in the City's refined model to quantify flood reductions in current and projected climate change conditions. Stantec will also quantify water quality benefits of implementation of the identified SMPs using the Massachusetts Stormwater Handbook TSS removal calculation tool, and the methodology described in the *General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4) in Massachusetts* for total phosphorus loading changes.

APPENDIX A

SMP Maps

City of Somerville MVP Grant Study Area #2

SMP Footprints & Drainage Areas

SMP Summary

A	Kent St and Somerville Ave System Type: Subsurface Trench Total Area: 35,353 SF SMP Footprint: 1,099 SF
B	Bleachery Ct and Somerville Ave System Type: Subsurface Trench Total Area: 20,343 SF SMP Footprint: 1,679 SF
C	Park St and Somerville Ave System Type: Subsurface Trench Total Area: 9,433 SF SMP Footprint: 646 SF
D	Washington St and Hanson St System Type: Bumpout Total Area: 37,237 SF SMP Footprint: 461 SF
E	Properzi Way and Hanson St System Type: Subsurface Trench Total Area: 8,910 SF SMP Footprint: 731 SF
F	Palmacci Playground System Type: Bumpout Total Area: 17,427 SF SMP Footprint: 628 SF
G	Church St and Somerville Ave System Type: Subsurface Trench Total Area: 5,060 SF SMP Footprint: 324 SF

Legend

- SMP Footprint
- **Priority**
  - High
  - Medium
  - Low
- Drainage Area
- Study Area
- Catch Basin
- Street Slope Direction
- Buildings
- Parcels

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 125 250 500 Feet

N

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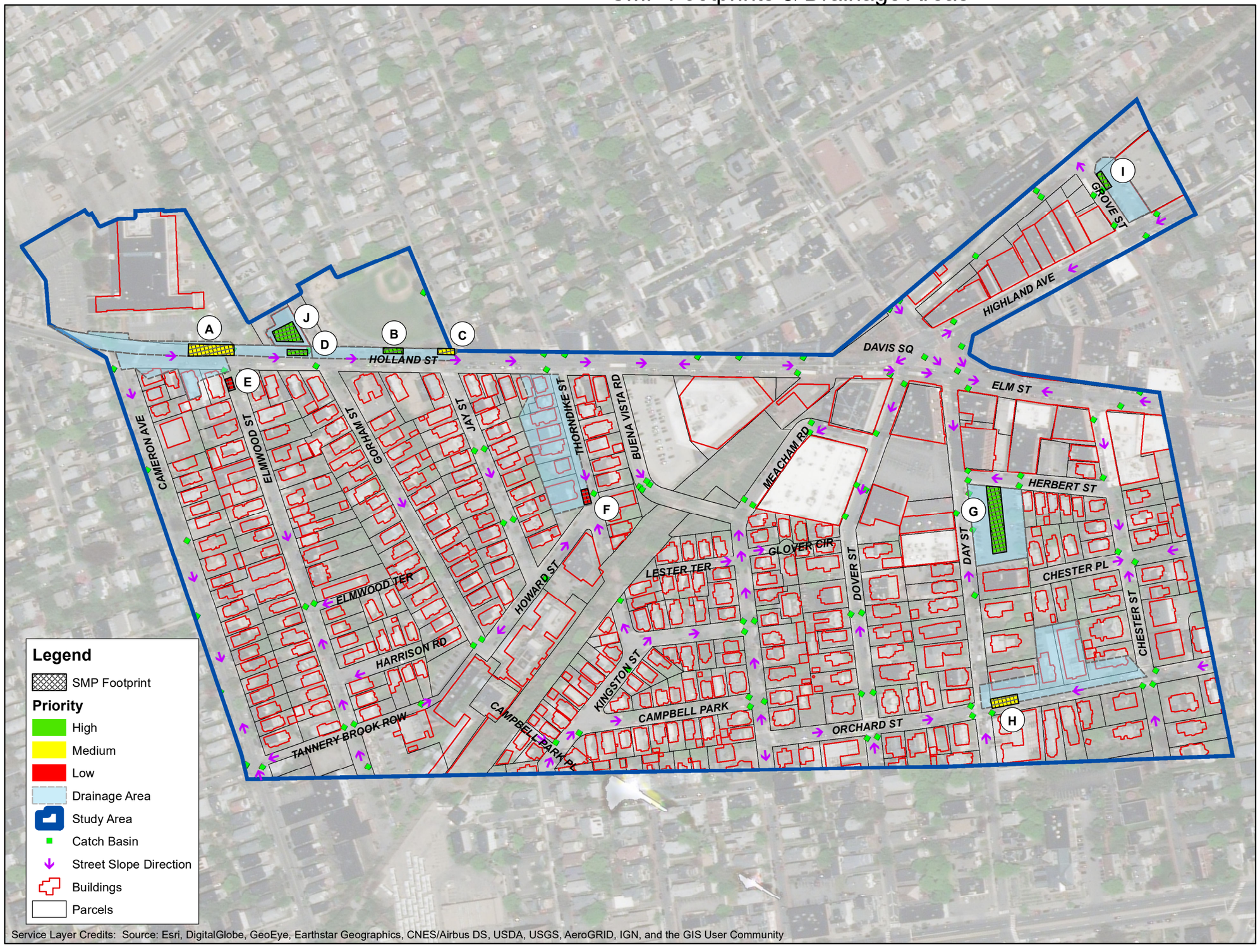
City of Somerville MVP Grant Study Area #3

SMP Footprints & Drainage Areas



Legend

- SMP Footprint
- **Priority**
  - High
  - Medium
  - Low
- Drainage Area
- Study Area
- Catch Basin
- Street Slope Direction
- Buildings
- Parcels

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMP Summary

A	Holland St and Elmwood St System Type: Planter Total Area: 14,841 SF SMP Footprint: 3,066 SF
B	Holland St Gorham to Jay System Type: Bumpout Total Area: 06,486 SF SMP Footprint: 671 SF
C	Holland Street at Jay St System Type: Subsurface Trench Total Area: 3,694 SF SMP Footprint: 598 SF
D	Holland St and Paulina St System Type: Planter Total Area: 5,274 SF SMP Footprint: 727 SF
E	Holland St and Elmwood St System Type: Subsurface Trench Total Area: 14,341 SF SMP Footprint: 494 SF
F	Thorndike St and Howard St System Type: Bumpout Total Area: 35,253 SF SMP Footprint: 633 SF
G	Herbert St Parking Lot System Type: Raingarden Total Area: 23,758 SF SMP Footprint: 5,458 SF
H	Orchard St and Day St System Type: Bumpout Total Area: 35,540 SF SMP Footprint: 1,485 SF
I	Davis Square Parking Lot System Type: Raingarden Total Area: 9,929 SF SMP Footprint: 670 SF
J	City Traffic & Parking Dept System Type: Raingarden Total Area: 6,256 SF SMP Footprint: 2,311 SF

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 125 250 500 Feet

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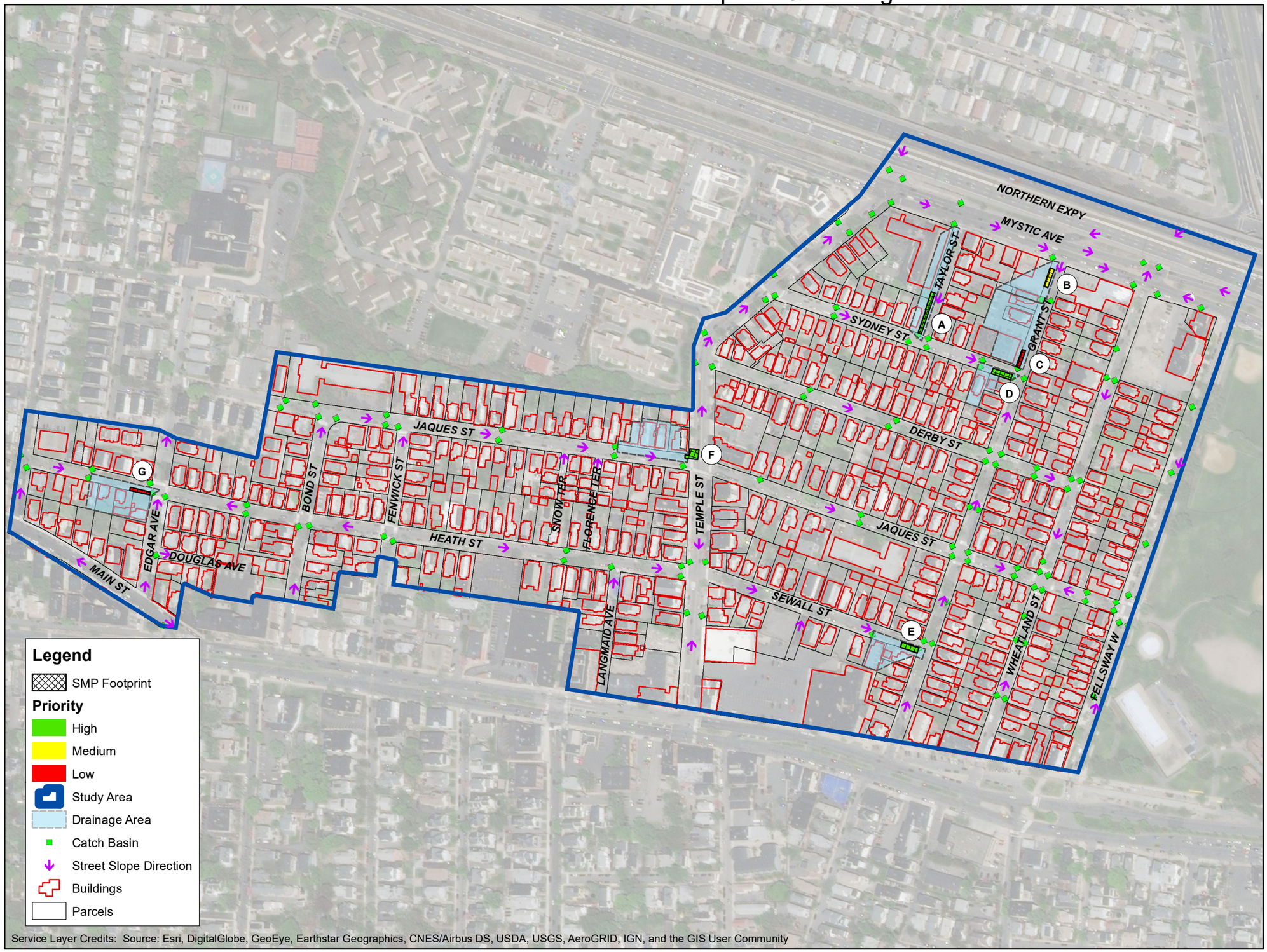
N

City of Somerville MVP Grant Study Area #8

SMP Footprints & Drainage Areas



SMP Summary

A	Sydney St and Taylor St System Type: Bumpout Total Area: 13,459 SF SMP Footprint: 1,165 SF
B	Grant St and Mystic Ave System Type: Subsurface Trench Total Area: 09,879 SF SMP Footprint: 638 SF
C	Grant St and Sydney St System Type: Bumpout Total Area: 23,053 SF SMP Footprint: 541 SF
D	Grant St and Sydney St System Type: Bumpout Total Area: 7,347 SF SMP Footprint: 899 SF
E	Grant St and Sewall St System Type: Bumpout Total Area: 10,313 SF SMP Footprint: 812 SF
F	Jaques St and Temple St System Type: Bumpout Total Area: 15,626 SF SMP Footprint: 800 SF
G	Edgar Ave and Heath St System Type: Bumpout Total Area: 17,089 SF SMP Footprint: 497 SF

Legend

- SMP Footprint

Priority

- High
- Medium
- Low
- Study Area
- Drainage Area
- Catch Basin
- Street Slope Direction
- Buildings
- Parcels

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 125 250 500 Feet

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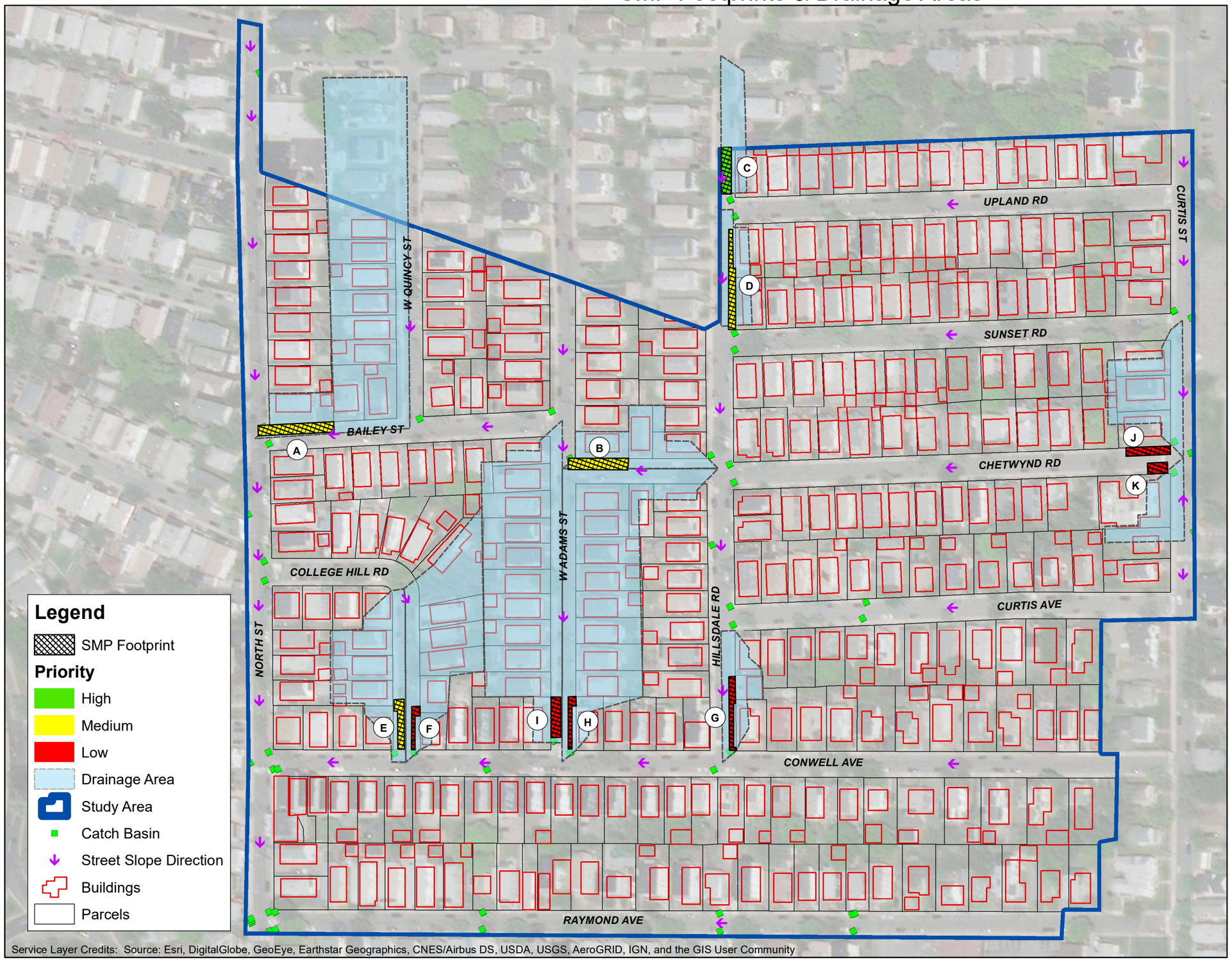
City of Somerville MVP Grant Study Area #10

SMP Footprints & Drainage Areas



Legend

- SMP Footprint

Priority

- High
- Medium
- Low
- Drainage Area
- Study Area
- Catch Basin
- Street Slope Direction
- Buildings
- Parcels

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMP Summary

A	North St and Bailey St System Type: Bumpout Total Area: 69,971 SF SMP Footprint: 1,775 SF
B	W Adams St and Chetwynd Rd System Type: Bumpout Total Area: 12,247 SF SMP Footprint: 1,551 SF
C	Hillsdale Rd and Opland Rd System Type: Bumpout Total Area: 7,190 SF SMP Footprint: 1,074 SF
D	Hillsdale Rd and Sunset Rd System Type: Subsurface Trench Total Area: 6,893 SF SMP Footprint: 1,341 SF
E	Conwell Ave and College Hill Rd System Type: Subsurface Trench Total Area: 18,705 SF SMP Footprint: 828 SF
F	Conwell Ave and College Hill Rd System Type: Subsurface Trench Total Area: 27,997 SF SMP Footprint: 439 SF
G	Hillsdale Rd and Conwell Ave System Type: Subsurface Trench Total Area: 7,969 SF SMP Footprint: 885 SF
H	W Adams St and Conwell Ave System Type: Subsurface Trench Total Area: 49,007 SF SMP Footprint: 537 SF
I	W Adams St and Conwell Ave System Type: Subsurface Trench Total Area: 7,969 SF SMP Footprint: 885 SF
J	Chetwynd Rd and Curtis St System Type: Subsurface Trench Total Area: 13,413 SF SMP Footprint: 861 SF
K	Chetwynd Rd and Curtis St System Type: Subsurface Trench Total Area: 7,632 SF SMP Footprint: 495 SF

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 75 150 300 Feet

N

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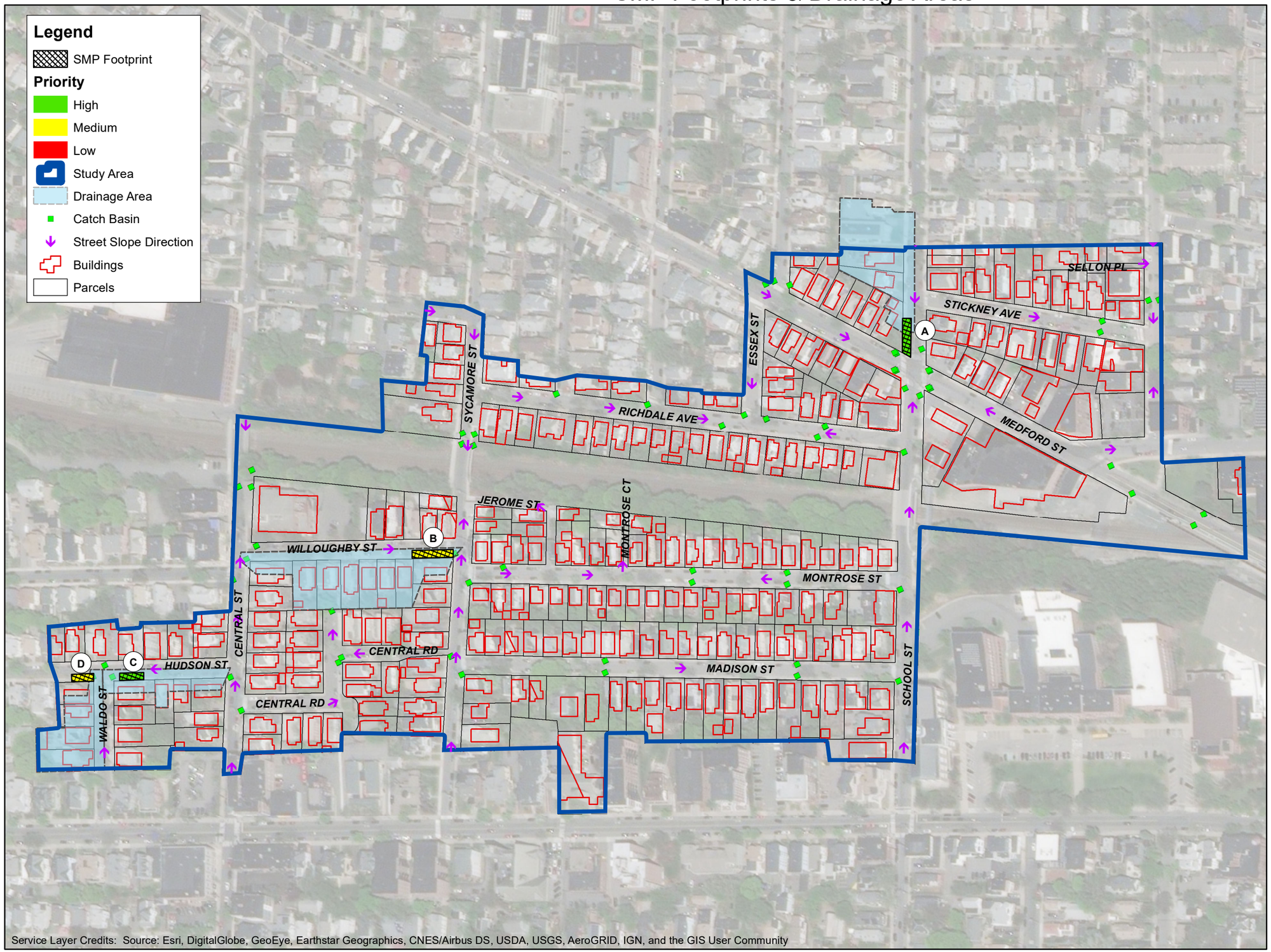
City of Somerville MVP Grant Study Area #11

SMP Footprints & Drainage Areas



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMP Summary

A	Medford St and School St System Type: Bumpout Total Area: 30,638 SF SMP Footprint: 1,328 SF
B	Central St and Willoughby St System Type: Subsurface Trench Total Area: 40,728 SF SMP Footprint: 1,365 SF
C	Waldo and Hudson System Type: Bumpout Total Area: 13,065 SF SMP Footprint: 753 SF
D	Waldo and Hudson System Type: Bumpout Total Area: 19,511 SF SMP Footprint: 712 SF

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 75 150 300 Feet

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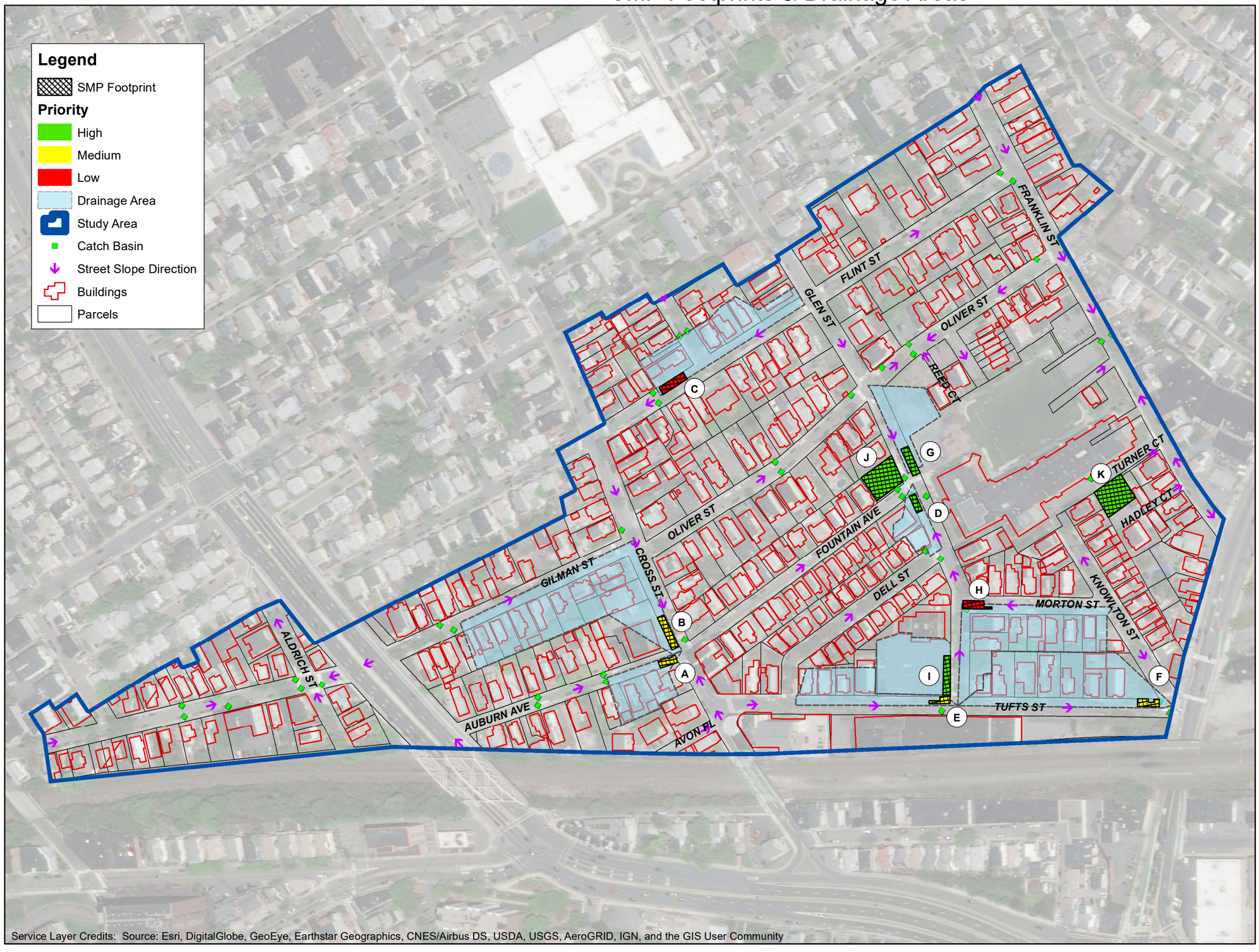
City of Somerville MVP Grant Study Area #12

SMP Footprints & Drainage Areas



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

SMP Summary

A	Auburn and Cross System Type: Subsurface Trench Total Area: 14,050 SF SMP Footprint: 637 SF
B	Auburn and Cross System Type: Bumpout Total Area: 58,356 SF SMP Footprint: 1,212 SF
C	Flint and Rush System Type: Subsurface Trench Total Area: 28,290 SF SMP Footprint: 1,101 SF
D	Glen St and Fountain System Type: Bumpout Total Area: 7,821 SF SMP Footprint: 499 SF
E	Tufts St and Glen St System Type: Bumpout Total Area: 17,155 SF SMP Footprint: 514 SF
F	Tufts St and Knowlton St System Type: Bumpout Total Area: 42,432 SF SMP Footprint: 685 SF
G	Glen St and Fountain System Type: Bumpout Total Area: 14,349 SF SMP Footprint: 1,130 SF
H	Glen St and Morton St System Type: Bumpout Total Area: 38,180 SF SMP Footprint: 917 SF
I	Tufts St and Glen St Parking Lot System Type: Raingarden Total Area: 14,349 SF SMP Footprint: 1,130 SF
J	Fountain Ave and Glen St Parking Lot System Type: Porous Paving Total Area: 4,565 SF SMP Footprint: 4,565 SF
K	Capuano School Vacant Lot System Type: Porous Paving Total Area: 4,451 SF SMP Footprint: 4,451 SF

SMP Ranking

- High Priority 2.4 - 3.0
- Medium Priority 2.0 - 2.3
- Low Priority 1.0 - 1.9

0 75 150 300 Feet

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APPENDIX B

SMP Ranking Spreadsheet

(provided electronically in Microsoft Excel)