Capisic Brook Watershed Management Plan

WOODARD & CURRAN

Submitted to:
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EXECUTIVE SUMMARY

Capisic Brook is a small stream located primarily in Portland, ME. The stream is approximately 2.5 miles in length and has a watershed of approximately 1,500 acres. The stream consists of several branches with headwaters located near Evergreen Cemetery in Portland and just west of I-95 in Westbrook, ME. The Capisic Brook watershed has approximately 31% of its area covered by impervious surfaces and small urban watersheds in Maine with greater than 10% of their land area covered by impervious surfaces are generally impaired for designated uses. Capisic Brook has been designated by the MaineDEP as an urban impaired stream under Chapter 502 of the Maine Stormwater Management Rules.

The results of the Maine Department of Environmental Protection's Biological Monitoring Program (2003) summarize the conditions in Capisic Brook at two monitoring locations. Maine legislature has designated Capisic Brook as a Class C water, which is intended to meet the State's minimum environmental goals for water quality. The upstream station near Evergreen Cemetery had a healthy macroinvertebrate community, good water quality and adequate habitat according to the MaineDEP Report. The downstream station above Capisic Pond had impaired biota, poor water quality and degraded habitat. Variation in water quality at these two stations has been attributed to the differences in land use, especially the presence of impervious cover, and hence probable differences of polluted stormwater discharges into the brook between these two monitoring locations. Two existing combined sewer overflows (CSO) are located in the upper portion of Capisic Brook. These CSOs are also very likely to contribute to the impaired state of water quality at the downstream station, particularly during wet weather. The City has made significant progress toward the separation of the sanitary and storm sewer system within this watershed, and these efforts are expected to be completed over the next several years.

Over the previous 10 years, the City of Portland and the MaineDEP have conducted numerous watershed studies and assessments in order to prepare for future stormwater/sanitary sewer separation and to address in-stream biological impairments. These studies have provided an outline of strategies to abate combined sewer overflows, reduce stream flooding, enhance community green space and address stormwater pollutants in runoff.

The Capisic Brook Watershed Management Plan (Plan) has been developed to summarize the findings from previous studies in this watershed and explore additional recommendations necessary to meet state water quality standards. This plan has been developed to guide actions necessary for the long-term restoration of Capisic Brook to state water quality standards.

The Plan development process included the following:

- Determine watershed restoration needs through a review of existing studies and resources;
- Identify and engage key local, regional and watershed stakeholders in the planning process;
- Utilize community social marketing research to develop a targeted marketing strategy to overcome obstacles to voluntary implementation of stormwater pollution prevention;
- Identify opportunities within the Capisic Brook corridor to allow the brook to reach its high potential for a variety of uses including recreation and community space;
- Work with City planning staff and other stakeholders to evaluate planning policy changes necessary for long-term watershed improvement;
- Identify specific structural and non-structural stormwater improvement projects within the watershed;

- Outline an appropriate financing strategy for implementation of a Capisic Brook restoration plan; and
- Outline a water quality monitoring program that can help inform adaptive management and modifications to planning actions as needed.

Watershed Conditions, Previous Recommendations, and Regulatory Obligations and Actions

The review of existing conditions, previous recommendations and regulatory obligations included the following activities:

- an analysis of watershed geography including best available City and State data on impervious cover, land uses and zoning, natural resources, soils and stormwater drainage infrastructure assets,
- an overview of the sources of water quality data, water quality impacts identified by the MaineDEP during previous studies and summarize watershed restoration needs,
- a review of the City's current efforts toward water quality protection through its stormwater management programs, and
- a review of the regulatory obligations under the Clean Water Act and applicable state water quality standards.

Findings from this portion of the study are as follows.

Watershed Characteristics

- The watershed has approximately 31% of its land area covered by impervious surfaces. Extensive regional and national research indicates that once watersheds exceed approximately 10% impervious cover, they begin to show signs of impairment due to polluted stormwater runoff.
- Only 15% of the watershed is currently zoned as open space indicating that future development into undeveloped areas may continue to stress already impaired aquatic conditions. Conversely, the existing and remaining open space areas (particularly Evergreen Cemetery) provide important value to the watershed through natural groundwater recharge and clean water runoff.
- The watershed contains over 25 miles of mapped stormwater drainage pipe, over 300 stormwater catchbasins, over 600 stormwater manholes, over 26 miles of roadway, and approximately 140 piped outfalls for stormwater.
- The watershed currently receives combined sewer overflows at two locations near Warren Avenue in the upper portion of the watershed.

Previous Recommendations

- Previous recommendations were largely sourced from the Capisic Brook Greenway Master Plan (2001) and the MaineDEP Urban Streams Report (2005). Recommendations identified as critical to long-term sustainability of Capisic Brook have been incorporated into this Plan. The recommendations largely fall into the following categories and have been summarized in the Plan:
    - Infrastructure Improvements

- Planning and Outreach
- Community and Ecological Improvements

Regulatory Obligations and Actions

- The City of Portland, Westbrook, Maine Department of Transportation, Maine Turnpike Authority, and several private landowners currently comply with MEPDES General Permits for stormwater discharges into Capisic Brook. These permits include the Municipal Separate Storm Sewer System (MS4) for public entities and the Multi-Sector General Permit (MSGP) for private properties. Each of the public entities maintain an active stormwater management program, which includes Public Education and Outreach, Public Involvement/Participation, Illicit Discharge Detection and Elimination, Construction Site Storm Water Runoff Control, Post Construction Storm Water Management in New Development and Redevelopment and Pollution Prevention and Good House Keeping in Municipal or Transportation Operations. The private entities are required to maintain and implement a Stormwater Pollution Prevention Plan for their facilities.
- The MS4 and MSGP permit contains specific conditions and requirements applicable to impaired waters with approved Total Maximum Daily Loads (TMDLs). There is not currently a TMDL for Capisic Brook and therefore there are no additional regulatory obligations for these regulated dischargers at this time.
- The City of Portland maintains a Maine Waste Discharge License for the Combined Sewer Overflows in the city.
- The City of Portland and the Maine Department of Transportation have identified Capisic Brook as their "priority watershed areas" which is a requirement of their MS4 permits. This creates a particular focus of stormwater management actions for these entities within Capisic Brook.
- Recently there have been increases in federal and state stormwater regulations on previously unregulated private properties in "stormwater" impaired watershed in EPA Region 1 and in the nearby Long Creek under the Clean Water Act's Residual Designation Authority.

Overcoming Obstacles to a Sustainable Watershed

The objectives of establishing a watershed-based restoration plan is to improve water quality through targeted, specific actions and to ultimately realize the full benefits of the Capisic Brook as a community resource which meets its Water Quality Classification.

Long-term sustainable management of water resources is only possible with an engaged community, supportive local policy, a pragmatic financing strategy and political support. The Capisic Brook Watershed Management Plan outlines a stepwise approach that begins with actions aimed at building community support and creating supportive local policies. While community support and local policy are a fundamental component for long-term watershed restoration and sustainable management both politically and financially, the plan describes the necessary efforts including Combined Sewer Overflow abatement, pollution prevention, and stormwater and infrastructure management that will be necessary to meet state water quality criteria.

The following recommendations build upon previous studies and present a strategy for municipal and state management of the brook and its watershed. The plan is consistent with the recommendations of the Sustainable Portland report[1] and will set a path to meeting both state and federal clean water standards.

This Plan outlines targeted structural and non-structural management actions that will enhance community engagement in watershed restoration, refine local policies and standards for stormwater best management and ultimately improve Capisic Brook water quality. The development of each of the following strategies was through stakeholder collaboration over the course of the project. Four "teams" were developed as a part of the planning process to inform the development of the recommendations for action and include the Retrofit Inventory Strategy, Planning/Policy Initiatives, Marketing Initiatives, and Financing Planning teams.

The following table outlines the recommended restoration actions and an opinion of cost for each action. Each opinion of cost is for planning purposes only and will need to be refined during scoping and project/program development. Assumptions associated with these opinions of cost are identified within the Plan.

Recommended Actions		Opinion of Cost
Annual Operations and Maintenance	Commercial Facility Outreach/Training	$5,000
	High Efficiency Street Sweeping	$65,000
	Catch Basin Cleaning	$40,000
	Operations and Maintenance for Structural BMPs	$51,000
	Water Quality Monitoring	$60,000
Total		**$221,000**
Structural Stormwater Management	Sagamore Village	$1,475,000
	Riverside Street	$150,000
	Larrabee Road	$795,000
	West Tributary	$5,965,000
	Capisic Brook Stormwater Wetlands Park	$4,200,000
	Legal Easement Negotiation	$100,000
	Construction Administration	$150,000
Total		**$12,835,000**

[1] *Sustainable Portland Report*, Adopted June 2, 2010.

Recommended Actions		Opinion of Cost
Short-term Restoration Program Costs	Commercial Industrial Outreach Program Development	$50,000
	Shade Tree Planting Program	$162,000
	Social Marketing Campaign	$150,000
	Capisic Brook Watershed Map	$15,000
	Asset Management and Mapping	$40,000
	Education Station Development	$45,000
	School Outreach Program	$5,000
	Planning and Policy Initiatives	$83,000
	QAPP Development for WQ Monitoring Program	$10,000
Total		**$560,000**
Combined Sewer Overflow Abatement	CSO Separation	$4,900,000
Total		**$4,900,000**
Total Capisic Brook Restoration Cost		**$18,516,000**

Project Financing

- The summary of costs have been organized to evaluate the potential impact of restoration activities on a typical municipal stormwater program, and as such, the costs are identified in three categories; annual operations and maintenance, structural capital improvement costs and short-term restoration program costs.
- It is important to note that cost may include both municipal staff time and/or outside contractor fees. It should also be noted that certain Operations & Maintenance costs will only be realized after specific implementation actions (i.e. operations of structural BMPs, water quality monitoring, etc.). These costs have been assumed to be on-going annual costs to provide a conservative estimate.
- Combined Sewer Overflow costs have been excluded from further evaluation of project financing given that projects associated with CSO abatement are already being financed through bond revenues and will not need to be financed as a part of this watershed restoration program.
- An anticipated debt service has been considered for all eligible projects for planning purposes. The anticipated debt service for restoration costs are $1.048M annually. The short-

term restoration costs associated with city staff time and the short-term projects ineligible for tax-exempt financing were not included in this estimate. These costs are approximately $334,000 and would need to be financed via grants, short-term borrowing, or via existing programmed funds. The combination of projected annual debt service and annual operations and maintenance costs at $1.269M per year.

- The project financing recommendations consist of three primary components;
    - grant funding and regional collaboration for short-term, non-capital projects and programs,
    - institution of an appropriate compensation fee (consistent with state stormwater management law) for development and redevelopment projects,
    - and advocacy for a stormwater user fee to finance capital projects and sustainable operations and maintenance.
    - Additionally, it is recommended that project partners consider advocating for state funding support for municipally-led restoration programs as current funding from the state for water resource improvement programs are very limited and extremely competitive. Several states have recognized this shortcoming and address water resource financing through sales and excise taxes.

1. INTRODUCTION

1.1 PURPOSE OF THE PLAN

Develop a comprehensive scientifically based watershed management plan that will act as a guidance document to engage the community, establish guidelines to effect supportive local policy and a pragmatic financing strategy, and increase political support for necessary actions. The objectives are the following:

- Determine watershed restoration needs through a review of existing studies and resources;
- Identify and engage key conveners and regional and watershed stakeholders in the planning process;
- Utilize community social marketing research to develop a targeted marketing strategy to overcome obstacles to voluntary implementation of stormwater pollution prevention;
- Enhance conditions along the Capisic Brook corridor to allow the brook to reach its high potential for a variety of uses including recreation and community space;
- Work with City planning staff to evaluate planning policy changes necessary for long-term watershed improvement;
- Identify specific structural and non-structural stormwater improvement projects within the watershed that can provide a basis for watershed restoration costs and an analysis of benefits;
- Work with City finance staff to determine the appropriate financing for implementation of a Capisic Brook restoration plan; and,
- Meet Class C water quality standards for fresh surface waters, as MaineDEP has designated for Capisic Brook.

1.2 THE CAPISIC BROOK

Capisic Brook is a small stream located in Portland, ME. The stream is approximately 2.5 miles in length and has a watershed of approximately 1,500 acres. The stream consists of several branches with headwaters located near Evergreen Cemetery in Portland and just west of I-95 in Westbrook, ME (Appendix A – Figure 1). The MaineDEP "Preliminary Summary of Existing Biological Monitoring Data from Capisic Brook" indicates that the watershed has approximately 29% of its area covered by impervious surfaces. Small urban watersheds in Maine with greater than 10% of their land area covered by impervious surfaces are generally impaired. Capisic Brook has been designated by the MaineDEP as an urban impaired stream under Chapter 502 of the Maine Stormwater Management Rules.

Over the previous 10 years, the City of Portland (City) and the MaineDEP have conducted numerous watershed studies and assessments in order to prepare for future stormwater/sanitary sewer separation and to address in-stream biological impairments. These studies have provided an outline of strategies to abate combined sewer overflows, reduce stream flooding, enhance community green space and address stormwater pollutants in runoff. This Section of the Capisic Brook Watershed Management Plan has been developed to summarize the findings from previous studies in this watershed as a foundation for the plan.

1.2.1 A Watershed

The watershed, with the exception of the wooded area within the Evergreen Cemetery, is highly developed. Residential and commercial development and an extensive road system comprise the majority

of impervious surfaces within the Capisic Brook watershed. In 2003, the MaineDEP investigated impacts of urban non-point source (NPS) pollution in four streams in Maine, including Capisic Brook, as part of its Urban Streams Project[2]. Figure 1-1 shows the path of Capisic Brook as well as the biological monitoring stations studied during the Urban Streams Project.

The main branch (East Tributary) of the Capisic Brook originates in a wooded area within Evergreen Cemetery. The headwaters of the North Tributary are located near Forest Avenue, and this branch flows through a residential and commercial-industrial area before joining the main branch just north of Evergreen Cemetery. Here, two active overflows release combined storm and sanitary wastewater into the brook during times of precipitation. The stream then flows through a residential area and is joined by the West Tributary, which originates near I-95, approximately 3,280 feet (1,000 meters) downstream from where the North Tributary and the main branch converge. The West Tributary receives runoff from I-95 and extensive commercial development near Exit 48. Capisic Brook continues to flow through a residential area until it reaches Capisic Pond, eventually discharging into the Fore River, a major tributary of Casco Bay. Table 1-1 summarizes these reaches of the brook and potential impacts to water quality as reported in the MaineDEP Urban Streams Report.

Table 1-1: Water Quality Impacts along Capisic Brook by Reach

Reach	Potential Impacts from Land Use
East Tributary (ET) – headwaters to convergence with NT	Receives little stormwater runoff due to sanitary sewer interception; headwaters in wooded area and buffered by Evergreen Cemetery open space.
North Tributary (NT)– headwaters to convergence with ET	Runoff from impervious surfaces within residential and commercial/industrial area along and north of Warwick Avenue.
ET/NT convergence to convergence with West Tributary	Two CSO discharge points at the ET/NT convergence; runoff from impervious surfaces within adjacent residential areas.
West Tributary – headwaters to convergence with Middle Reach	Runoff from I-95 and significant commercial development near the highway interchange.
Final convergence to Capisic Pond (Middle Reach and Lower Reach)	Runoff from impervious surfaces within adjacent residential areas and associated roadways.

The MaineDEP has been studying three biological monitoring stations along the Capisic Brook since 1996. These stations are labeled as S256 (Upstream – Evergreen Cemetery), S257 (Downstream – above Capisic Pond), and W-023 (wetland station by Capisic Pond).

[2] MaineDEP, 2005. *Urban Streams Nonpoint Source Assessments in Maine Final Report*. Prepared by Susanne Meidel and MAINEDEP for the U.S. Environmental Protection Agency, Report Number DEPLW0699.

Table 1-2, 2003 Results of Biological Monitoring Program summarizes the conditions in Capisic Brook at the two monitoring locations as reported in the Urban Streams Report. Maine legislature has designated Capisic Brook as a Class C water, which is intended to meet the State's minimum environmental goals for water quality. The upstream station in Evergreen Cemetery had a healthy macroinvertebrate community, good water quality and adequate habitat according to the Urban Streams Report. The downstream station above Capisic Pond had impaired biota, poor water quality and degraded habitat. Variation in water quality at these two stations has been attributed to the differences in land use, especially the presence of impervious cover, and hence probable differences of NPS discharges into the brook between these two monitoring locations. CSO wastewater outfalls are also very likely to contribute to the impaired state of water quality at the downstream station, particularly during wet weather. The City has made significant progress toward the separation of the sanitary and storm sewer system within this watershed, and these efforts are expected to be completed 2013.

Table 1-2: 2003 Results of Biological Monitoring Program – Capisic Brook

Parameter	Upstream Station S256 (Evergreen Cemetery)	Downstream Station S257 (above Capisic Pond)
Macroinvertebrates	Healthy community; meets Class C criteria	Degraded (animal diversity is low, most species present are tolerant of pollution)
Fish	Not studied	
Water Quality (e.g., dissolved oxygen levels, water temperature, nutrient levels)	Good	Impaired (i.e., at levels that may negatively affect biological communities)
Concentration of bacteria	Low	Elevated
Instream habitat quality	Good	Impaired

While the Urban Streams Report focuses largely on the ecology of the brook and watershed, imperviousness associated with development contributes to periodic flooding in the watershed, which can compromise both ecology and infrastructure. DeLuca-Hoffman Associates, Inc. was retained by the City and published a flood control study in September 1999[3]. The study considered flooding issues along the Capisic Brook corridor and developed preliminary design concepts for two flood control facilities within the watershed: the West Branch and East Branch Detention Basins. The construction of these two detention basins was initially recommended in "The Capisic Brook Greenbelt/Stormwater Abatement Study"[4] (Greenbelt Study), a 1996 study by CH2M Hill. The West Branch Detention Basin includes an area capable of reducing the peak flow of the 25-year storm by approximately 50%. It requires 33 acre-feet of storage to mitigate flooding in the adjacent neighborhoods and reduce peak flows in the lower reaches of the watershed.

[3] DeLuca-Hoffman Associates, Inc., 1999. *Capisic Brook Watershed Flood Control Study Re-evaluation Draft Final Report.* Prepared for the City of Portland Public Works Department.

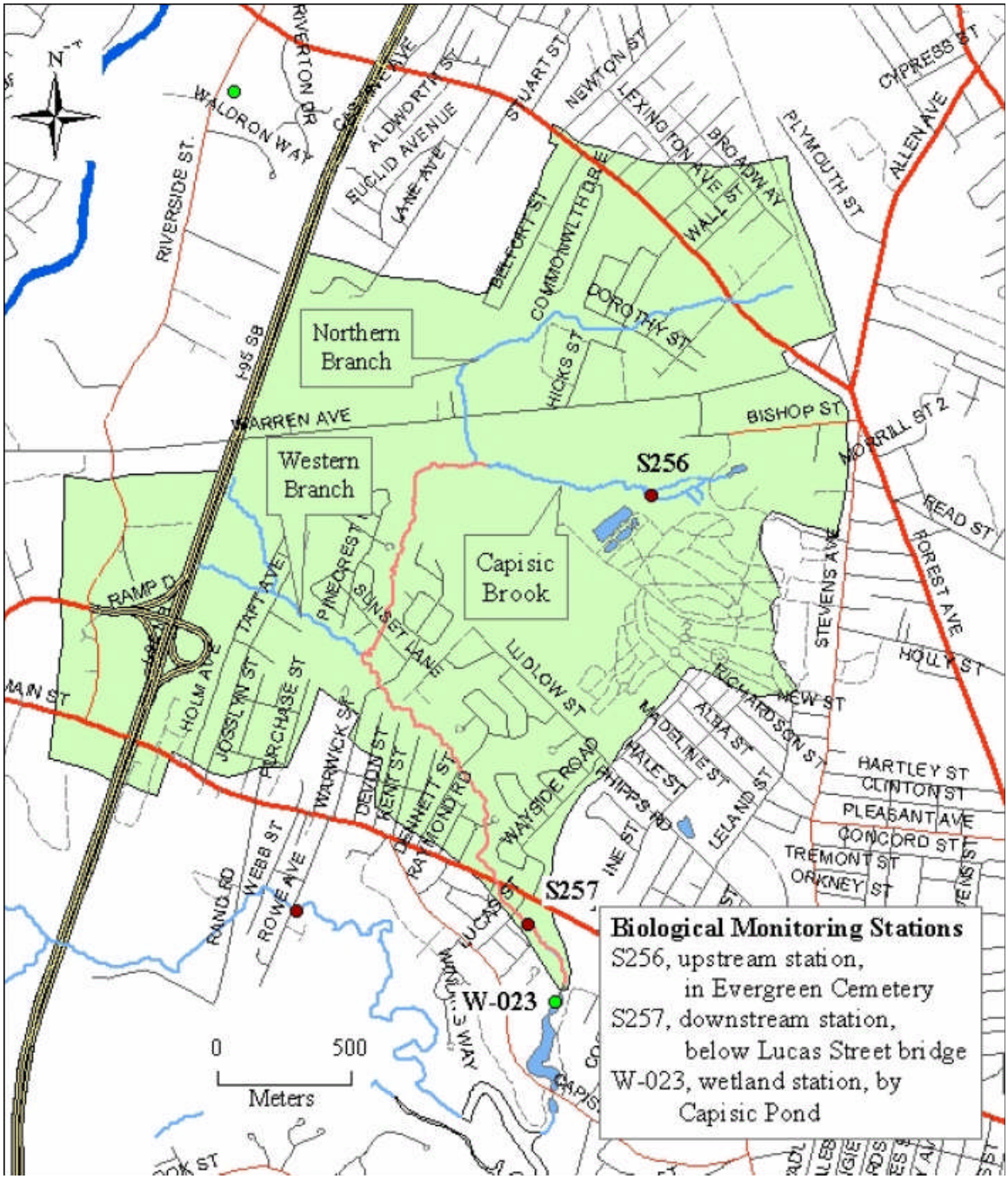
[4] CH2M Hill, 1996. *The Capisic Brook Greenbelt/Stormwater Abatement* Study. Prepared for the City of Portland Department of Public Works.

1.2.2 Watershed Restoration Needs

Improvement of the overall stream health of Capisic Brook will depend upon the actions taken within the watershed to reduce negative impacts on water quality. MaineDEP developed the following goals for Capisic Brook as a result of its Urban Stream Project:

1. Improve instream habitat quality;
2. Restore the natural hydrology,
3. Reduce inputs of toxics, nutrients, elevated water temperature in runoff and bacteria; and
4. Improve dissolved oxygen levels.

Figure 1-1: Capisic Brook, Portland



Source: MaineDEP. 2005. Urban Streams Nonpoint Source Assessments in Maine, Final Report.

Note: Capisic Brook as shown in this figure was traced from Citipix images, requiring some inferences where the stream was obscured or running underground. A more recent figure is shown in Appendix A – Figure 1.

1.2.3 A Community Resource

The water quality of Capisic Brook is of particular concern due to the potential for recreational use within Capisic Pond and high quality natural areas along the stream corridor. In 1996, the Greenbelt Study was conducted to develop watershed goals and create an urban recreational, educational, and aesthetic resource. According to the Greenbelt Study, there has been strong public and regulatory support for implementation of a plan to improve water quality, control flooding, enhance environmental habitat, and provide recreational opportunities in the Capisic Brook Watershed.

Existing resources include the 239 acres within Evergreen Cemetery, Portland's largest open space, which contains 70 acres of urban forest acting as a wildlife and bird sanctuary. Both the Friends of Evergreen Cemetery[5] and the Portland Land Bank Commission[6] advocate for the cultural, historical and recreational resource value of the park.

The design team of Carol R Johnson Associates (CRJA), CH2M Hill, and Eco-Analysts, Inc. developed a Capisic Brook Greenway Master Plan[7] (Greenway Plan) in 2001 for the Capisic Brook Watershed based largely on the Greenbelt Study. The team designed the network of trails and "greenway" to create new opportunities for public access, recreation, and habitat improvement along Capisic Brook. The greenway was designed to be a natural scenic passage that connects neighboring parks and recreational facilities, schools, communities and other natural resources. A primary objective of the Master Plan was to provide a continuous trail along the length of the Greenway. According to CRJA, the linkage between the existing Evergreen Cemetery trail and Capisic Park, as well as additional trail amenities, is greatly supported by the community. The proposed trail improvements include the addition of two Education Stations which may include outdoor classrooms with benches and tables, loop rails, monitoring stations, interpretive signage as well as trails from local schools.

Community parks were also proposed at the West and East Branch Detention Basins, and were envisioned to include play fields, a playground, picnicking and a community garden.

CH2M Hill's Greenbelt Study divided Capisic Brook into eight Focus Areas that were further partitioned into 18 segments in the Master Plan. Table 1-3, Ecological and Recreational Resources summarizes the key educational, recreational, and ecological resources located within each Focus Area as described in the Greenbelt Study and the Master Plan, and as investigated and described in 1996 and 2001.

[5] *Friends of Evergreen Cemetery*, 2009. <http://friendsofevergreen.org/index.htm> Accessed 12/7/2009.

[6] *Portland Land Bank Commission: Current Holdings, Recommendations, & Priorities*, 2005; *Portland Land Bank Commission: Report and Registry*, 2007.

[7] Carol R Johnson Associates, Inc. et al, 2001. *Capisic Brook Greenway Master Plan.* Prepared for the City of Portland, Maine.

Table 1-3: Ecological and Recreational Resources

Focus Area	Ecological and Recreational Resources
(1) – Capisic Pond	Capisic Park: 25 acre park consisting of freshwater pond, wetlands and uplands. Passive recreation walking path.
(2) – Violette Avenue to Dennett Street	High ecological value and high potential. Some forested wetland; Japanese Knotweed bamboo (invasive species) is prevalent along the banks.
(3) – Dennett Street	Education Station #1 (proposed) High ecological value and wildlife habitat potential and proximity to two schools makes this an appropriate place for environmental education. Upstream, channel diversion forms islands and back waters. Red stem dogwood is common in this stretch.
(4) – Warwick Street to Taft Avenue	Education Station #2: Hall School (proposed) Small tributary enters the brook at Hall School. Potential for habitat enhancement and proximity to the school makes this an appropriate place for environmental education.
(5) – Taft Avenue to Westbrook (West Tributary)	West Branch Detention Basin: community parks are proposed and would include play fields, playground, picnicking and a community garden. Largely forested wetland and wet meadow.
(6) – Downstream from Sunset Street	High ecological value and appears to be near its maximum potential. Forested wetlands. Extensive dead mature trees and woodpecker activity.
(7) – North Evergreen Cemetery Area	Evergreen Cemetery: forest and open space. East Branch Detention Basin: community parks are proposed and would include play fields, playground, picnicking and a community garden.

Focus Area	Ecological and Recreational Resources
	Lack of development along power line easement enhances wildlife value.
(8) – North of Warren Ave (North Tributary)	Residential area. Wet meadow and wetland communities north of brook corridor.

The Capisic Brook corridor is considered to have a high potential as a natural resource, as can be seen in the summaries of the sections listed in Table 1-3. The location of the corridor in the midst of extensive residential development makes the corridor especially attractive as a community resource. Areas such as Capisic Park in Focus Area 1 are of particular concern to the community as its walking path and freshwater pond serve as recreational resources. Capisic Park is located along Capisic Pond, downstream of the majority of the watershed. The health of the brook and its watershed will determine the water quality, aquatic and terrestrial plant and wildlife presence and general aesthetics at downstream resources such as Capisic Pond and its park.

1.2.4 Previous Recommendations

The recommendations outlined in this section are not new; the recommendations are as proposed in previous studies as well as within the Draft Total Maximum Daily Load (TMDL) Report by the MaineDEP[8]. Recommendations include structural and non-structural management solutions to improve aspects of watershed health, enhance natural areas, and increase community use and recreational opportunities. Several of the previous recommendations have been completed or are ongoing and are listed in each section. These specific actions are noted in each subsection and are described in more detail as a component of this plan. Discussion of each of the previous recommendations is included in the Retrofit Inventory Strategy Team meeting notes in Appendix D.

Infrastructure Improvements

1. Continue separation of the City's CSO system in order to eliminate input of sanitary wastewater into the stream thus significantly reducing nutrient and bacterial loads;
2. Construct the West Branch and East Branch Detention Basins to provide flood control and, if possible, develop the area around the basin to be used for active recreation play fields, and walking and hiking trails;
3. Reduce NPS runoff by replacing impervious cover with pervious material and channeling runoff through treatment/infiltration systems; and
4. Implement the following structural improvements to control overbank flooding:

[8] MaineDEP, *Capisic Brook Total Maximum Daily Load (TMDL) Draft Report*, 2005. Prepared by Susanne Meidel and MAINEDEP. Report Number DEPLW0713.

a) Extension of the Capisic Pond Dam weir;

b) Increase conveyance by executing channel improvements as outlined in the DeLuca-Hoffman Flood Control Study;

c) Install a 4' x 8' box culvert at Capisic Street;

d) Install a 48" diameter culvert adjacent to the existing culvert at Lucas Street;

e) Install a second 3' x 6' concrete box culvert at Taft Avenue; and

f) Install a 3' x 9' box culvert at Holm Avenue.

Previous Recommendations Completed or Ongoing:

- The City continues to make progress towards separation of Combined Sewers within the Capisic Brook watershed under the Tier 1 and Tier 2 plans (see Section 2.3). The separation projects remaining to be completed are discussed in more detail in Section 3 and are a critical component of long-term watershed sustainability.
- A section of the brook north of Warren Avenue that had been diverted into the combined sewer system for more than 50 years was returned to its historic channel in the winter of 2010. This will help reduce CSO events downstream, while restoring flow to portions of the upper watershed that still retain significant wetlands & riparian buffers.
- The West Branch and East Branch Detention Basins have not been constructed at the time of this report. During a meeting of the Retrofit Inventory Strategy team, the recommendation to construct both detention basins was discussed. Although the costs of retrofitting this proposed design with appropriate water quality treatment modifications must be evaluated relative to the economic costs (e.g., redesign, construction, land acquisition, legal considerations, etc.) and ecological impacts to remove the existing riparian habitat at this location, it was determined that this facility should be considered as part of this planning process. The proposed East Branch detention facility was determined to provide limited value for treatment of polluted stormwater given its proposed location and was not further considered in the planning process. An alternative to the East Branch detention facility is discussed in Section 3.
- Structural stormwater treatment facility recommendations are proposed in Section 3 in order to reduce the impact of existing impervious surface.
- The following conveyance structure modifications have been completed: extension of the Capisic Pond Dam weir, a 4' x 8' box culvert at Capisic Street; and a 48" diameter culvert adjacent to the existing culvert at Lucas Street. The previously recommended improvements at Taft and Holm Avenue have not been completed and will be considered in conjunction with the West Branch Detention facility.

Planning and Outreach

1. Implement non-structural strategies to provide long-term improvements, including implementation of Education Stations and other outreach and education, pollution prevention, water quality monitoring, and policy and planning initiatives to reduce the likelihood for pollutants to enter the stream;

2. Increase the dissolved oxygen concentration in the stream through a managed reduction of stream water temperatures and a reduction in the discharge of nutrients to the stream;

3. Physically enhance the riparian zone and area around detention basins, including the replanting of native trees and restoring the natural morphology of Capisic Brook;

4. Develop a periodic maintenance schedule for the Capisic Brook channel system, including review of the channel for erosion and sedimentation, identification of debris accumulation and removal;
5. Reduce sewer system and septic leaks by inspecting and maintaining systems;
6. Utilize a road sweeping program to reduce road sand in stormwater and snow melt runoff during winter months; and
7. Encourage responsible development: Smart Growth and Low Impact Development (LID).

Previous Recommendations Completed to Date:

- Combined Sewer Overflow abatement, which is ongoing in the Capisic Brook watershed, will greatly reduce nutrient discharge into the stream and will partly address Previous Recommendation #2.
- The City is required to identify septic systems within the watershed that are 20+ years old by the end of the current permit year (June 30th, 2010). At this time is not expected that any septic systems still exist in the Capisic Brook watershed.
- The City has purchased a high-efficiency vacuum sweeper and has begun to develop a water quality sweeping program in the Capisic Brook watershed.

Community and Ecological Value

1. Design and implement a greenway within the Capisic Brook watershed as described in the Greenway Master Plan;
2. Enhance aesthetic value through construction of small bridges over water control structures, interpretive signs, and plant material identification markers; and
3. Modify and dredge Capisic Pond to create an environment suitable for fish and other wildlife after upstream modifications have been carried out.

Previous Recommendations Completed to Date:

- The comprehensive greenway development proposed for Capisic Brook has not approved by City Council given private property landowner objections and cost[9]. Specific education station and interpretive development on public land has been considered in Section 3.
- The City of Portland is currently considering Capisic Pond sustainability planning and management.

1.3 REGULATORY OBLIGATION

1.3.1 General Overview

The Clean Water Act (Act) was enacted in 1972 to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Act sought to do this by employing a "cooperative federalism" approach that provided for active state regulatory participation, rather than a purely national form of control. The primary mechanism for pollution control is the National Pollutant Discharge Elimination System (NPDES). NPDES applies to any addition of any pollutant to navigable waters from any point source and prohibits such discharges unless in accordance with a permit, issued by the United States Environmental Protection Agency (EPA), or by a delegated state, such as Maine. In addition to the end-of-the-pipe effluent limitations imposed by the NPDES program, the Clean Water Act also provides

[9] Roland, B, 2010. Personal Interview. City of Portland Engineering.

for an ambient approach to regulation, which requires states to establish water quality standards for every waterbody in its jurisdiction. This provision, entitled "Water Quality Standards and Implementation Plans," is provided in Section 303 of the Act.

Permits issued in accordance with the NPDES program must establish discharge limits that are stringent enough for each waterbody to meet the applicable, state-set water quality standards. Maine has established water quality standards under the Water Classification Program (Title 38 MRSA Art. 4-A) which sets forth the following four classifications of fresh surface waters:

- Class AA Waters. Class AA shall be the highest classification and shall be applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic or recreational importance.
- Class A Waters. Class A shall be the second highest classification.
- Class B Waters. Class B shall be the third highest classification.
- Class C Waters. Class C shall be the fourth highest classification.

Each of the four classes of fresh surface waters includes designated uses, which are the appropriate uses to be achieved and protected for each waterbody.

The MaineDEP is tasked with monitoring the State's waterbodies to determine if they are meeting the assigned water quality class. Those waters that are unable to meet their applicable water quality standards are said to be in "nonattainment." The State must then, for every waterbody in nonattainment, establish the "total maximum daily load" (TMDL) for pollutant discharges, at a level necessary to meet the applicable water quality standards. A TMDL is defined as the sum of wasteload allocations for point sources, load allocations for nonpoint sources, and the natural background loads. This sum represents the total amount of pollution a waterbody can accept and still be in attainment of state water quality standards. Therefore, if pollution loads are at or below the applicable TMDL, that waterbody will theoretically meet its water quality standard.

Upon completion, states must submit TMDLs to EPA for approval and once approved, the discharge allocations must be incorporated into NPDES permits, which allocate the amount of effluent that can be discharged into the waterbody from all point sources and nonpoint sources. Additionally, the TMDL is incorporated into the state water quality management plans under Section 303(e) of the Clean Water Act. Therefore, the approval of a TMDL does not improve water quality; rather, water quality improvement occurs only when the pollution allocations are integrated into the permits and water quality management plans and those permits and plans are complied with or enforced.

Although the NPDES permitting system was originally applied only to point sources of pollution, 1987 amendments to the Clean Water Act expanded the scope to address the growing concern related to discharges composed entirely of stormwater through non-point sources. Under what is known as "residual designation authority," EPA or the states may require NPDES permits of any source that is found to be contributing to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

1.3.2 Capisic Brook's Regulatory Overview

Maine Pollution Discharge Elimination System

Maine was authorized to implement the NPDES program in January of 2001. Pursuant to this authorization, the State plays the lead role in administering the Clean Water Act, including issuing Maine Pollution Discharge Elimination System (MEPDES) permits to authorized dischargers. Once issued, these MEPDES permits contain legally binding effluent limits that are enforceable through the Clean Water Act.

Maine has developed a general permit that covers discharges from Small Municipal Separate Storm Sewer Systems (MS4s). The City of Portland and the City of Westbrook are regulated Small MS4 Municipalities and therefore are obligated to comply with the provisions of the MS4 General Permit. Additionally, the Maine Department of Transportation (Maine DOT), and the Maine Turnpike Authority (MTA) have permitted discharges into Capisic Brook under the MS4 transportation general permit. The General Permits contains the following: permit coverage and limitations, definitions, authorization and notice requirements, stormwater program management plan requirements, and standard conditions for the three MS4 General Permits which cover municipalities, transportation MS4s, and state or federally-owned MS4s.

The MS4 General Permit authorizes the direct discharge of stormwater from Small MS4s to waters of the State other than groundwater. These discharges, however, must be in accordance with the requirements of the General Permit. One such requirement is found in Part I, Section D.5, entitled "Violation of water quality standards," which provides:

> This general permit does not authorize a discharge that causes or contributes to a violation of a water quality standard. Discharges covered under this permit may not:
>
> 1. Contain any pollutant, including toxic substances, in quantities or concentrations, which may cause or contribute to any adverse impact on the receiving water;
> 2. Be to a receiving water which is not meeting its classification standard for any characteristic which may be affected by the discharge; or
> 3. Impart color, taste, turbidity, radioactivity, settleable materials, floating substances or other properties that cause the receiving water to be unsuitable for the designated uses ascribed to its classification.

Additionally, Part IV of MS4 General Permit requires permittees to "develop, implement, and enforce a Stormwater Program Management Plan (Plan) implementing six minimum control measures designed to reduce the discharge of pollutants within the Urbanized Area, from its regulated small MS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act." These six minimum control measures are: 1) Public Education and Outreach; 2) Public Involvement and Participation; 3) Illicit Discharge Detection and Elimination; 4) Construction Site Stormwater Runoff Control; 5) Post-construction Stormwater Management; and 6) Pollution Prevention/Good Housekeeping. Further, the minimum control measures must be stated in measurable goals by which each Best Management Practice (BMP) will be measured; identify the responsible party charged with implementing the BMPs; and identify a date by which each BMP will be implemented.

Maine also manages a general permit that covers discharges from industrial facilities under the Multi-sector General Permit (MSGP). The Multi-sector permit requires facilities that fall into particular categories of industrial activity to obtain a permit for discharges of stormwater. Similar to the MS4 permit the General Permits contains the following: permit coverage and limitations, definitions, authorization and notice requirements, stormwater pollution prevention requirements, and standard conditions. The key component to the MSGP is the development of requirement for a Stormwater Pollution Prevention Plan that summarizes site-specific BMPs and requirements, including quarterly site inspections and visual monitoring. In 2011, an updated MSGP was issued that increased requirements for permittees and regulated facilities. The following facilities in the Capisic Brook watershed are currently regulated under the MSGP according to the MaineDEP, although there may be additional facilities that are not aware of their MSGP obligations. The following facilities in the Capisic Brook are regulated under the MSGP according to the MaineDEP.[10]

NO EXPOSURE

- Game Room Supply LLC - 324 Warren Avenue – Blanchard, James - #878-6601 – Permit #MERNEA949
- Nilsen Canvas Products – 212 Warren Avenue – Nilsen, David - #797-4863 – Permit #MERNEB098
- Showroom, Inc. – 240 Warren Avenue – Garvey, Larry – #797-6228 – Permit #MERNEB167
- H.W. Demmons, Inc – 93 Warren Avenue – Martin, Douglas W. - #797-7468 – Permit #MERNEB261

Notice of Intent to Comply with General Permit

- Isherwood Enterprises, Inc. – 535 Warren Avenue – Isherwood Greg - #797-9100 – Permit #MER05B436
- Pike Industries, Inc. – 102 Bishop Street – Robillard, Robert E. - # (603) 527-5100 – Permit#MER0B314
- Plasmine Technology, Inc. – 33 Bishop Street – Ulichney, Peter - # (850) 438-8550 – Permit #MER05B646

The City of Portland

The City of Portland finalized its current Stormwater Program Management Plan on December 23, 2008. As a vital component of the MS4 General Permit, the conditions of the Stormwater Program Management Plan are legally binding and enforceable. The City's Plan has identified Capisic Brook as its highest priority watershed. As such, the Plan contains the required six minimum control measures applicable to all waterbodies within the City, as well as a number of provisions specific to the Capisic Brook watershed. The additional efforts are as follows:

1. Data Collection
    a. Compile an inventory of City operations
    b. Identify landowners and assess their stormwater knowledge
    c. Map catchment areas and identify "hot spots"
2. Public Education and Outreach

[10] Kale, D, 2011. Personal Interview. MaineDEP.

   a. Place informational signs in parks and schools.
   b. Develop an awareness plan and seek partnerships with the City of Westbrook, neighborhood groups, and Deering High School to assist in the implementation.
3. Public Involvement and Participation
   a. Public meeting for landowners
   b. Encourage the creation of a Stream Team for Capisic Brook and explore the creation of a Watershed Stewards program within the four schools in the watershed.
   c. Explore the creation of a voluntary downspout disconnection program.
4. Illicit discharge detection and elimination
   a. Priority mapping of the Capisic Brook watershed.
   b. Increased monitoring and inspection of Capisic Brook.
5. Construction site stormwater runoff control
   a. Additional inspection to construction activities with the Capisic Brook watershed.
   b. Evaluate various LID techniques for effectiveness to determine which should be included in ordinances.
6. Post-construction stormwater management in new development and redevelopment
   a. City will propose an amendment to its Stream & Watercourse Protection Ordinance to expand protection.
7. Pollution prevention/good housekeeping for municipal operations
   a. Annual vacuum sweeping of streets in the Capisic Brook watershed; annual catch basin cleaning and assessment.
   b. More frequent vacuum sweeping of public roads and parking lots in identified "hot spots".

The City of Westbrook

The Stormwater Program Management Plan for the City of Westbrook was finalized on February 3, 2009. Like the City of Portland, Capisic Brook is identified in the Plan as one of the priority watersheds, which imposes the requirements of the six minimum control measures applicable to all waterbodies in the City of Westbrook as well as additional, watershed specific measures. The Plan contains the following six minimum control measures (MCMs):

1. Public education and outreach on stormwater impacts
   a. Participate in the Interlocal Stormwater Working Group (ISWG) and fund the ISWG Public Education and Outreach services
2. Public involvement and participation
   a. Participate in the ISWG
   b. Host/conduct or participate in public events such as storm drain stenciling, stream clean-up, etc.
3. Illicit discharge detection and elimination

   a. Develop a watershed based storm sewer infrastructure map
   b. Implement and enforce a non-stormwater discharge ordinance
   c. Develop and implement a prioritized dry weather outfall inspection plan and a strategy to detect illicit discharges in priority watersheds
4. Construction site stormwater runoff control
   a. Notification to construction site developers of the requirements for Chapter 500 registration
   b. Annual documentation of construction activity and develop and implement a construction site inspection program.
5. Post-construction stormwater management in new development and redevelopment
   a. Enact and implement a post construction ordinance or similar measure that ensures long term operation of post construction BMPs
   b. Post construction inspection for BMP compliance
6. Pollution prevention/good housekeeping for municipal operations
   a. Develop an inventory of municipal operations that have the potential to cause or contribute to stormwater or surface water pollution
   b. Develop written O&M procedures for priority watershed that include maintenance schedules and inspection
   c. Develop a program to sweep all publicly owned streets and parking lots and clean catch basins and other stormwater structures

Maine Department of Transportation

The Maine DOT also identified Capisic Brook as one of its two priority watersheds, in its Stormwater Program Management Plan finalized in December 2008. This designation obligates the Maine DOT to incorporate additional stormwater treatment controls into the minimum control measures for discharges from Maine DOT infrastructure and operations in the Capisic Brook watershed. Specifically, priority will be given to cleaning out stormwater catch basins in the high priority watersheds including Capisic Brook, and the Maine DOT is obligated to perform street sweeping.

Maine Turnpike Authority

The Maine Turnpike Authority (MTA) also finalized its Stormwater Program Management Plan in December 2008. This Plan outlines the six required MCMs applicable to all of its regulated MS4 discharges, as well as more stringent measures for higher priority watersheds identified by MTA, which does not include Capisic Brook. Although MTA chose two alternate priority watersheds in the Plan, the MCMs that apply to the Capisic Brook watershed require MTA to sweep all paved areas at least one time per year, giving a higher priority to UIS watersheds. Additionally, all CBs must be cleaned annually.

Combined Sewer Overflow Consent Decree

In 1991, the City and the Portland Water District entered into a legal obligation with the MaineDEP and EPA to perform a number of sewer separation projects to reduce and eliminate a large portion of existing

combined sewer overflows (CSOs) from the City's sewer system. In accordance with this consent decree, the City developed a long-term program to cost-effectively abate CSOs in the City. The plan called for eliminating 33 of the 39 active CSOs, of which three of the 39 are within the Capisic Brook watershed.

Capisic Brook still has two active CSOs in the watershed that directly discharge untreated sanitary wastewater and stormwater during wet weather events; Warwick Avenue CSOs 42 and 43. These discharges are in accordance with a combination MEPDES permit #ME0101435/Maine Waste Discharge License (WDL) #W008010-5T-C-R, issued on October 24, 2008, valid until October 24, 2013. This combination permit/license authorizes discharges from certain enumerated discharges based on several conditions and requirements pertaining to: Location, Prohibited Discharges, Narrative Effluent Limitations, and the CSO Master Plan.

Water Quality Standards

As Class C waters, the applicable criteria for Capisic Brook and Capisic Pond are found in 38 M.R.S.A. § 465, reproduced below and summarized in the table following.

A. Class C waters must be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; agriculture; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; navigation; and as a habitat for fish and other aquatic life.

B. The dissolved oxygen content of Class C water may be not less than five parts per million or 60% of saturation, whichever is higher, except that in identified salmonid spawning areas where water quality is sufficient to ensure spawning, egg incubation and survival of early life stages, that water quality sufficient for these purposes must be maintained. In order to provide additional protection for the growth of indigenous fish, the following standards apply.

C. Discharges to Class C waters may cause some changes to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community. This paragraph does not apply to aquatic pesticide or chemical discharges approved by the department and conducted by the department, the Department of Inland Fisheries and Wildlife or an agent of either agency for the purpose of restoring biological communities affected by an invasive species.

Table 1-4: Applicable Water Quality Criteria

Numeric Criterion	Narrative Criteria	
Dissolved Oxygen	**Habitat**	**Aquatic Life (Biological)**
5ppm; 60% Saturation	Habitat for fish and other aquatic life	Discharges may cause some changes to aquatic life, except that the receiving waters must be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Pursuant to Section 303(d)(1) of the Clean Water Act, States must identify those waters within their jurisdiction for which effluent limitations are not stringent enough to implement any applicable water quality standard and to establish a priority ranking system for such waters. Maine submitted its most recent 303(d) list on July 22, 2008 which was approved by the EPA on August 21, 2008. Capisic Brook is listed on the State's 303(d) list for impairment due to Benthic-Macroinvertebrate Bioassessments, and Habitat Assessment, therefore requiring the development of a Total Maximum Daily Load (TMDL).

Total Maximum Daily Load

Maine established a priority ranking for listed waters; Capisic Brook was assigned a high priority, and a goal date of 2008 was set for its TMDL development. The TMDL schedule was based on the value of the water, the nature of the impairment and the source(s) of the problem, available information to complete the TMDL, and availability of staff and contractual resources to acquire information and complete the TMDL study. The *Capisic Brook Total Maximum Daily Load Draft Report* was submitted to the EPA under the bundled Urban Stream Report on July 29, 2005. EPA however, returned the Draft TMDL to MaineDEP in order to revise and incorporate comments from EPA.

The *DRAFT Capisic Brook TMDL* was prepared by MaineDEP using the Percent Impervious Cover Method, a model that has been used in Maine, and throughout EPA Region 1, for several urban impaired streams' TMDLs. Strong evidence supports the finding that biological impairment is generally present when a watershed's impervious cover reaches and exceeds 10%, and watersheds with 25% imperviousness are almost invariably impaired. The percent imperviousness for the Capisic Brook watershed was found to be 23%. The Impervious Cover Model links changes in water quality directly to land use and treats urbanization of the watershed, measured by the amount of imperviousness, as the pollutant of concern, thus serving as a proxy for the mixture of pollutants carried in stormwater.

Impervious Cover TMDLs differ from "traditional" TMDLs not only in their methodology of determining the pollutants of concern, but also in the way they measure the allowable maximum daily load. Rather than establishing the loading capacity, which is essentially a pollution budget, in terms of mass per time (e.g. pounds per day); the Impervious Cover TMDL establishes a target "effective" percent impervious cover for the watershed. The effective impervious cover is the amount of imperviousness that is directly connected to the stream, rather than the total amount of imperviousness in the watershed. The Draft Capisic Brook TMDL established a target effective impervious cover at 13%.

From a regulatory standpoint, the target effective impervious cover would be met not by rendering impervious surfaces pervious by tearing up asphalt, but instead through Best Management Practices (BMPs) that become enforceable through the General Permit(s) that incorporates the TMDL. The goal of the BMPs is ultimately to achieve the water quality standards by altering the watershed to resemble conditions of lower imperviousness. This may include, but is not limited to, pollution prevention, stream restoration or disconnection of impervious surfaces from the waterbody.

It is uncertain when the revised Capisic Brook TMDL will be resubmitted to EPA. Until then, there are no additional regulatory obligations imposed by the TMDL that the City of Portland, City of Westbrook, Maine Turnpike Authority or Maine Department of Transportation must meet, but the City and other permitted dischargers are still prohibited from causing or contributing to a violation of water quality standards. However, when the TMDL is approved, certain aspects of the MS4 General Permit may be implicated.

Summary

The Capisic Brook watershed has been identified by the City as its highest priority watershed. It is currently in non-attainment of its applicable water quality standards. MaineDEP, as the NPDES permitting authority, issued a MS4 general permit applicable to Capisic Brook imposing several requirements, including a prohibition on discharges that cause or contribute to water quality violation, and the obligation to complete and adhere to a Stormwater Program Management Plan, which carries with it its own requirements. Additionally, the CSO consent decree and Waste Discharge License obligate the CSO owners to reduce and eliminate these discharges into Capisic Brook. Therefore, the City, the City of Westbrook, the Maine Department of Transportation, and the Maine Turnpike Authority need a comprehensive long-term watershed management plan to develop a compliance strategy in order to meet these obligations in a cost-effective manner. Additionally, regulated industrial facilities within the watershed are obligated to meet specific requirements under the MSGP related to discharges into impaired waters.

1.3.3 Recent Stormwater Regulation Case Studies

The focus on urban impaired streams as a result of non-point source pollution is not new in Maine or in EPA Region 1. For example, recent actions have been taken in the Long Creek watershed in Maine; in the Charles River watershed in Massachusetts; and in five watersheds in Chittenden County, Vermont.

Long Creek is an urban impaired stream with a watershed or approximately 3.5 square miles in and around South Portland, Maine. The watershed is comprised of approximately 30% impervious cover, which has led to an inability to achieve its designated water quality standards, due largely to polluted stormwater runoff. EPA determined that stormwater discharges from impervious surfaces equal to or greater than one acre were causing or contributing to water quality violations. This finding allowed EPA to exercise its Residual Designation Authority and require this category of dischargers to obtain NPDES permits. With this designation, approximately 90% of the impervious area in the Long Creek watershed is under the permitting jurisdiction the NPDES program.

In contrast to the relatively small Long Creek watershed, the Charles River drains a watershed area of 310 square miles. However, both watersheds share the similar characteristics of urbanized watersheds and the Charles River is impaired largely because of polluted stormwater runoff. In exercising its Residual Designation Authority, EPA determined that stormwater discharges from property containing impervious surfaces equal to or greater than two acres cause or contribute to water quality violations and are therefore subject to NPDES stormwater permitting requirements.

In Vermont, the Vermont Department of Environmental Conservation gave notice on July 19, 2009 that it was exercising Residual Designation Authority for stormwater discharges to five watersheds in Chittenden County that fail to meet water quality standards, each of which has an EPA approved TMDL. As was the case in the Long Creek and Charles River watersheds, the cause of impairment in Chittenden County was also polluted stormwater runoff that resulted from urbanization and impervious surfaces. The Residual Designation applies to all stormwater discharges from impervious surfaces that are not covered by the MS4 General Permit or another NPDES permit. This is the broadest use of Residual Designation to date, as it applies to every contributor of stormwater, without a size threshold. In order to permit these dischargers, the Vermont Agency of Natural Resources intends to issue a general stormwater permit for dischargers brought under NPDES permitting authority as a result of the designation.

These examples show that previously unregulated properties that discharge stormwater into impaired waterbodies can easily come within the scope of NPDES permitting requirements. When it is determined

that a particular discharge or category of discharges causes or contributes to a water quality violation, EPA can require previously unregulated dischargers to obtain a permit for their stormwater discharge.

2. EXISTING CONDITIONS

2.1 THE WATERSHED

The City has refined the original MaineDEP Capisic Brook watershed boundary to focus on a study area of 1,418 acres as shown in Figure 1 – Appendix A (Aerial Site Location). The figure depicts three "holes" within the watershed boundary that have been excluded from the study watershed area. These areas are located at the northern end of Warwick Street, the eastern end of Warren Avenue, and the northern border of the watershed area. Stormwater from these areas does not remain in the watershed to recharge the brook and either flows to a combined sewer for discharge at the wastewater treatment plant, or is discharged in the CSO below Capisic Pond (CSO #36).

The watershed has been divided into five subwatersheds: the North Tributary, East Tributary, West Tributary, Middle Reach, and Lower Reach. Figure 1 shows the location of each subwatershed area.

The following Geographic Information System (GIS) analysis was performed from a compilation of the best available data sources, including 2006 aerial photography, Federal Emergency Management Agency (FEMA) flood maps, MaineDEP GIS data layers and City of Portland planimetrics.

2.1.1 Natural Resources

Figure 2 – Appendix A (Natural Resources) includes FEMA Flood Insurance Rate Map (FIRM) 100-year (AE) and 500-year (X500) flood zones, National Wetlands Inventory (NWI) wetlands, ponds and surface water bodies, and areas of vacant land greater than 5 acres within the watershed.

The wetland, floodplain, and urban forest areas have been identified as they are remnant natural areas which help to maintain the ecological diversity and overall environmental health of downstream water bodies. For instance, wetlands provide natural attenuation of stormwater runoff and can also help to maintain watershed water quality. Intact floodplains are critical to the function of stream systems, provide flood attenuation and, when forested, help to maintain stable stream temperatures. Areas depicted as FEMA flood zones are regulated by floodplain regulations in Chapter 14 under Division 26.5 of the City of Portland Code of Ordinances. The floodplain regulations do not specifically restrict floodplain development in the zones relevant to the Capisic Brook but do provide a basis for municipal review when filling or construction within the floodplain is proposed. Flood zone areas that do not follow the stream corridor can be explained by variations in the MaineDEP and FEMA stream GIS layers.

There are approximately 64 acres of NWI identified wetlands in the watershed, with the majority located in the North Tributary subwatershed and additional limited areas within the West Tributary. The Capisic Brook has been impounded creating the Capisic Pond and its adjacent wetland areas, which is zoned as recreational open space. While forested areas are not shown on Figure 2 – Appendix A, there are 70 acres of protected urban forest within the Evergreen Cemetery, which helps to maintain the hydrologic integrity of the upper watershed.

Additionally, vacant lands greater than 5 acres are depicted in the figure and may be functioning as natural recharge areas. Within a highly developed urban watershed, any land areas that remain vacant (not covered by impervious surfaces) may help to maintain deep and shallow groundwater recharge. The preservation or conservation of open space/vacant parcels can offset the negative impacts on stormwater quality from developed areas.

In general, streams within the City are regulated by Chapter 14 of the Portland Code of Ordinance, Division 26 Shoreland Regulations. In the case of the Capisic Brook, the shoreland area extends 75-feet from the high water line of the stream. The Shoreland Regulations do not specifically preclude development but aid in the conservation of stream channels and floodplains and minimize adjacent activity impacts on the stream. The area directly adjacent to the Capisic Brook is zoned as Residential over the majority of the stream corridor. Activities within these shoreland areas are also regulated by the state of Maine under the Natural Resources Protection Act. Additional stream protection district regulations within the City of Portland include the Stream Protection Zone (Division 26.7). The City currently regulates a SPZ within this watershed with the exception of the West Tributary and other minor tributaries.

2.1.2 Land Cover

Approximately 31% of the study watershed is covered by impervious surfaces (Figure 3 – Appendix A – Impervious Cover). Small urban watersheds in Maine with greater than 10% of their land area covered by impervious surfaces are generally impaired. Impervious surfaces contribute to increased stormwater runoff, route surface pollutants quickly to receiving waters and restrict the recharge of groundwater. Pervious areas allow the infiltration of precipitation to recharge shallow and deep groundwater and preserve the hydrologic integrity of the watershed. The majority of the impervious cover is made up of buildings, parking lots, driveways, and roads. Table 2-1 demonstrates the breakdown of impervious surfaces within the watershed.

Table 2-1: Impervious Cover within the Watershed

Impervious Area	Acres	Percentage of Total Impervious Area by Type
Parking	137	31%
Buildings	119	27%
Roads	114	26%
Driveways	47	11%
Sidewalks	15	3%
Cemetery	10	2%
Other	2.2	<1%
Total	444.2	-

Data Sources: Impervious Area (City of Portland GIS/DEP, 2009), Capisic Watershed Boundary (City of Portland GIS/DEP, 2009).

The greater part of the impervious cover is located within residential and commercial areas. These areas also comprise the majority of the watershed, with residential and commercial land uses making up 35% and 11% of the entire watershed, respectively. Other significant land uses include the cemetery and vacant land, which comprise 15% and 12% of the total watershed, respectively. The latter land uses

consist of far less impervious area, and are less likely to contribute stormwater runoff during smaller storm events. These less developed lands can help maintain some of the Capisic Brook's ecological integrity in the upper reaches.

Impervious cover types are often distributed by land use. Commercial areas in the watershed contain over 66% of all parking impervious area but only 32% of the building impervious cover (i.e. rooftop). Conversely, over 50% of the building impervious cover in the watershed is in the residential areas. Roadways and driveways are also significant components of the impervious cover in residential areas. Rooftop, roadway, and parking impervious cover can have significantly different stormwater pollutant characteristics and should be considered differently under pollution prevention and management scenarios.

Woodard & Curran also evaluated impervious cover and land use by subwatershed. The breakdown of impervious cover by subwatershed is included in Table 2-2 and is helpful to prioritize watershed improvement activity. Refer to Figure 4 – Appendix A (Land use) for land use within the watershed. The land use within the West Tributary subwatershed is largely commercial and the watershed area is 46% impervious, with significant parking, roadway and building areas. The North Tributary subwatershed is primarily residential, but has a significant commercial district along Warren Avenue. Nearly half of the land in the Lower Tributary subwatershed is residential and most of the impervious area is roadway and buildings.

Table 2-2: Impervious Area by Subwatershed

Subwatered	Subwatershed Area (Acres)	Impervious Surfaces (Acres)	Percent of Subwatershed Area covered by Impervious Surfaces	Percent of Subwatershed covered by Parking	Percent of Subwatershed covered by Roadway	Percent of Subwatershed covered by Buildings
West Tributary	339	155.5	46%	21%	11%	11%
North Tributary	370	99.8	27%	8%	6%	7%
East Tributary	220	47.5	22%	12%	3%	4%
Middle	80	17.8	22%	4%	6%	8%
Lower	413	123.5	30%	1%	10%	10%

Data Sources: Sub Watersheds (Woodard & Curran, 2010), Impervious Area (City of Portland GIS/DEP 2009).

The MaineDEP has further divided the subwatersheds into individual catchments of 135 acres or less. Catchments, in this case, represent developed areas in a discrete hydrologic unit. The precipitation that falls in a catchment eventually makes its way to a single outfall location. The outfalls may be a pipe or

open channel. Catchments are typically an appropriate scale for recommendations for structural stormwater management.

Woodard & Curran determined the amount of impervious cover in each MaineDEP defined catchment. The types of impervious cover (e.g. driveway, roadway, and building) can be used as a surrogate measure of the potential for specific pollutants and was also evaluated. Catchments in which roadways made up greater than 5% and parking greater than 10% of the drainage area were identified to guide further structural field evaluation and are listed in Table 2-3. The identified catchments are primarily located within the North Tributary subwatershed (Figure 5D – Appendix A), West Tributary subwatershed (Figure 5E – Appendix A), and the East Tributary Watershed (Figure 5A – Appendix A). Other subwatersheds are shown in Figure 5C,5B – Appendix A (Middle and Lower Reach).

Figure 5E – Appendix A (West Tributary) shows a high density of parking areas and roadways due to commercial use and highway I-95 (Maine Turnpike). Though the North Tributary subwatershed (Figure 5D – Appendix A) is less densely developed and includes more vacant land when compared to other subwatersheds; the commercial/light industrial district along Warren Avenue within this subwatershed will be considered for potential structural management opportunities.

Table 2-3: Catchments Identified to Guide Structural Stormwater Management Considerations

Catchment ID	Catchment Area (acres)	Roadway Impervious Cover (% of Catchment Area)	Parking Impervious Cover (% of Catchment Area)	Subwatershed Location
M27	40.8	13.6	31.2	East
N1a	2.1	13.8	22.1	North
N3	9.2	15.5	36.0	North
N4	4.3	23.8	54.2	North
N6	4.0	20.8	37.9	North
N7	2.7	29.7	39.5	North
W7	42.3	14.4	10.8	West
W9	82.0	7.6	46.2	West
W10	2.1	17.8	53.2	West

Data Sources: Catchments (City of Portland GIS, 2009), Imperious Area (City of Portland GIS/DEP, 2009).

2.1.3 Hydrology and Stormwater

The Capisic Brook watershed consists of soils of glaciomarine origin. The watershed soils are primarily of fine grain texture with smaller areas consisting of coarse grained glaciomarine soils. The predominant soils associations are the Suffield-Buxton-Hollis Association and the Hollis-Windsor-Au Gres

Association. These soils have generally slow to very slow permeability and in some cases shallow water table and/or bedrock.

Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups (HSG) based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D, where A generally has the least runoff potential and D the greatest. An evaluation of the watershed soils indicate that approximately 78% of the watershed soils are comprised of C or D soil types, indicating a propensity of the watershed toward high runoff potential and limited potential for infiltration. Small areas of the watershed, primarily along the watershed boundaries, include soils in the HSG A and B and are more conducive to infiltration (Figure 6 – Appendix A –Hydrologic Soil Groups).

Streamflow monitoring evaluations were conducted between July and December 2009 (Draft Report in Appendix E). The flow data indicate a wide range of flows at the two monitored stations. Flow monitoring was conducted just below the confluence of the North and East Tributary (WAGS site) and just downstream of Warwick Street (WSGS site). The WAGS site has a drainage area of 590 acres and the WSGS site has a drainage area of 1016 acres. Flow rates at the WAGS site varied from base-flow conditions of approximately 0.6 cfs to greater than 100 cfs. Flow at the WSGS site varied from base-flow conditions around 0.8 cfs to an estimated 1,000 cfs. The bank full stages of the WAGS and WSGS sites as measured at the installed staff gauges are 3.1 feet and 3.43 feet respectively. The bank full stage at the WAGS site was exceeded four times during the monitoring period (approximately 6 months). The flow was above bank full at the WSGS three times during the same time period. While 2009 was an unusually wet summer, bankfull events in natural watersheds occur on average once a year. It is likely that the Capisic Brook sees more frequent bankfull events than natural channels which can contribute to stream bed instability.

The Capisic Brook watershed contains 11 significant stream crossings. The conveyance through the stream crossings are typically culverts with a smaller number of bridges. Each of these crossings has the potential to impede the flow rate in the floodplain upstream of the crossing and to contribute to high stream velocities below the crossing. In 1999, the City evaluated the Capisic Brook for potential flow restrictions at these crossings and at the Capisic Pond Dam. Significant flow restrictions were identified (See Section 1.1.3) and all recommendations were addressed by the City over subsequent years, with the exception of Taft and Holm Avenue. Each of the crossings provide appropriate conveyance during the 25-yr, 24 hour precipitation event. Minor flooding continues to occur at and around the Violette Street and Brighton Avenue areas due to floodplain constrictions in this area and less due to crossing restrictions[11]. Additionally, flow restrictions during smaller storm events may occur upstream of Taft and Holm Ave. but limited development in these areas reduces the impact of flooding. Flow studies in 2009, which included a 25-year, 24-hour precipitation event, did not indicate any major flooding in the gaged locations.

2.2 THE COMMUNITY

The Capisic Brook watershed is largely made up of residential neighborhoods, schools, and recreational and open space. Parcels zoned as residential make up 35% of the entire watershed, and open area including parks, cemeteries and vacant land make up an additional 30%. There are approximately 2,800 residential parcels within the watershed, with an average residential parcel size of 0.1 acres (Figure 7 – Appendix A –Parcels). Given the land use within this watershed, resident activities and management of homes and properties, is likely to have a significant influence on the water quality of Capisic Brook.

[11] Roland, B, 2010. Personal Interview. City of Portland Engineering.

2.2.1 Land Ownership and Zoning

Figure 8 – Appendix A (Zoning) depict the municipal zones within the watershed. Tables 2-4 and 2-5 summarize the land use and zoning within the Capisic Brook watershed. As previously stated, the majority of the watershed is residentially zoned and largely developed. While this is important for management considerations, commercial/light industrial land use are significant in certain subwatersheds. Note that the acreage of recreation/open space land is not the same in Tables 2-3 and 2-4. In some cases, areas zoned for use are considered in a different category of land use. Most notably, the land use of Evergreen Cemetery is considered "cemetery," but the area is zoned as recreation/open space. Therefore, land use describes current conditions and zoning largely describes future build out conditions.

Table 2-4: Watershed Land Use

Land Use	Acres	Percentage of Watershed
Residential	412	35%
Cemetery	175	15%
Vacant	143	12%
Commercial	136	11%
Transportation	106	9%
Institutions	67	6%
Schools	49	4%
Recreation / Open Space	31	3%
Industrial	29	2%
Government	25	2%
Other	15	1%

Data Sources: Landuse (City of Portland GIS, 2009), Capisic Brook Watershed (City of Portland GIS/DEP, 2009).

Table 2-5: Zoning

Zoning	Acres	Percentage of Watershed
Residential	850	62%
Business	278	20%
Recreation/Open Space	200	15%
Industrial	35	3%

Data Sources: Zoning (City of Portland GIS, 2009), Capisic Brook Watershed (City of Portland GIS/DEP, 2009).

2.2.2 Infrastructure and Assets

City stormwater management infrastructure includes a variety of assets, including combined sanitary/stormwater and separate stormwater drainage pipe and manholes, stream culvert structures, and detention ponds. Table 2-6 includes stormwater assets pertinent to the operation and maintenance of the City's current separated stormwater system within the Capisic Brook watershed. A 10% allowance has been included for infrastructure that may not be mapped.

Table 2-6: Stormwater Infrastructure Assets

Assets	No. in Portland	No. in Westbrook	10% Allowance	Probable Total
Stormwater Discharge Points / Outfalls	135	5	14	140
Stormwater Catch Basins	655	26	68	681
Stormwater Manholes	303	4	30	307
Stormwater Pipes	22.2 miles	0.92 miles	2.3 miles	27.8 miles

Data Sources: Stormwater Infrastructure (City of Portland GIS, 2009), Town Boundary (ME GIS, 2010).

Figure 9 – Appendix A (Storm Drainage System) depicts the infrastructure currently mapped within the watershed. While the majority of assets are the property of the City or State, privately owned assets are also included in this summary table. While maintenance on private property is the owner's responsibility, the City or State may be responsible for the quality of the stormwater discharge if private systems are connected to the public stormwater drainage system. According to a Woodard & Curran analysis of storm drainage infrastructure adjacent to roadways in the Capisic Brook watershed, the City of Portland is the owner of approximately 70% of mapped drainage manholes and catchbasins within the Capisic Brook

watershed. The State of Maine is the owner of approximately 18% of drainage structures. Based on field evaluation, many private drainage structures do not appear to be mapped despite potential connection to the public drainage system.

Winter snow and ice management is a significant cost for municipalities and has an influence on infrastructure maintenance and watershed management. The costs associated with salting and sanding of roads in winter and the subsequent street sweeping in the spring and catch basin cleaning in the summer are assumed to be proportional to the miles of roadways within the watershed. Table 2-7 lists the inventory of roadways within the watershed and ownership (City, State, Private, or the Maine Turnpike Authority).

Table 2-7: Roadway Ownership

Roadways	Linear Feet	Acres of Roadway Surface
City	97,162	81
Private	61	N/A
State	25,108	19
MTA	15,963	15

Data Source: Roadways (City of Portland GIS, 2009).

Note: Data on the acreage of private roadways is unavailable.

2.2.3 Schools, Parks and Open Spaces

The watershed includes three areas and a total of 200 acres of land zoned as recreational open space (ROS). The largest is Evergreen Cemetery, with two smaller areas on either side of Brighton Avenue. At the northern end of Westminster Avenue is a section of Presumpscot Park located within the watershed. The third ROS-zoned area is located at the southern border of the watershed study area, which is a section of Capisic Pond Park just north of Capisic Pond.

The Evergreen Cemetery is the largest cemetery in Maine, with four ponds, a network of wooded trails, and approximately 70 acres of urban forest acting as a wildlife and bird sanctuary. The Friends of Evergreen Cemetery[12] is a nonprofit organization that advocates for the cultural, historical and recreational resource value of the park. With so much of the Capisic Brook watershed covered by impervious surfaces, a large open area such as Evergreen Cemetery may be valuable for the sustainability of the watershed.

Capisic Pond Park is an 18-acre park consisting of a freshwater pond, wetlands and uplands. Residents frequent the park for recreation, particularly the half-mile Capisic Brook Trail walking path, and for bird watching. Several undeveloped side trails offer exploration of the pond and surrounding wetlands[13].

[12] *Friends of Evergreen Cemetery*, 2009. <http://friendsofevergreen.org/index.htm> Accessed 12/7/2009.

[13] Portland Trails, 2010. *Capisic Brook Trail* < http://www.trails.org/map_files/capisic_page_description.html>.

Community organizations such as Portland Trails task themselves with engaging the participation of neighborhoods, schools, and the business community in trail use and land stewardship and making Greater Portland a model for environmental recreation. Portland Trails is a non-profit urban land trust dedicated to creating and maintaining a network of multi-use trails in the Greater Portland area. The Maine Audubon has listed both Evergreen Cemetery and Capisic Pond Park as "two of the best places in southern Maine to see a wide variety of songbirds during spring migration."[14]

Other vacant lands that might be used as passive recreation include the vacant land parcel north of Warren Avenue. This property is currently being considered for residential/commercial development. The development of this large parcel would leave the only large tracts of remaining undeveloped land within the watershed and outside of the parks, as the power line right-of-way owned by Central Maine Power.

2.2.4 Community Organizations

Public interest in the Capisic Brook and other natural resources in the City are evident in the presence of community and nonprofit organizations such as Portland Trails, the Friends of Evergreen Cemetery, the Friends of Capisic Pond Park, and exhibited in the City's commitment to the development of the Capisic Brook Greenway Master Plan. Schools, such as the Hall School, have been identified as important educational nodes for the Capisic Brook Greenway and focal points for public educational access to the stream. As water quality improves through the abatement of combined sewer overflows, the potential expansion of a network of public educational access trails, particularly with the incorporation of education stations at the Hall School and Capisic Pond Park, will enhance outreach about the ecological and natural resources of the Capisic Brook.

As a part of this planning project, a strategy to engage the residents of the watershed in pollution prevention activities have been developed (Section 3).

2.3 THE COMBINED SEWER

Combined sewers are a vestige of the interest of municipal governments in the 19th and 20th century to safely convey stormwater and wastewater away from developed areas. Initially, these combined sewers discharged directly into receiving waters without treatment. The combined sewer systems in Portland discharged into Back Cove, Capisic Brook, Fore River, Presumpscot Estuary and Portland Harbor. As centralized wastewater treatment became available, adjustments have been made to the combined sewer system to divert flows to the wastewater treatment facility. As these systems remain combined, precipitation or runoff from snowmelt can exceed the capacity of the system, resulting in Combined Sewer Overflows (CSOs). Without overflows the combined wastewater and stormwater would overwhelm the capacity of the system creating backups into basements and city streets.

In 1989, the US Environmental Protection Agency (EPA) adopted a CSO Control Strategy to comply with the Clean Water Act (CWA). The objectives of this strategy were to ensure that CSOs only occurred in wet weather, to ensure compliance of all CSO discharges with the requirements of the CWA and to minimize CSO's to reduce impact on water quality and human health. In 1994, the EPA adopted a Combined Sewer Overflow Control Policy designed to reduce and eliminate combined sewer overflows nationwide. In 1991, the City of Portland entered into an agreement with the MaineDEP with the goal to

[14] Maine Audubon, 2008. *Build Your Birding Skills.* http://www.maineaudubon.org/explore/event/bthon/calendar.shtml

reduce and eliminate a large portion of CSOs from Portland's sewer system. CH2M Hill was hired in 1991 to complete a long-term control plan to evaluate and cost-effectively abate CSOs in Portland. The resulting Combined Sewer Overflow Abatement Study was delivered in 1993 and outlined a strategy to eliminate 33 of 39 CSOs in three stages of planned construction (Tiers I, II and III). In 1997, the City prepared a Tier I implementation Plan and in 2003 completed a Tier II implementation plan. The Capisic Brook watershed CSO abatement schedule and costs are identified in the 2008 update to the Tier II plan[15]. Currently, the City has completed Tier I projects and approximately 25% of Tier II projects. The City is currently engaged in the development of the Tier III implementation plan which is expected to be completed in 2011. An early draft of that plan includes an updated implementation timeline for remaining Tier II projects in the Capisic Brook watershed.

2.3.1 Capisic Brook's Combined Sewer System

There are currently two active CSOs in the Capisic Brook watershed. CSO 36 previously occurred below the Capisic Pond Dam which falls outside of the project study area and has been closed as of 2010. CSOs 42 and 43 remain active at this time and are regulated near Warren Avenue, discharging into the Capisic Brook just upstream of the junction of the Main Branch and Northern Branch. In 2008, the City of Portland reported that CSO 42 and CSO 43 contributed 47 and 4.4 million gallons, respectively, of combined sanitary waste and stormwater to Capisic Brook[16]. Flow monitoring at CSO 42 and downstream of CSO 42 and 43 indicate that in some high intensity storm events the majority of flow in the stream is comprised of combined sewer overflow discharges.

The CSO abatement projects scheduled for CSO 42 and 43 drainage areas, as described in the Tier I and Tier II Plan include the following: Capisic Brook Disconnect, Forest Avenue – Avalon to Belfort Street, Warren Avenue, Dorothy Diabase & Hicks, Lexington, Broadway Belfort Street, and Commonwealth Avenue. At this time, these projects are in design, construction or completed and will greatly reduce CSOs in this watershed. According to the Tier II plan, the areas draining to the Combined Sewer in this portion of the Capisic Brook watershed is 101 acres. Figure 5D – Appendix A – (North Tributary) shows the location of CSO 42 and 43.

[15] *City of Portland Tier II Combined Sewer Overflow Abatement 8-Year Implementation Plan*, 2003 updated January 2008. Prepared For: The City of Portland By: Deluca-Hofmann Associates, Inc.

[16] Annual CSO Progress Report for 2008, MaineDEP Doc Num: DEPLW0059-J2008.

3. OVERCOMING OBSTACLES TO A SUSTAINABLE WATERSHED

The objectives of establishing a watershed-based restoration plan is to improve water quality through targeted, specific actions and to ultimately realize the full benefits of the Capisic Brook as a community resource which meets its Water Quality Classification.

Long-term sustainable management of water resources is only possible with an engaged community, supportive local policy, a pragmatic financing strategy and political support. This section outlines a stepwise approach that begins with actions aimed at building community support and creating supportive local policies. Community support and local policy are a critical component of cost-effective long-term watershed restoration and sustainable management.

The following recommendations build upon previous studies and present a strategy for municipal and state management of the brook and its watershed. The plan is consistent with the recommendations of the Sustainable Portland report[17] and will set a path to meeting both state and federal clean water standards.

It is important to note that watershed modeling (and resultant stream chemical and biological response) was not included in the development of this plan. The management strategies expressed herein are based on previous recommendations, stakeholder input and professional judgment but do not include an evaluation of specific stream response through the implementation process. The EPA provides guidance for adaptive management strategies in lieu of extensive watershed modeling. EPA indicates that "adaptive management is the process by which new information about the health of the watershed is incorporated into the watershed management plan. Adaptive management is a challenging blend of scientific research, monitoring, and practical management that allows for experimentation and provides the opportunity to "learn by doing." It is a necessary and useful tool because of the uncertainty about how ecosystems function and how management affects ecosystems.[18]" The watershed monitoring program described in Section 5 provides the basis for evaluation of initial watershed response to implementation of CSO abatement and pollution prevention actions and then structural management. Watershed stakeholders can utilize monitoring information to refine and adapt final priorities, recommendations and actions.

This Plan outlines targeted structural and non-structural management actions that will enhance community engagement in watershed restoration, refine local policies and standards for stormwater best management and ultimately improve Capisic Brook water quality. The development of each of the following strategies was through stakeholder collaboration over the course of the project. Four teams were developed as a part of the planning process to inform the development of the recommendations for action. Appendix D includes meeting notes from each team meeting. The teams included Retrofit Inventory Strategy, Planning/Policy Initiatives, Marketing Initiatives, and Financing Plan. Team members are identified in the contributors section at the front of this document.

- Retrofit Inventory Strategy – The team guided the development of the structural and non-structural stormwater management strategies for consideration in the planning effort. The structural stormwater management strategies, outlined herein, were informed by a targeted watershed assessment conducted by Woodard & Curran and through previous studies conducted by the City and MaineDEP.

[17] *Sustainable Portland Report*, Adopted June 2, 2010.

[18] Step 5: Adaptive Management, EPA's Watershed Academy webpage, http://www.epa.gov/owow/watershed/wacademy/wam/step5.html

- Planning/Policy Initiatives – The team identified key components of the City of Portland zoning, stormwater and technical design standards which influence sustainable Capisic Brook development and redevelopment and made recommendations to strengthen current planning components relative to Capisic Brook.
- Marketing Initiatives – The team reviewed results of watershed demographics analysis, a phone survey of watershed residents and focus group meetings in order to develop a comprehensive social marketing/outreach strategy for residential landowners.
- Financing Plan – The team explored financing, organizational and staffing options for implementation of the proposed watershed improvement recommendations.

Each of the following recommendations includes an opinion of cost and a suggested implementation schedule has been included at the end of this section. Each opinion of cost is for planning purposes only and will need to be refined during scoping and project/program development. Assumptions associated with these opinions of cost are identified within the respective sections. Potential project/program partners have been listed as organizations or entities that could assist in the implementation of the action but the listed entities do not expressly support this plan or the actions identified herein.

3.1 POLLUTION PREVENTION AND BEST MANAGEMENT

3.1.1 Commercial/Industrial

Almost 100 acres of the watershed's 400 acres of impervious surfaces are located within commercial and industrial land uses. These land uses are concentrated around Warren Avenue and the Maine Turnpike/ Exit 48 area. According to the National Stormwater Quality Database, commercial/industrial properties can generate higher than average metals and toxics concentrations in stormwater runoff. This is a result of frequent motor vehicle activity and industrial processes, making commercial and industrial landowners an important stakeholder in sustainable management of Capisic Brook.

The commercial and industrial areas of the watershed were prioritized for consideration for structural stormwater management retrofits. Unfortunately, highly impervious privately owned parcels, high seasonal groundwater, shallow drainage infrastructure and significant below-grade utilities will make retrofitting private and roadway parcels within this portion of the watershed difficult and costly. As an alternative to widespread structural stormwater management within these areas, we recommend the following program for pollution prevention within the commercial and industrial districts in Capisic Brook.

There are over 280 parcels within the Capisic Brook watershed in commercial and industrial land uses. A targeted commercial pollution prevention program would initially focus on the Warren Avenue corridor and then could be expanded to other commercial/industrial landowners in the watershed. The program would rely on municipal/watershed partner outreach initially to assist the landowners with understanding the basics of the interconnected stormwater drainage system (particularly in the Riverside Street, Bishop Avenue and Warren Avenue areas), potential sources of stormwater pollutants on their facilities and the value of best management of impervious surfaces through high-efficiency street sweeping and materials handling and storage.

As noted in Section 1, several properties in this watershed are regulated under the MSGP. This program may provide welcome support to complement requirements under the MSGP permit.

Program development would include the following:

- Compile mailing lists for commercial/industrial landowners within the Warren Avenue corridor and obtain contact information for facility managers where possible.
- Initiate a mailing/phone/personal survey to determine:
    - Business activities conducted onsite that may affect stormwater quality;
    - Knowledge of the property's effect on municipal infrastructure and water quality; and
    - Controls and practices already in place to manage stormwater quality and quantity.
- Identify contractors that can provide high-efficiency pavement sweeping services, catch basin cleaning and "stormwater friendly" landscaping services.
- Collaborate with the Greater Portland Region Chamber of Commerce and the City of Portland Economic Development Division to develop initial outreach content. The mailing would be informed by the survey and may include specific information on Clean Water Act regulatory provisions and the potential economic benefit of engaging in a voluntary program focused on non-structural actions.
- The initial mailing would also provide a brief overview of a potential program and include a meeting invitation.
- Conduct facilitated meeting to provide specific information on water quality issues and implications, local pavement or landscape management contractors, and brainstorm potential program components.
- Establish a steering committee from the initial stakeholder meeting that will further consider program components. The steering committee would oversee the development of information for a Commercial Pollution Prevention Program and advocate for development, or extension of an incentives program through the Portland Economic Development Division. Informational materials would provide specific information on non-structural facility management such as; vacuum pavement sweeping, alternative deicers, low or no fertilizer and toxics landscape management, appropriate pavement sealants, and snow removal and storage strategies and a list of local contractors providing these services.
- The final Program would serve to provide commercial and industrial landowners and business owners with:
    - Information about the impact of their business activities and site activities on stormwater and water quality;
    - Site-appropriate best management practices; and
    - Access to an annual training program and other incentives for pollution prevention and infrastructure management strategies specific to their properties.
    - Upon completion of training and/or through achievement of management metrics, participating watershed commercial landowners could receive signage and/or other documentation of program participation for public display.

Table 3-1: Commercial/Industrial Pollution Prevention Program

Opinion of Cost	Cost Assumptions	Potential Partners
$50,000 (initial development) $5,000 (annual training program)	Phone/mailer survey development, program material development, organizational meetings, marketing and engineering consulting and municipal staffing.	City of Portland Public Services and Economic Development Division Greater Portland Region Chamber of Commerce University of Maine – Sustainability Solutions Initiative MaineDEP Cumberland County Soil and Water Conservation District

The program outlined above will provide business owners with the opportunity to voluntarily participate in a program to improve the quality of Capisic Brook. In the event that business owners do not take advantage of the program within a period of years, a non-voluntary program should be considered. Many of the commercial and industrial properties within the Capisic Brook watershed discharge directly to the municipal or state separate storm drain system and are responsible for the quality of runoff leaving their facilities. Pollution in stormwater discharges to the municipal drainage system is currently regulated through City of Portland Code Chapter 24 – Section 24-47 and 24-48 and through MS4 and MSGP permit requirements. Non-voluntary compliance requirements could become a more significant component of the Capisic Brook Watershed Management Plan if the watershed is assigned a TMDL, in which case, all discharges may become more closely regulated under the MS4 or MSGP permit as discussed in Section 1.2. The goal of the voluntary program will be to prevent non-voluntary compliance requirements.

3.1.2 Municipal

Street Sweeping

Reducing pollutant migration from streets is particularly important in urban areas like the Capisic Brook watershed. The watershed contains over 26 miles of roadways which account for 25% of the watershed's impervious cover. Structural stormwater management of roadways is complicated and expensive. Non-structural strategies such as street sweeping have a positive impact on stormwater runoff, community aesthetics and stream health.

Pavement sweeping is considered to be 10 times less expensive than catchbasin cleaning and is therefore a value added activity. Pavement sweeping for stormwater pollutant prevention must be accomplished by

using the best available vacuum or regenerative air sweeping technologies. A 2010 study (Brown, et al, 2010) in San Diego, California investigated the effects of street sweeping on reducing pollutant concentrations in stormwater runoff. The study reported an increase in amount of debris collected with vacuum and regenerative air sweepers (approximately 90 lbs/mile) compared to traditional mechanical sweepers (68 lbs/mile). Other research in this field, indicate that street sweeping may reduce total suspended sediment (TSS) loading by 20% in a watershed through a targeted pavement sweeping program from spring through fall. This reduction in sediment loads would also reduce bacteria, metals, toxics and nutrient sources from reaching Capisic Brook and Capisic Pond.

The City of Portland recently invested in a Tymco 500x regenerative air street sweeper as part of their efforts to reduce the potential for roadway pollutants to be released in stormwater discharges. The continued targeted use of this sweeper within the Capisic Brook watershed will reduce pollutant loads, reduce the sedimentation of Capisic Pond and improve watershed aesthetics. This recommendation specifically evaluated the cost to perform sweeping on municipal roadways (and state roads managed by Portland under the Urban Compact zone). While is it suggested that the MTA consider more frequent sweeping it is recognized that there are potential limitations for sweeping on the Turnpike and a specific recommendation for MTA to sweep quarterly is not included here nor has cost been evaluated. It is recommended that the City of Westbrook also consider quarterly street sweeping but costs were not included here. Appendix B contains opinion of cost worksheet for street sweeping activities.

Table 3-2: Street Sweeping Program

Implementation Schedule	Opinion of Cost	Cost Assumptions	Potential Partners
Ongoing	$65,000 (annually, escalating at COLA rate)	Quarterly street sweeping of all state and City roadways within Capisic Brook watershed. Opinion of cost includes equipment maintenance and replacement, operations labor and disposal costs. Cost does not include mobilization to watershed.	City of Westbrook City of Portland Public Services Maine Turnpike Authority Maine Department of Transportation

Catch Basin Cleaning

Sediments and pollutants build up in catch basins over time and are conveyed to receiving waters with excessive stormwater runoff. Regular cleaning and maintenance of stormwater catch basins may help prevent sediment, bacteria and urban pollutants such as heavy metals from entering Capisic Brook. During the City's 2010 catch basin cleaning effort, catch basin cleaning resulted in the removal of 247 bags of pet waste and 30 hypodermic needles in addition to sediment removal. It is also recommended that the City of Westbrook clean all catchbasins in public right of ways annually but costs were not included here. Appendix B contains opinion of cost worksheet for catchbasin cleaning activities.

Table 3-3: Catch Basin Cleaning Program

Implementation Schedule	Opinion of Cost	Cost Assumptions	Potential Partners
Ongoing	$40,000 (annually, escalating at COLA rate)	Cleaning of all catch basins within city roadways on an annual basis. Opinion of cost includes labor, equipment and disposal costs. Cost does not include mobilization to watershed.	City of Westbrook City of Portland Public Services Maine Turnpike Authority Maine Department of Transportation

Shade Tree Planting Program

As communities become more urbanized, land uses shift from forested and open space to developed urban uses. This change has well-established effects on a watershed's hydrology as well as air temperature, ultraviolet radiation levels, and noise. Recently, an increased interest in the hydrologic benefits that tree canopies may have on the urban environment and particularly urban watershed hydrology has spurred an increase in tree planting efforts as a way to mitigate urban watershed hydrologic problems. Tree cover provides two discrete watershed benefits:

- Reduction of ground and near ground temperature; and
- Rainfall and snow interception, soil water infiltration and evapotranspiration.

The City of Portland is a Tree City USA participant and the City's Public Services - Forestry Division offers a number of privately and publicly funded tree planting programs for residents. However, the City is unable to meet all requests given existing funding and does not have a specific program in place for commercial and industrial landowners. Tree plantings within highly impervious commercial and industrial parcels, such as those along Warren Avenue, may provide stormwater quality improvements where structural retrofits are not feasible. Increased outreach to commercial and industrial landowners on the benefits of trees for water quality and stormwater reduction may have a positive impact on stormwater runoff in these districts.

The City should consider development of a Commercial District Tree Planting Program that would include a targeted planting plan within the commercial and industrial areas of Capisic Brook. The program would be an extension of the current municipal tree planting program and would overlap with Commercial/Industrial Pollution Prevention Program. Appendix B contains opinion of cost worksheet for shade tree planting activities.

Table 3-4: Shade Tree Planting Program

Opinion of Cost	Cost Assumptions	Potential Partners
$162,000	Identify best opportunity areas for planting in the commercial districts. Assume three trees planted per commercial parcel with 50% of parcels participating. Tree planting cost includes cost of tree and labor. Staff administrative oversight.	City of Portland Public Services - Forestry Division City of Westbrook Private Landscaping Contractors

3.1.3 Residential Pollution Prevention

35% of the watershed area is occupied by residential land use, including over 2800 parcels. Within the residential areas, rooftops occupy over 62 acres of impervious area and driveways occupy over 32 acres. Total residential area impervious surfaces make up close to 25% of overall watershed impervious area. There are also approximately 500 acres of managed landscape including lawns in this watershed.

The National Stormwater Quality Database indicates that stormwater runoff from residential areas contains the highest concentration of nutrients and bacteria of any land use. Unfortunately, structural retrofitting within the public right-of-way within residential areas can be exceedingly expensive (upwards of $100,000 per impervious acre managed) and may ultimately cost tens of millions of dollars.

Resident support and action within the residential areas of Capisic Brook will likely be necessary for long-term sustainable management of the watershed. This planning project focused on development of a comprehensive outreach strategy for residents of the watershed in order to:

- build support for watershed improvement activities,
- engage residents in behaviors to reduce common residential pollutants from leaving their property, and
- incentivize the actions necessary to maintain private residential property without compromising watershed health.

The proposed outreach campaign and supporting documents are included in Appendix C. In addition to the development of a social marketing campaign, we have included an additional cost for the development of a user-friendly Capisic Brook watershed map that would be developed as a “leave-behind” during expert visits and workshops.

Table 3-5: Residential Pollution Prevention Program

Implementation Schedule	Opinion of Cost	Cost Assumptions	Potential Partners
Currently being implemented (2011)	$50,000 (annually for three year social marketing program) $15,000 for watershed map	Staff and consultant time for development of program, administration, outreach, publication development and annual program evaluation. Watershed map includes publication development and illustrator cost.	City of Portland Public Services Maine Yardscaping Partnership MaineDEP University of Maine Sustainability Solutions Initiative Cumberland County Soil and Water Conservation District Portland Trails (map) Private Landscaping Contractors Friends of Casco Bay

3.2 STRUCTURAL STORMWATER MANAGEMENT

The Capisic Brook watershed, as previously described, is largely developed. Pollution prevention, outreach and planning actions addressed in this plan will provide the most cost-effective mitigation strategies for polluted stormwater runoff, but structural management actions may be necessary as a part of an overall watershed management restoration plan.

Structural retrofitting of existing developed areas is expensive and has unique challenges; however, with the right approach they can be successful. Private property, below ground utilities and existing infrastructure connections constrain opportunities. For the purposes of this report, structural retrofit opportunities were considered on public or private land, and private land acquisition or easement costs are included in the opinion of cost where applicable. Without watershed hydrologic and hydraulic modeling, detailed survey or below-grade utility data, the opportunities recommended here are concepts for planning and cost estimating purposes only.

Opinions of cost are based upon 2011 Construction Costs and do not predict or include future costs. Opinions of cost include survey, engineering, permitting, land acquisitions (where noted), but do not include legal, administrative or other soft costs; see Section 3.2.2 for additional background on legal and administrative costs and Appendix B for detailed opinion of cost worksheets for structural retrofits.

3.2.1 Structural Stormwater Management Opportunity Assessment

The Capisic Brook watershed contains over 400 acres of impervious surface and an additional 500 acres of developed landscape (i.e. lawn). The cost to retrofit developed areas to meet current stormwater management treatment strategies and standards would likely cost tens of millions of dollars (based on an assumed cost of $100,000 per impervious acre treated[19]). In order to prioritize areas considered for structural retrofit opportunities, the Retrofit Inventory Strategy Team identified specific drainage areas that should be the focus of the structural retrofit opportunity assessment in the Capisic Brook. These areas include the Exit 48 Commercial Area/Riverside Street, Sagamore Village and the Warren Avenue commercial district. Prioritization was based on existing impervious cover and miles of roadway in catchment areas. Other residential and commercial areas will be largely addressed through pollution prevention efforts in this Plan.

In order to identify potential opportunities for structural stormwater management, W&C conducted a field-based structural retrofit inventory. In general, the intent of a structural retrofit inventory is to identify locations within the prioritized areas that would allow the implementation of stormwater management systems to be constructed with minimal impact on existing land uses. Structural management systems selected for possible implementation have the potential to reduce stormwater volume discharges through infiltration and evapotranspiration and reduce pollutant loading through filtration, settling, adsorption or other processes. Structural treatment systems selected for consideration in this inventory are assumed to follow MaineDEP design standards. Section 3.2.2 describes the five recommended structural retrofit project areas.

The structural stormwater retrofit inventory generally follows the guidance of the *Center for Watershed Protection's "Eight Step Approach to Stormwater Retrofitting"*. For the purposes of this project, the term retrofit is used to describe any engineered modification to existing infrastructure or land area(s) in order to improve stormwater quality or quantity runoff from impervious and developed land surfaces. The recommended structural retrofit areas, opinions of cost and figures are shown in Appendix B.

3.2.2 Structural Stormwater Management Recommendations

As discussed in Section 2, the West Tributary of the Capisic Brook has 46% of its (subwatershed) area covered by impervious surfaces, totaling over 150 acres, and has been identified as a priority area for stormwater structural treatment in Capisic Brook. The Riverside Street and Larrabee Road projects, as described below, would have the potential to address a portion of the Exit 48 commercial district impervious area (approximately 20 acres). Unfortunately, shallow depth to water table, existing stormwater conveyance pipe invert depths and extensive utility infrastructure (including the Portland Pipeline) will make further decentralized retrofitting in this subwatershed challenging and potentially cost-prohibitive. We are recommending a combination of "upstream" treatment systems, utilizing existing roadway setback areas and existing detention basins, in combination with a "downstream" treatment system in the location of the previously recommended West Branch Detention Facility. Hydrologic and retrofit optimization modeling should be utilized for further consideration of the appropriate combination of "upstream" retrofits with a regional "downstream" facility as described below. The Sagamore Village retrofit would address a significant mixed commercial and residential development discharge to the east of the Maine Turnpike but still within this subwatershed.

[19] Based on recent City of Portland and regional stormwater management retrofits in commercial and residential areas.

The North Tributary was identified as the other priority subwatershed for structural retrofit considerations. This watershed contains the Warren Avenue commercial corridor. Retrofit opportunities within the Warren Avenue corridor are severely limited due to the proximity of development to Warren Avenue restricting available land for surface treatment. Retrofitting within the priority catchments in this subwatershed will likely require some level of below grade storage and filtration within the Warren Avenue roadway Right of Way and/or extensive undersized surface retrofits. At this time, we are recommending consideration of a Commercial/Industrial pollution prevention program in the Warren Avenue corridor as a first step towards pollutant load reduction from this tributary in combination with a regional facility that would address mixed commercial and residential development in the upper portions of the North Tributary subwatershed. Base flow augmentation and water quality treatment through the Capisic Brook Wetland Park, as described below, would moderate the influence of polluted stormwater runoff from the untreated Warren Avenue corridor.

Overall, the following structural stormwater management projects would provide polluted stormwater runoff treatment for approximately 160 acres of impervious surface in the Capisic Brook watershed. Currently, the watershed contains close to 450 acres of impervious surface. An Impervious Cover TMDL, in progress by the MaineDEP[20], will presumably recommend disconnection or treatment of impervious surfaces within the watershed to a level where no more than 10% of watershed impervious surfaces are untreated. Under the following structural implementation, the watershed would still contain close to 20% impervious surfaces (281 acres) and subsequently another 150 acres would remain in need of disconnection or treatment in order to reach the 10% IC threshold.

It is our recommendation that the comprehensive non-structural efforts outlined herein be considered in conjunction with the following recommended structural implementation as a first step towards watershed restoration implementation, but further structural improvement projects may still be necessary to meet water quality criteria in Capisic Brook. In each recommendation, and particularly for the larger "regional" structural retrofits, additional hydrologic and hydraulic analysis will be needed to size and site final structural management measure(s) and therefore to also determine more accurate estimate of land acquisition costs.

Sagamore Village Stormwater Improvements (Appendix B – Figure 1)

The Sagamore Village Stormwater Improvements focus on the utilization of large undeveloped open space within the Portland Housing Authority-owned Sagamore Village and the Hall School properties. The identified retrofits would address stormwater discharges from Catchment W7 (as described in Section 2). Catchment W7 (42 acres as described by MaineDEP) contains 40% impervious surface and is largely developed as residential housing with significant lawn areas. Stormwater runoff from the catchment discharges just north of the Hall School.

The identified retrofit opportunities in this area include below-ground storage and filtration systems. The systems would collect stormwater runoff from existing storm drains through diversion structures. We hold concern with potential design constraints including depth to water table and fixed existing infrastructure invert elevations in Godfrey Street and Purchase Avenue and near the Hall School. Additionally, adjacent sanitary sewer may restrict available space and drainage diversion depth in both retrofit locations. A potential opportunity for expanded value of this project may include the development of improved recreation facilities (e.g. soccer fields) in the Sagamore Village green space as a part of construction, but have not been included in the opinion of cost.

[20] Roncarati, D. 2010. Personal Interview. City of Portland.

Location of Proposed Sagamore Village Structural Retrofit

Table 3-6: Sagamore Village Stormwater Management Improvements

Treatment Systems	Opinion of Cost	Impervious Area Managed (acres)/Percent of Water Quality Volume Managed[1]	Constraints and Issues
SV-01 Below Grade Storage and Filter	$705,000	6.7/117%	Easements and/or approval From Portland Housing Authority, existing infrastructure invert elevations, depth to water table.
SV-02 Below Grade Storage and Filter	$370,000	8.9/41%	Easements and/or approval From Portland Public School District, existing infrastructure invert elevations, depth to water table.
Diversion System Piping and Structures	$400,000	N/A	

[1] Stormwater Volume Managed is based on the footprint of the treatment system as conceptualized. The Water Quality Volume from the drainage area is equal to 1" depth of rainfall times the drainage area Impervious Cover and 0.4" depth of rainfall times the developed area and is based on existing City GIS data.

Riverside Street Stormwater Improvements (Appendix B – Figure 2)

Three potential opportunities are identified in the Riverside Street area and include retrofitting existing dry detention basins on private property for enhanced stormwater quality management. The identified retrofits would address stormwater discharges from Catchment W8. Catchment W8 (9.9 acres as described by MaineDEP) contains 72% impervious surface and is developed commercial area. Stormwater runoff from the catchment discharges into the Maine Turnpike Right-of-Way.

Actual available stormwater storage depths in each retrofit will need to be determined through site survey of drainage system infrastructure discharging to these retrofits in order to determine acceptable level of surcharge, but were assumed to be three feet.

Location of One of Proposed Riverside Street Structural Retrofits

Table 3-7: Riverside Street Stormwater Management Improvements

Treatment Systems	Opinion of Cost	Impervious Area Managed (acres)/Percent of Water Quality Volume Managed[1]	Constraints and Issues
RS-01 Gravel Wetland	$95,000	Combined with RS-02	Private Property
RS-02 Gravel Wetland	$40,000	3.2/149%	Private Property
RS-03 Gravel Wetland	$15,000	1.0/15%	Private Property

[1] Stormwater Volume Managed is based on the footprint of the treatment system as conceptualized. The Water Quality Volume from the drainage area is equal to 1" depth of rainfall times the drainage area Impervious Cover and 0.4" depth of rainfall times the developed area and is based on existing City GIS data.

Larrabee Road Stormwater Improvements (Appendix B – Figure 3)

The potential Larrabee Road Stormwater Improvements focus on utilization of existing drainage swales and closed drainage systems within the Larrabee Road Right-of-Way and within private developments adjacent to the roadway. The proposed system would help to address stormwater discharges from Catchment W9. Catchment W9 (82 acres as described by MaineDEP) is almost entirely covered by impervious surface (73% Impervious Cover) and developed landscape area. The catchment discharges at the intersection of Riverside Street and Exit 48. This concept assumes a comprehensive reevaluation and reconstruction of the municipal separate storm sewer system drainage system on the north side of Larrabee Road for stormwater quality treatment benefits.

The identified retrofit opportunities in this area have been clustered based on contributing drainage area. For the purposes of this concept, the clustered systems can be considered as multi-bay treatment units. Depth to water table and fixed existing infrastructure invert elevations will constrain retrofit opportunities and the potential for upgradient surcharge within proposed in-line stormwater storage will require hydraulic modeling as a part of engineering design effort. Additionally, significant below grade utilities (including the Portland Pipeline), gas, water and sewer will complicate retrofit implementation in this area. Costs include replacement of most of the existing drainage infrastructure in this area.

Location of One of Proposed Larrabee Road Structural Retrofits

Table 3-8: Larrabee Road Stormwater Management Improvements

Treatment Systems	Opinion of Cost	Impervious Area Managed (acres)/Percent of Water Quality Volume Managed[1]	Constraints and Issues
LR-01 Gravel Wetland	$95,000	5.2/48%	Private property, adjacent infrastructure constraints, existing infrastructure invert elevations, depth to water table.
LR-02 Soil Filter, Gravel Wetland Treatment Train	$210,000	3.8/146%	Private property, utility conflicts, depth to water table.
LR-03 Gravel Wetland, Soil Filter Treatment Train	$400,000	4.9/177%	Private property, hydrology from upstream management systems, landscaping considerations, existing infrastructure invert elevations, depth to water table.
LR-04 Soil Filter, Gravel Wetland Treatment Train	$90,000	3.0/84%	Private property, existing infrastructure invert elevations, depth to water table.

[1] Stormwater Volume Managed is based on the footprint of the treatment system as conceptualized. The Water Quality Volume from the drainage area is equal to 1" depth of rainfall times the drainage area Impervious Cover and 0.4" depth of rainfall times the developed area and is based on existing City GIS data.

West Tributary Stormwater Improvements (Appendix B – Figure 4)

The only remaining undeveloped land within the West Tributary, which may provide a suitable area for a regional stormwater treatment system, is located just east of the Maine Turnpike. Currently, the undeveloped land is in Maine Turnpike Authority and private ownership and has been previously identified for a regional stormwater management system (West Branch Detention Facility); as you will read, we recommend this regional system continue to be considered as a future improvement with modifications for water quality treatment. See Appendix D – Retrofit Inventory Strategy Team Meeting Notes for description of previous West Branch facility design.

Two retrofit opportunities are identified in this area including a soil filter system to address unmanaged runoff from parking lots at the Howard Johnson Plaza Hotel (Catchment W-13) and a regional stormwater management system just east of the Maine Turnpike. The regional treatment system was originally recommended for flood control in the Capisic Brook watershed and opinions of cost for this system were based on estimates from the original study[21] with adjustments for inflation and gravel wetland stormwater quality treatment modifications. Property acquisition costs were not considered as a part of the West Branch facility as it is assumed that the MTA, MaineDOT, City of Westbrook and City of Portland will cooperate on further consideration of construction and installation of this retrofit and determine appropriate partitioning of cost and resources to the project. Furthermore, additional investigation of the size and siting of this facility will be required in order to evaluate the full extent of land acquisition costs.

Location of One of Proposed West Tributary Structural Retrofits

[21] DeLuca-Hoffman Associates, Inc., 1999. *Capisic Brook Watershed Flood Control Study Re-evaluation Draft Final Report.* Prepared for the City of Portland Public Works Department.

Table 3-9: West Tributary Stormwater Management Improvements

Treatment Systems	Opinion of Cost	Impervious Area Managed/Percent of Water Quality Volume Managed[1]	Constraints and Issues
WT-01 Soil Filter, Gravel Wetland	$265,000	3.7/74%	Private Property
WT-02 Detention/Gravel Wetland	$5.7M	91.8/96%	Private property, hydraulic and hydrology evaluation, existing wetlands permitting.

[1] Stormwater Volume Managed is based on the footprint of the treatment system as conceptualized. The Water Quality Volume from the drainage area is equal to 1" depth of rainfall times the drainage area Impervious Cover and 0.4" depth of rainfall times the developed area and is based on existing City GIS data.

Capisic Brook Wetlands Park (Appendix B – Figure 5)

The North Tributary of the Capisic Brook has 27% of its subwatershed area covered by impervious surfaces. The majority of this development is in the northeast of the subwatershed and includes residential and commercial development along Forest Avenue. This subwatershed also contains a significant amount of undeveloped land in areas just north of Warren Avenue. Currently, the undeveloped land is in private ownership and is being considered for development.

The undeveloped properties within the North Tributary subwatershed afford an opportunity for the implementation of a regional stormwater treatment system. The treatment system would require acquisition of private property or easement and could include the development of the area as a public park with walking trails and landscape features.

The concept for treatment includes an on-line multi-bay treatment system comprised of an initial wet-pond for sediment storage and a series of gravel wetland treatment cells. Given the on-line nature of the system, further hydrologic and hydraulic modeling will be necessary; a high-flow pipe bypass may be required but was not included in the opinion of cost.

Location of Proposed Capisic Brook Wetlands Park

Table 3-10: Capisic Brook Wetlands Park Stormwater Management Improvements

Treatment Systems	Opinion of Cost	Impervious Area Managed/Percent of Water Quality Volume Managed[1]	Constraints and Issues
CW-01 Wet Pond, Gravel Wetland	$4.2M	48.2/56%	Private property, hydraulic and hydrology evaluation, existing wetlands permitting

[1] Stormwater Volume Managed is based on the footprint of the treatment system as conceptualized. The Water Quality Volume from the drainage area is equal to 1" depth of rainfall times the drainage area Impervious Cover and 0.4" depth of rainfall times the developed area and is based on existing City GIS data.

Legal, Administrative and Operations and Maintenance Costs Associated with Comprehensive Structural Retrofitting

The structural management of stormwater in existing built landscapes is extremely complex. In order to engage in comprehensive retrofit implementation on private land, the responsible managing entity will need a public-private legal agreement to allow easement acquisition, access, construction, and long-term maintenance of management systems. The development of a public-private legal agreement will require time and legal counsel. Construction project management and long-term operations and maintenance will require additional funding. The legal, construction management administration and operations and maintenance costs associated with the previous structural retrofit recommendations are included for a 10-year time period, which would include legal agreement development and five-year retrofit implementation and five years of operation and maintenance.

Table 3-11: Legal, Administrative and Operations, and Maintenance Costs

	Development of Public-Private Legal Agreement[1]	Administrative Management of Construction Projects[2]	Operations and Maintenance[3]
Opinion of Cost assumes multi-year implementation schedule and 5-year post-construction O&M	$100,000	$150,000	$255,000

1. Opinion of Cost assumes 20 participating private properties within the five identified retrofit project areas that would require on-site retrofitting. Opinion of cost based on legal staff negotiation and meetings with private property legal counsel and easement development through City legal staff.
2. Opinion of Cost assumes one municipal half-time staff for management of structural implementation program including contracting, construction administration and construction inspection services over a five-year period.

3. Opinion of Cost assumes municipal staff time for post-construction annual inspection for proposed number of structural retrofits. Maintenance costs are assumed as a percentage (2%) of base implementation costs once per five years. Costs are shown for a period of five years post-construction.

3.3 ASSET MANAGEMENT AND MAPPING

A comprehensive understanding of urban hydrography is the foundation of effective long-term stormwater management. The infrastructure mapping efforts in Capisic Brook are currently being undertaken by the Maine Turnpike Authority, Maine Department of Transportation and the cities of Portland and Westbrook, but data gaps remain with no single entity responsible for watershed hydrography geodata. We recommend a complete Capisic Brook drainage map be developed and attributed with appropriate data. The mapping effort would include a refinement of catchment boundaries for each stormwater outfall, field assessment of open and closed drainage systems regardless of ownership with attributing and an inventory of all existing detention and post-construction stormwater management facilities.

Before completion of this action we recommend the attributes of the City of Portland and Westbrook database be reevaluated to determine if appropriate for future stormwater management and asset management analysis. The mapped drainage systems should also be developed with consideration for future automated network analysis.

Appendix E contains a table that shows a simple GIS analysis of the current available data attributed to drainage manholes, pipes, and catchbasins within the City of Portland's Capisic Brook drainage infrastructure geodatabase (2010). This evaluation provides the basis for the assumptions regarding the remaining level of effort required to complete the drainage geodatabase in Portland with information valuable to watershed management. It is assumed that Westbrook, MTA and MaineDOT data follow a similar pattern of data attributing and may require a similar effort for completion of drainage infrastructure data attributing.

Table 3-12: Asset Management and Mapping

Opinion of Cost	Cost Assumptions	Potential Partners
$40,000	Staff-time for field assessment of infrastructure, assumed 50% infrastructure requiring additional survey for attributing and 10% of pipe length requiring televising through contractors. GIS mapping QA/QC.	City of Portland Public Services City of Westbrook Public Services Maine Department of Transportation Maine Turnpike Authority

3.4 EDUCATION STATION DEVELOPMENT

The 2001 Capisic Brook Greenway Master Plan proposed the development of education stations to offer opportunities for educational opportunities around habitat enhancements. With this planning project, we consulted the Greenway Plan and recommend retaining the concept for watershed education stations; however, the Greenway Plan assumed costs in the context of habitat enhancements and a trail system, which will no longer be implemented. Thus, we recommend alterations to the location and some aspects of the education stations, as described herein.

3.4.1 Education Station #1 – Hall School

The location of an education station is proposed near the Hall School, at or near the stream crossing at the Pinecrest Road extension. Schools are obviously important focal points for public educational access to the stream. Wayfinding markers visible from the Hall School will lead students and residents to this education station, which will include interpretive signage about the Capisic Brook, stormwater and responsibilities of residents for watershed health. A footbridge reconstruction of Pinecrest Road extension or overlook could be considered at this location to enhance views of the stream corridor.

This education station is recommended in close proximity to the Sagamore Village Structural Retrofit, also a recommendation in this Plan. Construction of the Hall School Education Station could be constructed in conjunction with the structural retrofit.

3.4.2 Education Station #2 – Capisic Pond

A second education station is recommended to be developed near Capisic Pond. The Capisic Pond Park is frequented by area residents and would be an ideal location to raise awareness about the role of the Capisic Brook in Capisic Pond health. Community advocacy for the Park demonstrate community interest in this area and provide a valuable basis on which to raise awareness of the watershed. Interpretive signage at this station would serve to describe the impairment of Capisic Brook, illustrate the relationship between the brook and the pond and explain what steps residents can take to reduce the impact on the Pond. We recommend an overlook for this station to give a wider view of the pond and park.

Table 3-13: Education Station #2

Opinion of Cost	Cost Assumptions	Potential Partners
$45,000	Development and construction of interpretive signage, wayfinding stations at both locations and installation including self-standing overlook at Capisic Park.	City of Portland Public Services – Parks and Recreation

3.5 SCHOOL OUTREACH PROGRAM

In 2010, the Cumberland County, Portland Water District, Project Learning Tree, Project WET, the City of Portland, and Friends of Casco Bay developed and presented the *Over the Watershed and Through the Woods: Local Field Studies and Service Projects.* This three day series of "train-the-teacher" workshops utilized the Capisic Brook watershed to study forests, water quality, and the relationship between the two. Activities were geared towards teachers in grades 4-12 and included lesson plan development and distribution and service learning project ideas.

In order to continue to build upon this program, it is recommended that the City of Portland, Portland Water District and other partners identify and work with at least one teacher at the Lincoln Middle School to develop and implement a service learning project on school property (e.g. school raingarden or rainwater harvesting).

Table 3-14: School Outreach Program

Opinion of Cost	Cost Assumptions	Potential Partners
$5,000	Education consultant, meetings, soil sampling, and supplies.	City of Portland Public School Department City of Portland Public Services Portland Water District Cumberland County Soil and Water Conservation District

3.6 COMBINED SEWER OVERFLOW ABATEMENT

The City of Portland continues to implement Tier II projects of its Long Term Control Plan for Combined Sewer Overflow Abatement within the Capisic Brook watershed. The abatement of Combined Sewer Overflows is a critical path to reclaiming water quality in the watershed. There are no additional recommendations for CSO abatement in this Plan, but the following table outlines the currently projected costs to complete CSO separation within the watershed. The abatement effort is a cost associated with sustainable management of the Capisic Brook and thus has been included in this Plan.

Table 3-15: Combined Sewer Overflow Abatement

Implementation Schedule	Cost Projection[1]	Cost Assumptions	Potential Partners
Ongoing	$4,900,000	Based on Tier I and Tier II Plan estimates for projects remaining in Capisic Brook.	City of Portland Public Services

1 Cost projection based on personal communication with Brad Roland, City of Portland (2010) and includes the following projects: Capisic Brook Disconnect - Mount Sinai Cemetery to Warren Avenue, Warren Ave - Forest to Bishop Sewer Separation, Dorothy, Dibiase and Hicks, Commonwealth sewer separation, and the Belfort Street sewer separation. Some projects have currently been completed at the time of final draft report (June 2011).

3.7 PLANNING AND POLICY RECOMMENDATIONS

Land use, which is largely directed by local zoning, influences the distribution of stormwater discharges and the magnitude of pollutant loads. The National Stormwater Quality Database uses land use types (e.g. residential, commercial, industrial) as a basis for classifying the predicted "typical" level of pollutant concentrations in stormwater runoff. As such, consideration of land use regulatory tools for the Capisic Brook watershed, including water quality-related performance standards and/or an overlay zone with provisions intended to mitigate stormwater pollutants can become important considerations within the overall strategy for effective watershed management. Additionally, maximum impervious surface cover ratios and other such dimensional requirements dictated by zoning can help anticipate future build out scenarios.

The implementation of local and regional planning policies may be one of the most economical and effective long-term strategies for stormwater pollution mitigation in urban water bodies.

- The American Rivers publication, Local Water Policy Innovation – A Road Map for Community Based Stormwater Solutions[22,] indicates that "local environmental protection ultimately relies on local solutions. "Regardless of federal laws, our local and regional water quality will not be protected unless we take action at home." The report goes on to identify why local policy is important to stormwater management, including;
    - Local governments have the experience and authority to regulate land use,
    - Zoning and development review regulations are ideal processes for stormwater regulations,
    - Local governments can remove barriers to Low Impact Development (LID),
    - Local action is vital to the federal Clean Water Act permitting system, and
    - Individuals have great power to create change on a local level.

[22] Brent, Denzin, 2008. *Local Water Policy Innovation – A Road Map for Community Based Stormwater Solutions.* American Rivers.

- During a recent panel discussion, Andy Fisk, MaineDEP, Former Director Bureau of Land and Water Quality, expressed his view that proactive watershed restoration planning is probably the best method to improve water quality over the long term in urban water bodies. He emphasized, however, that this burden cannot be borne by individual municipalities alone and will likely require regional and state and local collaborations along with adjustments in the way land use permits are issued at the state level.

- The Center for Watershed Protection contends that requiring stormwater retrofits during redevelopment is the most effective method to achieve maximum water quality improvements over time in impaired water bodies.

3.7.1 Modifications to the City of Portland Technical and Design Standards and Guidelines

Section I – Transportation Systems and Street Design Standards - Drainage and Curbing

Current Standards: Standard details in the City's Technical and Design Standards and Guidelines (Technical Manual) for curbing on roadways and parking areas inadvertently create the necessity for closed drainage systems. Any proposed deviation from the standards and specifications listed in the Technical Manual, such as implementation of an open drainage system, would currently require a waiver.

Recommendation: Develop standards and corresponding design details for open drainage systems in an urban setting, including their appropriate application, design details and required long-term maintenance, and/or consider adding sections to the street and parking design standards that specifically recommend curb breaks or no curbing as a part of post-construction stormwater management plans. New design details will require an explanation of when open drainage is appropriate for consideration and locations where open drainage is likely to provide maximum value (e.g. soils with infiltration capacity). Develop design specifications for curb inlets associated with open drainage systems and other BMPs including but not limited to tree box filters and soil filters.

Section I – Transportation Systems and Street Design Standards - Pervious Pavement Installations

Current Standard: Pervious pavements are not addressed in the current sidewalk, street and parking design standards and details.

Recommendation: Consider amendments to the Technical Manual to include pervious pavement, their appropriate application, design details and required long-term maintenance, for pervious sidewalks and parking areas. Allow the use of pervious pavements (porous asphalt, pervious concrete, pervious pavers, and consideration for new/alternative porous pavements) where appropriate for private parking, sidewalks and along non-city streets as a part of post-construction stormwater management system design. Pervious pavements are a stormwater management system and as such should be subject to long-term maintenance requirements as required in Section 5 of the Technical Manual. Consider the modification of Site Plan standards to require pervious pavements on the portion of parking that exceeds off-street parking requirement by more than 10% unless depth to groundwater or other parent soil conditions would restrict pervious pavement use.

Section I – Transportation Systems and Street Design Standards - Parking Lot/Parking Space Design-Compact Car Spaces

Current Standard: Parking lots with ten (10) or more spaces may be comprised of up to 20% compact spaces. The space shall have a minimum design of 8' wide by 15' long.

Recommendation: Increase allowance of compact spaces from 20% to 35% (or more) of required minimum off-street parking for parking lots with ten or more spaces. Require (versus "allow") a percentage of compact vehicle spaces with a waiver provision for specific uses (e.g. commercial, retail, construction supply) that would typically have frequent "pull in and pull out" traffic and/or need to accommodate larger sized vehicles in parking areas.

Section I – Transportation Systems and Street Design Standards - Parking Lot/Parking Space Design – Parking Space Dimensions

Current Standard: The standard parking space is 9' x 18'.

Recommendation: The current standard of 9' x 18' meets the recommendations of the Center for Watershed Protection[23] for parking stall size; however, any strategy to further reduce the construction of new impervious surface should be explored. Modify standard to a maximum parking stall size of 9' x 18' with consideration for shorter dimensions (9' x 16') as a part of post-construction stormwater management plans.

Table 3-16: Modifications to the City of Portland Technical Manual

Opinion of Cost	Cost Assumptions	Potential Partners
$25,000	City staff time, engineering consultant time for engineering details development and assistance.	City of Portland Planning and Public Services

3.7.2 Soil Restoration

Development dramatically alters the hydrologic cycle by changing the relative percentage of precipitation that contributes to groundwater recharge, evapotranspiration, and runoff. As land is developed, infiltration tends to decrease and stormwater runoff increases in both rate and volume due to increases in impervious area, soil crusting, and soil compaction. The addition of organic material and mechanical tillage has shown the potential to reduce runoff from compacted soils after construction from 36 to 91 percent[24]. Residential development of single-family homes typically provides 50% or more of open space, making

[23] *Center for Watershed Protection. Better Site Design: A Handbook for Changing Development Rules in Your Community.* 1998. Center for Watershed Protection. Ellicott City, MD.

[24] Jeremy Balousek, P.E., 2003. *Quantifying decreases in stormwater runoff from deep tilling, chisel plowing and compost amendment.* Dane County Land Conservation Development.

the soil profile of a residential parcel a potential water management and water storage resource. Numerous states have adopted soil management BMPs specifically for stormwater management[25].

Current Standard: Currently, the City of Portland Technical Manual does not define loam or provide specifications for loam and loam placement. The Maine Department of Transportation does define Loam in Section 615 of the Department's Standard Specifications but area preparation and final organic content percentages described by MaineDOT are not necessarily consistent with other stormwater management manuals utilizing soil restoration as a stormwater best management practice.

Recommendation: Consider a loam material and installation specification (or standard) that will at a minimum meet MaineDOT standards. This may have implications for smaller thresholds of development and applicability of this recommendation for these projects should be considered by city planning staff. Additionally, consider the development of a Loam Restoration standard which will allow landscaped developed areas to meet state stormwater storage requirements within the soil profile (currently 0.4" rainfall depth times developed landscape area); an example standard is included in Appendix E. Verification of most material specifications requires lab testing, thus, this recommendation includes review by Planning and Public Services to develop effective strategies for the management and enforcement of proposed regulations along with review by local contractors and suppliers prior to final development of the standard.

Table 3-17: Soil Restoration

Opinion of Cost	Cost Assumptions	Potential Partners
$8,000	City staff time, engineering consultant time for research and specification development.	City of Portland Planning and Public Services

3.7.3 Modification to City of Portland Code of Ordinances – Land Use

Chapter 14 - Section 14-343 and 14-344 - Shared Parking or Overall Parking Reductions

Recommendation: Section 14-343 authorizes the Zoning Board of Appeals or the Planning Board to grant joint use parking, meeting specific criteria. Simplify the process for considering shared parking arrangements and allow decisions to be made both administratively and by the Planning Board under Sections 14-343 and 14-526. The regulations would be designed to allow off-street parking reductions if the applicant demonstrates that the off-street parking proposed is adequate for the use based upon current ITE Parking Generation rates, parking demand/supply study for the project, and/or consideration of the availability of transit service, shared use of parking facilities or other parking reduction strategies.

[25] Washington Department of Ecology, *Building Soil: Guidelines and Resources for Implementing Soil Quality and Depth BMP T5.13*. WDOE Stormwater Management Manual for Western Washington.

Division 26.7 Stream Protection Zone – Zone Expansion

Current Standard: The Stream Protection Overlay District does not extend up the Western, Northern or Eastern Tributaries of Capisic Brook and may not include other important intermittent stream channels and/or hydrologically connected wetland systems.

Recommendation: Consider expanding the Stream Protection Overlay District into hydrologically connected areas of Capisic Brook. Consider amending the language within the overlay zone to enhance/maintain riparian vegetation and conservation of wetland/riparian area hydrologic functions (i.e. fill placement, subsurface diversions, compaction, etc.). This recommendation will require field mapping, confirmation, documentation of hydrologically connected areas and a public planning process to notify property owners of potential zone changes. Final mapped streams should be consistent with definitions of streams under the Maine Natural Resources Protection Act. Field documentation of stream and valley dimensions will increase the City's capacity to accurately and effectively designate Stream Protection Overlay zones.

Chapter 14 – Section 14-256 and Section V of the Technical Manual - Stormwater Management During Redevelopment Projects

Current Standard: It is not clear whether redevelopment projects require stormwater management when not regulated by the state stormwater law. Additionally, the City of Portland currently requires Flooding standards to be met by developments that would not typically meet flooding standards under state law.

Recommendation: Clearly define redevelopment within the Code of Ordinances. Require some level of stormwater quality management during redevelopment projects of certain size thresholds. Consider reducing the area treated requirement, as appropriate, from state standards (currently 90-95% of developed or redeveloped area with lower thresholds for linear transportation impervious area) to make stormwater management less expensive or more manageable on small sites.

Chapter 24 – Section 24-44 – Modifications to Sewer Connection Language

Current Standard: The section of code that deals with public sewer connection limitations indicates that "*no person shall make"* connection of drainage infrastructure to sanitary sewer, but does not require separation of these connections during combined sewer separation projects.

Recommendation: Consider amending the language to require any new and/or redevelopment in combined sewer areas to consider on-site detention or retention options before connection to combined sewer is allowed. Consider modifying existing language to require private drainage infrastructure to be connected to storm sewer system during combined sewer separation projects.

Current Standard: *Stormwater and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as combined sewer or storm sewer…*

Recommendation: Consider amending the language in this section in order to encourage the use of on-site retention or detention and other best management practices to reduce the potential for direct connection of drainage infrastructure to municipal stormwater drainage system. Details and programmatic guidance should be developed with other revisions to the Technical Manual. Modify language indicating that stormwater "shall be" discharged to combined sewers to reflect the intent that stormwater should only be discharged to a combined sewer when all other management options (i.e., on-site storage, discharge to a

storm drain, etc.) have been eliminated and any discharge to the combined sewer system should be minimized. Waiver provisions should be developed if on-site retention or detention is not possible.

Table 3-18: Modification to the City of Portland Code of Ordinances

Opinion of Cost	Cost Assumptions	Potential Partners
$35,000	City staff time, engineering consultant time for research and development including mapping, City Council workshops.	City of Portland Planning and Public Services

3.7.4 General Policy Recommendations

Incent Redevelopment within Zone B4

Recommendation: Work with commercial property owners to determine effective incentives that may attract redevelopment. Consider zoning modifications in B4 to allow more flexibility in uses (e.g. floor to area ratios, building height) to attract redevelopment and therefore improve stormwater management through redevelopment. Develop modified zoning requirements in connection with Commercial Pollution Prevention recommendations (see Section 3.1.1) that would enhance environmental and aesthetic quality of this zone through tree planting, streetscaping, or other program recommendations.

Develop a Compensation Fee for Capisic Brook Development and Redevelopment Activity

Recommendation: See Section 4 –Financing for discussion of Compensation Fee recommendation.

Identify Solutions to Winter Deicer Related Chloride Issues

Numerous studies have established that chlorides from winter deicers can compromise freshwater environments, pollute groundwater supplies and are detrimental to infrastructure and automobiles. There is increasing exposure within the state associated with this issue as a result of the Maine Road Salt Risk Assessment project report (http://mcspolicycenter.umaine.edu/?q=RoadSalt) and a Maine Salt Managers Task Force has been initiated in 2010[26].

Recommendation: Municipal and state stakeholders should continue to participate in meetings of the Maine Salt Managers Task Force in order to dialogue with other local, state, and regional organizations concerning long-term solutions to winter deicer issues.

Maine DOT and Maine Turnpike Authority (MTA) Projects

Recommendation: The MaineDEP, City of Portland and Westbrook should promote/advocate stormwater management enhancements for state and MTA projects through Portland Area Comprehensive Transportation System (PACTS) project requests or during other transportation planning efforts with

[26] Zollitsch, Brenda. September 8, 2010. Meeting Minutes of Salt Management in Impaired Streams Roundtable.

specific short-term focus on Maine Turnpike widening project and Exit 48 upgrades. As of the printing date of this document, the MTA has initiated a stormwater quality improvement project for existing impervious areas as a part of the Exit 48 reconstruction.

Critical Lands Acquisition and Conservation

Recommendation: Cooperate with the Portland Land Bank Commission, large private landowner, Central Maine Power and other state and regional conservation organizations to advocate for the preservation and conservation of critical lands within the Capisic Brook Watershed. Several areas/parcels within the Capisic Brook Watershed Projects have been identified in the City of Portland Wetland Compensation Opportunities Assessment: Phase 1[27] and the Portland Land Bank Commission Annual Report[28].

Utilize Long Creek Watershed Management District Implementation for benefits to Capisic Brook

The Planning and Policy Recommendations described herein, focus largely on the City of Portland as the primary regulated discharger into Capisic Brook. As has been noted in Section 2 of this Plan, the City of Westbrook, MTA, and the Maine DOT also currently have permitted discharges into Capisic Brook and hold the need to comply with the Maine General Stormwater Discharge Permit.

Additionally, the MaineDEP General Permit – Post Construction Discharge of Stormwater in the Long Creek Watershed (Long Creek General Permit) directs the four municipalities within the watershed including the transportation agencies to implement the Long Creek Watershed Management Plan as a condition of the General Permit. Over the next several years, the Long Creek Watershed Management District (LCWMD) will be working with the regulated municipalities and agencies to implement numerous planning and policy recommendations.

Recommendation: The City of Westbrook should continue to implement modifications in planning and policy consistent with requirements of the Long Creek General Permit in order to improve policy and standards in their portions of Capisic Brook. Planning considerations outlined in the Long Creek Watershed Management plan related to Westbrook's design standards and zoning requirements that are considered for Long Creek may also be instituted on a city-wide basis.

[27] *Wetland Compensation Opportunities Assessment: Phase 1*. July 2009. Prepared by Boyles Associates for the City of Portland,

[28] *Portland Land Bank Commission: Report and Registry*. Submitted January 2007.

Table 3-19: General Policy Recommendations

Opinion of Cost	Cost Assumptions	Potential Partners
$15,000	Zone B4 considerations included in zoning modification cost. Zoning and Technical Standards in Westbrook costs assume municipal and Long Creek Watershed Management District staff time. Other recommendations are not considered direct cost to watershed implementation.	City of Portland Planning and Public Services City of Westbrook/Long Creek Watershed Management District Maine Department of Transportation Maine Turnpike Authority Portland Land Bank Commission

The proposed project timeline has been included in Table 3-20 below and includes a conceptual implementation schedule. The years expressed in this timeline correspond to city fiscal year (June 30 – July 1). The timeline has been provided as a guideline for stepwise implementation, but actual implementation will depend on a number of factors.

Table 3-20: Project Timeline

Task	Year 1						Year 2												Year 3												Year 4												Year 5												Year 6-10					
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Commercial Outreach Program Development																																																													
Continue Residential Pollution Prevention Program																																																													
-Develop Capisic Brook Watershed Map																																																													
Support Planning and Policy Updates																																																													
Initiate Planning and Policy Updates																																																													
-Include Field Mapping for Stream Overlay District																																																													
Obtain/Consider Grants for Tree Planting, Education																																																													
Stations, HUD Property, Wetland Park																																																													
Initiate Tree Planting Program																																																													
-ID Opportunities																																																													
Commerical Outreach Training																																																													
Complete Asset Mapping																																																													
Develop Legal Agreement for Public-Private																																																													
Structural Systems																																																													
Complete Planning and Policy Updates																																																													
Implement Tree Planting Program																																																													
Implement Education Stations																																																													
Initate WQ Monitoring (Assuming Completion of																																																													
CSO Abatement)																																																													
Structural Stormwater Management Design,																																																													
Permitting and Project Initation																																																													
Muncipal Street Sweeping - 4X Per Year																																																													
Catch Basin Cleaning																																																													
Combined Sewer Overflow Abatement																																																													
General Policy Recommendations																																																													

4. FINANCING

The following table provides a summary of costs for implementation of the Capisic Brook Watershed Management Plan as recommended in the previous sections. In order to evaluate the potential impact of restoration activities on a stormwater program, the costs are identified in three categories; annual operations and maintenance, structural capital improvement costs and short-term restoration program costs. Furthermore, short-term program costs have been separated by city staff versus contractor in Section 4.1.1 to inform staffing recommendations.

It should be noted that certain O&M costs will only be realized after specific implementation actions (i.e. operations of structural BMPs, water quality monitoring, etc.). These costs have been assumed to be on-going annual to provide a conservative estimate of annual watershed restoration O&M costs.

Table 4-1: Financing

Recommended Actions		Opinion of Cost
Annual Operations and Maintenance	Commercial Facility Outreach/Training	$5,000
	High Efficiency Street Sweeping	$65,000
	Catch Basin Cleaning	$40,000
	Operations and Maintenance for Structural BMPs	$51,000
	Water Quality Monitoring	$60,000
Total		**$221,000**
Structural Stormwater Management	Sagamore Village	$1,475,000
	Riverside Street	$150,000
	Larrabee Road	$795,000
	West Tributary	$5,965,000
	Capisic Brook Stormwater Wetlands Park	$4,200,000
	Legal Easement Negotiation	$100,000
	Construction Administration	$150,000

Recommended Actions		Opinion of Cost
Total		**$12,835,000**
Short-term Restoration Program Costs	Commercial Industrial Outreach Program Development	$50,000
	Shade Tree Planting Program	$162,000
	Social Marketing Campaign	$150,000
	Capisic Brook Watershed Map	$15,000
	Asset Management and Mapping	$40,000
	Education Station Development	$45,000
	School Outreach Program	$5,000
	Planning and Policy Initiatives	$83,000
	QAPP Development for WQ Monitoring Program	$10,000
Total		**$560,000**
Combined Sewer Overflow Abatement	CSO Separation	$4,900,000
Total		**$4,900,000**
Total Capisic Brook Restoration Cost		**$18,516,000**

4.1 PROJECT COSTS

In an effort to assess the potential funding needs associated with the Capisic Brook restoration project, we have completed a simple financial analysis. Portions of this financial analysis have been based on the ongoing City of Portland efforts evaluating the viability of stormwater user fees. This project financing section is intended to provide an early sense of the long term costs associated with the capital, operations, and maintenance expenses associated with the project.

4.1.1 Estimated Cost

The total estimated capital cost for the CBWMP is $18,295,000; $12.835M of this opinion of cost includes the structural stormwater management projects presented in Section 3. $560,000 of the opinion of cost includes short-term restoration costs for projects and programs. These projects include planning and policy efforts, watershed infrastructure mapping, watershed map development, shade tree planting program, residential social marketing implementation and commercial outreach program development. It should be noted that not all of these projects are necessarily eligible for typical municipal financing through tax-exempt bond revenues[29].

The expected cost of Combined Sewer Overflow (CSO) abatement work in the watershed ($4,900,000) has been excluded from the overall CBWMP implementation estimate for the purposes of financial planning. We understand that work is currently being financed through bond revenue and would not need to be financed as a part of this restoration effort.

Annual operations and maintenance (O&M) associated with the CBWMP projects include compliance street sweeping, catch basin cleaning, ongoing outreach/training to commercial landowners for pollution prevention, a water quality monitoring program (See Section 5) and O&M for structural management systems. We estimate an annual O&M cost of approximately $221,000 for the Capisic Brook watershed restoration effort. It should be noted that some of these costs may increase, decrease or even be eliminated over time depending on implementation timing and specific program need. For the purpose of this report they are assumed to be constant as on-going efforts. These ongoing costs may also escalate as a result of cost of living increases, but future costs have not been evaluated for these programs at this time.

Many of the costs associated with the short-term restoration program include both an opinion of cost related to City of Portland staff time and contractor cost. For the purposes of evaluating possible CBWMP implementation staffing needs, the cost of city staff has been separated from the overall short-term program costs. Short-term restoration program costs include approximately $391,000 for contractor support and $174,000 of cost associated with City of Portland staff labor. Of the contractor fees associated with short-term restoration costs, $231,000 may be eligible for tax-exempt bond revenue.

4.1.2 Anticipated Debt Service

Section 4.2 describes some of the various options that communities have utilized to finance large municipal projects. For the purpose of this project financing section, annual principal and interest payments were calculated with the assumption that Portland will finance the eligible project costs ($13,066,000), which include structural BMP implementation and short-term restoration costs associated with contractors at a 5% interest rate over 20 years. Debt terms between 20 and 30 years are fairly common for financing projects of this kind. Debt terms, in excess of 20 years, are often used to reduce the burden on ratepayers.

A market rate of 5% was assumed, however over the past year W&C has seen municipal market rates range from of 2.2% to 5.8%. A municipal market rate is partially based upon a community's bond rating, its ability to repay the debt and on market forces beyond local control. A rate of 5% is used in this financing evaluation. It is important to note that changes in interest rates and loan terms can profoundly alter the results (impacts) of a financial analysis.

[29] Cuetara, J, 2011. Personal Interview. Bond Counsel for City of Portland, Moors and Cabot.

It is estimated that an annual debt service payment on a $13.066M twenty-year loan at a market rate of 5% will be approximately $1.048M. This annual debt service payment is provided for financial planning purposes only and actual debt service payments will ultimately depend on a number of factors including how the overall CBWMP implementation is initiated and bonded.

4.1.3 Revenue Requirements

The CBWMP revenue requirements are determined by adding anticipated debt service and annual operations and maintenance costs. The combination of the anticipated Capisic Brook restoration debt service and ongoing O&M will be $1,269,000 per year. The short-term restoration costs associated with city staff time and the short-term projects ineligible for tax-exempt financing were not included in this estimate. These costs are approximately $334,000 and would need to be financed via grants, short-term borrowing, or via existing programmed funds. For context, the recent stormwater program evaluation through a City of Portland study indicated that existing city stormwater program costs were approximately $1.1M in 2010. While the existing stormwater program is not considered adequate for sustainable compliance and infrastructure management, the CBWMP implementation would more than double the annual stormwater program costs.

4.2 SOURCES OF FUNDING

There are a limited number of alternatives available to fund the development of the proposed watershed management and restoration system. The revenue alternatives generally fall into three different categories: user based, infrastructure/economic development/grants, and general fund based. As is typical with other municipal infrastructure projects, a combination of these categories could be used to fund the Capisic Brook Watershed Management Plan. This Plan section focuses on the City of Portland for financing alternatives, however as described in Section 1, the responsibility for water quality improvements in Capisic Brook should be a joint effort between regulated dischargers in the watershed including the City of Westbrook, the Maine Turnpike Authority and the Maine Department of Transportation.

Within Maine, our understanding of the most recent mechanisms for financing urban impaired stream watershed restoration efforts is through the use of grants. The City of Bangor is considering user-based revenues to finance impaired watershed restoration efforts with desired funding of approximately $600,000 per year. Albeit operating under different regulatory requirements, the Long Creek Watershed Management District uses “permit” fees as its revenue source for restoration and fee assessments result in approximately $1.7M in annual revenue for the comparably sized watershed.

User based revenue is generated from the use of the stormwater drainage, water or sanitary wastewater system through user fees. User fees are generated from residential, commercial, industrial, public sector, and other users. The City of Portland Sewer Fund is an existing user based revenue source that provides funding for sanitary wastewater and stormwater program services. Infrastructure/economic/grant based revenue are generated by grants and low interest loans obtained from the federal or state government agencies, used to reduce the debt load generally associated with the capital requirements of projects. General fund revenue is taxation based, given the universal public benefit and economic and community development components of a watershed restoration project.

4.2.1 User Based

Revenues generated from the use of the stormwater drainage, water or sanitary wastewater systems are typically the means of paying for capital operations and maintenance of the system, with a depreciation account to fund repairs and infrastructure replacement once its service life is reached, and debt service incurred to construct the structural components of the management system.

The City of Portland currently funds all of its stormwater projects, operations and compliance though sewer revenue funds. In FY2010, the City of Portland Sewer Fund generated $20.68M in revenue through a sewer rate of $7.64 per Hundred Cubic Feet (HCF) of water usage. Stormwater program costs encompassed/represented approximately 5% of the sanitary sewer revenue ($1.1M) in 2010, although stormwater comprised approximately 23% of funded annual operation costs.

User fees based on "equivalent users" for stormwater, ensures that each user pays for the stormwater they generate; properties that generate more stormwater will pay more in user fees than properties that generates less. This creates a more equitable fee structure. Typically, the amount of impervious cover on a property is used as the means of estimating stormwater infrastructure usage.

At this time, the City of Portland and Westbrook do not have a user based revenue system for stormwater drainage utilities. Portland has conducted the a "Does it Make Sense" (DIMS) study to determine whether a user based fee system would be appropriate for the City and has initiated a Sustainable Stormwater Financing Task Force (SSTSF) to evaluate the pros and cons of a stormwater user fee.

Special Assessment Districts

Several methods can be used to recover the carrying costs on large municipal capital projects. Special Assessment Districts (aka Betterments) represent one of the methods that a municipality can use. A Special Assessment District (SAD) is a special property tax that is assessed to a property due to the benefit the property receives as a result of a construction project. SADs are assessed upon the property in proportion to the amount of such benefit. A municipality may formally adopt an ordinance which describes the area to be improved by the construction project and states the special assessment that will be levied for the improvement(s). There are several methods for estimating the special assessment. SADs can be assessed using a uniform unit method. The uniform unit method calculates assessment costs by dividing the project cost by the total number of "units" contributing to the project in this manner. In the case of stormwater mitigation projects the following may be a possible way to assess the SAD:

- Every property is assessed for impervious cover (if applicable)
- Residential properties are assessed based on an "equivalent residential unit" (ERU). The ERU is defined as the quantity of stormwater flow expected from the unit based on general or specific impervious cover.
- Non-residential properties are assessed based on existing zoning regulations and best use. Residential equivalency can be determined by floor space (e.g. 2500 s.f. = 1 equivalent residential unit) or total developable area. For undeveloped properties, determined by likely use, an equitable method should be determined to accommodate future development impact on the receiving stormwater management system.

Tax Increment Financing

Tax increment financing (TIF) is a tax incentive program that is used to help communities finance public investments, including infrastructure improvement projects. A TIF provides a municipality a mechanism

to use some or all of the property taxes that result from an investment project within a designated area, commonly referred to as "district", to assist in that project's expenses. The equalized assessed value of the taxable property can be frozen for up to 30 years in the designated district. The incremental equalized assessed value is used to pay for the project costs. One benefit of a TIF is that the incremental equalized assessed value is sheltered from the computation of adjustments and state taxes based on its total municipal valuation. The municipality may use the taxes to retire bonds issued to finance the project or pay for project costs. It does not appear that TIFs would be particularly applicable in Capisic Brook.

4.2.2 Infrastructure/Economic Development Grant and Loans

Grant programs are available from various state and federal agencies such as the MaineDEP, the Department of Economic and Community Development (DECD), and often through Congressional earmarks for worthy projects. Each funding agency has its own unique requirements but they often collaborate to fund projects. Recent discussions Woodard & Curran has had with funding agencies indicate that Portland is a recognized priority in terms of need and would rank well on a comparative basis with other communities. This does not indicate funding is guaranteed, but it suggests an awareness of the issues and a commitment to eliminating problems currently experienced in Portland on behalf of the agencies.

Maine Department of Environmental Protection

The MaineDEP offers grant/loan packages for towns to improve their wastewater treatment systems. In addition, loan money is available through the Clean Water State Revolving Loan Fund (SRF) at 2-percent below the market interest rates for terms up to 20-years. Recent changes in the State Revolving Load Fund program provide for principle forgiveness on up to 50% of the loan. The amount of principle forgiveness is based on specific economic criteria and environmental worthiness. Grant eligibility is determined by comparing user rates to the users or municipalities Median Household Income (MHI). A town will be classified as disadvantaged, and therefore grant eligible if rates exceed a certain percentage of the MHI. Applications to the SRF program are accepted throughout the year with bond sales generally occurring twice per year in April and October to coincide with the Maine Municipal Bond Bank (MMBB) schedule of bond sales. The MMBB assists the DEP in the administration of the SRF program. Twenty percent of the federal capitalization grants are set-aside for funding "green" projects. Green projects include: a.) green infrastructure, projects that mimic natural biological systems, rain gardens, swales; b.) water and energy conservation, reduced use; and c.) environmentally innovative activities, including planning studies that integrate resources in a more sustainable manner, utility sustainability, greenhouse gas inventory, LEED buildings, etc. These projects are eligible for principle forgiveness.

Additionally, the MaineDEP maintains the Nonpoint Source Grant Program which is administered by the MaineDEP in consultation with the U. S. Environmental Protection Agency (EPA). The grant program provides funding for nonpoint source implementation projects once an approved watershed management plan exists. The development and acceptance of the Capisic Brook Watershed Management Plan by the MaineDEP will make these grant funds available for use. The MaineDEP states that the implementation project must be designed to substantially contribute to protection or improvement of a waterbody. MaineDEP accepts applications for funding annually in the spring of each year. These are generally highly competitive grants.

It should be noted that the financing of implementation projects cannot be for projects that "undertake, complete or maintain erosion or storm water control work otherwise required by existing permits or orders (examples: Maine Pollutant Discharge Elimination System Stormwater Permit, Site Location of

Development Permit or Stormwater Law permit). At this time, it is our assumption that some of projects identified in the Capisic Brook Watershed Management Plan would not be eligible for this funding if identified explicitly within the MS4 permit (i.e. catch basin cleaning, street sweeping).

Department of Economic and Community Development

Portland, as a community within Cumberland County has been identified since 2007 as an entitlement community and is not eligible to receive Community Development Block Grants (CDBG) funding as administered by the State of Maine Department of Economic and Community Development. Cumberland County however, is a direct recipient of CDBG program funds from the U.S. Department of Housing & Urban Development (HUD) and both Portland and Westbrook are eligible for funding through the County. Funds are distributed through the Cumberland County Community Development Office and programs; there is an annual competition and selection process. Applications are generally distributed in November; pre-applications are due in mid-December; with final applications due in early February of each year. Grants are directed toward projects that will encourage or support employment opportunities for low to moderate income people and can therefore be used to benefit business that employ low to moderate income people.

Compensation Fee Utilization

The Maine Stormwater Management Law (38 M.R.S.A. §420-D.11.) authorizes the Department (or communities delegated by the department) to accept a compensation fee in lieu of meeting all or part of water quality standards in the watershed of a coastal wetland, river, stream or brook. In Department Rule Chapter 500, Section 6, the Department establishes compensation fee requirements for projects located in the watersheds of urban impaired streams. Capisic Brook is considered by the MaineDEP as an urban impaired stream and requires compensation fees (or off-site mitigation) for development and redevelopment projects of a particular size. The Rule restricts the use of compensation fees to watersheds where “a compensation fee utilization plan has been approved by the department”. A Compensation Fee Utilization Plan has not been developed for Capisic Brook, but in other municipalities a watershed management plan approved by the Department can be used as a basis for identifying appropriate compensation projects. According to City of Portland staff, off-site mitigation within the impaired watershed is the preferred approach to ensure continued restoration of water quality, because it provides immediate benefits for the watershed. The current compensation fee structure established in Chapter 500 is considered by Portland staff as quite modest and fees from numerous development projects would need to be collected under a Compensation Fee Utilization Plan before a substantial structural mitigation project could be implemented. The City of Portland is considering the possibility of revising the compensation fee structure to reflect the actual cost of implementing mitigation projects. This would make the option of collecting compensation fees more useful in effecting water quality improvements in impaired watersheds.

U.S. EPA STAG

U.S. EPA's State and Tribal Assistance Grant (STAG) grants are requested by Congress, i.e. Maine delegation, as an allocation to address a specific project within a State. STAG applications are available through the delegation’s local offices.

Other Grants

The following grants were identified as possible funding opportunities which appear to be well suited to actions identified in the Capisic Brook Watershed Management Plan. See Appendix E for a full listing of possible grant funding sources.

Watershed Protection and Flood Prevention - USDA/NRCS

The Wetlands Protection and Flood Prevention program funds projects related to watershed protection, flood mitigation, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, agricultural water conservation, and public recreation are eligible for assistance. Technical and financial assistance is also available for planning new watershed surveys.

Wetlands Reserve Program - USDA/NRCS

The Wetlands Reserve Program assists landowners in restoring and protecting wetlands on eligible lands on which they agree to enter into a permanent or 30- year long-term easement (30- year contract for Indian tribes) , or a restoration cost-share agreement with the Secretary. The goal of WRP is to maximize wetland functions, values, and wildlife benefits on every acre enrolled in the program. Eligible landowners may offer farmed wetlands, prior converted wetlands, wetlands farmed under natural condition, former or degraded wetlands on lands that have been used or are currently being used for the production of food and fiber, including rangeland and forest production land, lands substantially altered by flooding, certain riparian areas, along with certain adjacent areas, to be placed under a permanent easement. Once the easement is created, USDA/NRCS completes the restoration of the former wetland. This program has approximately $1,000,000 annually going to Maine communities. Last year 4 parcels were enrolled in the Wetlands Reserve Program, it is expected that an additional 5 or 6 parcels will be enrolled next year.

Five Star Restoration Program - USEPA/US Fish and Wildlife

EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference is given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments.

4.2.3 General Fund Revenues

Revenues generated from taxation have been a method that municipalities use for stormwater drainage infrastructure capital projects, operations and compliance. The intent behind the use of the general fund is to distribute the cost among the broader beneficiaries of the watershed management project, extending beyond the direct watershed users. This funding source is particularly appropriate in watershed pollution

issues where non point source pollution is a contributor to water quality impairment, one example being that pollution is generated by vehicles passing through or using a watershed.

In Portland, it is our understanding that the General Fund is not used for stormwater programs or capital improvements. In 2010, the City of Portland maintained a tax rate of $17.74 per $1000 of valuation for total annual revenue of $133M. Only $66M of this annual revenue is allocated for non-school programs.

4.3 COST RECOVERY OPTIONS

Sanitary Sewer Rate Structure

User fee revenue from the City of Portland sanitary sewer has been and could continue to be utilized for stormwater management efforts. According to 2001-2010 city sewer rate and water usage data, the City sewer fund generates approximately $1.16M annually for every $0.40 increase in the sewer rate. It should be noted that several city initiatives are being considered for funding through the existing sewer user fund, including the Tier III Combined Sewer Overflow Abatement strategy, which may impact the ability of the sanitary sewer fund from being utilized for CBWMP efforts.

Stormwater User Rate Structure

Based on the results of the DIMS studies, the City could utilize an Equivalent Residential Unit (ERU) rate structure to finance various stormwater programs, capital needs and restoration. The ERU rate structure assigns an ERU to each developed or developable property in the City; each ERU is the equivalent to one single family residence. The DIMS studies identified a possible ERU rate structure and subsequent range of revenue generated annually. The studies indicate that for every $1 in monthly fee per ERU, the city could generate approximately $600,000.

General Fund Revenues

While general fund revenue is not currently used to finance stormwater program costs, the general fund could in theory be used for restoration efforts in Capisic Brook. According to current valuation and tax rate, the City of Portland requires approximately $7.5M in increased costs to raise the mil rate by $1.00.

Betterments

In support (or in lieu) of the user funds generated, and in addition to exhausting grant funding sources identified within this Plan, one method of cost recovery for consideration is through the assessment of betterments. Specific structural stormwater management improvements identified in the CBWMP may be applicable to use of betterments. Betterments are usually assessed one year after construction is completed to each ERU that has been “bettered” by the project. Betterments may be paid in full by each ERU or may be apportioned for up to 20 years. Interest rates for apportioned betterments are typically 5%, but may vary if optional rates are established by the City.

For example, The West Tributary project would provide water quality improvements for stormwater runoff from approximately 95 acres (4,160,482 sf) of impervious surface (excluding the Maine Turnpike). The capital cost opinion of cost for this project is $5,965,000 with an annual debt service of $455,854. If properties were assessed fees based on impervious surfaces only, an annual fee per acre of impervious surface would be between $4,000-$5,000.

4.4 PROJECT FINANCING RECOMMENDATIONS

The project financing recommendations consist of three primary components; grant funding and regional collaboration for short-term, non-capital projects and programs, institution of an appropriate compensation fee for development and redevelopment projects and stormwater user fee creation to finance capital projects and sustainable operations and maintenance. Additionally, advocacy for state funding support for municipally led restoration programs is recommended and staffing implications of the CBWMP are discussed.

Grant Funding and Regional Collaboration

While grants are not a guaranteed or reliable source of funding for any municipal program, the use of grant funding may be particularly applicable to the implementation of short-term restoration projects. Recommended CBWMP projects that fall into the general category of "non-capital" projects include planning and policy initiatives and education and outreach programs. These types of projects are not likely eligible to be included in long-term bond packages and would therefore only be able to be financed through short-term taxable loans, grants or user-fees. It is our recommendation that the regulated entities in Capisic Brook and regional partners (identified in proposed project descriptions in Section 3) consider joint submission of grant applications for financing of these non-capital projects. It should also be noted that several of the projects that are generally bond-eligible could also be considered for grant funding given the type of project. These might include the education stations and tree planting programs.

Compensation Fees

As discussed in this section, the "compensation fee" is a form of impact fee required by state law for development projects that meet certain applicability requirements. In order to make use of a compensation fee, a CFUP should be developed for Capisic Brook based on the recommended projects identified in Section 3. Currently, the state recommended compensation fee (established in 2006) may not be adequate compensation given current cost of structural retrofit projects. It is our recommendation that the City of Portland and Westbrook consider modifying compensation fee rate structure to more adequately reflect current retrofitting construction costs and benefit of stormwater mitigation practices.

Stormwater User Fund

As described in this section, a Stormwater User fee may be a viable mechanism to generate revenue for stormwater program, infrastructure and restoration costs in a municipality. Current efforts through the City of Portland Sustainable Stormwater Financing Task Force will determine if a user-fee for stormwater is appropriate for further consideration. If appropriate, the outcome of the SSFTF effort will presumably lead to the development of a reasonable rate structure and revenue for stormwater compliance programs, infrastructure capital renewal and operations and restoration activities. It is our recommendation that the anticipated CBWMP debt service identified in Section 4.1.2 be considered by the SSFTF as a part of future stormwater program costs and subsequently as a basis for future rate studies.

State Funding Advocacy

It is clear that state funding for impaired waters restoration programs are limited. As discussed, typical financing for these programs comes through federal funding and is administered by the state. These grant programs are competitive and do not adequately address the significant costs of urban restoration projects. Several states have recognized this shortcoming and address this through sales and excise taxes. The

following list provides a few examples of state programs for clean water programs financed through sales or excise tax.

- Florida has developed a Water Quality Assurance Trust financed through sales of batteries, solvents, motor oil, petroleum products, pesticides and other water quality impacting chemicals.
- Pennsylvania enacted gas tax legislation that generates $5M per year for environmentally sensitive maintenance of unpaved roadways.
- Minnesota maintains a Clean Water Fund that uses sales tax to finance drinking water and surface water programs.
- Maine established a Coastal and Inland Surface Oil Clean-up Fund to provide funding for research and clean-up of surface oil spills financed through excise tax on petroleum products.
- The City of Santa Barbara maintains a Transient Occupancy Tax on hotel room charges for the cleanup of local streams and water bodies.

It is recommended that project partners consider advocacy towards development of a state funding source for impaired water restoration.

Staffing Considerations

Currently, stormwater program administrative responsibilities in the City of Portland are largely distributed between Planning and Public Services. The implementation of the CBWMP will not only require increases in revenue as discussed but will also presumably require increases in city staffing in order to implement and manage the restoration program. Section 3 provides reference regarding our assumptions on where it was assumed that city staff would be engaged in the implementation of a specific restoration program action. The increased staff responsibilities in the CBWMP are largely associated with the administration of structural projects and the short-term restoration projects/programs. The implementation of the CBWMP includes new programs and projects that are not currently undertaken through Planning or Public Services and additional staffing may be required in order to manage these additional programs.

5. WATERSHED RESTORATION MONITORING

This section describes the Capisic Brook monitoring program as the basis for an adaptive management approach.

According to the EPA's Watershed Academy website, *"Adaptive management is the process by which new information about the health of the watershed is incorporated into the watershed management plan. It is a necessary and useful tool because of the uncertainty about how ecosystems function and how management affects ecosystems. The results of this process are essential to validate the Watershed Assessment, to ensure that ecosystem relationships were considered adequately, and to show that management solutions have been implemented and are effective at achieving watershed objectives."*[30]

The adaptive management approach generally includes four steps according to the EPA; develop an adaptive management plan, monitor, evaluate monitoring results and adjust watershed management plan.

5.1 INTRODUCTION

In conjunction with the implementation of the CBWMP, a stream monitoring program will be implemented for the middle and lower reaches of Capisic Brook. The purpose of the monitoring is both to evaluate the performance of specific restoration measures as well as to help guide the type and extent of any future restoration activities in the watershed.

This monitoring program has been designed to build on and complement previous MaineDEP studies, which assessed in detail the biological, physical, and chemical characteristics of the stream at an upstream and downstream location. As described in Section 1, MaineDEP conducted biomonitoring at both an upstream location on the East Tributary (station 0256) as well as at a downstream location near Capisic Pond (station 0257) in 1996, 1999, and 2003. Each event included both benthic macroinvertebrate community assessments as well as chemical sampling, and the 2003 event included the assessment of physical characteristics of the sample area as well. These studies, which used established protocols and consistent sample locations, provide a preliminary baseline dataset to which future conditions can be compared. This monitoring plan is thus designed to integrate with the on-going MaineDEP biomonitoring program for Capisic Brook by using similar techniques and evaluation strategies so that changes in stream conditions can be ascertained by comparison to the existing body of historical MaineDEP data.

This sampling program describes performance monitoring after abatement of CSOs 42 and 43 and after implementation of the Sagamore Village and the West Tributary structural retrofits. An overview of the logic and rationale for the monitoring program is provided below, followed by a detailed description of proposed activities.

5.2 OVERVIEW OF PERFORMANCE MONITORING PROGRAM COMPONENTS

As described in Section 6 of the Urban Streams Project Report, MaineDEP conducted detailed chemical, biological, and physical sampling and assessment of Capisic Brook in 2003 in support of TMDL development. The data from 2003 and the historical sampling were reviewed in accordance with EPA's Stressor Identification protocol to identify the primary characteristics and causes of stream impairment. From this effort, a series of goals, which reflect the identified stressors, were established with the aim of

[30] http://www.epa.gov/owow/watershed/wacademy/wam/step5.html.

restoring aquatic communities within the stream to Class C standards. These goals formed the basis for the restoration strategy and were the starting point in the design of this monitoring plan.

The restoration goals for Capisic Brook can be summarized as follows:

1. Improve instream habitat quality (channel morphology, riparian tree cover, stormflow volume)
2. Restore natural hydrology
3. Reduce toxicants
4. Reduce nutrient levels
5. Reduce water temperature
6. Improve dissolved oxygen (DO) levels
7. Reduce bacteria levels

Over time, the restoration implementation actions (BMPs) planned for Capisic Brook are expected to result in improvements in all of the characteristics targeted by these goals. BMPs can be both structural and non-structural in nature and have been described in detail in previous sections. The monitoring program focuses on performance monitoring for structure BMPs but it is our judgment that non-structural BMPs will also positively influence stream condition.

Each BMP will affect the brook in different ways or in different areas, so the monitoring plan consists of activities that will detect changes in stream conditions that result from the installation of a few of the major structural BMPs. The methods used to measure improvements in the stream will be the same ones used by MaineDEP to identify the stream's problems, an approach that will both promote a consistent depiction of stream conditions over time as well as allow the utilization of historical information as baseline data.

In general, the performance monitoring program consists of a four-pronged approach comprised of the following:

1. flow and precipitation monitoring, to document changes over time in stormwater volume and duration in relation to precipitation;
2. baseline and annual water quality sampling, to document changes in water chemistry both before and after structural BMP installation;
3. Stream characterization, consisting of formal habitat assessment, physical characterization, and geomorphologic assessment, to document changes in the physical structure of the stream in response to stormflow alterations, and
4. macroinvertebrate community assessment, to determine if the documented changes in stream physical characteristics result in an improvement in the aquatic community, which is the primary goal of the TMDL program.

These activities mirror those used by the DEP in the 2003 evaluation of Capisic Brook. Each is directly related to one or more restoration goals, as illustrated in the following table:

Table 5-1: Maine DEP Identified Restoration Goals

Restoration Goal	Monitoring Activity
Improve instream habitat quality (channel morphology, riparian tree cover, stormflow volume)	Habitat, physical, and geomorphological assessment Macroinvertebrate sampling
Restore natural hydrology	Flow and precipitation monitoring
Reduce toxicants	Baseflow and stormflow chemical and field sampling
Reduce nutrient levels	
Reduce water temperature	
Improve dissolved oxygen (DO) levels	
Reduce bacteria levels	

Specific details of these and other aspects of the monitoring program are described in the following section.

5.3 PERFORMANCE MONITORING IMPLEMENTATION

The implementation protocols for the performance sampling programs for CSOs 42 and 43, Sagamore Village, and the West Tributary are described below and summarized in Tables A, B, and C in Appendix F**,** respectively. Based on current appraisals, CSO 42 and 43 abatement is assumed to occur first, followed by the Sagamore Village and the West Tributary structural retrofits. The program is cumulative, and is based on the conservative assumption that structural BMP installations may be separated by several years.

5.3.1 Sampling Site Selection

Sampling sites for all three BMPs are shown in Appendix A – Figure 10. Sampling sites Cap-1 and Cap-2 are downstream sampling stations and are locations where improvements resulting from the installations of the structural BMPs are expected to be discernible. Cap-1 is located downstream of CSOs 42 and 43, and are placed specifically to monitor the effects of the abatement of these CSOs; Cap-2 will monitor all the structural BMPs. Locations shown on Appendix A – Figure 10 are approximate; final locations will be selected in the field in areas where stormflow effects are apparent. To ensure consistency with historical data, sample reaches will be selected in collaboration with the MaineDEP.

5.3.2 Implementation Timing

The monitoring program will be comprised of both baseline, annual, and tri-annual (every 3 years) sampling. Baseline sampling will be conducted during the year prior to the installation of each BMP

described above, and will provide data reflective of current conditions. The annual sampling program will be implemented after the BMP is installed or abatement completed, and will continue for three years afterwards. The annual program consists of sampling at several times each year to monitor the response of the stream to the restoration activity. The tri-annual sampling program consists of stream biomonitoring and physical assessment, in addition to the chemical monitoring component of the annual program. The tri-annual program will be coordinated with the MaineDEP's biomonitoring events, and will continue until stream changes resulting from the BMP are considered to be complete. Each program consists of similar components, to facilitate before-and-after comparisons of stream conditions. These three programs consist of the following specific activities, which are described in detail in Section 5.3.3.

Table 5-2: Sampling Program Summary

Sampling Program:	Baseline	Annual	Tri-annual
Schedule:	One year prior to BMP implementation	For 3 years after implementation	Every 3 years, or on MaineDEP biomonitoring schedule
Activities:	• Flow monitoring • Stormflow and baseflow sampling • Stream assessments: geomorphological, habitat, and physical characteristics • Rock bag biomonitoring • Precipitation vs. streamflow analysis	• Flow monitoring • Stormflow and baseflow sampling	• Flow monitoring • Stormflow and baseflow sampling • Stream assessments: geomorphological, habitat, and physical characteristics • Rock bag biomonitoring • Precipitation vs. streamflow analysis

These activities are described below.

5.3.3 Performance Monitoring Activities

On the schedule and river stages described in Section 5.3.4., Capisic Brook will be evaluated by measurements of streamflow, water chemistry and parameters, stream characteristics, and macroinvertebrate community structure. The data obtained from these samples constitute the performance measures for the stream, and are described below.

Streamflow and Precipitation Monitoring

Streamflow in Capisic Brook is currently monitored by the City of Portland at two locations in the watershed, and it is our understanding that up to three additional flow monitoring locations may be added in the future. These monitoring stations are comprised of stilling wells and are equipped with data loggers, which provide continuous (every 10 minutes) flow data at each location. In addition, precipitation data is obtained from either a station installed within the watershed or an existing station near the watershed. Flow and precipitation data from these sources will be collected and evaluated together to characterize the flow response of the stream to precipitation events. Because the watershed

restoration activities will affect both the volume and duration of stormwater inputs to the stream, changes in streamflow patterns resulting from implementation, it is our judgment that changes will be discernible from the flow data downstream of each structural BMP. Changes in streamflow in relation to precipitation events will directly measure improvements in stream hydrology, which is a fundamental restoration goal for Capisic Brook.

Water Quality and Parameter Sampling

Water samples will be analyzed for metals, nutrients, and other parameters that reflect stream health. Both dissolved (filtered) and total (unfiltered) metals samples will be collected. Dissolved metals are typically the bioavailable fraction, and are the form of metals described by most water quality criteria (WQC) (except aluminum). Total metals include metals bound to particulates, and are a form likely to increase with the suspended solids load in stormwater. Target analytes and parameters and the use of the data are described in Table 5-3 below.

Table 5-3: Water Quality Sampling Program Parameters

Analyte or Parameter	Location of Analysis	Purpose of Data
Metals: Total and dissolved aluminum, cadmium, chromium, copper, nickel, lead, and zinc	Laboratory	Common stormwater toxicants. All except cadmium and copper have been previously detected in Capisic Brook stormwater. Cadmium and copper are common stormwater constituents.
Total Nitrogen (TN)	Laboratory	Nutrient from sewage overflows, atmospheric deposition, roadways and developed landscape runoff.
Total Phosphorus (TP)	Laboratory	Nutrient from sewage overflows and sediments in stormwater runoff.
Chlorides	Laboratory	Constituent in road salt; common toxicant in runoff.
Ions (calcium, magnesium, sodium, potassium), alkalinity, and dissolved organic carbon (DOC)	Laboratory	Necessary to estimate copper WQC.
Total suspended solids (TSS)	Laboratory	Estimates the suspended sediment load. Often higher in stormwater runoff events.
Hardness	Laboratory	Necessary to calculate WQC for metals.
E. coli	Laboratory	Measures bacterial contamination from sewage and stormwater runoff.

Analyte or Parameter	Location of Analysis	Purpose of Data
Dissolved oxygen (DO)	Field	Necessary for aquatic life; levels reflect eutrophication effects.
Temperature	Field	A boundary parameter for aquatic species; also affects DO content. Typically increased by summer stormwater discharges.
Conductivity	Field	A general guide to ion content of stream. Typically high in stormwater runoff.
pH	Field	Affects solubility and toxicity of metals; boundary parameter for aquatic organisms.

TN will be obtained by addition of the results of separate analyses from "nitrogen in nitrate and nitrite" and Total Kjeldahl nitrogen (TKN), which measures ammonium, organic nitrogen, and other reduced forms. Together they comprise a total nitrogen value. This is the reported form of EPA's draft Ecoregional Nutrient Criteria[31].

Because levels of these parameters and analytes may change as soon as structural BMPs are implemented, water sampling will occur at multiple times during the year, under both baseflow and stormflow conditions (Section 5.3.4).

Stream Characteristics

At designated locations and times identified in the tables in Appendix F, stream channel condition will be evaluated for habitat quality, physical characteristics, and geomorphology by both photo documentation and completion of the following three assessment forms, used in the 2003 MaineDEP study of Capisic Brook:

- Habitat Assessment Form (low gradient stream)
- Physical Characterization Form
- Rapid Geomorphic Assessment Form

The purpose of this sampling is to identify changes in stream physical characteristics and morphology that may result from changing flow patterns attributable to restoration activities. The evaluations will be conducted for the same measured reach of stream during each assessment event. Because these characteristics will change slowly over time, an every three-year sampling schedule is proposed (Section 5.3.4).

Macroinvertebrate Sampling

At designated locations and times identified in the tables in Appendix F, macroinvertebrate community assessment will be conducted using rock bags. The assessment will follow the methodology described in the MaineDEP, *Methods for Biological Sampling and Analysis of Maine's Rivers and Streams*, or later

[31] http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/ecoregions/ecoregions_rivers_index.cfm

versions[32]. Under this protocol, three rock bags per station are placed in the stream to provide substrate for colonization by native stream invertebrates. After 30 days the bags are retrieved and the invertebrates removed and identified by a certified taxonomist. Taxonomy results will be sent to the MaineDEP for analysis of an array of community metrics (such as abundance and diversity) which in turn are used to gage the health of the aquatic community.

Because the macroinvertebrate community will respond slowly over time to changes in stream physical and chemical conditions attributable to the restoration actions, macroinvertebrate sampling at downstream locations will be conducted on an every three-year schedule, in coordination with MaineDEP biomonitoring of the site. Rock bags will be placed and retrieved on the same schedule as the MaineDEP upriver and downriver stations (0256 and 0257, respectively) and subject to the same analyses, so that a complete depiction of stream conditions throughout Capisic Brook are obtained at one time.

5.3.4 Sample Collection Timing and Schedule

Sampling for different performance measures will occur under different flow regimes and at prescribed monthly schedules. These are described below.

Stormflow and Baseflow Sampling

Sampling will be conducted under both stormflow and baseflow conditions. Stormflow sampling will be used to gage the immediate effect of the structural BMPs, which are designed to prevent or reduce stormwater impacts and thus affect stream composition primarily during storm events. Thus, stream water samples from locations downstream of the structural BMPs will be collected during storms and compared to both upstream data and baseline data collected prior to structural BMP implementation.

Stormflow sampling will consist of manual grab samples collected during the midpoint of flow conditions under moderate runoff conditions. The correlation of precipitation and streamflow data collected during baseline sampling events may be used as a guide to when “moderate” flow conditions can be expected at a given location. Likewise, the minimum storm size and duration necessary to produce measurable runoff can be estimated from the baseline data. Weather tracking will be coordinated with local National Weather Service offices to project a “quantity of precipitation forecast” (QPF) for impending storms.

Manual grab samples are a relatively inexpensive means of attaining a “snapshot” view of surface water conditions. The collection of samples at the same relative point in the storm will be key to obtaining consistent and comparable results. Because storms and flow are notoriously difficult to predict, however, differences in the estimation of storm “midpoint” will likely be the largest single source of variability in water chemistry data. Flow- or time-weighted composite sampling may be substituted for manual grab samples to reduce this source of variability, but have not been included in the monitoring program at this time.

Baseline sampling will be conducted in periods of stable flow that are not affected by precipitation or runoff contributions. The purpose of baseline sampling is to identify conditions that exist in the stream most of the time, and are thus are the conditions to which aquatic life are most frequently exposed. These data will help to describe the relative contribution of stormwater vs. other flow sources (such as groundwater) to the overall composition of stream water and the exposure regime of macroinvertebrates.

[32] Susan Davies and Tsomides, L, August 2002. *Methods for Biological Sampling and Analysis of Maine’s River and Streams*, LW0387-B2002.

Monthly Sampling Schedule

As shown in Appendix F tables, stormflow and baseflow sampling will be conducted during specific months of the year, as follows:

Table 5-4: Sample Collection Schedule

Stormflow Sampling Month	Rationale
March	Spring runoff conditions; accumulated snow contaminants
July	Mid-summer conditions; accumulated aerial fallout on pavement, maximum temperature effects
October	Transition season
Baseflow Sampling Month	**Rationale**
January	Mid-winter, frozen ground and routine road runoff
July	Mid-summer; correlates with stormflow sampling month.

As noted, sampling on this schedule will apply to baseline, annual, and tri-annual sampling programs.

5.3.5 BMP-Specific Sampling Programs

BMP-specific sampling programs for CSO 42 and 43, Sagamore Village, and the West Tributary retrofits were referenced previously in the tables in Appendix F. The composition of these programs reflects the project components and logic described in previous sections.

As noted, the programs described in the tables in Appendix F are cumulative, and reflect the assumption that CSO 42 and 43 abatement actions will be addressed first. The program for CSO 42 and 43 (Table A) consists of upstream sampling at MaineDEP location 0256 and downstream sampling at Cap-1 under both baseflow and stormflow conditions. Although downstream location Cap-2 may be too downstream to detect changes from the abatement of the CSOs, baseline sampling at this location is included to help develop a database for this key sampling point.

Sagamore Village BMPs (Table B) is monitored by sampling at upstream location WT-up and downstream locations WT-2 and Cap-2. Additional baseline sampling at Cap-2 is included, since the completion of this BMP may be separated from the CSO abatement activity by several years.

Monitoring the West Tributary BMP (Table C) requires only the addition of a single sampling point, WT-1, which is directly downstream of this BMP. Upstream sampling and additional downstream sampling will already be underway as part of the performance monitoring of the Sagamore Village BMP.

5.3.6 Clarifications and Assumptions

A Quality Assurance Project Plan (QAPP) may be required for various elements as described above and would be advisable to ensure defensible results. Such a plan would cover the details of any sampling, quality control procedures (sampling methods, blanks and duplicate sampling, data management), and

planned uses of data. The necessity of the QAPP will be determined during preparation of specific watershed monitoring scope of work and a fixed on-time fee has been included in the opinion of cost for this effort.

5.3.7 Opinion of Cost

Table 5-5: Watershed Restoration Sampling Opinion of Cost

Implementation Schedule	Opinion of Cost	Cost Assumptions	Potential Partners
Dependent on Abatement of CSO 42, 43 and Structural BMPs implementation	$10,000 (QAPP one-time cost) $15,000 (Flow Monitoring Annual) $25,000 (Pre-Monitoring and tri-annual) $20,000 (Post-Monitoring Annual)	Flow monitoring wells and equipment established prior to program. All sampling performed by contractors and includes analysis. Costs may vary depending on timing of implementation and monitoring initiation. For purposes of general financial planning all annual costs included in annual O&M costs (escalating at COLA rate).	City of Portland Public Services MaineDEP

6. DEFINITIONS

Best Management Practices (BMP): Structural and non-structural practices implemented to control nonpoint source pollution.

Buffer: A barrier of permanent vegetation, either forest or meadow, located adjacent to and down-gradient of developed areas, designed to intercept and infiltrate runoff before it reaches the surface water resource.

Catchment: (Also referred to as a watershed or drainage basin) an area of land that drains downhill to a discrete point and then into a body of water, such as a stream, river, lake, estuary or the sea.

Closed Drainage: A system of below surface pipes, manholes and catchbasins used to convey stormwater (see also Open Drainage)

CLF: Conservation Law Foundation

Combined Sewer Overflow (CSO): Combined sewer overflow is the discharge of a combination of storm water and domestic waste as a result of the combined sewer capacity being exceeded during heavy storms. The resulting volume of rainwater and sanitary wastewater exceeds the system's capacity and sewage is forced to overflow into area streams and rivers through CSO outfalls.

Confluence: Point at which two or more watercourses intersect.

Critical area: That part of the watershed that is contributing a majority of the pollutants and is having the most significant impacts on the waterbody.

Culvert: A channel or a pipe that directs water flow beneath a bridge or roadway

DCIA: Directly Connected Impervious Area - impervious surfaces that contribute concentrated runoff directly to a water body without engineered or natural mitigation. Natural mitigation may include effective buffers, natural depressions, or shallow wetland areas.

DEP: Department of Environmental Protection

Designated uses: Recognized uses of water established by state and federal water quality programs

Detention basin: An artificial flow control structure that is used to contain flood water for a limited period of a time, thereby providing flood protection for areas downstream. This is opposed to a retention basin that holds water for an extended period of time and promotes infiltration. Most detention basins have not been designed specifically for water quality treatment.

Dissolved Oxygen (D.O.): The amount of free (not chemically combined) oxygen dissolved in water, wastewater, or other liquid, usually expressed in milligrams per liter, parts per million, or percent of saturation.

DOT (Maine): Department of Transportation

E. coli: Bacterium used as an indicator of the presence of waste from humans and other warm-blooded animals in freshwater.

EPA: Environmental Protection Administration

Erosion: Detachment and movement of rocks and soil particles by gravity, wind, and water.

Floodplain: Land built of sediment that is regularly covered with water as a result of the flooding of a nearby stream.

Fluvial Geomorphology: The study of the shape and stability of river and stream systems. It assesses not only the form of these watercourses, but also the associated contributing physical processes related to water and sediment transport. At the advanced level, this science applies to natural channel design for restoring or rehabilitating channel reaches, and provides integration with aquatic biology to enhance habitat or community structure.

Focus groups: Groups of individuals brought together to discuss a particular topic or situation.

Geomorphology: A branch of both physiography and geology that deals with the form of the earth, the general configuration of its surface, and the changes that take place due to erosion of the primary elements and the buildup of erosional material.

GIS: Geographical Information System: A software system that analyzes and models data in a spatial context and displays the data in a visual format (e.g. map).

GPS: Global Positioning System: A system capable of providing worldwide navigation and positioning by pinpointing locations from satellites.

Groundwater: The subsurface water supply in the saturated zone below the water table.

Head: The difference in elevation between two points in a body of fluid.

Headwaters: The origin and upper reaches of a river or stream.

Hotspots: Stormwater hotspots are land uses or activities that may produce higher concentrations of trace metals, hydrocarbons, or priority pollutants than are normally found in urban runoff. Common hotpsots may include auto recyclers, commercial parking lots, fleet storage areas, industrial rooftops, landscaping/nurseries, public works facilities, vehicle washing areas, auto repair services and others.

Hydrologically distinct: Defined by drainage basins or watershed boundaries rather than areas arbitrarily defined by political boundaries.

Impairment: The description used when a body of water falls below its designated use.

Impervious Cover (IC): A surface through which little or no water will move. Impervious areas include paved parking lots, roof tops, streets, highways, and many compacted gravel surfaces.

Infiltration: The penetration of water through the ground surface into subsurface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls.

MTA: Maine Turnpike Authority

Open Drainage: a system of ditches, channels and swales used to convey stormwater at the surface of the ground

Nonpoint source pollution: Pollution caused when rain, snowmelt, or wind carry pollutants off the land and into adjacent waterbodies.

Permit: An authorization, license, or equivalent control document issued by EPA or an approved state agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Point source: The release of an effluent from a pipe or discrete conveyance into a waterbody or a watercourse leading to a body of water.

Pollutant: Any substance of such character and in such quantities that when it reaches a body of water, soil, or air, contributes to the degradation or impairment of its usefulness or renders it offensive.

Riparian Area: Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants requiring saturated soils during all or part of the year.

Runoff: That portion of the precipitation or irrigation water that travels over the land surface and ends up in surface streams or water bodies as opposed to infiltrating.

Sediment: Soil, sand, and minerals which can take the form of bedload, suspended, or dissolved material.

Soil erosion: The wearing away of land surface by wind or water. Erosion occurs naturally from weather or runoff but can be intensified by land-clearing practices related to farming, residential or industrial development, road building, or timber cutting.

Spatially referenced data: Assigning specific geographic locations to information.

Stakeholder: Any organization, governmental entity, or individual that has a stake in or may be affected by a given approach, permit or project.

Stormwater: Runoff from a storm, snow melt runoff, and surface runoff and drainage.

Stream Channel: A long narrow depression shaped by the concentrated flow of a stream and covered continuously or periodically by water.

Suspended solids: Sediment particles in the water column and carried with the flow of water.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

Topographic maps: Land maps that display elevation along with natural and man-made features.

Topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

Tributary: A river or stream that flows into a larger river or stream.

Water Quality: The biological, chemical, and physical conditions of a waterbody, often measured by its ability to support life.

Water Quality Classification: Defines water quality criteria for fresh surface waters, as well as estuarine and marine waters Typically using a letter or numeric system such as AA, A, B, & C.

Watershed: The geographic region within which water drains into a particular river, stream, or body of water. Watershed boundaries are usually defined by the ridges separating watersheds. Urban watershed boundaries may be defined by storm sewer drainage infrastructure as opposed to surface ridges. Subwatersheds are a smaller hydrologically-distinct unit and can be broken down into catchments, subcatchments, or drainage areas. These terms can be used interchangeably. These areas may represent an area as small as a single shed roof or a few parking spaces. Engineers use the term subcatchment to define small "watershed" boundaries in hydrologic modeling efforts.

Wetland: An area that is regularly saturated by surface or groundwater and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include swamps, bogs, fens, and marshes.

Nonpoint source pollutants are any of the substances listed below (or others) that can degrade the water quality by impairing the designated use(s) of the water.

Animal Manure: Manure is a source of nutrients, salts, and organic matter that can degrade water quality.

Depressed Dissolved Oxygen: When the oxygen dissolved in water and readily available to aquatic organisms (mg/l) is below optimal levels.

Hydrologic Flow Alteration: When the natural hydrology of the watershed changes due to increases in stormwater runoff creating impacts on stream morphology or aquatic life.

Metals: Toxic substances, such as mercury and lead, that come from urban runoff or atmospheric deposition.

Nitrogen: An element that at certain levels can cause excessive algae and aquatic weed growth.

Organic matter: Residue from plant or animal origin (including leaves and grass clippings). In excessive amounts organic matter can lower dissolved oxygen levels.

Pathogens: Human disease causing bacteria or viruses.

Pesticides: Chemical substances used to kill pests such as weeds, insects, algae, rodents, and other undesirable agents.

Petroleum and petroleum by-products (oil and grease): Urban pollutants that are transported by rainfall from roads, parking lots, and automobiles.

Phosphorus: a limiting nutrient for algal production. Predominant sources in urban areas are high use road and parking lot runoff and fertilized lawns and landscapes.

Salts: Chemical compounds from winter road deicing, septic systems, and water softener outwash.

Sediment: Soil that is transported by air and water and deposited on the stream bottom.

Temperature: An elevation in water temperature that stresses fish and aquatic insects.

APPENDIX A: MAPS

APPENDIX B: STRUCTURAL RETROFIT FIGURES AND OPINIONS OF COST

APPENDIX C: SOCIAL MARKETING PLAN

APPENDIX D: PLAN MEETING NOTES

APPENDIX E: ADDITIONAL INFORMATION – 2010 FLOW MONITORING STUDY, GIS ATTRIBUTE ANALYSIS, POTENTIAL GRANT FUNDING LIST, EXAMPLE SOILS RESTORATION SPECIFICATION

APPENDIX F: WATERSHED RESTORATION MONITORING PLAN