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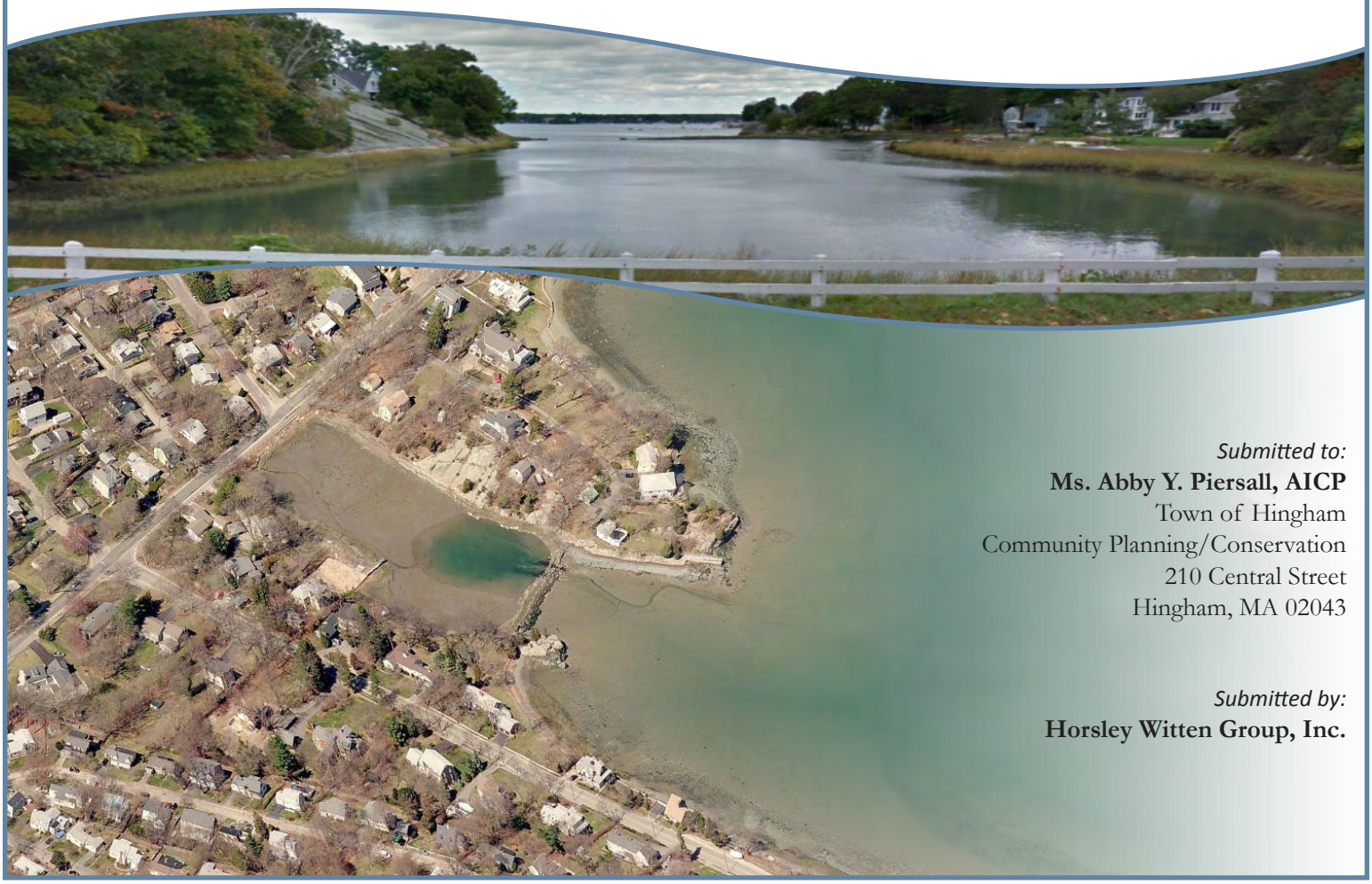
REPORT for

Walton's Cove Stormwater Mitigation Project

Town of Hingham, Massachusetts

June 13, 2014



Submitted to:
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1.0 Introduction

1.1 Purpose of the Report

This report focuses on identifying cost-effective structural and non-structural practices to reduce overall pollutant loadings (i.e., sediment, bacteria, nutrients) and runoff volume to Walton's Cove. The approach included rapid field assessment for stormwater management throughout the watershed. The stormwater assessment was used to identify likely stormwater pollutant sources as well as areas where structural and non-structural best management practices (BMPs) could be implemented to improve the management and treatment of stormwater in the watershed. Successful implementation of the recommendations in this report is expected to help reduce stormwater runoff pollution and improve overall water quality conditions in the Cove.

Caveats

The following limitations on the information presented in this report should be considered:

- While field investigations were conducted, the list of stormwater retrofits and non-structural opportunities presented here should not be considered exhaustive.
- Project ranking is intended to inform the implementation process; actual implementation frequently occurs as other opportunities arise, and the ranking should not be viewed as an absolute sequence for implementation.
- Where planning-level construction costs were used, these costs are based upon unit cost data compiled from various sources and should be used for general planning purposes and comparison between candidate projects only.

1.2 Walton's Cove Background

Walton's Cove is a relatively small coastal embayment located in the Crow Point area of Hingham, Massachusetts (Figure 1-1). An amusement park, Melville Garden-Downer Landing was operated in Walton's Cove from 1876 to 1891 (Kitty Ward, pers comm.; see Figure 1-2). Walton's Cove was isolated from Hingham Harbor following the construction of a rip-rap breakwater to create an aquarium to house harbor seals, leading to a drastic reduction in natural tidal flushing and sediment transport through the embayment. This feature, combined with development throughout the contributing watershed with minimal stormwater treatment, has contributed to the accumulation of several feet of sediment in the Cove.

Figure 1-1. Aerial showing sediment build-up in Walton's Cove

Figure 1-2. Sketch of Melville Garden-Downer Landing (Kitty Ward).

1.3 General Watershed Characteristics

We delineated six separate subwatersheds that contribute runoff to Walton's Cove. These are summarized in Table 1-1 and shown on Figure 1-3. There are three subwatersheds that discharge via outfall pipes, two that discharge overland flow directly into the Cove, and one that discharges into the Fee Pond wetland system before flowing into the Cove via outfall pipe 1.

Table 1-1. Summary of Walton's Cove Subwatersheds

Subwatershed Name	Total Area (acres)	Impervious Area (acres)	% Impervious
Walton's Cove Outfall Pipe 1 (WCOP1)	25.62	5.27	21%
Walton's Cove Outfall Pipe 2 (WCOP2)	20.19	5.21	26%
Walton's Cove Outfall Pipe 3 (WCOP3)	0.37	0.07	18%
Walton's Cove North (WCN)	1.08	0.10	9%
Walton's Cove South (WCS)	2.21	0.24	11%
Fee Pond (FP)	45.75	7.82	17%
Total	**95.20**	**18.70**	**20%**

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Legend

Subwatershed Boundaries

WCOP1 - Walton's Cove Outfall Pipe 1
WCOP2 - Walton's Cove Outfall Pipe 2
WCOP3 - Walton's Cove Outfall Pipe 3
WCN - Walton's Cove North
WCS - Walton's Cove South
FP - Fee Pond Subwatershed

Impervious Cover

Parcels

10ft. Contours (LiDAR)

0 400

1" = 400 feet

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Subwatershed Map
Walton's Cove
Hingham, MA

Date: 6/13/2014

Figure 1-3

1.4 Land Use and Infrastructure

The majority of the Walton's Cove Watershed consists of medium-density residential development. Table 1-2 shows a summary of the land uses in the subwatershed, and a land use map is provided in Figure 1-4. There is only minimal public open space in the watershed, particularly near the outfall locations along Downer Avenue. Opportunities for retrofitting within the road rights-of-way and on publicly-owned lots were the primary focus of assessment efforts.

Table 1-2. Land Use Summary

Land Use	Percent of Watershed
Forest	8.3%
Forested Wetland	2.6%
Very Low Density Residential	1.1%
Low Density Residential	1.3%
Medium Density Residential	84.6%
Water	1.3%
Saltwater Sandy Beach	0.3%
Saltwater Wetland	0.4%

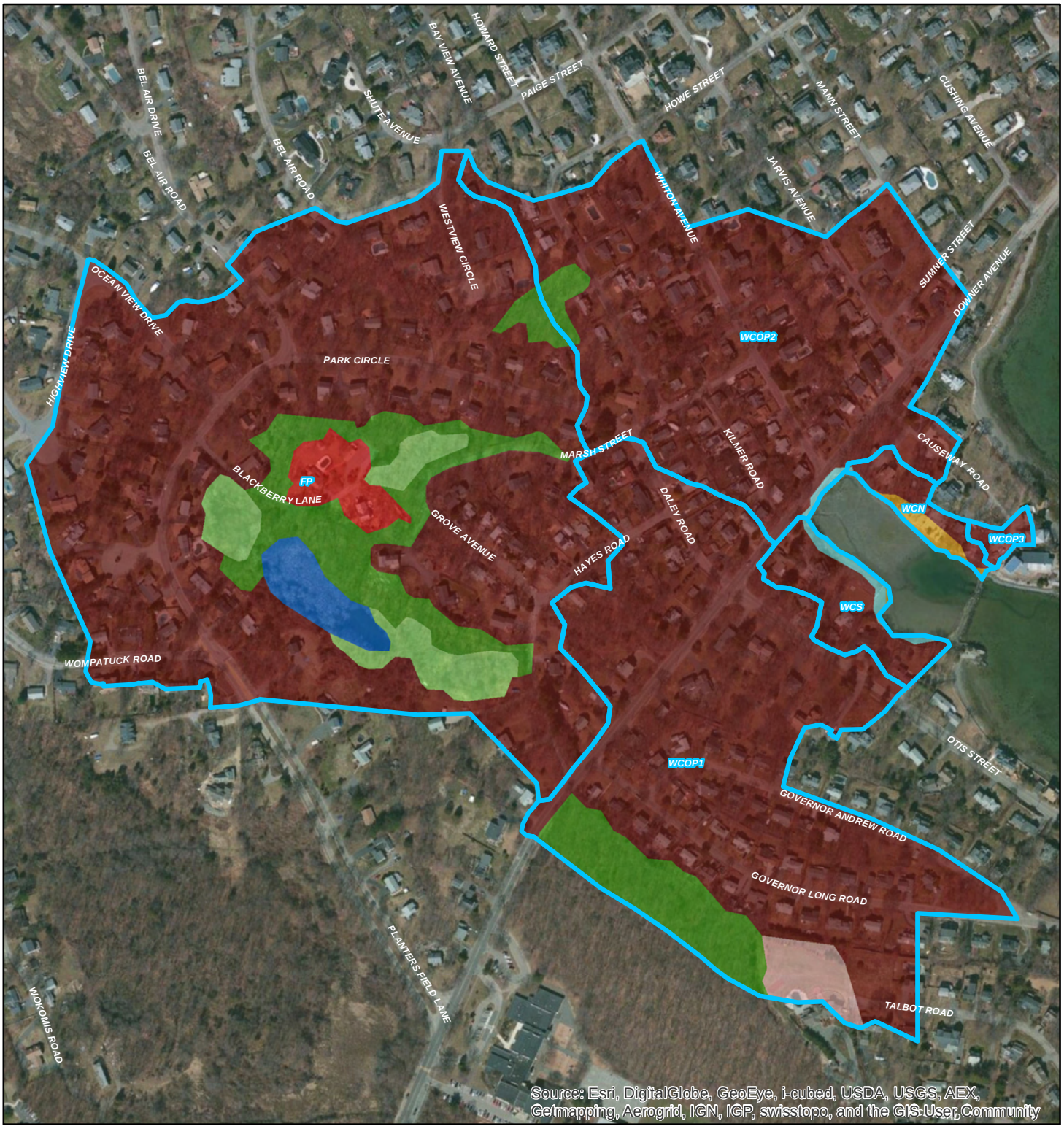
The current drainage system servicing this area is mainly made up of two separate, aging catch basin/pipe closed drainage systems that discharge to the Cove. When this system was constructed several decades ago, stormwater management had not advanced to include treatment of runoff, and over the years, this system has introduced a range of pollutants into the Cove that are commonly associated with roadway runoff, such as sediment, nutrients, metals, and bacteria. This, among other factors, has contributed to water quality issues; Hingham Harbor (and Walton's Cove) was recently listed on the 2012 Massachusetts Integrated List of Waters for fecal coliform and PCBs and other contaminants in fish tissue, and is suffering from degraded water quality and habitat impairment.

1.5 Soils and Hydrology

The soils in the subwatershed are mapped by the USDA Natural Resources Conservation Services as mainly Canton-Chatfield-Rock outcrop complex and Newport and Pawton fine sandy loams, with small areas of Brockton sandy loam and Aquents. The hydrologic soil group (HSG) indicates the infiltrative capacity of the soils, with A indicating high infiltration rates (i.e., sands and gravels) and D representing very poorly drained soils. Table 1-3 provides a breakdown of the HSGs found in the watershed. The soils are classified as either C or D, signifying that infiltration is not a feasible stormwater practice in this area. Instead, filtering practices, porous pavements, rainwater harvesting, and other practices to help reduce runoff volume and improve water quality treatment are the best options. A map of the soil conditions is provided in Figure 1-5.

Table 1-3. Summary of Soil Conditions

Soil HSG	Percent in Watershed
C	41%
D	58%
Water	1%



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**MassGIS Data - Land Use (2005)*

Legend

Subwatershed Boundaries

Land Use

- Forest
- Forested Wetland
- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- Saltwater Sandy Beach
- Saltwater Wetland
- Water

N

0 400

1" = 400 feet

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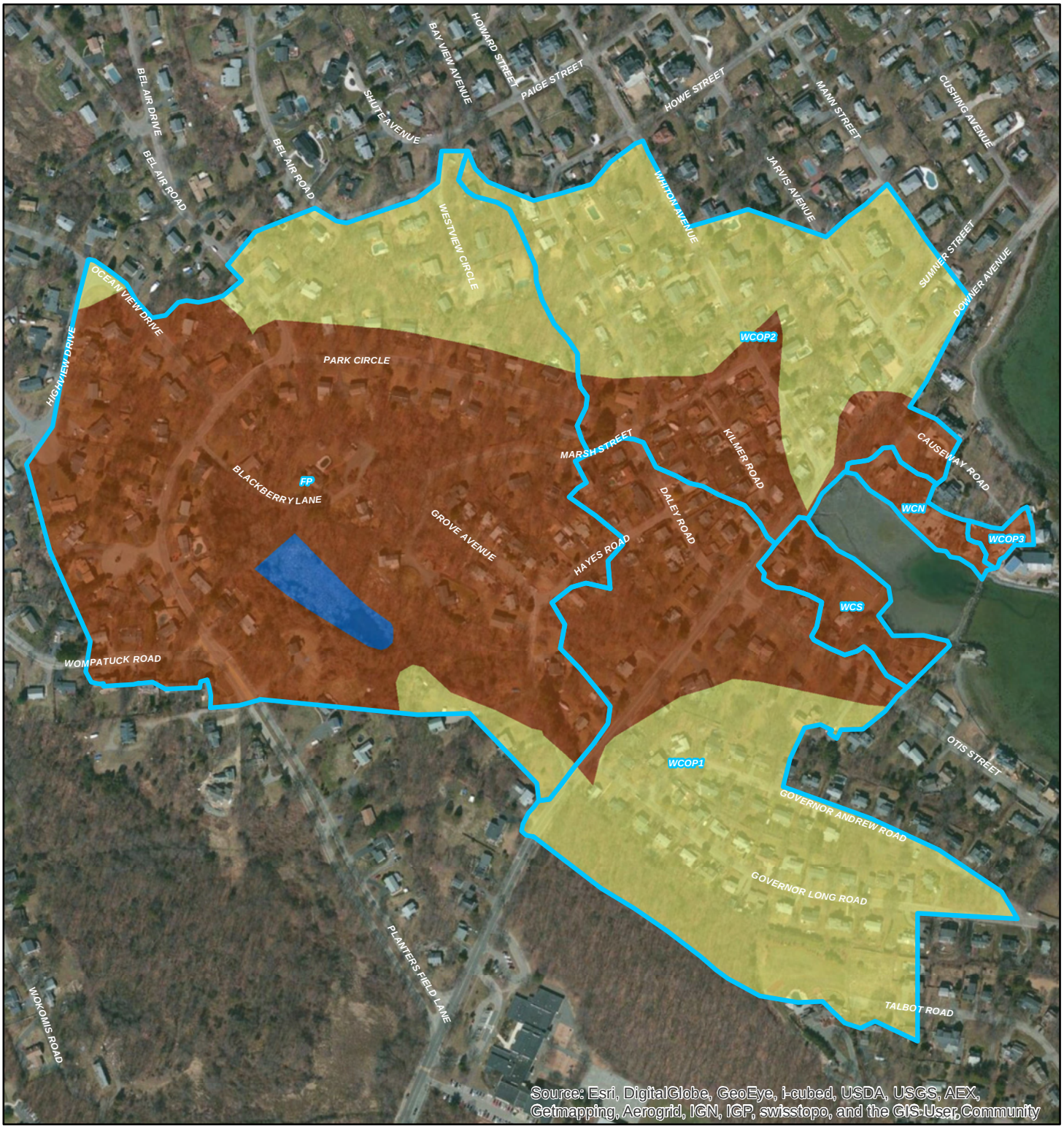
Land Use Map
Walton's Cove
Hingham, MA

Date: 5/27/2014

Figure 1-4



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**MassGIS Data - NRCS SSURGO-Certified Soils, November 2012*

Legend

Subwatershed Boundaries

Hydrologic Soil Groups

- C
- D
- Water

N

0 400

1" = 400 feet

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Soils Map
Walton's Cove
Hingham, MA

Date: 5/27/2014

Figure 1-5

2.0 Field Assessment of Restoration Opportunities

This chapter describes both the methodology used for the watershed assessment and the proposed recommendations to help improve the water quality of Walton's Cove. The proposed options range from site-specific stormwater retrofits to non-structural control measures.

2.1 Assessment Methods

HW conducted a watershed assessment using an adapted retrofit inventory methodology outlined in the publication "Urban Stormwater Retrofit Practices" (Schueler et al., 2007). Candidate BMP sites were evaluated to assess drainage conditions and site constraints. The primary goals of the retrofitting process was to propose stormwater management strategies for reducing sediment and bacteria loads to Walton's Cove and for improving groundwater recharge where possible. Opportunities for non-structural improvements, such as impervious cover reduction, rooftop disconnection, and pollution prevention, were also explored in order to provide the Town with low-cost options in addition to structural treatments. Siting and design targets for the retrofits were based on trying to manage as much of the 1-yr, 24-hr storm (2.47 inches from Cornell's Northeast Regional Climate Center) as possible.

In March 2014, an initial field reconnaissance was performed in the subwatershed to identify preliminary retrofit and restoration sites. Following the site walk, a "desktop analysis" was performed to identify soils, wetlands, other site constraints, and any known stormwater infrastructure using geographic information system (GIS) data and other data from the Town.

The full field reconnaissance was conducted in April 2014. Field assessment was performed using computer tablet-based data collection methods that utilized the available GIS data. Pre-defined data entry forms were used to collect geo-referenced information (e.g., drainage area to practice; available area; proposed BMP area; and site constraints) and photos at each site. When possible, field teams discussed alternatives on site with interested abutters. Key observations during the assessment included existing flow paths, proximity of existing drainage infrastructure to potential BMP sites, indicators of existing drainage problems such as erosion or ponding water, and potential land uses and/or behaviors that may be contributing higher pollutant loads to the Cove. HW took measurements at potential sites, and opened catch basins and drainage manholes to measure inverts where necessary. Restoration opportunities were evaluated using watershed assessment protocols originally developed by the Center for Watershed Protection (Kitchell and Schueler, 2004; Wright et al. 2005; and Schueler et al., 2007) and adapted by HW for application in Hingham. The completed field reconnaissance forms can be found in Appendix A.

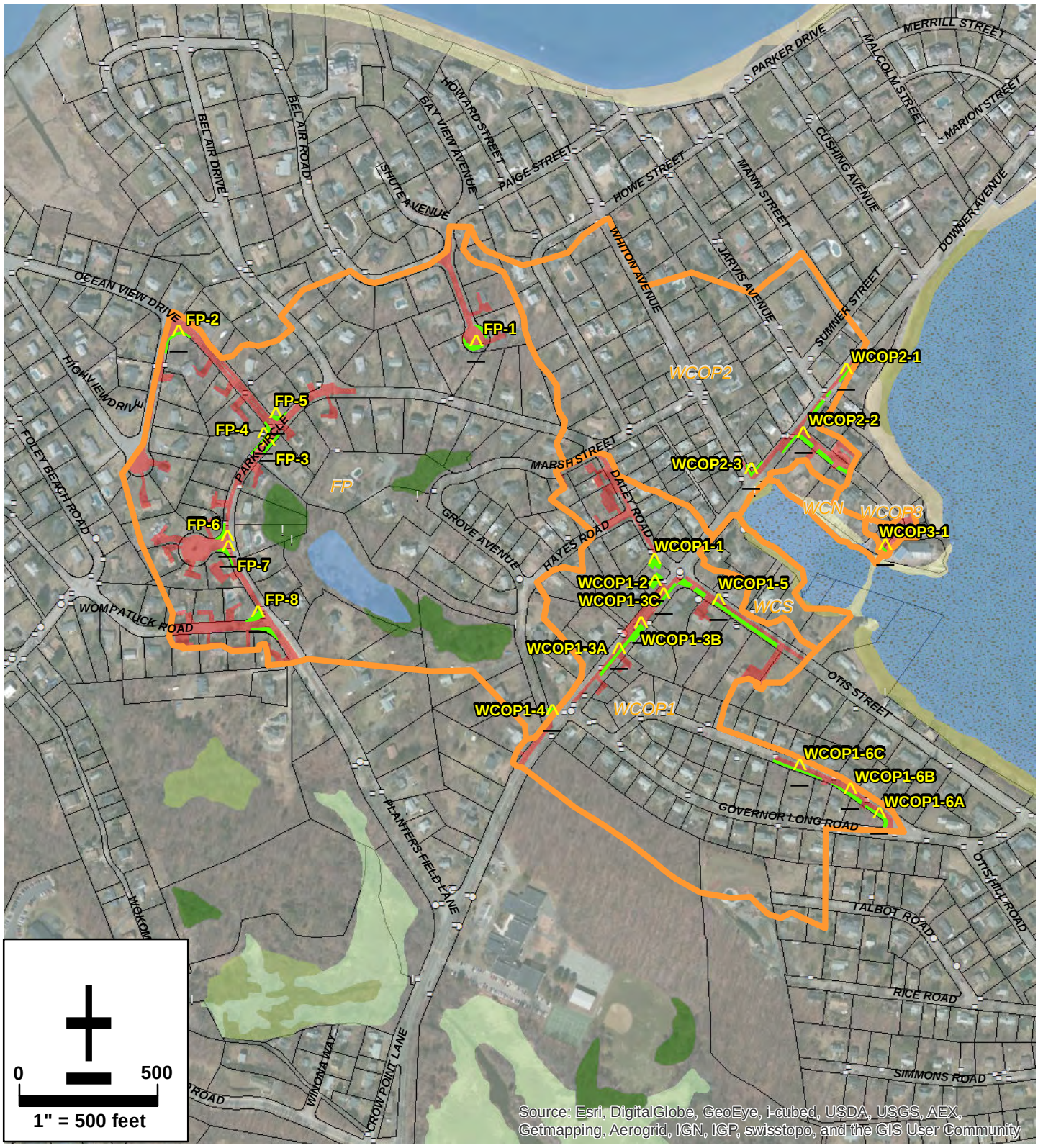
Figure 2-1. Photos taken during the field assessment. Left – measuring inverts in a drainage manhole; Right – indicators of the existing flow path and areas of sediment and leaf build-up.

2.2 Stormwater Retrofits

HW identified potential stormwater retrofit opportunities throughout the watershed (listed in Table 2-1 below). Three main types of best management practices (BMPs) were recommended: bioretention areas, green streets, and dry swales. These BMPs are well-documented as higher performing practices that both treat and reduce runoff through soil and vegetation components. Locations were chosen based on space available, contributing drainage area, ownership, and existing drainage structures, among other factors. At a minimum, the practices were preliminarily sized for the 1-inch water quality volume, though many have the capacity to manage up to the 1-year storm event (2.47 inches) to provide additional climate change resiliency. Photos and schematics describing these practices are included below (Figures 2-3, 2-4, and 2-5). A map showing the locations of the recommended stormwater retrofit opportunities is included as Figure 2-2. A preliminary ranking process was conducted to determine which of the retrofit design concepts should be further refined – the ranking process is described below, and the full results are included in Appendix B.

Table 2-1. Identified stormwater retrofits for Walton's Cove

WCOP1-1	Sewer Pump Station (Daley Road) - Bioretention
WCOP1-2	Sewer Pump Station (Downer Avenue) - Bioretention
WCOP1-3	Downer Ave South - Green Streets
WCOP1-4	Downer Ave at Grove St - Bioretention
WCOP1-5	Otis Street - Green Streets
WCOP1-6	Governor Andrew Road - Dry Swales
WCOP2-1	Downer Ave North - Green Streets
WCOP2-2	Causeway Road at Downer - Bioretention
WCOP2-3	Downer Ave at Whiton Ave - Bioretention
WCOP3-1	Causeway Road - Basin Retrofit
FP-1	Westview Circle Cul-de-Sac - Bioretention
FP-2	High View Dr at Ocean View - Bioretention
FP-3	Park Circle SE - Dry Swale
FP-4	Park Circle NW - Dry Swale
FP-5	Park Circle at Ocean View - Bioretention
FP-6	Park Circle at Cul-de-Sac N - Bioretention
FP-7	Park Circle at Cul-de-Sac S - Bioretention
FP-8	Planter's Field Ln at Wompatuck Rd - Bioretention



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Legend

- Watershed
- Proposed Retrofit Sites
- BMP Impervious Drainage Areas
- Proposed BMP Footprint
- Outfall
- Drainage Catch Basin
- Drainage MH
- Parcels
- Open Water
- Coastal Beach
- Coastal Bank Fluff or Sea Cliff
- Shallow Marsh Meadow or Fen
- Wooded Swamp Deciduous
- Salt Marsh
- Shrub Swamp
- Tidal Flat

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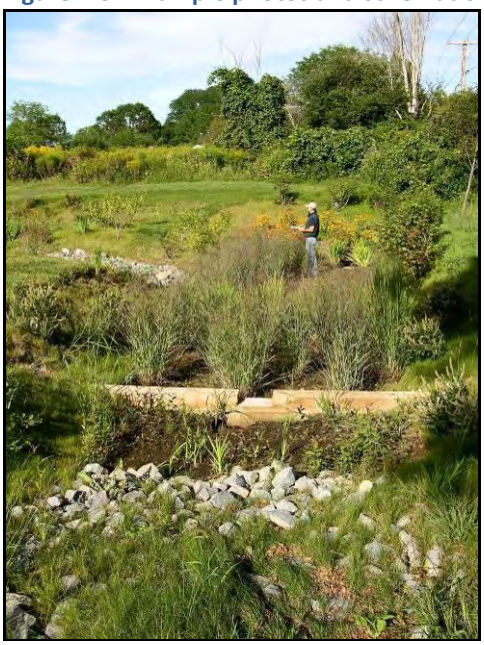
Stormwater Retrofit Opportunities
Walton's Cove
Hingham, MA

Date: 6/12/2014

Figure 2-2

Figure 2-3. Example photos and schematic of bioretention areas.



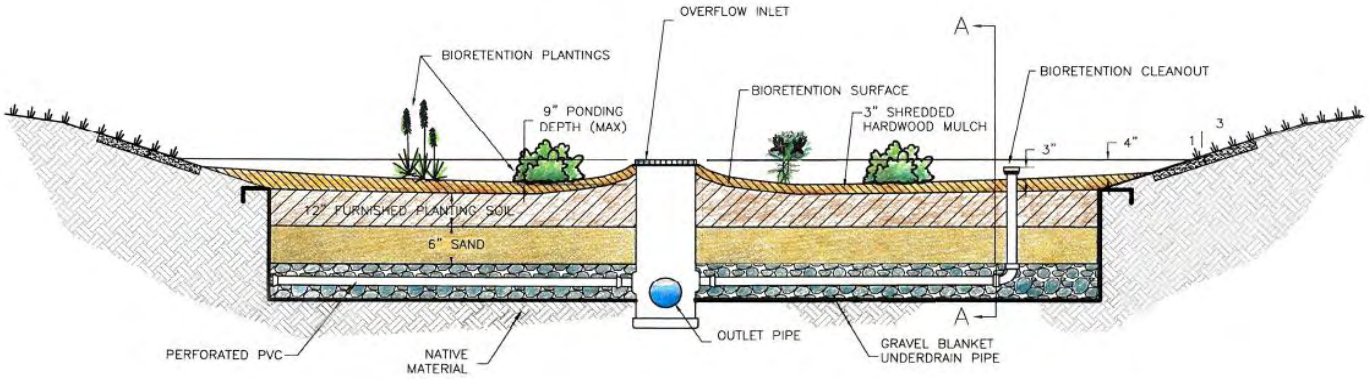


Figure 2-4. Example photos and schematic of green streets, also referred to as tree trenches or bioswales.

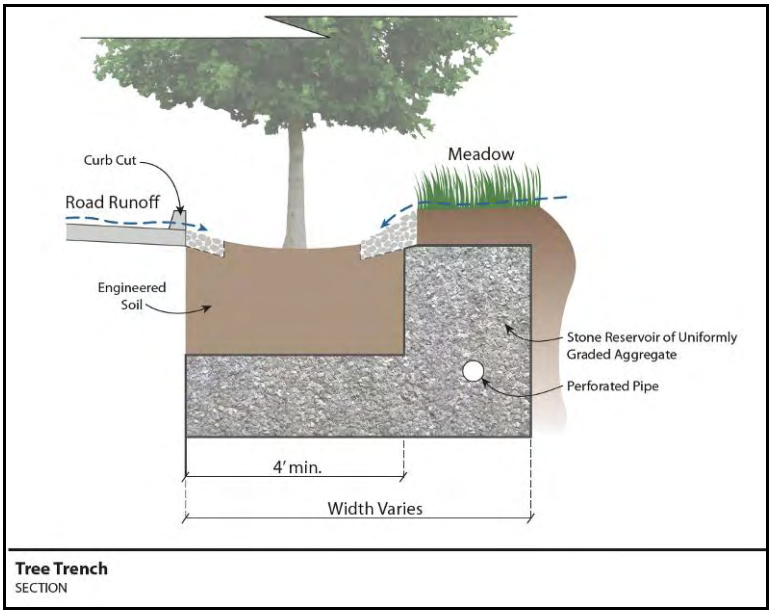
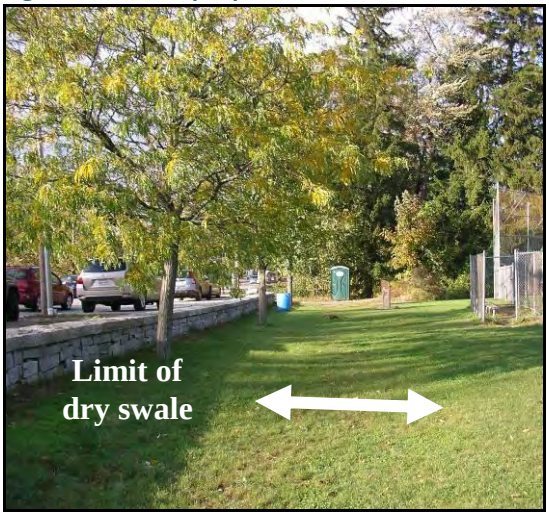
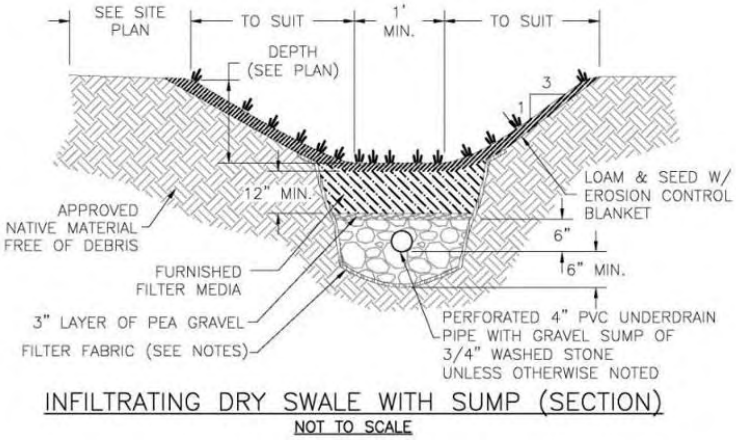


Figure 2-5. Example photos and schematic of swales.





Ranking Process

The potential projects were ranked based on the following factors to determine the highest priority sites:

- Treated Runoff
- Estimated Construction Cost
- Ease of Implementation:
  - Potential required permitting
  - Access issues
  - Ownership issues
  - Maintenance burden
- Additional benefits/factors:
  - Public Education/Demonstration
  - Additional Stormwater Benefits
  - Available partners

The Fee Pond Subwatershed sites were ranked separately since that runoff receives some treatment and attenuation as it flows through the wetland complex. Table 2-2 summarizes the site ranking (ranked in descending order) with the details included in the attached ranking spreadsheet. The red font indicates the sites that were chosen to be further analyzed as a part of this project and carried out to 30% design based on project visibility, constructability, potential water quality benefit, and educational value (see Chapter 3).

Table 2-2. Ranking Summary

Site #	Score
WCOP1-6	**67**
WCOP1-1	***65***
WCOP1-3	***63***
WCOP2-1	***61***
WCOP1-2	**60**
WCOP1-5	**60**
WCOP2-3	**60**
WCOP2-2	**57**
WCOP3-1	**55**
WCOP1-4	**53**
FP-8	**70**
FP-3	**68**
FP-1	**67**
FP-4	**66**
FP-6	**62**
FP-7	**61**
FP-5	**58**
FP-2	**55**

2.3 Non-structural Opportunities

HW also identified non-structural measures and activities that could be conducted in the watershed to help reduce and prevent sediment and other pollutant loading to Walton's Cove. These are described below, broken into two categories: homeowner opportunities and Town opportunities.

Homeowner Opportunities

There are many things that homeowners can do on their individual lots that can help improve Walton's Cove, even if the lots are not directly adjacent to the Cove. The stormwater drainage system (e.g., catch basins, manholes, and pipes) that is located throughout the watershed effectively connects all the lots to the Cove. Even small measures can make a big difference if implemented on many lots throughout the watershed.

Disconnection

Homeowners can help reduce the amount of stormwater runoff, and associated pollutants, leaving their lots by "disconnecting" paved areas and rooftops. In many cases, downspouts from roofs are directed to paved driveways, which then direct the water out into a catch basin on the street. This is referred to as "directly connected impervious cover" and impacts the overall drainage system and the receiving water (Figure 2-6). By adjusting downspouts to discharge to pervious areas like lawns, into rain barrels for later irrigation us, or even into rain gardens, this runoff can be disconnected from the system (Figure 2-7).

Rain gardens are similar to bioretention areas described earlier in Section 2.2, but instead of using an engineered planting media and infrastructure like underdrains and overflows, rain gardens are simply a flat, shallow depression with plants that can handle both dry and wet conditions. Rain gardens can be built in any shape and planted with a variety of colorful grasses, flowers, shrubs, and/or trees so that they can be blended in with other landscaping in the yard. Native plants tend to need the least maintenance, but ornamentals can be used if desired.

Figure 2-6. Examples showing directly connected impervious cover in the Walton's Cove watershed.

Figure 2-7. Examples showing good opportunities for rain gardens, i.e., lots that have downspouts that are currently discharging to lawn areas. Potential rain garden footprints shown in green.

Soil Stabilization

Sometimes patches of lawn alongside driveways and roads get disturbed, exposing bare earth to the elements. Even small areas can erode significantly during rain events and cause a lot of sediment to be carried into the storm drains (Figure 2-8). Homeowners should stabilize these areas as quickly as possible to prevent this sediment load from contributing to the problems in Walton's Cove.

Figure 2-8. Examples of small-scale erosion on residential lots in the watershed, where sediment paths into catch basins are visible.

Vegetated Buffers

Adding or increasing the shoreline buffer is a great opportunity for those homeowners who do live directly adjacent to the Cove, or adjacent to Fee Pond or the surrounding wetlands. Buffers help to stabilize soil and filter pollutants out of stormwater. Unlike rain gardens, which could be planted with a mix of native and ornamental plants, buffers should be only planted with native species that would be naturally found in those locations (e.g., different species would be appropriate along a freshwater pond/wetland vs. along the salt marsh).

Town Opportunities

There are many opportunities that the Town can take advantage of to help improve water quality in Walton's Cove in addition to the identified stormwater retrofits. These are described below.

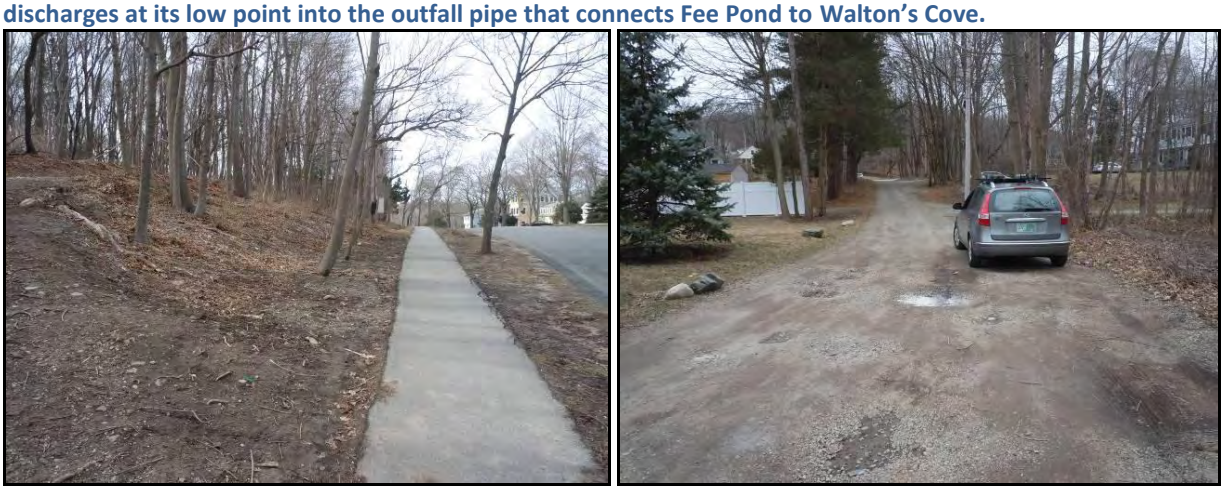
Erosion and Sedimentation Control

The Town should consider requiring specific erosion and sedimentation controls (ESC) for residential construction projects in the watershed. Even small construction sites high up in the watershed can contribute a great deal of sediment into the drainage system, ultimately impacting the Cove (Figure 2-9). This ESC requirement could potentially be incorporated into the Building Permit process.

Figure 2-9. Example of a residential construction site in/near the watershed.

In addition, the Town should consider stabilizing other areas of exposed sediment, such as eroding slopes, degraded right-of-ways, and unimproved roads (Figure 2-10). Grove Road in particular directly contributes sediment into the Cove via the outlet pipe from Fee Pond.

Figure 2-10. Example of eroding slope/right-of-way along Downer Avenue; Grove Road is an unimproved road that discharges at its low point into the outfall pipe that connects Fee Pond to Walton's Cove.



Pavement Reduction Opportunities

There are several areas throughout the watershed where there is excessive impervious cover. These areas include large cul-de-sacs, expanded intersections, and overly wide streets (Figure 2-11). The Town could reduce pavement and replace it with lawn, landscaping, or even use the area for a stormwater retrofit (e.g., several of these retrofit opportunities were identified and described in Appendix A). This pavement reduction has many benefits, including reduced costs of repaving and maintenance, traffic calming at high-traffic intersections and roads, and reduction of stormwater volume and pollution. Even removing a foot or two of unnecessary

pavement width along a roadway can make a big difference in terms of stormwater, as well as create a large cost savings for the Town every time that road needs to be repaved.

Figure 2-11. Example of an opportunity for pavement reduction and a busy intersection in the watershed.

Increased Street Sweeping and Catch Basin Maintenance

Even though the Town uses little to no sand in the watershed during the winter, sediment and leaves still build up on the roads and in catch basins throughout the year. The Town could increase street sweeping and catch basin maintenance in the watershed to help reduce a source of sediment to the Cove.

Public Outreach and Education

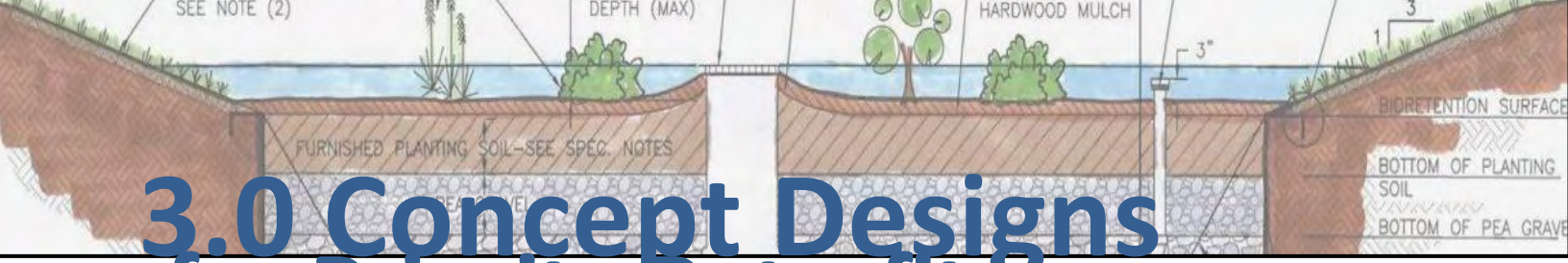
The Town could create and distribute education about the Walton's Cove watershed and impacts from stormwater runoff to the residents in the area. This material could focus on easy actions homeowners can do on their own lots (e.g., rain barrels, rain gardens, soil stabilization, etc.), as well as in the public right-of-way (e.g., pick up pet waste, no dumping into storm drains, etc.). The Town could offer technical assistance as needed. In addition, the Town could consider adding educational signage at any stormwater retrofit sites to reach both residents and visitors to the area (Figure 2-12).

Figure 2-12. Example of educational signage at a stormwater retrofit site.

Flushing Study

As mentioned in Section 1, the riprap breakwater across the mouth of the Cove impacts the tidal flushing in this area. While not part of the scope of the current assessment, a flushing study could be performed to analyze the impacts of potentially removing this breakwater. Tasks that might be included in such a study are as follows:

- Bathymetric survey of the Cove
- Tidal surveys using continuous data logging pressure-transducer tide-gauges
- Hydraulic/hydrologic model of existing and proposed tidal conditions (using a model such as PondPack)
- Memo quantifying impacts and costs of breakwater removal, as well as next steps such as permitting



3.0 Concept Designs for Priority Retrofits

HW, with input from Town staff, identified three priority sites to advance to 30% design to the extent possible with the existing funding. HW performed soils analyses (May 12, 2014) and topographical survey (May 13, 2014) at each site before refining the design for each (see Figure 3-1; Appendix C for the Soil Test Pit Logs). While this level of design is still considered conceptual, it has a sufficient level of detail for soliciting grant funding and facilitating permitting.

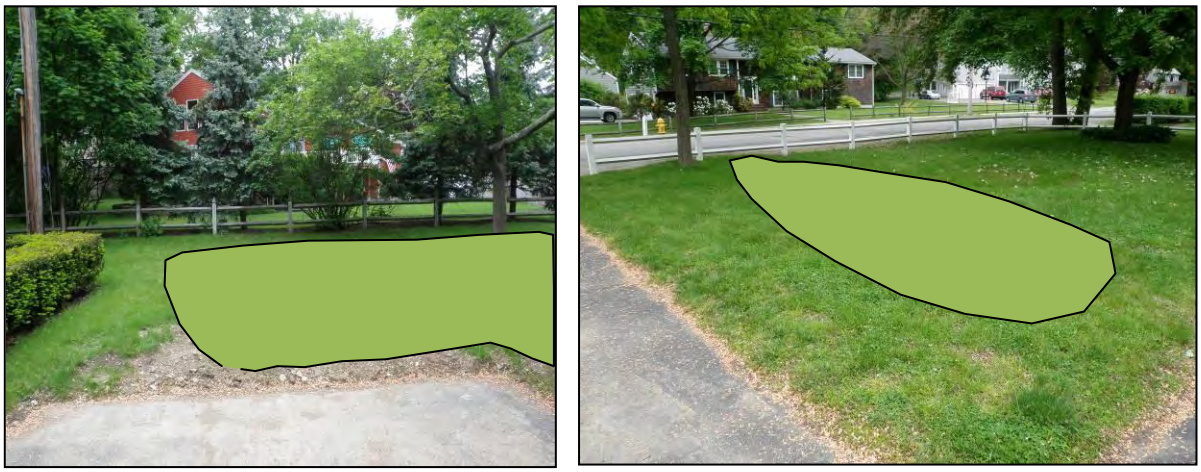
Figure 3-1. Photos taken during the soils analyses at each site

The sites that were advanced to 30% design correspond with retrofit sites WCOP1-1 and WCOP1-2 ("Sewer Pump Station"), WCOP1-3A-C and a portion of WCOP1-5 ("Downer Avenue South"), and a portion of WCOP2-1 ("Downer Avenue North"). The 30% Design Plans for these sites is included as 11x17 format in Appendix D; the Town also has the full-size (24x36) plans. Estimated planning-level construction costs are included in Appendix E; these costs are conservative, and the Town should expect significant cost savings if these retrofits are constructed in conjunction with planned road improvements in the area (currently scheduled for 2016). While the designs are shown for specific areas, the Town can adapt the details and basic design concepts in other areas in the watershed as funding becomes available.

3.1 Sewer Pump Station Drainage Improvements

Two bioretention facilities are proposed at the sewer pump station along Downer Avenue (WCOP1-1 and WCOP1-2). This is one of the only publicly-owned parcels in the watershed; the land is owned and operated by the Hingham Sewer Commission. The existing lawn areas are proposed to be converted into bioretention areas to treat a total of 0.6 acres of runoff from portions of Daley Drive and Downer Avenue (Figure 3-2). Overflow structures would be tied back into the existing storm drains in this area. The estimated construction costs for this site are $45,000.

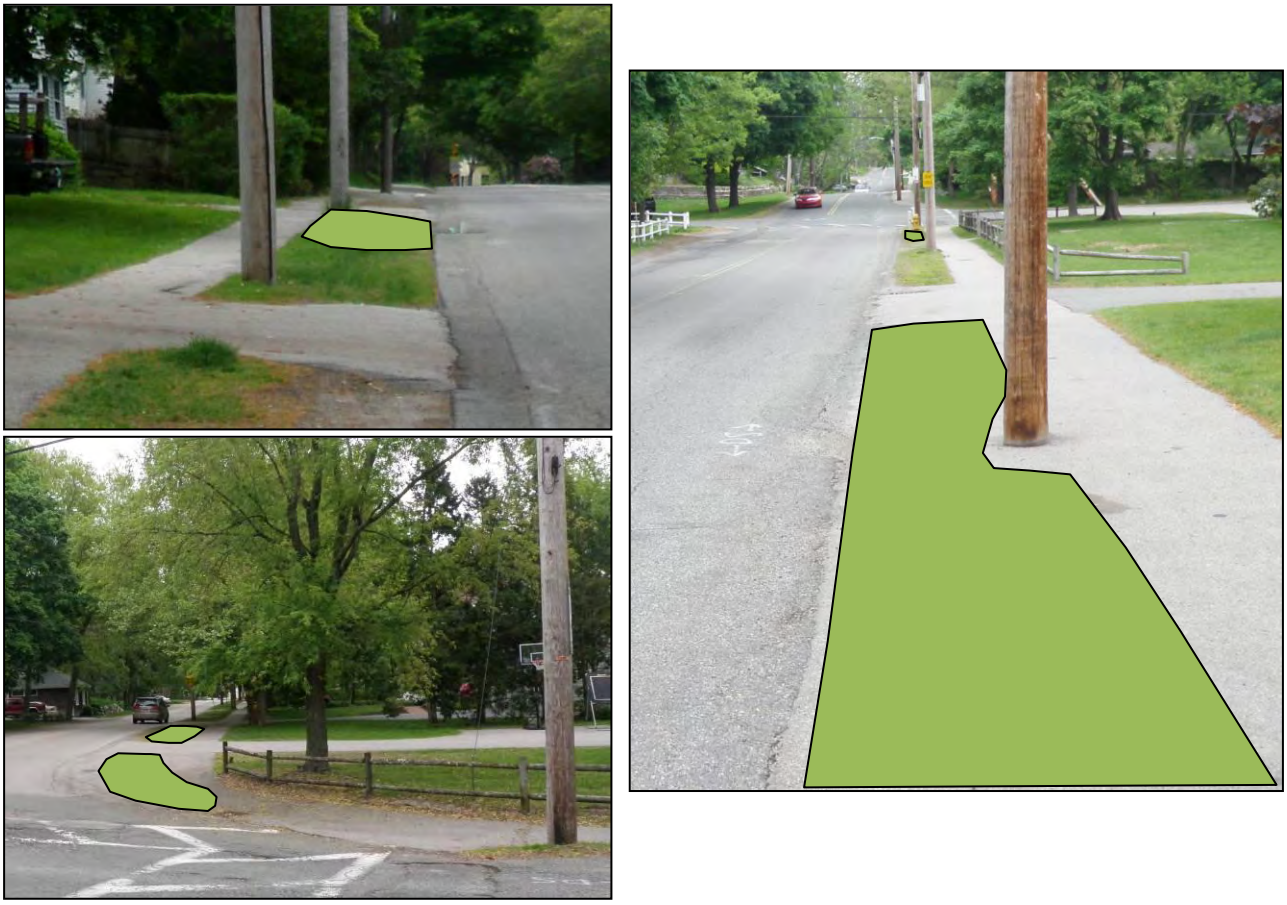
Figure 3-2. Proposed bioretention footprints at the Sewer Pump Station on Downer Avenue.



3.2 Downer Avenue South – Drainage Improvements

Green streets (also referred to as bioswales) and porous asphalt sidewalks are proposed along Downer Avenue south of the Cove and a portion of Otis Street (WCOP1-3A-C and a portion of WCOP1-5). These retrofits would be constructed in the right-of-way between the sidewalk and the road, and would treat the runoff from 0.5 acres of roadway as well as runoff from the adjacent residential lots (Figure 3-3). These bioswales can be planted with small tree species or grasses, flowers, and shrubs. Overflows would be tied back into the existing storm drains in this area. The estimated construction costs for this site are $242,000, but there would be considerable cost savings for the Town if timed with the upcoming road improvements in 2016.

Figure 3-3. Proposed green streets/bioswales along Downer Avenue-South.



3.3 Downer Avenue North – Drainage Improvements

Green streets (also referred to as bioswales) and porous asphalt sidewalks are proposed along Downer Avenue to the north of the Cove (a portion of WCOP2-1). These retrofits would be constructed in the right-of-way between the sidewalk and the road, and would treat the runoff from 0.25 acres of roadway as well as runoff from the adjacent residential lots (Figure 3-4). These bioswales can be planted with small tree species or grasses, flowers, and shrubs. Overflows would be tied back into the existing storm drains in this area. The estimated construction costs for this site are $76,000, but there would be considerable cost savings for the Town if timed with the upcoming road improvements in 2016.

Figure 3-4. Proposed green streets/bioswales along Downer Avenue-North.

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