DRAFT Capehart Brook Watershed Management Plan

A Plan for Nonpoint Source Pollution Control and Prevention for Capehart Brook, Bangor, Maine

February, 2011

Funded, in part by
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Acknowledgments

Funding for this project, was provided, in part, by the U.S. Environmental Protection Agency under Section 319 of the Clean Water Act. Section 319 grants are administered by the Maine Department of Environmental Protection in partnership with EPA.

This plan was developed by City of Bangor staff with assistance from SMRT, Inc. for retrofit recommendations and concept designs. It should also be noted that much of the core documentation that was developed for the Penjajawoc Stream Watershed Management Plan was prepared by Barbara Arter, BSA Environmental Consulting, was also used in this plan.

The following list of Stakeholders represents those present at meetings hosted by the City to provide information and gather input. The plan does not necessarily represent the individual views of these stakeholders, but rather, is a series of potential recommendations that were developed from numerous sources including sources from outside of the Stakeholder group.

Stakeholders

Art Morgan
Paul Nicklas
John Murphy
Wendy Warren
Sean Gambrel
James Ring
Cathy Conlow
More to be listed after stakeholder meeting is held Feb 16

Executive Summary

Background and Purpose

This document is a watershed management plan for Capehart Brook, an impaired, urban tributary of the Kenduskeag Stream located in the City of Bangor, Penobscot County, Maine. According to the Maine Department of Environmental Protection (DEP) 2002 through "2010 Integrated Water Quality Monitoring and Assessment Reports" (303(d) List), Capehart (Pushaw) Brook does not currently meet Class B standards and is listed as "impaired." The goal of this plan is to identify steps needed to attain Class B standards and to identify and prioritize restoration and protection opportunities that will allow the water body to continue to meet those standards as development continues in the watershed.

The plan is based on existing water quality data and goals developed by DEP within the Draft TMDL report for Capehart Brook. It is the City's intention to assist property owners and to avoid individual MPDES permits, by developing a team approach to the development of a watershed management plan to improve the water quality of the stream.

Stakeholder Participation

The plan was developed by the City of Bangor with the participation of the Maine Department of Environmental Protection, and SMRT Inc. Many core parts of the plan that are applicable city-wide were taken from the Penjajawoc Watershed Management Plan, 2008, developed by BSA Environmental Consulting. The Capehart Stakeholder Group was comprised of municipal, state, residential, commercial, and conservation representatives. An announcement about the plan and the public meeting for Capehart Brook was mailed directly to each property owner within the watershed. Those owners who called or wrote back or attended the public meeting are considered members of the Stakeholder group. One public meeting was held and the letter provided each property owner or stakeholder the opportunity to provide input on recommendations in the plan throughout the development process (February 2011).

Existing Conditions and Impairment

Capehart Brook has a watershed area of approximately 685 acres or 1.07 square miles. Capehart Brook is an urban stream located entirely in Bangor that is 0.46 miles in length. It is a second order stream that drains to the Kenduskeag Stream which flows into the Penobscot River. The land use in the watershed is fairly homogeneous being used as residential, or undeveloped forested and wetland areas. The majority of homes and drainage systems in the watershed were built around 1958 without consideration for reducing the volume of stormwater or removing pollutants from it. The main objective was to gather up the runoff and direct it to the stream as quickly as possible away from basements, roads, and parking lots.

The Stream is assigned as Class B water, and according to the Integrated Water Quality Assessment and Monitoring Reports to EPA (1998 through 2010), it is listed as "impaired" on Maine's 303(d) list of waters that do not meet State water quality standards. The listing was

based on a preliminary stream assessment and sampling results in 2001 from the Biological Monitoring Program of the Maine Department of Environmental Protection (MDEP). Additional data collected in 2003 indicated continuing water quality impairments in the stream. A Total Maximum Daily Load Report (TMDL) must be developed by the State as a result of being on this list of impaired waters. Capehart Brook was assigned a TMDL completion date of 2008. A draft TMDL report is in the process of being developed.

Restoration Toolbox

The plan provides over sixty (60) recommendations. Many of them are core recommendations intended to be implemented City wide and designed to help the Bangor community of business owners, government, conservation organizations, and citizenry improve all surface water bodies (streams). Where appropriate, each set of recommendations also includes an estimated cost, list of partners needed to complete the task, an assigned authority, potential funding sources, and timeframe. The plan provides recommendations for education, prevention, channel and riparian restoration, retrofitting existing structural BMPs, and administration and ordinances.

Implementation and Monitoring

The plan will be presented to the City Council after DEP has accepted the plan, at which time the Council will consider its adoption. Assuming Council approval, the City will exercise a good faith effort to see that the recommendations are enacted in a timely manner.

Implementation of the plan will begin immediately after adoption with one or more retrofits initiated within the first year. The plan may take up to 15-20 years to implement in its entirety. Successful implementation is dependent upon several variables including landowner cooperation, funding availability, agency cooperation, and administrative coordination.

The plan recommends the evaluation of the creation of a Stormwater Utility District, which will generate local funds to partially finance plan implementation. In addition, acceptance of the plan will improve the City's eligibility for grant funding from various sources including Nonpoint Source Water Pollution Control Grants (also known as 319 grants; see 33 U.S.C. § 1329) and Watershed Improvement Financial Assistance Partnership (WIFAP).

The plan also recommends that the City use an adaptive management approach during its annual review of plan progress and implementation. Numerous milestones and a monitoring plan are provided to help the City gauge its success toward achieving Class B standards.

Section 1 Introduction

1.1 Purpose and Background

The purpose of this project is to develop a Watershed Management Plan (WMP) for the Capehart Brook Watershed, located in Bangor, Maine. The primary goals for the plan are to identify the steps needed to attain Class B standards in the stream and to identify and prioritize restoration and protection opportunities that will allow the water body, once class B is attained, to continue to meet that status as development continues in the watershed.

Impaired Stream Listing

Capehart Brook (previously recorded as Pushaw Brook) is assigned as Class B water, according to the 2006 and 2008 Integrated Water Quality Assessment and Monitoring Reports to EPA, and is listed as "impaired" on Maine's 303(d) list of waters that do not meet State water quality standards. The listing was based on a preliminary stream assessment and sampling results in 2001 from the Biological Monitoring Program of the Maine Department of Environmental Protection (MDEP). Additional data collected in 2003 indicated continuing water quality impairments in the stream. A Total Maximum Daily Load Report (TMDL) must be developed by the State as a result of being on this list of impaired waters. Capehart Brook was assigned a TMDL completion date of 2008. A draft TMDL report is in the process of being developed.

Maine Stormwater Law

The Maine DEP's Stormwater Program works toward protecting and restoring surface and groundwater impacted by stormwater flows. Stormwater runoff from developed areas in watersheds carries pollutants, and affects the rates and volumes of flows in natural water bodies in ways that can cause damage. Everyone has a role in reducing impacts from stormwater runoff, from the large developer constructing a new parking lot, to the homeowner using good erosion control methods and handling chemicals carefully around the house.

Maine's Stormwater Management Law provides stormwater standards for projects located in organized areas that include one acre or more of disturbed area. Title 38 § 420-D of the law states that a person may not construct, or cause to be constructed, a project that includes one acre or more of disturbed area without prior approval from the department. More information about the Stormwater Law can be found at:
http://www.maine.gov/dep/blwq/docstand/stormwater/storm.htm

Maine General Permit for Municipal Separate Storm Sewer Systems (MS4)

This general permit authorizes the direct discharge of stormwater from or associated with a regulated municipal separate storm sewer system ("MS4") to an MS4 or waters of the State other than groundwater. Discharges must meet the requirements of the general permit and applicable provisions of Maine's waste discharge and water classification statutes and rules. The permit includes six minimum control measures which, implemented together make up a stormwater management plan. Numerous elements of the MS4 Stormwater Management Plan

overlap with recommendations included in this Watershed Management Plan. The goals of both plans are congruent.

1.2 Development of the Plan

Stakeholder Participation

The Capehart Brook watershed includes single-family and multi-family residential neighborhoods, a community center (Bangor Housing Authority administrative offices), two churches, one convenience store, and one school. All property owners and residents were notified by individual letter of the public meetings and the informational website available to them to provide a vehicle for providing input into the development of the plan. A public meeting will be held in February 2011 to provide stakeholders with an overview of the proposed recommendations for pollution prevention, riparian and channel restoration, retrofitting existing structural Best Management Practices (BMPs), ordinance review and modification, and water quality monitoring. Stakeholders invited to participate included municipal, state, residential, commercial, non-profit, and conservation representatives. (See Acknowledgments for a full listing of participants and contributors to the plan.)

Plan Description

The U.S. Environmental Protection Agency (EPA) has identified several elements that should be included in a watershed management plan for achieving improvements in water quality. This plan is written in accordance with those EPA guidelines and includes those elements in the following sections:

- Section 1: Description of stream, plan purpose, and other background information
- Section 2: Water quality and causes of impairment
- Section 3: Plan implementation and ownership
- Sections 4 - 7: Recommendations for reducing load through education, prevention, restoration, retrofitting existing stormwater structures, and government administration
- Section 8: Milestones for monitoring and evaluating progress

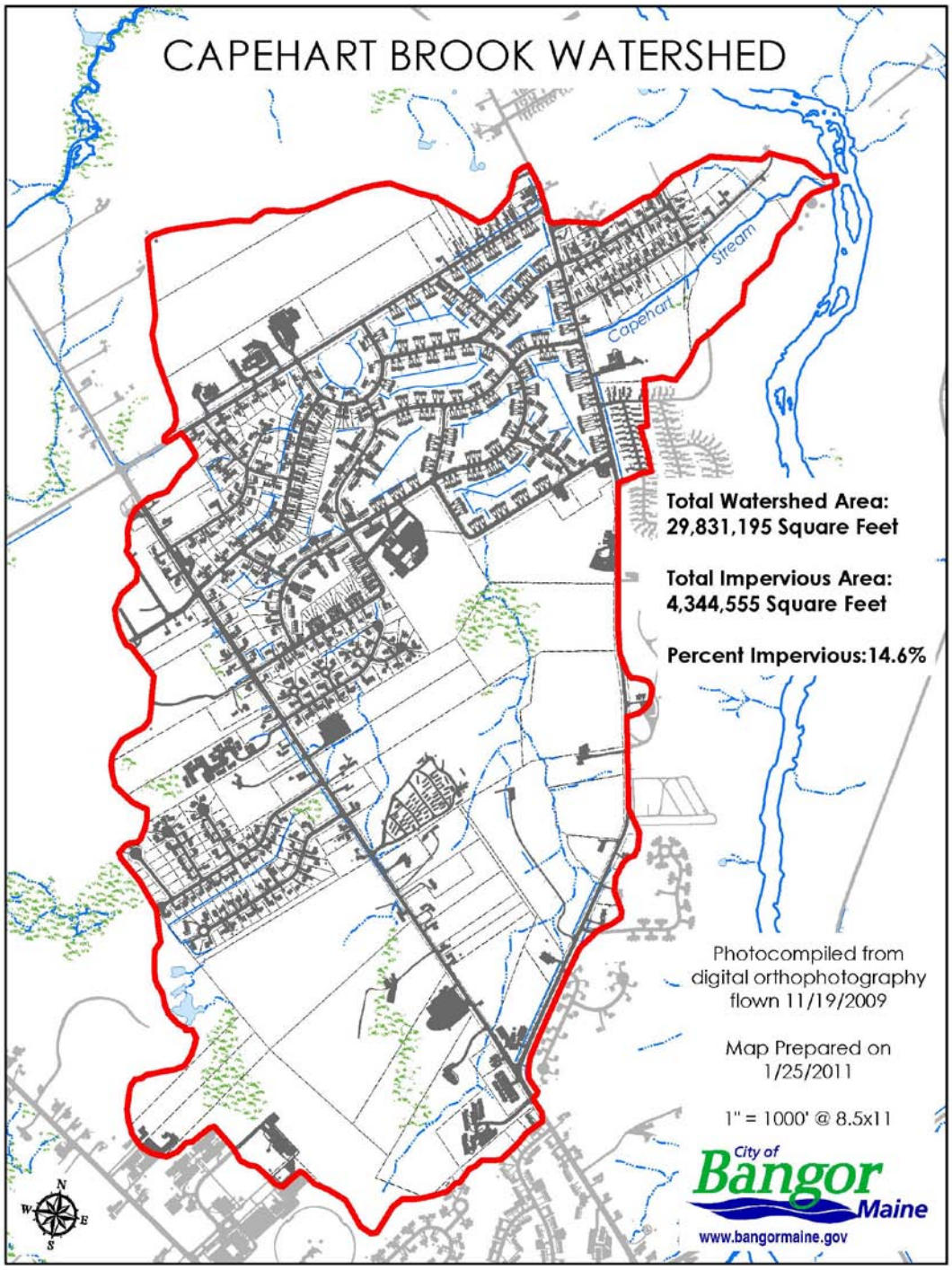
It should be noted that this Plan is not an unchanging document but rather is meant to be a guide and an adaptive plan so that necessary adjustments or changes can be made in the future. “Adaptive Management” principles will be employed in order to continually improve plan implementation. (See Section 3 and Section 8 for more on Adaptive Management).

1.3 Stream Description

Capehart Brook, situated in Bangor, Maine, originates from a high density residential development west of Finson Road and flows for approximately one (1) mile before reaching the Kenduskeag Stream. Capehart Brook, formerly referred to as Pushaw Brook, begins as a tributary located South of Ohio Street and then drains into a series of underground pipelines and open drainage ditches that drains the residential areas. Almost all of the watershed drains converge before crossing under Finson Road through one 66 inch culvert. The stream was dredged by the Army Corps of Engineers some decades ago (when the complex was being built) but has since become a “naturalized” stream flowing for approximately 0.46 mile to the Kenduskeag Stream. The naturalized portion of the stream parallels a residential area on Pushaw Road to the immediate north and a utility access

road to the immediate south. According to the City of Bangor GIS information, the watershed draining to the stream is approximately 685 acres or 1.07 square miles. See watershed map below.

Figure 1.1 Capehart Brook Watershed Boundaries



Source: City of Bangor, GIS, January, 2011.

1.4 Existing Reports

The Capehart Brook has been the subject of two existing reports, a draft TMDL (2011) and a Stream Corridor Survey. The draft Total Maximum Daily Load (TMDL) report is based on sampling data collected in 2001 and 2003 which includes monitoring of the macroinvertebrate community, physical habitat parameters and water chemistry. Sampling results were compared to Maine's statutory Class B water quality standards and the stream was listed due to non-attainment of aquatic life criteria.

The Stream Corridor Survey was directed by Maine Department of Environmental Protection (DEP) and conducted by volunteers from AmeriCorps NCCC (National Civilian Community Corps). The "naturalized" Stream scored an average of 3.75 on a scale of 1 to 5 with 1 being very good, and 5 being very poor existing conditions. The study provides a cursory evaluation of streamstreamside vegetation, streamstream bottom conditions, potential for significant pollution sources, and a rapid geomorphic assessment. The preliminary scores were based upon DEP best professional judgment after reviewing the available information such as volunteer field notes, photographs, and other observational data (including maps and aerial photographs).

1.5 Current Stormwater Efforts

In addition to the studies mentioned above, the City of Bangor has also initiated several efforts to manage stormwater on a city-wide basis. The following is a brief synopsis of the recent efforts the City has made to improve stormwater quality and reduce or prevent pollution of ground and surface waters in and around the City. Some of the efforts (e.g., Item 4) were designed to satisfy the City's permit regulations under the MS4 Program. This permit is part of the EPA National Pollutant Discharge Elimination System (NPDES) stormwater program, which requires the implementation of a stormwater management program as a means to control polluted discharges (US EPA 2005).

1. <u>Environmental Management System (EMS)</u> - City employees organized to focus on improving stormwater by:
   a. Becoming educated about stormwater issues relating to City operations
   b. Recommending new practices and procedures to improve City operations

2. <u>Watershed Management Plans -</u>
   a. Penjajawoc has an approved plan and is in process of being implemented. The plan is monitored by the Penjajawoc Citizen Review Panel. Several of the highest priority recommendations have been constructed using grant funding through the American Recovery and Reinvestment Act of 2009.
   b. A Draft plan for Birch Stream has been developed and has received comments from Stakeholders. The Draft plan was submitted to DEP and received initial approval on August 23, 2011. Several of the highest priority recommendations were constructed using grant funding through the American Recovery and Reinvestment Act (ARRA) of 2009.
   c. A Stream Corridor Survey of Shaw Brook was conducted by DEP staff, Americorps NCCC volunteers and City staff, directed by Maine DEP in August, 2011. Property owner notification was conducted through a collaborative effort between the towns of Herman, Hampden.

d. A Stream Corridor Survey was also conducted for Arctic Brook, and Capehart Brook in August, 2011.

3. Water Quality Monitoring of Impaired Streams -
   a. Temperature and flow data is being continuously monitored in all five impaired streams. The current contract, paid for with ARRA funds, ends June 2011.
   b. Water quality characteristics including pH, dissolved oxygen, chlorides and conductivity is being monitored monthly in each impaired stream.
   c. The City supports a volunteer stream team in the Penjajawoc Stream, directed by the DEP. The City would be willing to support volunteers that are interested in starting up teams for any additional streams..

4. Bangor Area Stormwater Group –
   The City of Bangor is a member of this collaborative, non-profit group whose mission is to develop mutual solutions and combine resources to address stormwater management locally and regionally. Examples include:
   a. Demonstrations and Presentations at Folk Festival and/or other public events
   b. Development and hosting of training sessions and workshops
   c. Combine resources to develop and present Stormwater Pollution Prevention media campaigns.
   d. Developed regional database for stormwater information to be stored and retrieved.

5. Stormwater Pollution Prevention Training of City Employees – The Environmental Coordinator takes the lead in developing and presenting training of City staff including; Airport, Public Works, Parks & Recreation, Fleet Maintenance, Police, Fire, School Custodians, etc.

6. Best Management Practices and Standard Operating Procedures within City operations have been developed such as:
   a. New ordinances with regard to construction
   b. Spill kits carried on all City motor vehicles, including the public Bus system.
   c. Spill kits carried on all School busses contracted with Cyr Bus.
   d. Spill logs & reporting integrated into daily operating procedures
   e. Spill containment measures implemented into routine work activities (hydraulic hoses, cleaning of equipment, vehicle washing)
   f. Sand/Salt storage procedures updated
   g. Street sweeping and catch basin cleaning increased
   h. Underground and Aboveground Storage Tank inspections centralized and tracked
   i. Oil/Water separator maintenance centralized and tracked

Section 2 Causes of Impairment

2.1 Water Classification

The Maine Water Classification Program has four classes with different levels of environmental protection (AA, A, B, and C). For each class, the Legislature defined the desired environmental goals (designated uses). The Legislature also established narrative and numeric criteria that must be met to attain the desired environmental goals (Table 2.1). The DEP stream bio-monitoring protocol provides a statistically defensible and reproducible decision-making tool for making quantitative determinations about attainment of biological water quality standards (DEP 2002).

Waters, such as Capehart Brook, that do not meet the water quality criteria for its designated class are called impaired and placed on the state's list of impaired waters, also called the 303(d) List**.** Capehart Brook does not meet Maine's Class B standards for aquatic life, and habitat. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. See 33 U.S.C. § 1313(d) (describing TMDL provisions). The goal is for all waterbodies to comply with the water quality standards of its assigned class.

Table 2.1 Maine Water Quality Criteria for Classification

Class	Dissolved Oxygen	Bacteria	Habitat	Aquatic Life (Biological) Narrative Criteria
Class AA	As naturally occurs	As naturally occurs	Free flowing and natural	No direct discharge of pollutants; as naturally occurs
Class A	7 ppm; 75% saturation	As naturally occurs	Natural	As naturally occurs
Class B	7 ppm; 75% saturation	64/100 ml (g.m.*) or 427/100 ml (inst.*)	Unimpaired	Discharges shall NOT cause adverse impact to aquatic life
Class C	5 ppm; 60% saturation	142/100 ml (g.m.*) or 949/100 ml (inst.*)	Habitat for fish and other aquatic life	Discharges MAY cause some changes to aquatic life

2.2 Monitoring History and Stressor Identification

<u>Department of Environmental Protection Report to EPA</u>
The 2002 through 2010 Integrated Water Quality Assessment and Monitoring Reports to EPA list Capehart Brook as "impaired". The listing was based on a preliminary assessment and sampling results in 1997 from the Biological Monitoring Program of the Maine Department of Environmental Protection (MDEP). The brook did not attain class B during the 1997

assessment. Additional data collected in 2001 indicated continuing water quality impairments in the stream.

Stream Corridor Study, 2010

Several potential stressors were identified during the Stream Corridor Study conducted in 2009. The Stream Corridor Study, although conducted by volunteers, provides information that indicates there may be several potential sources of pollution in the natural portion of the brook. For example, the report states, "natural streamside plant cover is degraded, or severely degraded" in two of three reaches. Additionally, the report mentions that "undercut banks are common, and garbage is present in and along the brook". This would indicate fast moving storm flows have occurred, with garbage being deposited along the way. One reach is noted as having a "dirt trail crossing that dumps sand/silt into the brook, and a hanging culvert present".
Algae is another indicator of poor stream health. The Corridor Survey reports "plentiful light coating of brownish/greenish algae" in all three reaches of the natural portion of the brook.
Rapid geomorphic assessment (RGA) conditions were assessed by the volunteers, and this cursory survey indicates that two of three reaches are in a stage termed "Aggradation" which indicates that the river channel is accumulating excess deposits of sediments.

City of Bangor Water Quality Sampling

Water quality sampling for flow, temperature, dissolved oxygen, pH, conductivity and salinity has been gathered over the course of the past year (July, 2010 - July 2011). Funding for this monitoring is available through July, 2011 and was provided by the American Recovery and Reinvestment Act funds, administered by the Maine DEP.

The information illustrated below is a snapshot of what has been gathered from November, 2010 through December 2011 and indicates that Capehart Brook exhibits characteristics which are typical of small urban streams. During low flow months, the temperature increases and the dissolved oxygen decreases in response. Aquatic life needs to have dissolved oxygen in the range of 75% to 100%. It appears that the stream reaches that lower threshold during a few months of the year, when flow is reduced due to dry weather. This stream has elevated chlorides/salinity during the winter months, but not nearly as much of an issue as it is in some other streams in Bangor that have documented specific conductivity (most likely road & parking lot salts) upwards of the 1000 range. As more information is continuously gathered each year, we will have the ability to see trends and begin to understand the stream characteristics and how it responds to seasonal variations.

Table 2.2 Water Quality Sampling

Capehart Brook Sampling

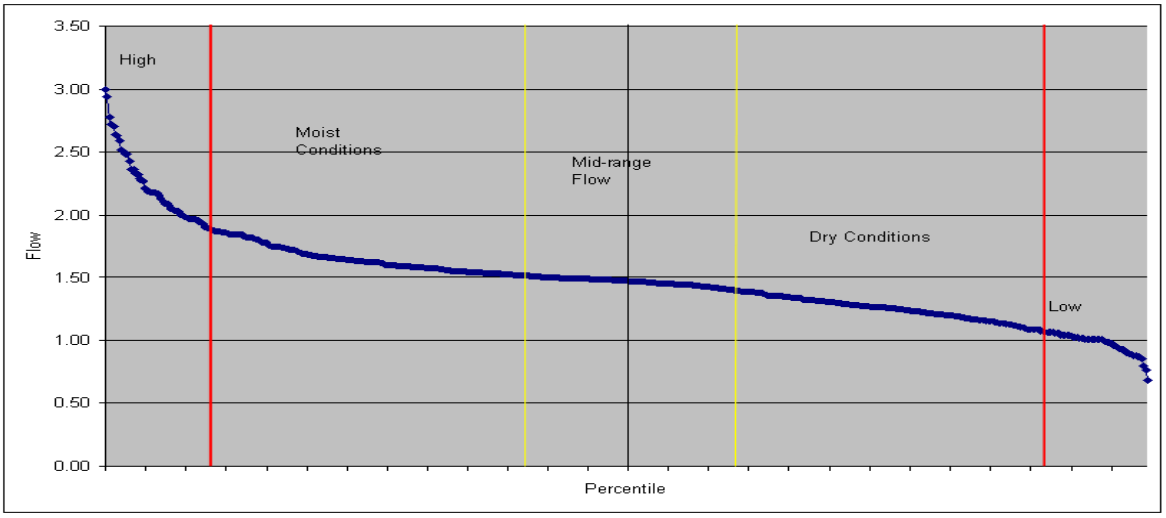
Date	pH	Sal. (ppt)	DO (mg/l)	Temp. Celcius	Temp. F	Cond (uS)	Specific Cond	Chloride mg/L	DO (%)
11/13/2011	8.1	0.2	12.65	4.6	40.3	244	401		98.1
12/19/2011	7.995	0.2	12.88	3.1	37.6	292	502	130	95.7
1/27/2012	7.995	0.1	12.97	1.6	34.9	173	n/a	70	92.7
3/4/2012	7.995	0.2	12.53	2.4	36.3	208	356	150	91.9
4/15/2012	7.8	0.2	11.08	9.4	48.9	232	331	62	96.9
5/13/2012	8.17	0.2	10.77	10.5	50.9	266	370	55	94.6
6/30/2012	7.91	0.2	7.7	17.8	64.0	295	342	80	81.1
8/26/2012	7.58	0.1	7.59	17.7	63.9	120	160	50	79.7

9/28/2012	7.83	0.2	8.21	17.4	63.3	278	326	100	86.2
10/28/2012	7.8	0.1	9.01	12.7	54.9	195	255	50	84.8
11/18/2012	8	0.1	11.08	6.3	43.3	174	270	130	89.9
12/15/2012	7.7	0.1	15.44	0.9	33.6	105	n/a	50	109.4

Source: Bangor Streams Water Quality Summary, Sewall Company, February 2011

The table below illustrates the daily average flow of the stream. The blue line illustrates that about 10% of the time the flow is above an extreme level and 10% below an extreme low level. During wet periods the stream will be in a range above the median values, in dry conditions the same thing. In the middle is the range of "normal" flows. What is significant here is the amount of time (percentile) the stream spends in any given state. Here the stream spends most of it's time in either a moist flow or dry flow condition and very little in the mid-range flow. That's not good and is characteristic of urban streams that are highly responsive to precipitation events and to dry events. Capehart is very flashy. The graph illustrates that fluctuations in base flow need to be stabilized (decrease high peak flows, and increase base flow during dry seasons) in order to increase the time spent in the mid range flow. Some streams are naturally like this (mountain streams or those with small drainages and very sloped topography).

Table 2.3 Summary Results of Flow in Capehart Brook.



Source: Bangor Streams Water Quality Summary, Sewall Company, February 2011

2.3 Total Maximum Daily Load Study

The draft Total Maximum Daily Load (TMDL) report is based on sampling data collected in 2001 and 2003 which includes monitoring of the macroinvertebrate community, physical habitat parameters and water chemistry. Sampling results were compared to Maine's statutory Class B water quality standards and the brook was listed due to non-attainment of aquatic life criteria. Macroinvertebrate populations indicate a combination of intricate environmental factors.

2.4 Pollutant Loading

The Draft TMDL establishes that since the impairment of the stream cannot be attributed to a specific pollutant, and is likely due to hydraulic stress and the suite of pollutants in urban stormwater, **impervious cover (IC)** was used as a surrogate measure of the range of pollutants in stormwater. Recent studies have shown that the percentage of impervious cover (% IC) in a watershed strongly affects the health of aquatic systems because land surfaces that block infiltration of rainwater cause increased amounts of stormwater to run off into gutters, untreated storm sewers or directly to streams. In general, stream quality declines as imperviousness exceeds 10% of watershed area, and may be severely compromised at greater than 25% (Schueler 1994, CWP 2003). Impervious cover in the Capehart Brook watershed was determined to be approximately 27% based on 5 meter SPOT imagery collected in the summer of 2004 over the State of Maine (Figure 3, p. 7). This data set (referred to as "IMPERV" by the Maine Office of GIS) is part of a larger mapping initiative by the State of Maine to quantify land cover (MELCD) at a 5-meter resolution over the entire state. Therefore, IC is an appropriate surrogate measure of impacts caused by stormwater, while aquatic life assessments (biomonitoring) provide an appropriate endpoint to measure the progress of TMDL implementation.[1]

Subsequent to the publication of the subject TMDL, the City of Bangor GIS department has developed a more detailed analysis of the watershed boundaries using recently flown aerial photography (2010). The new watershed boundary is based on a digital terrain model developed from 2' contours, then edited to reflect ditching and stormwater infrastructure. The City believes that it is significantly more accurate than the boundary in the Maine GIS dataset. The new boundary and digitized impervious cover has now been determined to be 14% based upon the City's GIS information.

[1] Draft Total Maximum Daily Load Report, Capehart (Pushaw) Brook, January 2009, FB Environmental.

Section 3 Plan Implementation

Plan Ownership, Adoption, Timing, Partners, Funding, Annual Review, and Adaptive Management

3.1 Plan Ownership, Adoption, and Implementation

The City of Bangor, with the assistance of Maine DEP, initiated the development of this watershed management plan in November, 2010. The planning process involved reviewing existing water quality data, integrating existing engineering and hydrology data, and soliciting and incorporating input from citizens, conservation organizations, state agencies, landowners, and business owners.

The plan will be presented to the City Council and considered for adoption after DEP has accepted it. Assuming Council approval, the City will exercise a good faith effort to see that the recommendations are enacted in a timely manner. Implementation of this plan, (plus two other watershed management plans) may require the enactment of ordinances, changes in staff duties, and/or the hiring of additional staff.

While the City Council has stated that it aspires to implement watershed management plans within 10 years, due to the number of watersheds in Bangor to be addressed simultaneously, the plan may take up to 15-20 years to implement in its entirety. Successful implementation is dependent upon several variables including landowner cooperation, funding availability, agency cooperation, and administrative coordination. Implementation is also dependent upon achieving Class B standards. If Class B standards are met before implementation is complete, the City may choose to discontinue implementation since the goal of the plan (to meet Class B standards) will have been met.

Stakeholders should be aware that much work will need to be done with regard to specific details and decisions associated with the plan (i.e., ordinances, policies, etc.,) after the plan is adopted. Significant decisions will be made through a local legislative process that allows stakeholders to participate in the process through review and comment prior to adoption.

Furthermore, the City assures stakeholders interested in installing new BMPs that the process for authorizing them will not be lengthy and complex but rather will be efficient, effective, and cooperative.

3.2 Implementation Timing

The plan recommends over 61 tasks in four different pollution-reduction categories including education and prevention, stream restoration, retrofitting existing stormwater structures, and government administration. While Sections 4 through 7 provide detailed information on each of the tasks sorted by pollution-reduction category, Appendix A provides an ”Integrated List” of all tasks sorted by 5-year time intervals. The Integrated Table is designed to guide overall implementation of tasks from all categories and illustrates how tasks and projects from various

categories may be implemented simultaneously. It is anticipated that additional retrofits will be implemented as appropriate (from the list or developed by private consultants) as facilities make improvements or maintenance projects are planned. City staff will encourage and assist with implementation of appropriate retrofits as new permits are submitted to the City.

3.3 Partners

The success of this plan will depend not only on the efforts and administration of the City but also on its stakeholders and partners in implementation. Although the City will take the lead in ensuring that the recommendations and tasks are initiated, partnering organizations, state agencies, and private landowners may have responsibility for actually completing some tasks. For example, the City may initiate a residential downspout disconnect program, but it will be up to individual residences to take the initiative to participate and have their downspouts retrofitted. Partnering organizations are listed in each set of recommendations in order to facilitate such partnering. Table 3.1 illustrates some examples of implementation through partnerships.

Table 3.1 Examples of Implementation Partners

Example Task	Initiating Party	Implementation Partners
Stabilize banks & improve riparian conditions by using plantings, live stakes, and root wads	City	Penobscot Co S&WCD, NRSC Landowners, Scouts, Conservation Groups,
Conduct screening level, rapid assessment for macroinvertebrates.	City	DEP, Stream Team, City
Landowners identify and assign maintenance responsibility for structural BMPs	Business Owners	City, DEP, Housing Authority, Business owners, Property Owners

3.4 Funding

General Project Funding

Funding for tasks and projects can come from a variety of sources, and the City and its stakeholders will work together to be creative and combine several funding sources in order to complete implementation. Table 3.2 lists potential types of funding for each recommendation category. An example of a typical project budget and how to fund a project is provided in Table 3.3. Further details and suggestions for funding specific recommendations are listed in each section (Sections 4 through 7).

Table 3.2. Potential Funding Sources

Recommendation Category	Type Of Funding
Education & Prevention	Landowner/Business Owner Sponsorship
	Pre-existing State Agency Programs
	Grant Funding such EPA and private education grants

	City Sponsorship
Stream restoration	Grant Funding such as DEP NPS Control Grants (319), NOAA, American Rivers, etc.
	City of Bangor Stormwater Budget
	New Development Incentive Programs
Retrofitting existing stormwater structures	Grant Funding such as MDOT Surface Water Quality Protection Program
	City of Bangor Stormwater Budget
	New Development Incentive Programs
Government administration	Stormwater Budget

Stormwater Utility District

The most costly and complicated projects will be those involving in-stream restoration and retrofitting or enhancing existing stormwater structures. In order to keep regulators at bay the City needs to ensure that the recommended projects are implemented in the most efficient manner. The City may want to fund the projects rather than wait for property owners to invest in retrofits at their own pace. In order to do so:

- The City intends to evaluate a suite of alternative stormwater funding approaches.
- The City is currently undergoing a Stormwater Utility District feasibility study with assistance from consultants.
- Many of the implementation options may require changes in administration and ordinances (See Section 7).
- Final funding decisions will be made by the City Council after additional public proceedings.
- Two of the most significant funding options include:

A. Stormwater Utility District: The City is studying the feasibility of establishing a Stormwater Utility District in which members of the district pay a pro-rated fee that can be used to pay for new structural BMPs or upgrades of existing systems. An effective stormwater utility district would provide credits for existing BMPs - especially updated stormwater treatment systems that meet Maine's most recent stormwater requirements. The City would need to establish this program in phases before it has collected enough fees to begin implementation

1. conduct utility district analysis
2. establish plan/criteria for fee structure
3. implement plan and fee notification
4. collect fees
5. establish program and implement plans

B. Incentive Programs: The creation of an incentive program whereby owners of new developments (which presumably would install modern, more effective structural BMPs) would undertake one of the retrofit projects as a requirement of its new development. This method could also be used with re-development of an existing site. Mitigating one of the retrofit sites could be a condition of re-development.

3.5 Further Studies

To help provide a sound basis for investment in stormwater measures, an appropriate and accurate model needs to be selected and utilized to evaluate the effectiveness of BMPs prior to their installation. Property owners have indicated that any costs incurred should be based upon well documented, scientific, and well understood baseline data, so that, as investment is made, measurable improvements can be directly linked to those costs. After additional monitoring and assessment has occurred and an appropriate model has been selected and applied to the watershed, the list of recommended BMPs (including the retrofits) may need to be revised accordingly. This will take place through a collaborative review, and the plan will be amended to include the revised integrated list.

3.6 Annual Review and Adaptive Management

Frequent review of water quality monitoring results will be conducted and periodically shared with stakeholders in order to guide the implementation of BMPs and gauge whether or not additional steps must be taken. Analysis of these results and any other pertinent information will provide feedback to indicate what adaptations may be necessary for the implementation plan to meet its objectives. Adaptations may include, but are not limited to, changes in whether and when restoration and improvement projects are implemented.

The City will meet with stakeholders at least annually to review progress on the plan. At that time, progress toward meeting milestones and any necessary changes will be discussed. Following the annual meeting, the City will publish a semi-annual newsletter that will include information on monitoring results, implemented BMPs, recent decisions, policies, ordinance changes, and upcoming events and meetings.

A five-year action plan for planned BMPs, as well as any amendments to the long-term implementation plan should be revisited as necessary and, at a minimum, at least once every five years through utilizing a stakeholder process. The five-year review will include Stakeholder involvement, review, and comment. Milestones (see Section 8) will also be considered and revised if necessary.

When reviewing and updating the plan, the City and its stakeholders will use an “Adaptive Management Approach.” Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs (Williams 2007). Figure 3.2 illustrates the steps in the adaptive management process. The technical reports (Section 1) represent the Assess Problem phase while this plan and its recommendations and strategies represent the Design phase. The annual review process will incorporate the Adjust phase of the process. If no improvement is found after the implementation, monitoring, and evaluation phases then the problem will be reassessed and design and implementation will be adjusted.

Section 4 Restoration Toolbox: Prevention, and Housekeeping

Public Awareness and Engagement, Sand and Salt, Fertilizers, Pesticides, Hazardous Substances, and Litter

4.1 Restoration Toolbox

Once a community becomes aware that they have an impaired stream, they must review the many options and resources available to them for the purposes of mitigation and restoration. These resources are called the Restoration Toolbox. The term "Restoration Toolbox" is used throughout this report in line with standard practice. It denotes a wide range of activities designed to improve water quality through reducing the amount of pollutants that reach a water body, managing stormwater appropriately, and improving impaired habitat and riparian areas. Sections 4 through 7 provide numerous recommendations from the Restoration Toolbox designed to help business owners, government, conservation organizations, and citizenry improve the brook. Where appropriate, each set of recommendations also includes an estimated cost, list of partners needed to complete the task, an assigned authority, potential funding sources, and timeframe.

This plan provides recommendations in the following categories:

- Education (Section 4)
- Prevention and Housekeeping (Section 4)
- Channel and Riparian Restoration (Section 5)
- Retrofitting Existing Structural BMPs (Section 6)
- Administration and Ordinances (Section 7)

4.2 Best Management Practices

Many of the recommendations suggested in this plan are considered Best Management Practices or BMPs. A BMP is a structure or practice designed to minimize the discharge of one or more pollutants to the land surface and their wash-off by stormwater; or to temporarily store or treat urban stormwater runoff to reduce flooding, remove pollutants, and otherwise mitigate the effects of runoff. For more information about recommended BMPs, please refer to the DEP Stormwater Management for Maine Manual (2006) at the DEP website:
http://www.maine.gov/dep/blwq/docstand/stormwater/stormwaterbmps/index.htm

4.3 Education and Awareness

Perhaps the most effective BMP in the Restoration Toolbox is education and awareness. Table 4.1 lists several recommendations with estimated costs, timeframes, and potential partners and funding sources. The City, local businesses, county and state agencies (such as Penobscot County Soil and Water Conservation District, and University of Maine, and Penobscot County Cooperative Extension), and conservation groups (such as Bangor Land Trust, Bangor Area Citizens for Responsible Development, and the local Audubon Chapter) can work together to conduct these activities. They can be started at any time, can occur simultaneously, and are

relatively low cost but can go a long way toward reducing the impacts from nonpoint source and stormwater runoff pollution. The Center for Watershed Protection Watershed Stewardship program provides some guidance on education, advocacy, and prevention. http://www.cwp.org/Resource_Library/Restoration_and_Watershed_Stewardship.

The overall goal of the education recommendations is to reduce pollutant loads and stormwater runoff by increasing the public's understanding of influences on the water quality of the brook. The recommendations in Table 4.1 are categorized into three objectives designed to meet this goal:

1. Increase public awareness about the brook and watershed
2. Increase knowledge and awareness about the impacts of NPS pollution and stormwater runoff in urban areas.
3. Increase public engagement in watershed issues and improving brook health.

4.4 Prevention and Housekeeping

The overall goal of preventive measures is to prevent the release of pollutants so that they are not available for mobilization by stormwater runoff. Table 4.2 lists recommendations designed to achieve this goal using objectives that address seven specific areas:

1. Ensure that sand/salt is properly stored and applied to avoid excess use and runoff.
2. Ensure that streets and parking lots are free of excess sand and salt.
3. Ensure that structural BMPs are properly designed and maintained so that they function properly (this is also required by the MS4 permit and associated post construction ordinance).
4. Reduce the use of fertilizers and pesticides in the watershed.
5. Reduce the use of coal tar containing pavement sealer, substitute with non-coal tar.
6. Reduce the amount of hazardous materials used in the watershed.
7. Reduce the amount of litter (and associated pollutants) getting into the stream.

Like the education and awareness recommendations, the prevention recommendations can be started at any time, can occur simultaneously, and can be completed by a variety of stakeholders in the watershed including individual landowners.

4.5 Potential Funding Sources for Education and Prevention

Education and prevention programs can be initiated, administered, and funded through a variety of mechanisms. The following are some examples of what the City can do to implement the education and prevention recommendations:

1. Landowner/Business Owner Sponsorship: Businesses, landowners, and the chamber of commerce can initiate a NPS prevention and education program.
2. Pre-existing State Agency Programs:
    a. Cooperative Extension
    b. Penobscot County Soil and Water Conservation District
    c. DEP Nonpoint Source Training and Resource Center
3. Grant Funding
    a. EPA Environmental Education Grants
       http://www.epa.gov/enviroed/grants.html
    b. Watershed Protection Grant Program (for schools)
       http://www.maine.gov/dep/blwq/docgrant/watershed/index.htm
    c. Project AWARE (Aquatic World Awareness, Responsibility and Education)

http://www.projectaware.org/americas/english/grantsasp

d. Jessie B. Cox Charitable Trust
   http://www.hemenwaybarnes.com
e. New England Grassroots Environment Fund
   http://www.grassrootsfund.org

4. City Sponsorship: The City could expand their current education programs and activities to include projects such as the creation and placement of signage, sponsoring NPS Workshops, and assisting in the coordination and implementation of residential stormwater pollution prevention projects.

Table 4.1 Capehart Brook Education and Awareness Recommendations

CAPEHART EDUCATION & AWARENESS RECOMMENDATIONS						
GOAL: Reduce pollutant loading and stormwater runoff.						
	Task	**Partners (Who can work together?)**	**Authority (Who will initiate or oversee?)**	**Cost (One time unless noted otherwise)**	**Funding**	**Timeframe**
4.1.0	**Public Awareness**					
	OBJECTIVE: Increase public awareness about the stream and watershed					
4.1.1	Install one or more demonstration sites with interpretive signs at sites where BMPs are being installed. These can be on public lands or on private with landowner cooperation.	Penobscot SWCD, Chamber of Commerce, Penobscot Job Corps Academy, Cooperative Extension, City	City	$500-$1,000/per site	City, Business Owners, Grants	2011
4.1.2	Develop a "Yardscapes" Demonstration site similar to the Back Cove site in Portland which showcases ecological landscaping with low-maintenance plants (http://www.yardscaping.org/demo/portland.htm).	City, Business owners, Master Gardeners, Flower Clubs, Cooperative Extension Service, Conservation Organizations	City	25,000	City, Business Owners, Grants	2011
4.2.0	**Education**					
	OBJECTIVE: Increase knowledge and awareness about the impacts of NPS pollution and stormwater runoff in urban areas.					
4.2.1	Initiate a commercial and residential BMP education program that encourages better housekeeping and management of:	Chamber of Commerce, Cooperative Extension, City, Bangor Area Stormwater Group	City	$5,000	City, Business Owners, Grants	2011
	a. Sand/salt/sealants					
	b. Fertilizer and pesticide					
	c. Dumpsters and litter control					

	d. Hazardous materials/spill prevention					
4.2.2	Increase awareness of education programs with a media campaign that includes:	Chamber of Commerce, Cooperative Extension, City	City	$5,000	City, Business Owners, Grants	2011
	a. Newspaper ads and press releases					
	b. Radio ads					
	c. Outreach through schools and community events					
4.3.0	**Public Engagement**					
	OBJECTIVE: Increase public engagement in watershed issues and improving stream health.					
4.3.1	Work with Citizen Review Panel and DEP to develop a Capehart Brook Team that will conduct water quality monitoring, habitat surveys, and NPS observations.	Chamber of Commerce, Cooperative Extension, City	City	$3,500 ongoing - $7,000 start up	City, Business Owners, Grants	In Progress
4.3.2	Develop an "Adopt a Stream" program whereby businesses adopt their portion of the stream and/or streets that drain to the stream and are responsible for trash clean up and riparian integrity.	Chamber of Commerce, , City, Business Owners, Conservation Organizations	Chamber of Commerce	$5,000	City, Business Owners, Grants	2011
4.3.3	Establish the "Business Friends" incentive program that generates dialogue between the City and business owners, encourages the use of Best Management Practices, and provides public acknowledgement for implementation of such programs.	Chamber of Commerce, Cooperative Extension, City	City	$5,000	City, Business Owners, Grants	2011
4.3.4	Work with state to require automobile undercarriage cleaning once per year prior to safety inspection in order to reduce leakage of automobile fluids in area parking lots.	State Department of Motor Vehicles. State Legislature	City Chamber of Commerce	0	Not Applicable	2012

Table 4.2 Capehart Brook Prevention and Housekeeping Recommendations

CAPEHART PREVENTION RECOMMENDATIONS						
GOAL: Prevent the release of pollutants in stormwater runoff.						
	Task	**Partners (Who can work together?)**	**Authority (Who will initiate or oversee?)**	**Cost (One time unless noted otherwise)**	**Funding**	**Timeframe**
4.4.0	**Sand/salt Management**					
	OBJECTIVE: Ensure that sand/salt is properly stored and applied to avoid excess use and runoff					
4.4.1	Ensure that all sand/salt storage areas comply with DEP requirements. Evaluate need for additional local regulations.	DEP, City, Landowner, Contractors	DEP, CEO	N/A	Landowner/ Business owner	Ongoing
4.4.2	Conduct annual inventory of all sand/salt storage areas.	City, Business Owners	City	$1,000/per year	City	2011
4.4.3	Develop and conduct a sand/salt management education and training program (similar to other DEP contractor training) based on the DEP Stormwater Management BMPs. Program would include:	City, DEP, Landowners, Chamber of Commerce, Contractors	DEP, City	$5,000	DEP	2011
	a. Developing an area s/s contractors list					2011
	b. Contractor training with certification					2011
	c. Evaluate need for sand/salt applicators' certification.					2011

Section 5 Restoration Toolbox: Channel and Riparian Restoration

Riparian Buffers, Channelization, Geomorphology, Erosion Control, and Bank Stabilization

5.1 Geomorphic Assessment Results

A geomorphic assessment of the Capehart Brook has not been conducted. However, volunteers took photos and after being trained, performed a brief, preliminary assessment of the stream in August, 2011. Their results were then interpreted and documented by the Department of Environmental Protection in 2012. The purpose of the preliminary assessment was to flag potentially problematic areas, and to determine, on a cursory level, what the conditions of the stream stability and aquatic habitat appeared to be. The assessment is not to be considered a professional-level, detailed assessment. The assessment found that, in general, two of the three reaches are in adjustment, one is widening, and the other reach is in aggredation (accumulating or infilling excess sediment). This is a typical response as the channel expands to accommodate the increased runoff being diverted from hard, urban surfaces. A summary of the existing conditions is provided in Table 5.1 below.

Table 5.1 Preliminary Summary of Existing Conditions

Reach	Summary of Existing Conditions
Reach A1-Mouth at Kenduskeag	--- 75% shaded; (channel width estimated to be 6 ft); trees, bushes, grasses and boulders are common in the riparian zone; gravel/sand and structures are present in the riparian zone; natural streamside plant cover is severely degraded. The reach is in adjustment (primary process is widening).
Reach A2-Middle Section	--- 75% shaded: (channel width estimated to be 9 ft); trees and grasses/ferns are common in the riparian zone; fields and pavement/structures are present in riparian zone; structures present along the stream; natural streamside plant cover is degraded. The reach is in adjustment, primary process is aggradation (accumulating or infilling excess sediment).
Reach A3-Finson Road Culvert	--- 25% shaded; (channel width estimated to be 4 ft); trees, bushes, grasses, gravel/sand, pavement/structures present in the riparian zone and lawn is common; structures are present along the stream.

Source: Stream Corridor Survey 2010.

5.2 Restoration Recommendations and Costs

Final recommendations for Capehart Brook cannot be developed until a professional-level geomorphic assessment is conducted. However, based upon general knowledge of stream

habitats, the stream will probably need traditional stabilization features/techniques. Specific site designs will need to be developed before the City and its stakeholders can make implementation decisions. As a result the cost for In-Stream Restoration efforts cannot be determined. However, we can estimate the probable cost of improvements to the stream if we assume that 1/3 of the length of the 0.46 mile stream will need traditionally accepted habitat improvement features. This includes the addition of native deciduous plantings to moderate stream temperature, create habitat, and stabilize banks. We can also anticipate that roughly 1/3 of the length of the stream will need traditional stream bank protection features added. One of the leading agencies in the implementation process is the USDA Natural Resource Conservation Service and the Penobscot County Soil and water Conservation District. They have provided the following estimates for site design and cost estimation (C. Brewer, Penobscot SWCD, Personal Communication, December 2007):

- 12"-24" culverts = $20.68/ft installed
- 36"-48" culverts = $83/ft installed.
- Stream bank Protection = $5.13/lft
- Stream habitat improvement = $50/ft
- Stream Rehabilitation simple structures = $75/ea
- Stream Rehabilitation complex structures = $3,750/ea (such as major road/train crossings)

Preliminary calculations for 1/3 of length to receive stream bank protection equals $4,152 and estimates for stream habitat improvement for 1/3 of the length would amount to $40,450 based upon the estimates listed above. The total preliminary estimated cost may be around $44,602.

The South side of the stream is currently undeveloped and appears to have a well used trail along the length of its natural corridor to the Kenduskeag. The trail presents and excellent opportunity for a potential public nature trail. It appears to be used by local area residents to the point where the vegetation is absent at the mouth of the stream where it meets the Kenduskeag. A properly maintained trail could provide better public access and improvement to the highly used areas where currently, erosion is occurring and may be considered a problem.

5.3 Potential Funding Sources for Restoration Projects

Funding for channel and riparian restoration projects can be raised through the same mechanisms listed for education programs listed in Section 4. The City can also work with landowners to obtain easements in order to conduct restoration projects and this can be achieved separately or in conjunction with the Stormwater Utility District (Section 6.3). There are also several grant sources for which the City can apply. In some cases, the City may need to form partnerships with various agencies such as the Penobscot Soil and Water conservation District or the Natural Resource Conservation Service. Some possible grant sources include:

Nonpoint Source Water Pollution Control Grants (319)

Grants to prevent or reduce nonpoint source pollutant loadings entering water resources so that beneficial uses of the water resources are maintained or restored. The Maine NPS Grants Program is administered by the Maine Department of Environmental Protection (MDEP) in consultation with the U. S. Environmental Protection Agency (EPA). Grants for projects will be

funded with monies provided to Maine by the U.S. Environmental Protection Agency under Section 319(h) and 604(b) of the Federal Clean Water Act.

(http://www.maine.gov/dep/blwq/docgrant/319.htm)

American Rivers & NOAA Community-Based Restoration Program River Grants

American Rivers and NOAA's Community-based Restoration Program provide financial and technical assistance for river restoration projects benefiting diadromous fish species in the Northeast. This funding seeks to enable environmental and economic renewal in local communities through the removal of stream barriers and realized benefits to diadromous fish species.

Surface Water Quality Protection Program (SWQPP)

SWQPP is a cooperative endeavor that joins local, state and federal organizations in efforts to reduce the effect of polluted stormwater runoff from state highways and other MDOT transportation facilities. The SWQPP uses federal and state funds to assist in the engineering design and construction of innovative and effective stormwater management projects. The program relies on the interest and expertise of local citizens and community groups to locate and nominate these problem areas.

(http://www.maine.gov/mdot/environmental-office-homepage/surface-water-quality-protection.php)

Table 5.2 In-stream and Riparian Habitat Restoration Recommendations

CAPEHART BROOK RIPARIAN RESTORATION RECOMMENDATIONS					
GOAL: Restore ecosystem integrity of riparian areas and functionality of stream channel.					
The following recommendations are PRELIMINARY ESTIMATES BASED UPON CURSORY EVALUATIONS					
	Preliminary Recommendation	**Partners (Who can work together?)**	**Estimated Cost**	**Funding**	**Timeframe**
5.1.0					
5.1.1	Reach A1 & A2 - Bank Protection	City, DEP, Landowners, Engineering Consultants, PCS&WCD, NRCS	$4,152	Habitat Restoration Grants (WIFAP, 319, NFWF, USDA, NOAA, USFWS)	2013-2016
5.1.2	Reach A1 & A3 - Habitat improvement	City, DEP, Landowners, Engineering Consultants, PCS&WCD, NRCS	$40,450	Habitat Restoration Grants (WIFAP, 319, NFWF, USDA, NOAA, USFWS)	2013-2016
5.1.3	Create a "river walk" trail and natural area in the riparian zone that would attract wildlife and walkers/hikers.	City, Landowners, Scouts, Conservation Groups, Cooperative Extension, PCS&WCD	$100,000	Habitat Restoration & Economic Development Grants	2016-2020

Section 6 Restoration Toolbox: Retrofitting Stormwater Measures

Past Practices, Prioritizing Sites, and Stormwater Utility

6.1 Past Stormwater Management Practices and Retrofits

In many cases, the traditional stormwater management standards that were applied in the past have been found to be either inadequate or, in some cases, to cause problems in the waters to which they drain. Many of the older standards failed to protect the stream channel and/or provided inadequate pollutant removal and inadequate shading. The current philosophy in stormwater management and the goal of each retrofit is focused on ensuring that stormwater systems meet the following four objectives (DEP 2006):

1. effective pollutant removal (reduce pollutant load),
2. cooling water temperatures,
3. channel protection, and
4. flood control.

The City of Bangor contracted with SMRT to assist in developing a suite of Low Impact Development (LID) and modern stormwater BMPs that could be implemented in the Capehart Brook watershed. This section of the plan attempts to prioritize the recommended retrofits for each of the recommendations based on a number of different variables.

6.2 Recommended Retrofits

Recommended Retrofits

Capehart Brook has a total watershed area of approximately 685 acres, of which approximately 100 acres are impervious[2]. Most of the development is moderate density residential housing with impervious area ratios of between 20% and 25%. The current overall imperviousness is about 14% in total. The goal of the draft TMDL is to reduce the effective impervious cover to 9%. The TMDL also suggests that the source of impairment is due to “unmitigated stormwater flow volume and a complex array of pollutants transported by non-point sources and urban stormwater run- off”. The TMDL recommends the solution is to effectively disconnect impervious areas from draining into the stream. This means that while impervious areas would still drain to the stream, the discharge would be treated to the point where pollutants would be reduced to levels resembling that of discharge from porous or pervious (undeveloped) areas.

The objective of the stormwater improvements described below is to effectively “disconnect” impervious areas from the watershed. The proposed schemes can be divided into three categories and are described below.

[2] City of Bangor, GIS information, January, 2011.

Bio-retention Retrofits in Existing Sub-drainage Areas

The existing complex is drained via a network of incised ditches that run throughout interior grassed areas and connect to the piped drainage system in the adjacent streets. These ditches present an opportunity for retrofitting with underdrained Bio-retention cells that will assist with surface water drainage and provide treatment for runoff from contributing areas.

The Bio-retention areas have been sized at a conceptual level to meet Maine DEP General Stormwater Standards Criteria. The regulations set sizing criteria that are aimed at reducing total suspended solids (TSS) and general non-point source (NPS) pollutant loading by 80% or more and to reduce phosphorus loading by 65%.

Table 6.1 below summarizes the treated areas proposed under this plan and indicates that this set of retrofits will address up to 7.5 acres of impervious area that can be effectively disconnected. This equates to a reduction of approximately 10% of the contributing impervious area draining to the stream from these sub-drainage areas.

Road Width Reductions

Many of the roads within the Bangor Housing Authority development appear excessively wide for the use. This is essentially a residential area with ample off-street parking provided for the housing units. During visit to the neighborhood, very few vehicles were observed parking in the streets, and adjacent off-street spaces were always available. There is also a strong desire in this neighborhood to provide pedestrian walkways, which are currently absent. A school is located at the center of the neighborhood, so the need for pedestrian walkways is a valid concern. These two items can be addressed simultaneously while also reducing impervious cover in the area. The proposed recommendation is to reduce the street widths when re-paving by cutting the edge of pavement back on each side and replacing it with under-drained porous pavement or grassed bio-retention cells and delineating the walkway with indentations or painted lines. This action in itself would reduce the paved area of the streets by up to 20%. It will also provide a reduction of cost in the construction of new sidewalks.

Wet Pond Repair and Retrofit

During observations of the watershed area, Bangor engineering staff noticed significant deterioration of a previously constructed stormwater wet pond at the end of Sunny Hollow Place. This basin was apparently constructed to capture and treat runoff from the upstream contributing developed areas along Sunny Hollow Place and Yankee Avenue. The basin outlet structure has collapsed and the downstream berm has breached, allowing flow to escape directly into the roadside ditch and hence into the upper reaches of Capehart Brook. The contributing area to the basin is approximately 19.5 acres, with an approximate impervious ration of 20%. By re-constructing the wet pond to current Maine DEP Stormwater Law Standards approximately 3.9 acres of impervious area will be “disconnected“.

Residential Rain Water Harvest Systems

Low impact development techniques are available for residential properties as well as multi-family and commercial properties. Since residential properties contribute stormwater runoff , it makes sense to consider disconnection of impervious surfaces on these properties as well. In addition to providing stormwater system relief, some of these systems can also offset the cost of water and therefore, sewer costs (in Bangor, sewer costs are measured by how much water is

used). Rain gardens, rain barrels, and cisterns are relatively easy to install and can be cost effective if a coordinated volunteer effort is utilized to enlist manual labor.

6.3 Pollutant Load Reduction

There are a number of alternative ways to equate the pollutant load reduction that could be anticipated from the implementation of these retrofits. However, the impervious cover method has been used as a measure of the stress level in the watershed, and provided as a goal in the Draft TMDL, so it would appear appropriate to measure pollutant reduction in these terms also. The table below summarizes the treated areas proposed under this plan and indicates the amount of area that will be effectively disconnected. Table 6.1 below includes the expected pollutant load reduction to be achieved by each of the recommended retrofits.

Table 6.1 Retrofit, Load Reduction & Cost Details

Retrofit	Area/Length	Amount IC Reduced/ Treated	IC Area Disconnected	Cost of Project (includes 20% for O&P)	Cost /per IC acre treated
Bio-Retention Cells					
Rangeley Place North	6260	75120	1.72 acres	$30,048	$17,469
Rangeley Place South	3960	47520	1.1 acres	$19,008	$17,280
Acadia Place	2320	27840	0.64 acres	$11,136	$17,400
Davis Road	3000	36000	0.83	$14,400	$17,349
Bald Mountain	2400	28800	0.66	$11,520	$17,454
Downeast School	9250	111000	2.55	$44,400	$17,411
Total Bio-Retention Cells Tier 1/Tier 2	**27190**	**326280**	**7.5**	**$130,512**	**$17,401**
Wet Pond Retrofit					
Total Wet Pond Tier 2/Tier3	**858,000**		**3.94**	**$122,400**	**$31,065**
Resident Rain Garden 24			0.82	$36,000	$43,902
Resident Rain Harvest 24			0.82	$72,000	$87,805
Total Resident Tier 1/Tier 4			**1.65**	**$108,000**	**$65,455**
Road Width Reduction + Porous Pavement					
Moosehead Blvd.	1809	32’	1.33	$90,399	$67,969
Bald Mountain	1651	32 ‘	1.21	$82,502	$68,184
Deer Isle Rd.	1813	34’	1.42	$105,090	$74,007
Blue Hill E.	1285	32’	0.94	$64,213	$68,311
Total Rd Width Tier 5	**6558**	**130’**	**4.90**	**342,204**	**$69,838**
TOTAL COST				**$703,116**	

6.4 Prioritization of Retrofit Recommendations

Prioritization of Retrofit Recommendations

A list of Capehart Brook Watershed recommended projects is provided in Table 6.1 above. The projects may be implemented using funds from the Capehart Brook Compensation Fee Utilization Plan (City of Bangor, 2006) and other funding sources as may become available. This list is not all encompassing as it is expected that new projects will be identified or existing projects modified as the Watershed Management Plan is implemented and the City begins to work with stakeholders in the watershed. The projects have been prioritized by the following criteria:

1. Provides the greatest amount of treatment for the least cost per acre treated
2. Easy and/or efficient to implement due to existing infrastructure, grade, or an associated project that can be constructed together (reducing cost and effort)
3. Proximity to the stream; it has been shown that the closer a property is to a stream, the greater the impact on that waterbody
4. Landowner willingness

It as anticipated that these projects would be completed within 15 to 20 years of the adoption of this plan, depending upon financial resources and property owner cooperation, and the ranking of priorities of other impaired streams the City must address.

Table 6.2 Caphart Brook Proposed Recommendations for Retrofits

	Retrofit Type	Estimated Cost	Partners Who can work together?	Authority Who will oversee?	Funding	Time-frame
6.1.1	Bio-Retention Cells in multi-family common areas	$130,512	Bangor Housing Authority	City	CFUP 319, SRF	2011-2021
6.1.2	Road Width Reduction and Treatment	$342,204	Adjacent Landowners, School	City	CFUP 319, SRF	2021-2031
6.1.3	Wet Pond Repair and Retrofit	$122,400	Subdivision HOA or Landowners	City	CFUP	2013-2015
6.1.4	Resident Rain Harvest Systems	$108,000	Landowners	City		2011-2026
	Total Cost	**$703,116**				

Retrofitting Sites on Private and Residential Property

Prioritization of sub-watersheds was primarily based on the relative contribution of impervious surface within the watershed, cost per impervious acre treated, and the potential load reduction after retrofitting. The prioritization process consisted of several steps:

Step One: Relative Impervious Cover – Sub-watersheds were preliminarily ranked based on their amount of impervious cover, existing stormwater treatment practices, and potential as high traffic and pollutant release areas.

Step Two: ***Treatment Options*** - City engineers and Consultant, SMRT, grouped the sub-watersheds by landowner and/or drainage patterns and determined the most appropriate treatment for each of the high priority sites.

Step Three: ***Cost Estimates*** - The Consultant, SMRT, developed estimated costs for each of the retrofit recommendations. The total estimated cost to retrofit all sites is $703,116. The cost per impervious acre treated ranges from $17,280 to $87,805. This range illustrates the fact that some retrofitted sites are more cost effective than others. It should be noted that pricing estimates are based on 2010/2011 industry pricing. Material and transport costs for site work have shown significant recent volatility that could impact actual costs both in the near future and over the period of expected construction.

Step Four: Load Reductions – The consulting Professional Engineer estimated the current load and load reductions for each of the 8 high priority sites and 24 residential properties. Load reductions are based upon impervious cover that is treated or "effectively disconnected".

Step Five: Evaluation Criteria - Based on stakeholder input, the sites were evaluated and scored based on the following set of criteria (Table 6.1):

- Cost per acre treated by retrofit
- Estimated Load Reduction with retrofit
- Landowner Willingness and Participation.

6.5 Funding Retrofit Projects

As stated in Section 3, Plan Implementation, the City intends to evaluate alternative stormwater funding approaches (Refer back to Section 3). Two of the most significant funding options include:

1. **Stormwater Utility District:** The establishment of a Stormwater Utility District in which users within the district pay a pro-rated fee which can be used to fund the upgrade of existing structural BMPs.

2. **Incentive Programs:** The creation of an incentive program whereby owners of new developments (which presumably would install modern, less polluting structural BMPs) would undertake one of the retrofit projects as a requirement of its new development. This method could also be used with re-development of an existing site. Mitigating one of the retrofits sites could be a condition of re-development.

Section 7 Restoration Toolbox: Ordinances and Administration

Enacting Implementation, Easements, Staffing Needs, Future Development

7.1 Administration

Given the number of programs and recommendations needed to improve water quality and prevent future NPS pollution, the City may need to consider changing staff duties and/or hiring new staff in order to complete the tasks in a timely manner. For example, additional staff may be needed to implement programs, enforce ordinances, oversee construction, implement BMPs, and conduct education programs. Table 7.2 lists the administrative recommendations needed for implementation. These recommendations will be initiated, enacted, and funded by the City. Funding for administrative changes will most likely come from the City's general funds.

7.2 Ordinances

In order to implement the recommendations for education, prevention, restoration, and retrofitting existing stormwater structures, the City will need to:

1. consider enacting ordinances which enable the City to conduct implementation,
2. consider obtaining easements on properties where the City will conduct implementation,
3. evaluate and possibly amend staff duties where needed,
4. review current ordinances to ensure that they address current and future development and stormwater BMP requirements.

The City recognizes that an equitable approach to new ordinances is necessary and will consider applying all new regulations City wide. Implementation of structural BMPs will require further and more specific site planning; and the City will need to establish easements and collect fees for any future work. Table 7.1 lists the recommended ordinances needed to continue with implementation. .

Table 7.1 Administrative Recommendations

CAPEHART ADMINISTRATIVE RECOMMENDATIONS				
All of the following would be initiated, enacted, and funded by the City.				
	Task	**Partners (Who can work together?)**	**Cost**	**Timeframe**
7.3.0	**GOAL: Ensure that there is sufficient support staff to enact plan.**			
7.3.1	Develop an annual work plan (and publish it to the public) by anniversary date of approved WMP.	City, Capehart Stakeholder Working Group	$1,000	2012
7.3.2	Hire required staff needed to implement programs, enforce ordinances, oversee construction, implementation of BMPs, and education program.	N/A	$67,000	2011-2013
7.4.0	**GOAL: Ensure that there is sufficient organizational structure to enact plan.**			
7.4.1	Adopt the Capehart Watershed Management Plan	City, Capehart Stakeholder Working Group	N/A	2011
7.4.2	Develop a Capehart Compensation Fee Utilization Plan and integrate with this management plan.	City, Capehart Stakeholder Working Group	N/A	2011
7.4.3	Establish a City staff working group that consists of representatives from all relevant City departments that reviews all stormwater, development, and planning related issues. Where appropriate, invite stakeholder involvement.	City, Capehart Stakeholder Working Group	N/A	2011
7.4.4	Where necessary and appropriate, seek public easements along stream in order to increase opportunities and access for restoration and water quality improvement.	City, Capehart Stakeholder Working Group	$20,000	Ongoing

Table 7.2 Ordinance Recommendations

CAPEHART ORDINANCE RECOMMENDATIONS		
All of the following recommendations would be initiated and administered by the City.		
	Proposed Ordinance Description	**Timeframe**
7.1.0	**GOAL: Establish ordinances that support the use of best management practices and other stormwater measures in all City watersheds**	
7.1.1	Consider the creation of an ordinance that establishes a Stormwater Utility District in which members of the district pay a pro-rated fee that can be used to pay for the upgrade of existing structural BMPs. Consider exempting residents and evaluate city-wide or by watershed district. (See Retrofit Funding and Incentives).	2011
7.1.2	Establish an ordinance requiring annual inspection and maintenance of all structural BMPs in accordance with MDEP Stormwater Manual.	Adopted 2010
7.1.3	Create a dumpster maintenance ordinance whereby businesses are required to regularly inspect and conduct maintenance on dumpsters on their property. (See Prevention/Housekeeping Recommendations)	2012
7.1.4	Evaluate the need to establish ordinances based on recommended BMPs (see CWP "Better Site Design Handbook") and on the following principles:	2012
	a. Require buffers that abut the stream on commercial and residential sites for all new development (Compare with current standards).	
	b. All new and existing buffers should be composed of woody shade-bearing, native tree species.	
	c. Consider banning the use of fertilizers and pesticides in the watershed, at least temporarily.	
	d. Implement salt use restrictions/limits near waterbodies or throughout watershed	
7.2.0	**GOAL: Ensure that current ordinances address current and future development BMP needs**	
7.2.1	Update current impervious cover data and build-out findings to include recent land-use changes and development in order to determine what levels are acceptable and what changes, if any, are necessary for future development levels.	2012
7.2.2	Systematically review existing codes, standards, and ordinances and compare them to the "model development principles" as established in the "Better Site Design" Handbook at the Center for Watershed Protection (http://www.cwp.org/PublicationStore/bsd.htm). Include in the discussion, the forthcoming Municipal Separate Storm Sewer Systems (MS4) rules that may apply Citywide (especially for new development). Assign to existing City committees (i.e., Marsh Mall Commission, Comprehensive Planning Committee).	2012
7.2.3	Develop a Stormwater Amendment to the City Comprehensive Plan.	2012
7.2.4	Create an incentive program where owners of new developments (which presumably would install modern, less polluting structural BMPs) would provide resources to fund one of the retrofit projects as a mitigation requirement to insure that a new development has no impact on water quality. This method could also be used with re-development of an existing site.	2012

Section 8 Milestones of Success and Monitoring for Future Evaluation

Measurable Milestones and Water Quality Monitoring

8.1 Adaptive Management

As discussed in Section 3, a critical part of the plan's success will depend on additional evaluations, modeling, and monitoring. The City will meet with the stakeholders at least annually to review progress on the plan. At that time, progress toward meeting milestones and any necessary changes will be discussed. The City will conduct an annual review beginning one year after the plan has been adopted. The City will also meet with the Stakeholders as necessary to review policy issues involving the implementation of this plan prior to advancing those issues through the City's formal governance process. The City agrees to provide a semi-annual newsletter that will include information on monitoring results, implemented BMPs, recent decisions, policies, ordinance changes, and upcoming events and meetings.

8.2 Measurable Milestones

The purpose of monitoring milestones is to evaluate the effectiveness of implementation efforts. Specifically, the milestones should measure progress toward implementation of the plan and whether the efforts are achieving load reductions over time and progressing towards attainment of Class B standards. All recommendations in the plan include a timeframe for initiating and, in some cases, completing the tasks. However, it is helpful to view the tasks in terms of milestones. Tables 8.1 through 8.4 include milestones for education and prevention, restoration, structural retrofits, and administration and ordinances that the City will incorporate into its annual review and adaptive management program.

Table 8.1 Milestones for Education and Prevention

Education and Prevention Milestones
Goal: Have education and prevention programs in place by 2016
Milestone
• One demonstration site is established per year for the next 7-10 years
• Signage is established throughout watershed in the first 5 years
• Stormwater Management Training for facilities managers is held annually for the first 3 years and biannually for the next 5-10 years
• Education programs are in place within the first 3 years and at least 3 program activities (training, newsletter, haz mat disposal) occur every year for the next 10 years.

Table 8.2 Milestones for Administrative and Ordinances

Administrative and Ordinance Milestones
Goal: Establish ordinances that support the use of best management practices and other stormwater measures in all City watersheds; ensure that current ordinances address current and future development BMP needs; ensure that there is sufficient staff and organizational structure to enact plan.
Milestone
• Annual work plan developed (and published to the public) by anniversary date of approved WMP.
• Organizational structure developed and staff increased by 1 part time person within 1 year.
• City staff working group reviews all stormwater related issues established and review of ordinances is completed within 2 years.

Table 8.3 Milestones for In-Stream and Riparian Restoration

In-Stream and Riparian Restoration Milestones
Goal: Restore ecosystem integrity of riparian areas and functionality of stream channel.
Milestone
• 1-2 restoration projects implemented per year. Restoration Projects should be completed by year 2020
• Buffers and/or riparian areas restored by 2021
• Trail and/or interpretative natural area along the stream developed by 2021
• Establish gages to monitor flow before and after restoration

Table 8.4 Milestones for Retrofitting Structural BMPs

Retrofit Milestones
Goal: Reduce pollutant and sediment loading, cool water temperatures, and reduce stormwater flow by 2021.
Milestone
• First and some second tier retrofit sites implemented in 5 years (with Grant Funds)
• Second tier retrofit sites implemented in 10 years
• Third tier retrofit sites implemented within 15 years
• Fourth tier retrofit sites implemented within 20 years
• Stormwater Funding is established by 2012.

8.3 Water Quality Monitoring

Every watershed management plan should incorporate a water quality monitoring component to assist managers in tracking progress toward attaining class standards. A monitoring program should be directly related to the management objectives and to the implementation schedule. The overall water quality goal for the Capehart is to achieve class B standards as stated in Table 2.1. The objective of the water quality monitoring recommendations as stated in Table 8.5 is to increase water quality monitoring and habitat assessment.

Table 8.5 Milestones for Water Quality Monitoring

Water Quality Monitoring Milestones
Goal: Establish and maintain a regular, continuous monitoring program and achieve Class B standards by 2026.
Milestone
• City will collect analytical sampling data over next 10 years to determine if improvements are having an impact.
• DEP will continue macroinvertebrate monitoring on rotation schedule and will follow-up on problems found by City's monitoring program.

Typical parameters that indicate water quality sources of impairement and/or measures of improvement include: Turbidity

- Bacteria (E. coli)
- Dissolved oxygen
- Conductivity
- Temperature
- Flow
- pH
- Nutrient
- Metals

In addition the DEP will conduct macroinvertebrate sampling during their regular five year rotational schedule. Volunteers will follow up with, flow and erosion studies, and habitat assessment using the DEP Rapid Assessment Stream Walk technique, and compare with 2011 Survey Report.

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Appendix A: Integrated Table of Recommendations Sorted by Timeframe.

Tasks may be abbreviated and summarized; for more information see original tasks and tables Sections 4-7.