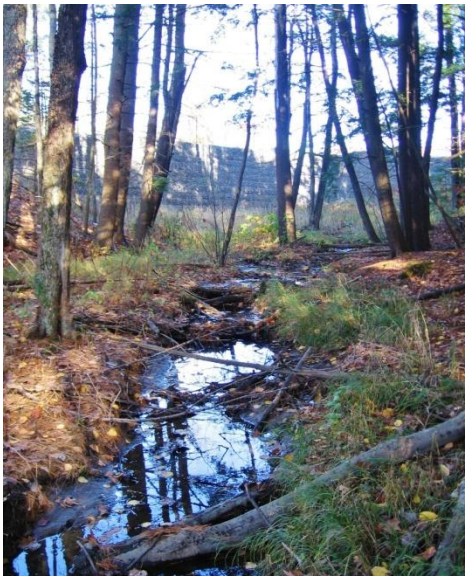
Topsham Fair Mall Stream Watershed Based Plan



April 2014

TOPSHAM MAINE

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Topsham Fair Mall Stream
Watershed Boundary
Rocky
Birch Ridge
Smith
I-295
Lewiston
I-295
Forest
Munroe
Winners
196
Topsham Fair Mall
Paddock
295
Monument
Jake
Hannah
Patricia
Carolyn
Chad
Mallett
Anthony
Sand Hill
Midway
Park
I-295
Harley
Rogers
Raymond
Faye
Riendeau
River
Rainbow
Winter
Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Data Source: MEDEP, MEGIS
Coordinate System:
UTM 1983 Zone 19N
Created by W. Baker,
FB Environmental June 2013
0
0.1
0.2
0.4 Miles
N
Watershed Boundary
Streams
Androscoggin River

TOPSHAM FAIR MALL STREAM WATERSHED BASED PLAN

Prepared by **FB Environmental Associates**

In cooperation with

Town of Topsham

Wright-Pierce

Field Geology Services

Maine Department of Environmental Protection

April 2014

Contact:

FB Environmental Associates, Inc.

97A Exchange St., Suite 305

Portland, ME 04101

(207) 221-6699

**Unless otherwise noted, photos by FB Environmental Associates, Inc.*

EXECUTIVE SUMMARY

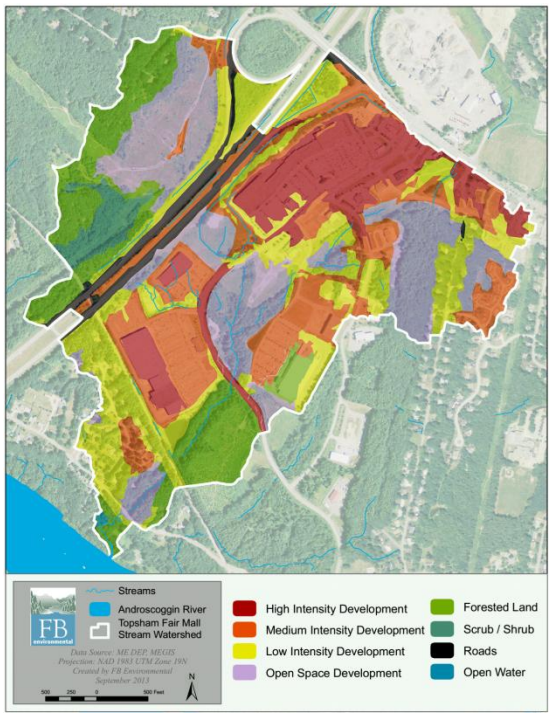
Project Overview

The Topsham Fair Mall Stream Watershed Based Plan was developed through a locally-supported and community-driven planning process. The project was initiated by the Town of Topsham and funded by Maine Department of Environmental Protection under Section 319 of the Clean Water Act. Plan development was coordinated by FB Environmental Associates (FBE), Wright-Pierce, the Maine Department of Environmental Protection (Maine DEP), the Town of Topsham, Maine Department of Transportation (Maine DOT), and a Technical Advisory Committee (TAC) composed of watershed stakeholders including local business owners and managers, engineers, environmental professionals, and residents. Field Geology Services provided technical assistance.

Mouth of Topsham Fair Mall Stream at the Androscoggin River.

The Topsham Fair Mall Stream and Watershed

The Topsham Fair Mall Stream is a small stream in a heavily developed area of Topsham, Maine. The 1.4 mile long stream flows through an area of high density commercial development and a section of Route 295, with small areas of residential development at the upper and lower edges of the watershed. The headwaters originate in the northeastern border of the watershed near Route 196 (Lewiston Road), and the stream flows southwest to its confluence with the Androscoggin River. Several road crossings of the stream consist of high earthen fill held by retaining walls, with only small pipe culverts for the stream to pass through. These road crossings block the floodplain and significantly alter the flow and ecology of the stream, and present a potential wash-out hazard.



High and medium density commercial land use predominates in the watershed.

The watershed (or land area which drains to the stream) is small, at about 320 acres. Drainage in much of the watershed has been altered by the construction of large buildings and parking lots, with associated drains and piping directing storm runoff to the stream. The watershed is highly urbanized, with 79% of the land area classified as developed. Over 30% of the watershed is impervious surface (roads, parking lots, buildings), which greatly increases the volume, intensity, and pollutant load of storm runoff. Heavy salt application in the winter enters the stream both directly and via groundwater, causing elevated chloride levels in the stream in both winter and summer. In addition, currently undeveloped portions of the watershed are slated for growth under the Town of Topsham's Comprehensive Plan.

Despite the impairments associated with development, data indicate that the stream is well oxygenated and groundwater recharge keeps temperatures low enough to make the stream a potentially valuable refuge for coldwater fish from the Androscoggin River. In addition, the stream's location in a high traffic area suggests that the stream offers potential recreational enjoyment for a large number of residents, employees, and other visitors.

Why Develop a Watershed Based Plan?

A watershed based plan helps identify problems, priorities and actions that are needed to improve the water quality of a stream or brook. Since each watershed is unique, the Topsham Fair Mall Stream Watershed Based Plan must be tailored to address the specific issues and concerns of both the community and the stream.

> ***A Watershed Based Plan*** *serves as a road map to stream restoration, providing guide to the actions, scheduling, monitoring, and costs along the route to meeting water quality standards.*

The Topsham Fair Mall Stream does not currently meet Maine water quality standards, and must undergo restoration action under the US Clean Water Act. The Class B stream, which is known formally as "Unnamed Tributary to the Androscoggin River" (ADB Assessment Unit # ME0104000210_420R05) is classified by the Maine DEP as an urban impaired stream under Chapter 502 of the Maine Stormwater Management Rules. It is also listed in the 2010 and 2012 Maine Integrated Water Quality Monitoring and Assessment Report as impaired for benthic-macroinvertebrate bioassessments. The impairment is based on data collected by Maine DEP in 2008 at one sampling station (S-634), and additional testing since then, including sampling done by FBE and Maine DEP during the development of this plan, has confirmed the impaired status of the stream. The stream is also listed in the 2011 Maine Impervious Cover Total Maximum Daily Load (TMDL) report, with a target for impervious cover reduction from current conditions of 30% to 8%. Combined, these designations all point to the need for stream restoration.

A watershed based plan provides an opportunity and structure for stakeholders to work together to prioritize, schedule, and fund restoration activities. It is an EPA-recognized planning document, and is an asset which helps the stakeholder group to qualify for grant funding to implement the plan.

What the Plan Includes

Members of the Topsham Fair Mall Stream Technical Advisory Committee (TAC) have helped guide the watershed planning process since the project began in 2012, and will continue to guide efforts to implement the restoration plan over the next 10-15 years. The Watershed Based Plan has an immediate time horizon of four years, with further implementation to be developed following an adaptive management approach. The plan is divided into seven major sections:

Upper reaches of the Topsham Fair Mall Stream. K. Feindel.

Section 1, Introduction, describes the purpose of the plan, provides background information about the Topsham Fair Mall Stream, a description of the data acquisition and planning process, and brief descriptions of recent stream-related work in the watershed.

Section 2, Watershed Characterization, describes the watershed, including a description of the subwatersheds, major stormwater outfalls, climate, topography, soils & geology, and land use.

Section 3, Causes of Impairment, describes applicable water quality standards, a summary of Maine DEP assessment data and supplemental monitoring data collected more recently by FBE and Maine DEP, and the degree and causes of impairment to the stream.

Section 4, Restoration Strategies, describes the watershed restoration goals and objectives including the Action Plan. Both structural and non-structural restoration opportunities and recommendations are discussed, along with the methods used to select and prioritize the most urgent action items. Estimates of pollutant removal from action items are also

included, with phosphorus used as a surrogate for other pollutants. Restoration strategies are presented in tables describing what needs to be done, who will help get it done, when it will be done, and how much it will cost.

Section 5, Implementing the Plan, discusses options for overseeing and administering the plan, as well as a budget summary and potential funding sources. Assigning an "owner" of the plan, an entity that will have authority and responsibility for plan implementation, is a key topic in this section and one of the most important elements of any restoration plan.

Section 6, Methodology for Measuring Success, describes specific recommendations for monitoring and evaluating the effectiveness of restoration efforts. This includes criteria for measuring progress, such as milestones along the way.

Administering and Funding the Plan

Restoration of the Topsham Fair Mall Stream will require a coordinated program supported by private, state, town, and federal funding. Private landowners owning businesses in the watershed can choose to implement recommended BMPs on a voluntary basis. Cost-share opportunities to retrofit existing impervious surfaces with improved stormwater treatment systems may be available at some point in the future, as well as grant-funding to set-up demonstration sites within the watershed.

The total estimated cost for phase 1 implementation of the Topsham Fair Mall Stream Watershed Based Plan is estimated at approximately $855,000 and $1,034,000 over the next four years. This first phase includes high and medium priority structural and non-structural recommendations, but does not include the long-term costs of re-opening the floodplain. Costs are described in Sections 4 and 5.

Ensuring the plan has an effective, locally-supported administrator is the most critical step in achieving the goals of this watershed based plan. Options for plan administrator described in Section 5.1 include a watershed management district, the Topsham Conservation Commission, a dedicated Technical Advisory Committee, or the Town of Topsham Planning Department and Planning Board. Although the organizational structure of the plan administrator may take several forms, the administrator will build on the strong stakeholder collaboration which contributed to the development of the plan. A long-term sustainable funding plan needs to be developed by the watershed plan administrator in order to acquire funds necessary to achieve the identified goals.

Next Steps

Successful implementation of a watershed plan depends primarily on the commitment and involvement of community members. Members of the watershed based plan TAC will need to engage the broader community of business owners and managers, planning and public works staff, Selectboard and Planning Board members, as well as engineering professionals and local residents. Having the Selectboard discuss and vote to officially adopt the plan would be a valuable gesture to raise awareness of the plan, and signal to potential funders that the plan has community support. The community engagement and adoption of the plan should focus on assigning or developing a formal administrator and "owner" of the watershed based plan, which is the key next step toward securing funding and taking action to restore the Topsham Fair Mall Stream.

ACKNOWLEDGEMENTS

Topsham Fair Mall Stream Technical Advisory Committee (TAC):

Chris Belanger, Belanger Engineers

Forrest Bell, FB Environmental

Daniel Catlin, Topsham Fair Mall

Dennis Cox, Topsham PWD

Cayce Dalton, FB Environmental

Jeff Dennis, Maine DEP

Jon Edgerton, Wright-Pierce

Kristin Feindel, Maine DEP

Gary Fogg, Topsham Conservation Commission

Tim Forrester, Ecoanalysts

John Larson, Topsham Fair Mall

Scott Libby, Topsham Planning Board

Rod Melanson, Topsham Planning Department

Curt Nuefeld, Sitelines, PA

Steve Pelletier, Stantec and Topsham Resident

Christine Rinehart, Wright-Pierce

Rich Roedner, Topsham Planning Department

Tom Saucier, Site Design Associates

Steve Tibbetts, Maine Department of Transportation

Ninespine stickleback from the upper reaches of the Topsham Fair Mall Stream in 2005. Photo: S. Pelletier, Woodlot Alternatives (now Stantec).

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

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1. Introduction

1.1. Purpose and Background

Small streams and their associated network of wetlands help to sustain the biological productivity of downstream rivers, lakes and estuaries. These small streams also provide natural flood control, recharge the groundwater, and maintain water quality by trapping sediments and pollution from fertilizers and other pollutants. Small streams recycle nutrients, create habitat, and maintain biological diversity for plants and animals including fish species (Meyer et al. 2007). Small streams also provide intrinsic benefits to our communities by providing a sense of place for the people that live nearby and a place for children to explore. Even highly urban streams can provide a valuable sense of being connected to nature, precisely because they are close and accessible to a large number of people.

Human activities such as clearing of vegetation, re-grading and paving, and routing storm drains from parking lots directly to streams can greatly alter the hydrology of a watershed. Increases in motor vehicle traffic, road and landscaping maintenance, and other human uses can affect the water quality of storm runoff. Combined, these factors can have serious effects on the health of small streams and the plants and animals that live there, introducing invasive species and eliminating many native species, as well as resulting in an overall sense of a degraded landscape. Conservation efforts, including protecting the riparian zone around small streams, preserving the natural undeveloped forest buffers along these streams, using low-impact development techniques, and providing recreational access through stable and attractive trails will ultimately protect these small streams in the long run.

The Topsham Fair Mall Stream watershed is at an important transportation crossroads, with Route 196 linking I-95 to US Route 1 (Coastal Route), and therefore has attracted intense commercial development. Road crossings in particular in the watershed have divided the floodplain with very large retaining walls hosting small pipe culverts. These walls hold back high flows and greatly alter the pattern of wetlands. In addition, the high proportion of impervious surfaces (roads, buildings, sidewalks, etc.), channelizes and accelerates storm runoff, providing in some cases a direct conduit for road pollution to the streams, and in other cases contributing to erosion or sedimentation. As a result, the stream is listed as an impaired Class B stream on Maine's 303 (d) listing of impaired waters based on aquatic habitat assessment and benthic macroinvertebrate results. The stream is also listed as "non-attaining" of its water quality goals based on stream monitoring results from 2008 at sampling station S-634 (Maine DEP, 2011a). The non-attainment status of the Topsham Fair Mall Stream prompted the development of a Total Maximum Daily Load (TMDL) report incorporated into a state-wide ***impervious cover (IC)*** TMDL using an IC target. The TMDL set a target goal of 8% effective impervious cover, which will help reduce current pollutant loads from the watershed, mimic natural watershed conditions, and help restore the Topsham Fair Mall Stream to achieve Class B water quality standards (ME DEP, 2011b).

The purpose of the Watershed Restoration Plan is to restore the Topsham Fair Mall Stream so that it:

1) Supports a healthy habitat.

2) Attains Maine's Class B water quality standards.

This can be accomplished with the commitment of a coordinated group of local community leaders, conservation groups, state and federal partners, and residents of the watershed working together to implement a long-term (10-15 year) plan to restore the Topsham Fair Mall Stream. The Restoration Plan identifies key actions needed to restore the stream, sets a timeline for these actions, and outlines the mechanisms by which they will be accomplished.

> ***Impervious cover*** *refers to any surface that will not allow water to soak into the ground. Examples include paved roads and driveways, parking lots and roofs.*

1.2. Developing a Community-Driven Watershed Based Plan

A watershed based plan is a guide to restoring a stream to levels which meet state standards. A good plan acts as a road map and includes where to start, which areas to focus on, a timeline, a budget, and standards for evaluating progress. Since each watershed is unique, the plan should also be unique, incorporating the specific goals and concerns of the community.

A community-driven plan is a locally supported plan. Successful restoration depends on the commitment and involvement of community members. Bringing together people, policies, priorities, and resources through a watershed approach blends science and regulatory responsibilities with social and economic considerations (EPA 2008). Even the process of gathering information and learning about the watershed, sharing information with other residents about the history of the stream, recent changes within the watershed, and developing a cooperative understanding of the local resources with others in the community can be one of the most productive outcomes of the plan. These partnerships help strengthen the plan through public awareness of the problems and public commitment to the solutions.

The Town of Topsham has demonstrated a strong commitment to work towards improving conditions in the Topsham Fair Mall Stream. Through funding and oversight from the Maine Department of Environmental Protection, and technical consulting by FB Environmental Associates, Wright-Pierce, and Field Geology Services, the Town of Topsham convened and actively participated in a watershed planning process that includes local residents, development consultants, and business owners, as well as municipal planning and conservation board members, the town's public works department, and Maine DOT. Many of these stakeholders were part of a Technical Advisory Committee (TAC) which was formed to solicit and review guidance for the plan's development and implementation. The TAC has meet several times, including November and December of 2012, and April and September of 2013, The community-based approach will continue through the implementation of the Watershed Based Plan.

1.3. Recent Efforts in the Watershed

The Town of Topsham has an ongoing interest in restoring the Topsham Fair Mall Stream. The Conservation Commission has been actively involved in the project since the development of the TMDL beginning in 2007. Both the US Environmental Protection Agency (USEPA) and the Maine DEP believe that restoration is attainable, and have provided both funding and staff support for the restoration effort.

Figure 1: Monitoring by Maine DEP has indicated water quality impairment in the stream. Photo: K. Feindel.

Topsham Fair Mall Stream Water Quality Assessment: Sampling data were collected by Maine DEP in 2002, 2006 and 2008 which included 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 as impaired due to non-attainment of aquatic life criteria and for non-attainment of habitat assessment (Maine DEP, 2011a).

The Total Maximum Daily Load (TMDL) for Topsham Fair Mall Stream (unnamed tributary of Androscoggin River – draining Topsham Fair Mall): An Impervious Cover Total Maximum Daily Load (IC TMDL) report was developed for the Topsham Fair Mall Stream by Maine DEP (ME DEP, 2011b), which is incorporated into a state-wide impervious cover (IC) TMDL using an IC targets for each stream watershed. The IC TMDL for Topsham Fair Mall Stream identified the high percentage of developed land (commercial, industrial and residential land uses) in the Topsham Fair Mall Stream watershed

Figure 2: Several on-the-ground studies were conducted during the development of this restoration plan.

as the primary cause of the current aquatic life impairment. Changes in the hydrologic cycle include increased surface flow during storm conditions which carry large volumes of water and attached pollutants to the stream. The TMDL set a target goal of 9% effective impervious cover, which, if addressed, will help reduce current pollutant loads from the watershed, mimic natural watershed conditions, and help the Topsham Fair Mall Stream achieve Class B water quality standards.

Topsham Fair Mall Stream Watershed and Impervious Cover Delineation: on-site detailed watershed delineation and impervious cover (IC) analysis was conducted by Maine DEP with assistance of a Bowdoin College/Town of Topsham intern during the summer of 2012 to include the watershed's stormwater conveyance system. This survey documented a high percent of IC in the watershed. The revised watershed boundary results in a determination of impervious cover within the Topsham Fair Mall Stream watershed of approximately 30%. This study also delineated several major watershed subcatchments that carry stormwater directly from areas of high impervious area directly to the stream. This survey supports the idea that the high percentage of IC, especially in the subcatchments, has led to dramatic impacts to the stream as a result of increased stormwater runoff, sedimentation and increased pollutant loads.

In-Stream Monitoring: Conductivity Screenings were performed in the Topsham Fair Mall Stream using DO and conductivity data sondes and conductivity hobo loggers to assess drainage conductivity at 5 sampling stations in the fall of 2012 and spring of 2013.

Stream Corridor Survey: Maine DEP staff and FB Environmental staff conducted a corridor survey on October 24, 2012. The survey consists primarily of visual observation of stream habitat characteristics, wildlife present, and gross physical attributes of the stream, as well as a simple in-stream macroinvertebrate evaluation. The primary use of the survey is to identify high-quality coldwater habitat as well as severe habitat or water quality problems. Results of this survey can be used to raise public awareness and to help prioritize management objectives for stream restoration.

Rapid Geomorphic Assessment: Completed in Spring 2013 by Field Geology Services.

Parking Utilization Study and Snow Storage Study: Completed by Maine DEP in Winter of 2012-13.

Retrofit Reconnaissance Investigation and Inventory: Conducted by Wright-Pierce in spring and summer of 2013.

2. Watershed Characterization

A watershed is a geographic area in which all the water running off the land drains to a given stream, river, lake, wetland or coastal water. Large watersheds, like the Androscoggin River watershed are made up of many smaller watersheds (also called subwatersheds). The Topsham Fair Mall Stream is a subwatershed of the Androscoggin River because all the water that flows overland to the Topsham Fair Mall Stream flows into the Androscoggin River via the Topsham Fair Mall Stream. The watershed is small at 312 acres (0.49 sq. mi.), and is located entirely within the boundaries of Topsham, Maine.

The 1.4 mile long stream primarily flows through high density commercial development, with small areas of residential development at the upper and lower edges of the watershed. There are eight road crossings along the stream, mostly consisting of large retaining walls with small pipe culverts. These walls and culverts have significantly altered the area's hydrology and ecology. The headwaters originate in the northeastern border of the watershed near Route 196 (Lewiston Road). The stream flows southwest parallel to Topsham Fair Mall Road and is crossed by Monument Place, Park Drive, and Midway Drive. The stream then continues southwest under Topsham Fair Mall Road, enters a forested area, crosses the Maine Central Railroad and lastly crosses River Road before flowing into the Androscoggin River.

2.1. Subwatersheds and Stormwater Outfalls

The Maine DEP 2012 watershed delineation and impervious cover (IC) analysis revised the watershed boundary for the Topsham Fair Mall Stream and mapped in detail the area's stormwater drainage network. This stormwater system captures water from the extensive parking lots and roads, often concentrating the flow into the floodplain or directly into the stream. In a few of the most recent developments, the catchbasins drain into stormwater treatment systems. However, most stormwater pipes drain directly to the stream. Water that does not flow into a stormwater catch basin either infiltrates into the ground, or reaches the stream as overland flow.

The watershed has been delineated into twenty subcatchments (Figure 3). These subcatchments generally follow divisions in the stormwater drainage system, each defined by a specific outfall point. With few exceptions, pollutants from parking areas and roads are thus channeled and piped directly to the stream without treatment. These pollutants, including a mix of heavy metals and hydrocarbons, can be toxic to stream life. The funneling effect of the pavement, buildings, and stormwater system intensifies the volume and velocity of storm runoff, and this intensified flow itself can cause harmful erosion, stream bank widening, and flooding.

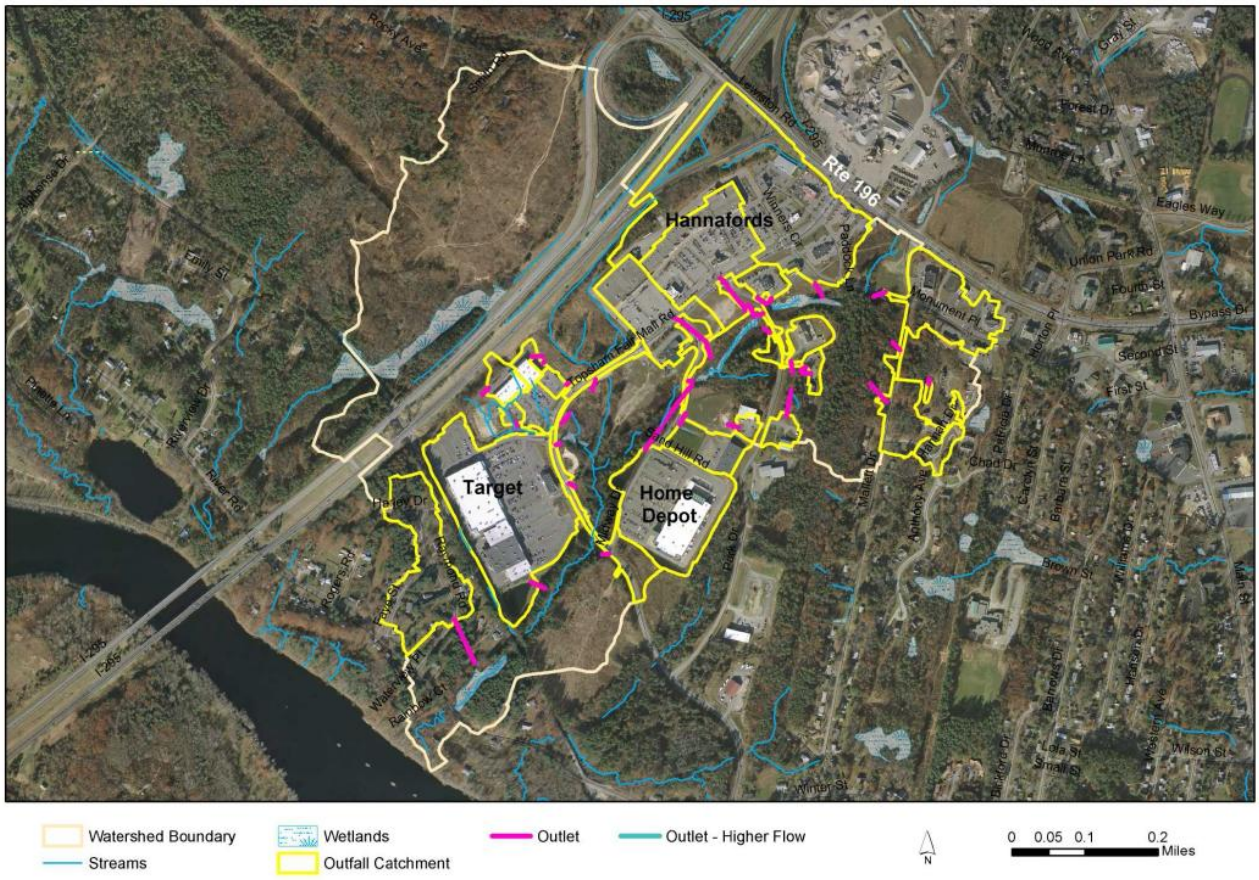

Figure 3: Topsham Fair Mall Stream catchment outfall basins.

2.2. Climate

The climate in the Topsham region is marked by a mean July temperature of 69.3° F, a mean January temperature of 21.3° F, and an overall average annual temperature of 46.5° F. The average annual precipitation is 52.2 inches, including rainfall and snow equivalent. The average annual snowfall for the region is 83.2 inches (National Weather Service, 2013).

2.3. Physical Features of the Watershed

Studying the physical characteristics of a watershed provides a better understanding of a stream's natural dynamics, those which existed before the land was developed. For example, in areas of sandy soils, rainwater tends to infiltrate into the ground quickly, and streams are largely groundwater fed. In clay-dominated soils, rainwater does not infiltrate into the soil as easily, and there is more overland flow to recharge the stream. Understanding the physical characteristics of the watershed provides clues about how we might mimic natural conditions and restore the stream.

2.3.1. Topography

The topography of the Topsham Fair Mall Stream watershed ranges from approximately 71 feet above sea level in the northwestern hills located west of I-295 to about 12 feet above sea level at the outlet of the Topsham Fair Mall Stream into the Androscoggin River. The stream itself is fairly low gradient with few areas of fast moving water. Steep embankments (slopes commonly greater than 30%) define a floodplain of about 200 to 250 feet wide along the stream.

2.3.2. Soils and Geology

Soils in the Topsham Fair Mall Stream watershed consist primarily of Adams loamy sand (AaB, AaC, AaD), which comprise approximately 76% of the soils in the watershed (Figure 4). Adams loamy sand is formed from a sandy glaciofluvial parent material and is generally found along terraces, and on ridges along streams and rivers. These soils have high infiltration rates and are somewhat excessively drained. Surface runoff is slow in areas of 0 to 8 percent slopes, and medium in areas where slopes are greater than 8 percent. Though surface runoff is slow to medium due to high permeability, the risk of pollutants leaching out of the soil into stream, rivers and other bodies of water is high. In addition to Adams loamy sand, 15 percent of the Topsham Fair Mall Stream watershed consists of Hollis Fine Sandy Loam with 8-15% slopes. This soil is formed from a coarse-loamy supraglacial parent material and is commonly found in wooded areas within the watershed. Hollis fine sandy loam is a thin soil, is somewhat excessively drained, and has high permeability.

Adams loamy sand and Hollis fine sandy loam constitute 91% of the watershed, and are high permeability soils. Sixty eight percent of the watershed has slopes greater than 8%, and 24% has slopes of greater than 15%. Areas with slopes greater than 15% have the highest potential for erosion. These highly erodible surfaces are found mainly along the Topsham Fair Mall Stream main stem corridor, as well as along the eastern and western branches.

The combination of steep slopes, sandy soils, and development suggest that soil erosion is a significant risk for the stream. Erosion a major cause of stream degradation, since it is a prime source of excessive nutrients, leading to problems such as algae growth and low oxygen. In addition, the sandy nature of the soils indicate that rainwater will infiltrate rapidly into the soils, and under natural conditions, much of the stream's flow comes from groundwater.

2.3.3. Land Use

A land use analysis of the Topsham Fair Mall Stream watershed shows that is highly urbanized, with 79% of the total area developed, and over 30% of the watershed as impervious surfaces (Figure 5). Fifteen percent of the watershed is considered high intensity development, and 21% is medium intensity development, both comprising primarily commercial complexes along Topsham Fair Mall Road (Figure 6). Low intensity development and developed open space each account for 22% of the total watershed areas. Low intensity development is mainly areas of low density residential development, and developed open space are the landscaped areas between developed areas.

Forest and woods cover 14% of the watershed area. Forested areas are found north and west of I-295 and along the southern watershed boundary. Wetlands, including scrub/shrub areas account for 3% of the watershed. Impacts from the highly developed character of the watershed are considered one of the primary sources of stream impairment.

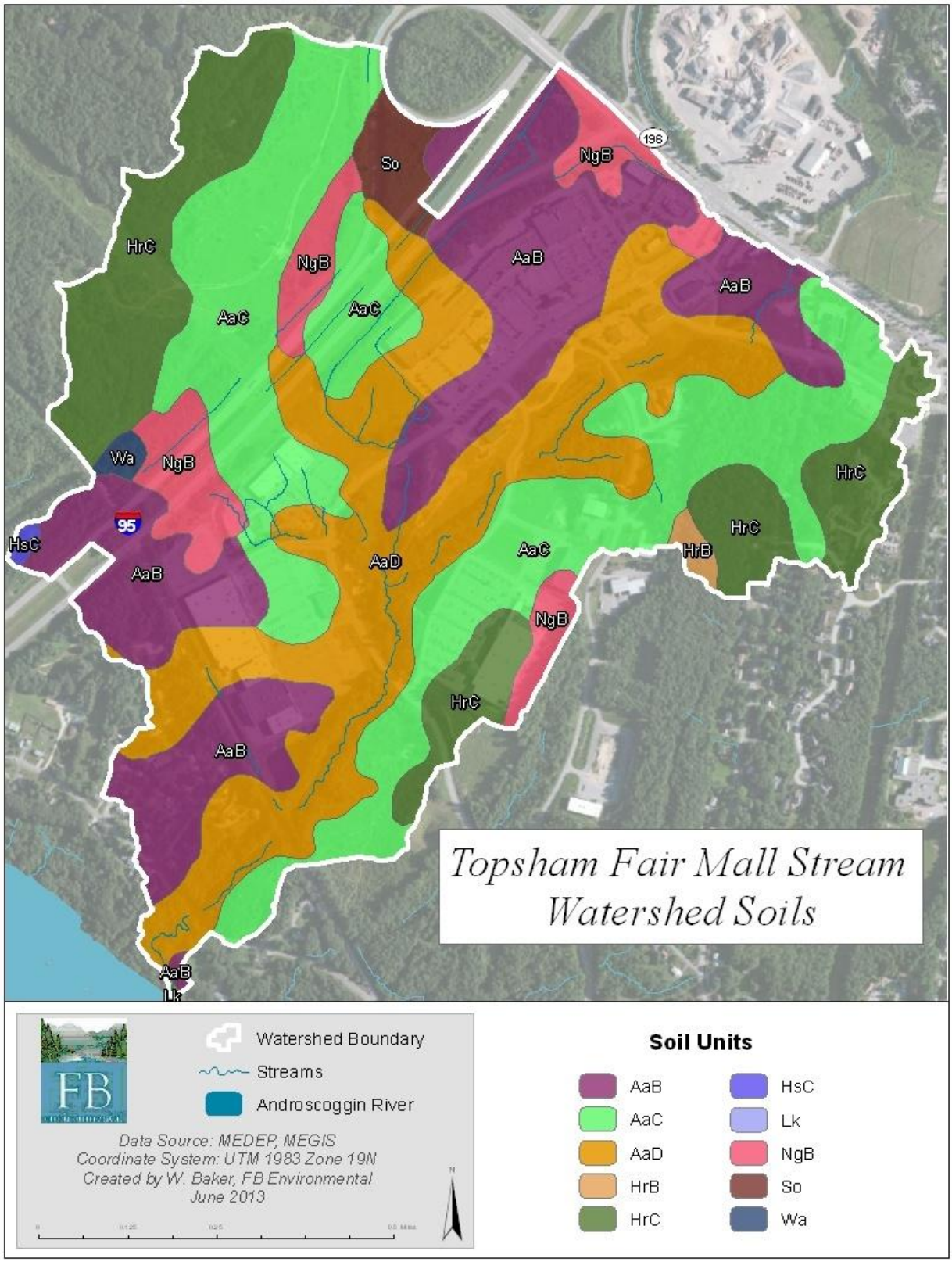

Figure 4: Soils within the watershed.

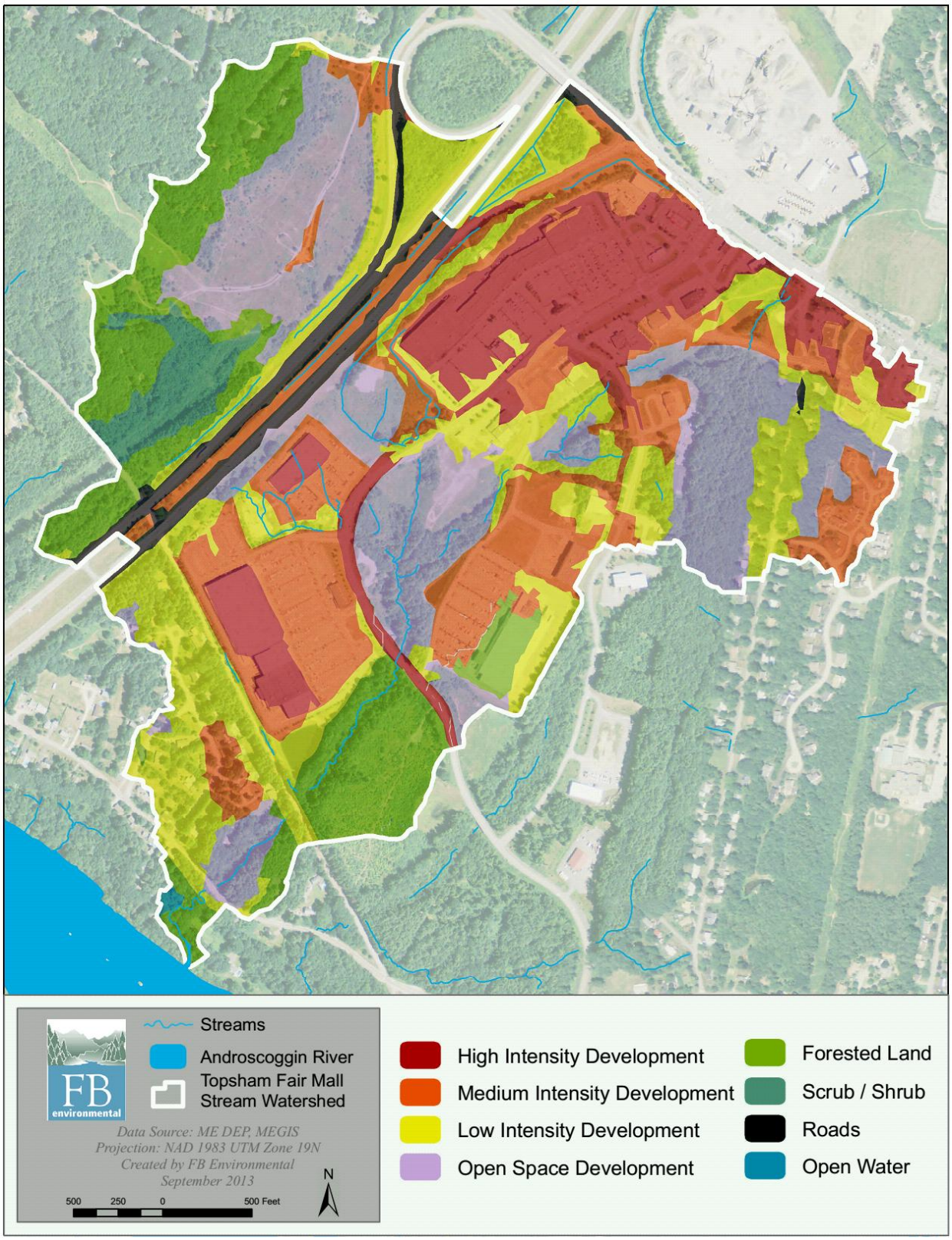

Figure 5: Map of land use within the watershed (data from Maine GIS).

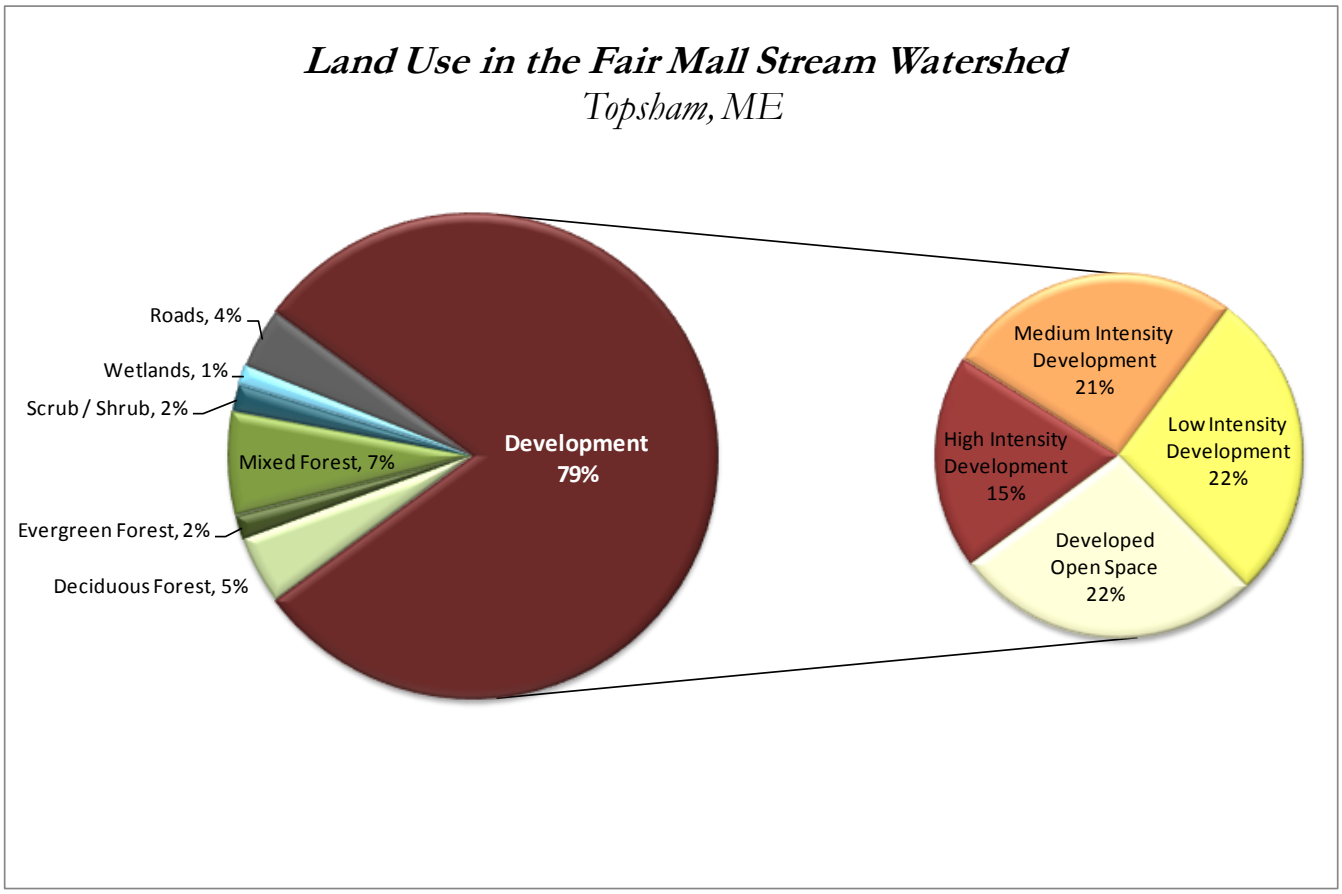

Figure 6: Land use percentages in the watershed.

2.4. Population and Land Use Projections

Population growth has been slow in Sagadahoc County and the town of Topsham. Sagadahoc County decreased in population by 951 residents between 2003 and 2013, a 2% drop in population. The population in Topsham decreased by 3% between 2000 and 2010, a drop from 9,100 to 8,784 residents (U.S. Census Data).

Contrary to regional population trends, however, the Topsham Fair Mall Stream watershed is located in a designated growth area for the Town of Topsham. In addition, its location at a major transportation crossroads of I-95 and US Coastal Route 1 has made it a rapidly developing area within the region. Nearly eighty percent of the land area is already developed. Still, there is additional undeveloped land in the watershed that appears to be buildable based on current zoning. The watershed has experienced, and will continue to experience, intense commercial development.

3. Causes of Impairment

The Topsham Fair Mall Stream is listed as impaired by the state of Maine. This is a formal designation reported by Maine DEP to the US EPA which indicates the stream has been monitored and found not to meet the applicable water quality standards established by the state, and therefore stream restoration actions are required. The assessment, impairment, and restoration efforts to date are described below.

3.1. Maine Water Quality Standards

The state of Maine, in accordance with the Federal Clean Water Act, has established minimum standards that all streams must meet. Topsham Fair Mall Stream must meet Class B stream standards as defined under Maine's Water Classification Program as established by the Maine Legislature (Title 38 MRSA 464-468). The Maine Legislature has established that "Class B waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life." Table 1 (below) summarizes the narrative and numeric water quality standards applicable to the Fair Mall Stream.

Table 1: Maine water quality criteria for Class B waters (38 MRSA § 465).

Parameter	Criteria for Compliance
Designated Uses	Water must be suitable for drinking water supply after treatment; fishing; agriculture; recreation in and on the water, industrial process and cooling water supply; hydroelectric power generation; an un-impaired habitat for fish and other aquatic life.
Dissolved Oxygen *Year-Round*	May not be less than 7 ppm or 75% saturation, whichever is higher.
Dissolved Oxygen *October 1st – May 15th*	In order to ensure spawning and egg incubation of indigenous fish species, the 7-day mean dissolved oxygen concentration may not be less than 9.5 ppm and the 1-day minimum dissolved oxygen concentration may not be less than 8 ppm in identified fish spawning areas.
***E. coli* Bacteria**	Between May 15th and September 30th, the number of *Escherichia coli* bacteria in these waters may not exceed a geometric mean of 64 per 100 milliliters or an instantaneous level of 236 per milliliters.
Discharges	Must not cause adverse impact to aquatic life, and the receiving waters must be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

3.2. Maine DEP Stream Assessment and Total Maximum Daily Load

Water quality sampling data were collected in the Topsham Fair Mall Stream between 2002 and 2008. This includes monitoring of the macroinvertebrate community, physical habitat parameters, and water chemistry. Sampling results were compared to Maine Class B water quality standards, and the stream was first listed as impaired in 2008 due to non-attainment of aquatic life criteria, specifically the habitat and benthic-macroinvertebrate parameters.

The Clean Water Act requires all impaired streams to undergo an analysis of pollutant loading to calculate the amount of pollutant the impaired stream may accept while still attaining water quality standards. The resulting calculated value is called a *Total Maximum Daily Load*, or TMDL. The TMDL can be expressed in a variety of ways. The Topsham Fair Mall Stream (unnamed tributary of the Androscoggin River – draining Topsham Fair Mall) TMDL was released in 2011 and is expressed in terms of impervious cover (IC) in the watershed (Maine DEP, 2011b).

According to Maine's 2009 list of impaired waters (or 303(d) list, named for the section of the Clean Water Act which requires it), the reason for the aquatic life impairment in the Topsham Fair Mall Stream is unknown, because it cannot be attributed to a specific pollutant; however, is likely due to runoff containing a variety of pollutants associated with urban stormwater. Since portions of the Topsham Fair Mall Stream watershed are highly developed (total impervious surface area of approximately 30%), impervious cover was used as a surrogate measure of the range of pollutants in stormwater for the TMDL. The TMDL sets a target goal of 8% effective impervious cover, a level at which streams in Maine in general are expected to attain Class B water quality standards. Effective impervious cover can be reduced by implementing stormwater treatment and prevention measures, so physical removal of impervious surfaces to the 8% threshold is not anticipated. Periodic aquatic life assessment (biomonitoring of the benthic macroinvertebrate community) provides the formal measurement of progress toward meeting the TMDL.

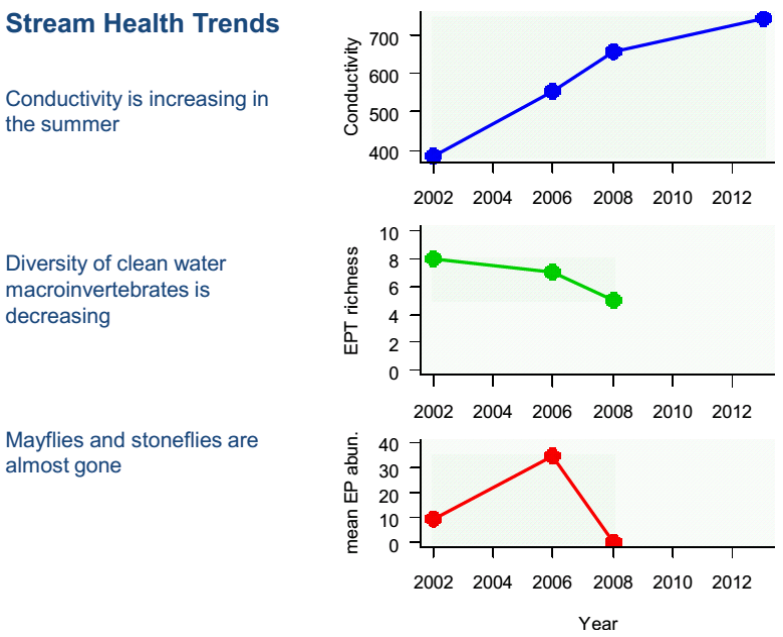

Figure 7: Trends in conductivity (related to road salt pollution) and key biological indicators of stream health. Source: T. Danielson, Maine DEP.

3.3. Additional Monitoring and Assessment

Additional monitoring and assessment has occurred as part of this project, beyond the aquatic life assessment conducted by Maine DEP as part of its regular state-wide stream assessment programs. These additional efforts have focused on key in-stream data, stream channel and floodplain dynamics (geomorphology), and stormwater infrastructure. The extra data collection has contributed to a better understanding of why the benthic macroinvertebrate community is not meeting minimum Class B standards.

3.3.1. In-Stream Data Collection

Maine DEP and FB Environmental both provided staff and equipment to measure key parameters in the Topsham Fair Mall Stream. Initial screening by Maine DEP indicated that in-stream temperature and oxygen attained water quality standards, but specific conductance (a proxy for chloride from de-icing salt) was high. More detailed screening by Maine DEP using handheld meters and longer term data sondes and loggers showed that in-stream specific conductance levels were high throughout the main stem of the stream, but were low in the tributary draining land west of the Maine Turnpike (Figure 9). A supplemental monitoring plan focused on road salt was therefore developed as part of developing this watershed based plan.

Figure 8: Water quality monitoring indicated high salinity from road salt in both winter and summer conditions.

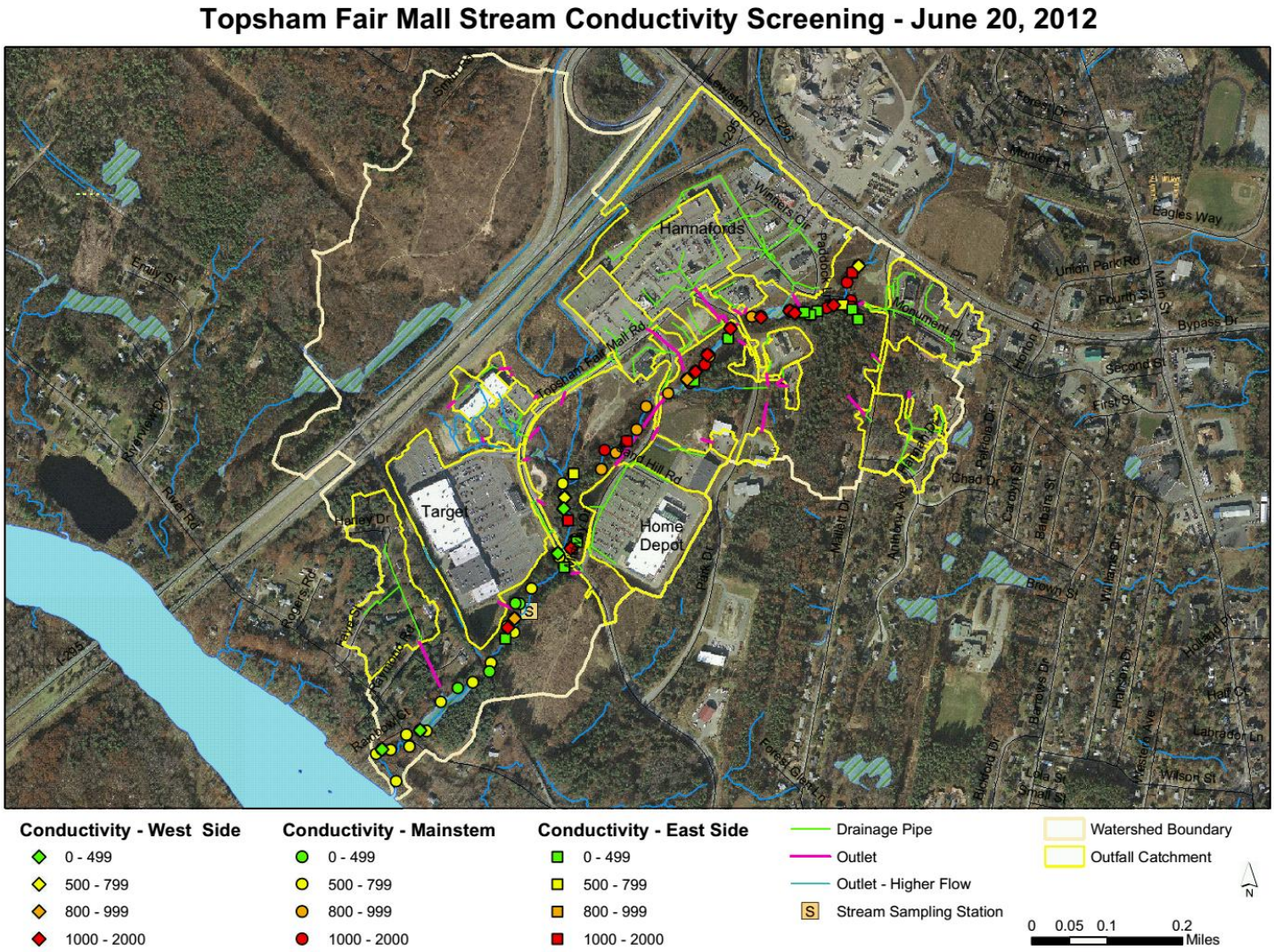

Figure 9: Initial specific conductance screening data from Maine DEP.

Data sondes were placed at three locations in Topsham Fair Mall Stream and recorded dissolved oxygen (percent saturation and mg/L), temperature, and specific conductance. In addition, chloride was measured via grab samples and laboratory analysis at several locations and times (n=10; R^2=0.89). Chloride and specific conductance are strongly correlated (typical R^2 values >0.9 for linear relationship). Similar correlations have been developed in Long Creek (South Portland, ME; n=89; R^2=0.97) (K. MacDonald, pers. comm.) and Trout Brook (South Portland, ME; n=41; R^2=0.88) (F. Dillon, pers. comm.). Using these correlations allows for in-stream chloride levels to be calculated based on specific conductance measurements. Regional correlations have been used for regulatory purposes in New England (NH DES 2006; 2007a, b; NH DES 2008a, b, c, d). The ability to measure specific conductance at high frequency and low cost means that the location, timing, and severity of chloride pollution can be seen, which in turn helps identify sources and develop stream restoration strategies.

Table 2: Preliminary in-stream chloride estimates based on specific conductance measurements from data sondes.

Site ID	Location	Spring Runoff - March 2013		Baseflow - August 2013	
		Time in Chronic Exceedance >230 mg/L	Time in Acute Exceedance >860 mg/L	Time in Chronic Exceedance >230 mg/L	Time in Acute Exceedance >860 mg/L
TMN	Monument Drive	89%	1.4%	100%	0%
TMD	Midway Drive	91%	2.4%	99.6%	0%
RR	Railroad Culvert	31%	1.0%	0%	0%

Calculations based on median of three chloride to specific conductance data sets: Topsham Fair Mall Stream, n=10; Long Creek (South Portland, ME), n=89; Trout Brook (South Portland, ME), n=42.

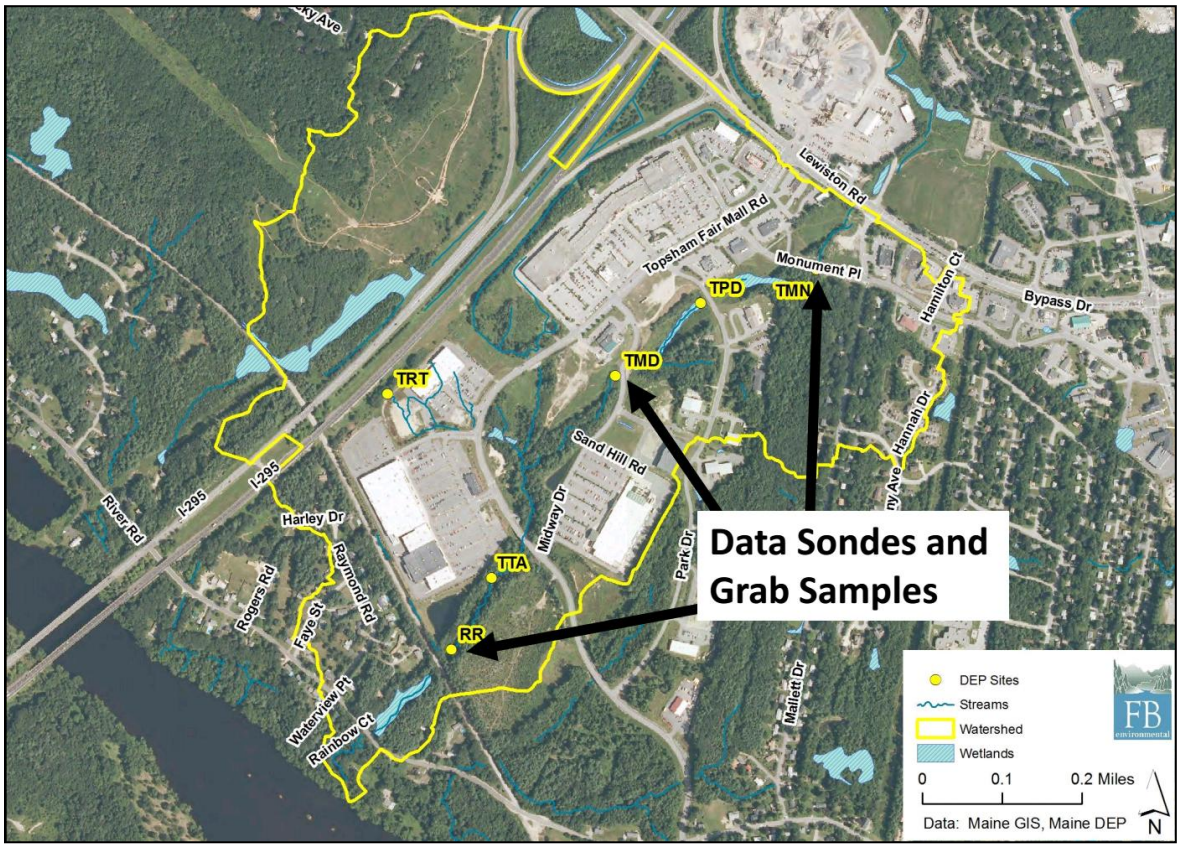

Figure 10: Location of data sondes and chloride grab samples.

The monitoring data clearly indicate that chloride is a pollutant of concern in Topsham Fair Mall Stream throughout the year. Chloride concentrations in the middle and upper portion of the stream are constantly above the chronic pollution threshold of 230 mg/L during summer baseflow periods, and nearly so in winter. In the winter, they are over the acute threshold of 860 mg/L about 2% of the time, coinciding with salt application during storm periods. Chloride concentrations are much lower in the downstream reaches, with water quality exceeding chronic standards about one third of the time in winter, acute standards about 1% of the time in winter, and water quality in compliance during the summer baseflow period.

The geographic and temporal patterns of chloride concentrations in the Topsham Fair Mall Stream strongly suggest that de-icing salt applied to parking lots and roads in the upper and middle watershed is entering the stream through two pathways: runoff and groundwater. Direct runoff can occur when salty melt water (or excess rock salt) flows directly to the stream overland or through stormdrains, and when salt-laden snow is dumped next to a stream and then rapidly melts. Highly salty runoff creates an extremely large spike in chloride concentrations which causes in-stream conditions to rise above the acute water quality standards for a period of hours or days.

Groundwater, a second pathway by which chloride enters the stream, occurs as salty melt water gradually seeps into the ground (via the surface or through leaking stormwater pipes), and then is gradually released into the stream over a period of months or years. Salty groundwater is indicated by higher chloride concentrations during the stream's low-flow periods in the late summer and fall, interrupted by a temporary decline during storms when rain provides in-stream dilution. Based on limited monitoring during this study which indicated low chloride levels downstream, it appears that contaminated groundwater is localized in the upper and middle watershed where commercial development is most intense and has been around longer, and there are very high levels of impervious surfaces.

3.3.2. Geomorphic Assessment

Dr. John Field of Field Geology Services conducted a reconnaissance-level fluvial Geomorphic Assessment of the Topsham Fair Mall Stream in the summer of 2013 to better document and understand the stream's geomorphology (stream and floodplain shape), aquatic habitat, and channel stability. The geomorphic assessment consisted of document and map review, followed by a field visit. Jeff Dennis and Kristin Feindel of Maine DEP were present during the field visit. The assessment found that the several large retaining walls built across the floodplain to support road crossings have severely altered the stream habitat, causing sediment to back up behind the walls, and creating scouring downstream of the small culverts. In addition, the blocked floodplain represents a potential threat to life and property should the culverts ever become blocked in a storm. See Section 3.4 for further description of the impairment due to road crossings. The geomorphic assessment report is available online at:
http://www.fbenvironmental.com/images/PDF/Topsham/TopshamFairMallGeomorphReport.pdf.

3.3.3. Rapid Habitat Assessment (RHA)

FB Environmental and Maine DEP collaborated to conduct a rapid habitat assessment of the Topsham Fair Mall Stream. In October 2012. Scientists visited the stream in person to measure and characterize vegetation, temperature, streambed, stream banks, and pollution, using an EPA-approved standardized scoring method. The stream survey was divided into seven major stream reaches (Figure 11). Reach lengths were defined by physical characteristics of the stream, as well as man-made structures such as road crossings.

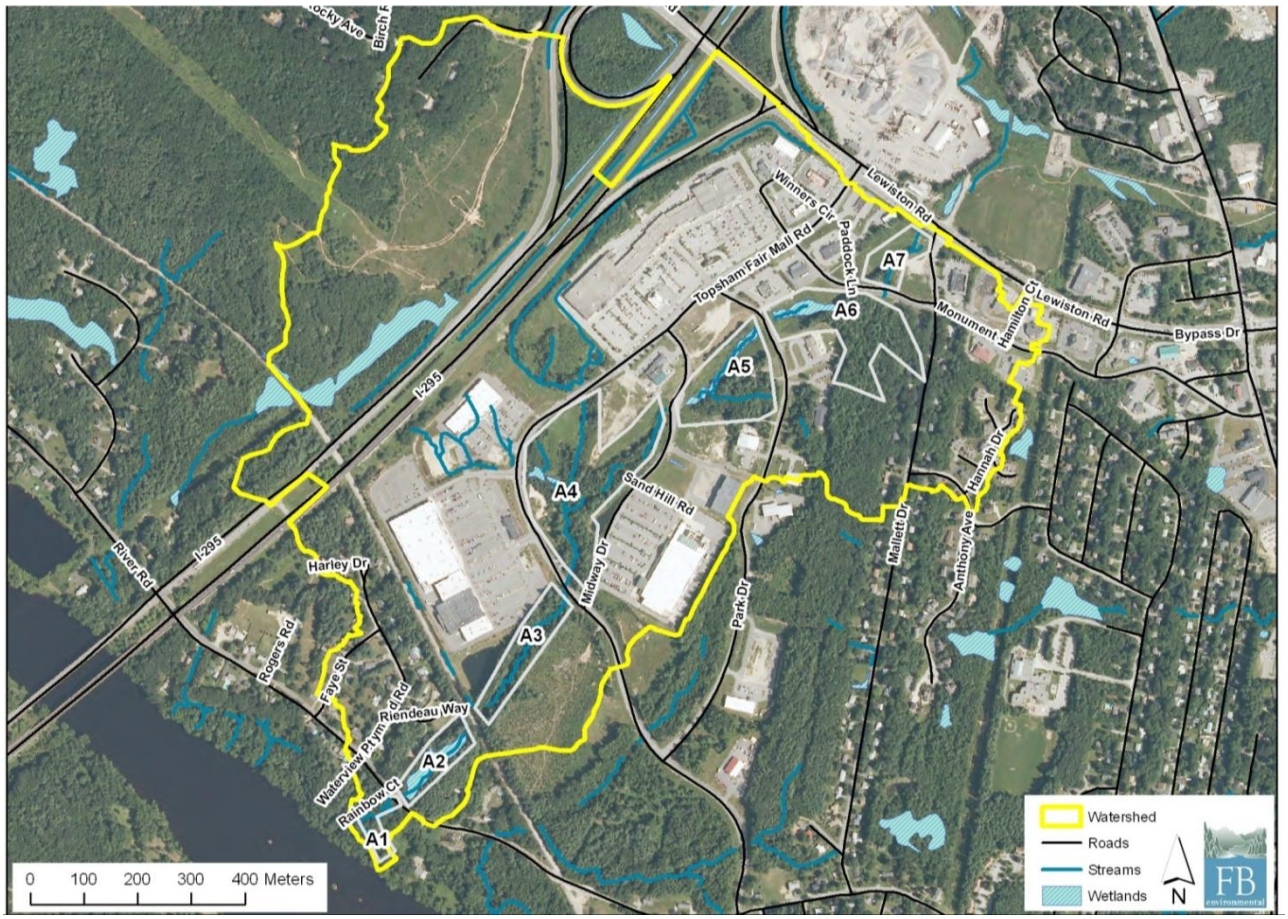

Figure 11: Rapid habitat assessment stream reaches.

Habitat: Examination of the in-stream characteristics indicate the presence of a variety of habitat types within all reaches of the stream. The most prevalent habitats include pools, riffles and runs.

Nature of Particles in Stream Bottom/Embeddedness: Embeddedness indicates how deeply rocks and woody debris are buried in the streambed. The results for this assessment category were concerning. Overall, the stream reaches are dominated by sand that is in continual movement, as evidenced by the high levels of embeddedness (50-100%). An unstable, highly embedded stream bed is considered poor habitat for fish and aquatic life.

Woody Debris: Woody debris is essential for good stream habitat. The upper reaches of the stream were scored as "few" or "none" for coarse woody debris (reaches A-5 and A-7). These reaches are located in intensely developed areas with many road crossings. Stream reach A-6, however, flows through a small wooded area. Coarse woody debris was scored as "many" in this stream reach. The lower portions of the main stem (Reaches A-1 through A-4) were characterized as having "many" or "plentiful" coarse woody debris. These reaches begin at Midway Drive and flow south through a wooded corridor to the stream's confluence with the Androscoggin River.

Water Appearance/Odor: During non-storm flow conditions, the water in the Topsham Fair Mall Stream is generally clear with a few notable exceptions. These include stretches that were light brown (Reach A-6 between Pearl Drive and Monument Drive road crossings), orange (assumed to be due to iron bacteria, Reach A-5 located between Midway Drive and Park Drive), and foamy (Reach A-5). Foam was observed at stormwater outfalls in reach A-5, and an oily sheen

(characteristics indicate a natural origin) was documented in reach A-7 north of Monument Drive. All reaches were documented as having a natural odor.

Streamside (Riparian) Vegetation and Water Temperature: Riparian cover provides shade and protects the stream from harmful temperature extremes. Six of the seven stream reaches surveyed in the stream had good riparian cover (75% or more). Four reaches (A-2, A-3, A-4, and A-7) exhibited 100% cover, while two of the reaches (A-1 and A-6) had vegetation that shaded 75% of the stream. Areas with low percentages of riparian cover were often located in highly developed areas, roadways and parking lots adjacent to the stream where trees had been cut in the recent past, or located within an emergent wetland with little tree cover. Reach A-5 exhibited only 25% riparian cover. Instantaneous temperature readings in the Topsham Fair Mall Stream ranged from 6.8°C (Reach A-1) to 10°C (Reach A-4). Reaches A-3, A-5 and A-6 were consistently at 8°C, and reach A-2 was 7°C.

The existence of reasonably wide forest buffers along portions of the stream (especially the lower section below the Topsham Fair Mall shopping complex), and sections of fair to good riparian cover, even in developed portions of the stream, are important protective features of the stream corridor. In addition, the stream is believed to be primarily groundwater fed, which probably helps maintain a constant in-stream water temperature.

Streambank and Channel Characteristics: The Topsham Fair Mall Stream is a relatively shallow stream with the exception of a few small pools greater than 2 feet deep found in reach A-1 just above the Androscoggin River. A majority of the stream has at least one bank with steep, eroding slopes above the stream, and vertical undercut banks at the stream. Degradation of natural streamside plant cover and undercut banks is common. Discharging pipes (including storm drain outfalls) and/or ditches are present in all but two of the seven stream reaches (A-1 and A-2), carrying stormwater and attached sediment and pollutants, and causing erosion where the incoming water meets the stream. Reaches that ranked poor exhibited few to no pools less than two feet deep, road crossings, or retaining walls and parking lots causing erosion and sedimentation in the stream.

Visual Biological Survey: Similar to the Maine DEP 2002 and 2007 biomonitoring results, macroinvertebrates were found occasionally, but not in abundance. These results, although not as in-depth as periodic Maine DEP bioassessment, support the idea that benthic communities in the Topsham Fair Mall Stream lack species richness, which suggests impaired habitat. Small fish were documented in two reaches. Signs of mammals present within the reach areas were documented in four of the seven reaches. Small mammal holes and deer beds were observed, along with the sighting of one raccoon.

Water Quality and Potential Pollution Sources and Problems: Water quality and potential pollution problems are common in the majority of stream reaches in the Fair Mall Stream. Road crossings with unstable and eroding culverts, storm drains and stormwater outfalls, ditches that drain directly to the stream, bank erosion, as well as trash and debris all contribute to the problem. Invasive plants pose another threat to water quality. These plants replace native riparian vegetation, potentially destabilizing stream banks, and make stream access difficult.

Overall scores were the average of above categories on a scale of 1 (best) to 5 (worst). Water temperature and shading scored best, and stream bottom and potential pollution sources scored worst. The highest quality habitat was in stream reach A-2 (score 2.15), and the worst in A-5 (score 3.57). All other sectors scored between 2.5 and 3.15.

3.3.4. Stormwater Retrofit Reconnaissance Inventory (RRI)

Stormwater retrofits provide stormwater treatment in locations where existing stormwater management practices do not exist, or they can enhance existing stormwater management practices and provide a benefit to the receiving waterbody.

To assess the potential for stormwater storage and onsite stormwater retrofit opportunities within the Topsham Fair Mall Stream watershed, a retrofit reconnaissance inventory (RRI) was completed in July/August of 2013. Wright-Pierce staff completed a desktop analysis and site visits to 34 individual parcels identified as "commercial" properties within the watershed to assess their existing stormwater practices and potential as stormwater retrofit sites. Although the watershed does include residential properties, they were excluded from the RRI evaluation as they were seen as having a limited potential for reduction in impact on stream impairment.

Benefits of Stormwater Retrofits:

- Regulate stormwater runoff
- Reduce sedimentation
- Provide channel protection
- Reduce erosion & geomorphic change
- Improve community aesthetics
- Improve water quality
- Improve biological communities

In general, retrofit opportunities within the watershed are focused on treating localized, "hot spot" areas (high use/heavy traffic). For the most part, potential retrofits are aimed at improving stormwater quality rather than stormwater quantity; however, there were a few instances where quantity issues were addressed. Proposed retrofits include both structural and non-structural stormwater management practices, such as tree box filters, disconnection of roof drains, modification of existing stormwater best management practices, and closed-circuit television (CCTV) inspections of underground infrastructure as well as procedures related to good housekeeping and pollution prevention. Since chlorides are a concern as a cause of impairment in the watershed, retrofits involving infiltration were avoided, unless the stormwater to be infiltrated came from an area that would not receive salt application (such as rooftop runoff).

3.4. Stream Impairment from Road Crossings

The geomorphic assessment conducted by Field Geology Services in 2013 found that the Topsham Fair Mall Stream basic shape (geomorphology) has been severely altered by the seven road crossings along the 1.4 miles of the stream's main stem. These crossings consist of large walls which completely block the flood plain, constricting the stream channel to a narrow culvert and greatly altering flood flows and overall sediment transport dynamics. As a result, the areas upstream and downstream of each crossing have poor aquatic habitat, which contributes to the stream's low assessment results and impaired status.

Figure 12: Stormwater detained behind the Midway Drive road crossing. (C. Rinehart, Wright-Pierce).

Specific symptoms of poor habitat were identified in the geomorphic assessment. Upstream of the culverts, there tends to be marshy floodplain with poorly defined, multiple channels, and downstream of the culverts the stream channel is incised. The few areas of potentially good, meandering aquatic habitat suitable for trout and other aquatic life are therefore too small and isolated from each other to support the minimum aquatic life required by state standards.

In addition to impairing habitat, the massive amount of fill which is blocking the floodplain at each road crossing creates a serious flood hazard potential. If any of the seven small culverts ever become plugged during a storm, there is a risk that the floodplain will fill with water, overtop and cause a cascade of road washouts which would threaten life and property.

Figure 13:Retaining wall and fill, with small culvert for stream, blocking the floodplain beneath a road crossing. Photo: K. Feindel, Maine DEP.

3.5. Stream Impairment from Stormwater and Impervious Cover

One of the primary causes of impairment of the Topsham Fair Mall Stream is polluted runoff, also called stormwater runoff. In urban areas, rainwater flows quickly over impervious surfaces, picking up pollutants such as metals, petroleum products, eroding soil from construction, winter salt and sand, lawn fertilizers and pesticides. In addition to these chemical pollutants, the intensified flows of runoff from the high level of impervious surfaces can interfere with natural stream hydrology.

Vegetation tends to slow down the flow of rainwater, and natural soils often allow rain to infiltrate into the ground. By contrast, hard surfaces and stormwater drains and pipes tend to funnel rainwater rapidly to the stream channel, resulting in higher volume and velocity over a shorter period of time, as a result eroding and widening the flood plain, damaging aquatic habitats, and increasing the likelihood of property damage. (Allan and Castillo 2007). Watersheds exceeding 12% IC usually fail to meet aquatic life criteria and narrative water quality standards (Stanfield and Kilgore, 2006). Other research has shown that sensitive species of fish may decline in watersheds with 4-6% IC or less, and declines in sensitive macroinvertebrate species can also occur at very low levels of urbanization (Wenger et al., 2008).

Figure 14: Heavy salt application can cause high chloride levels in both winter from direct runoff, and in summer due to groundwater contamination.

The current estimate of impervious cover in the Topsham Fair Mall Stream watershed is 30%, more than twice the typical threshold for impairment (Figure 15). Impervious cover, primarily associated with commercial development, is concentrated in the upper and middle portions of the watershed on both sides of the stream, and much of that land use is in high vehicle turnover commercial usage. In the Topsham Fair Mall Stream, severe habitat alteration has occurred from the stream crossings which completely block the floodplain (see Section 3.1). Stream habitat (geomorphology) is severely degraded by these road crossings, overshadowing the effects of stormwater flows. Nonetheless, in-stream monitoring of water quality clearly shows stormwater impairment. High salinity in both winter and summer in the upper and middle portions of the watershed has been found. Maine DEP macroinvertebrate assessment, along with the land use and impervious cover characteristics of the watershed, indicate that a broad suite of stormwater pollutants including nutrients, metals, and hydrocarbons are affecting the stream.

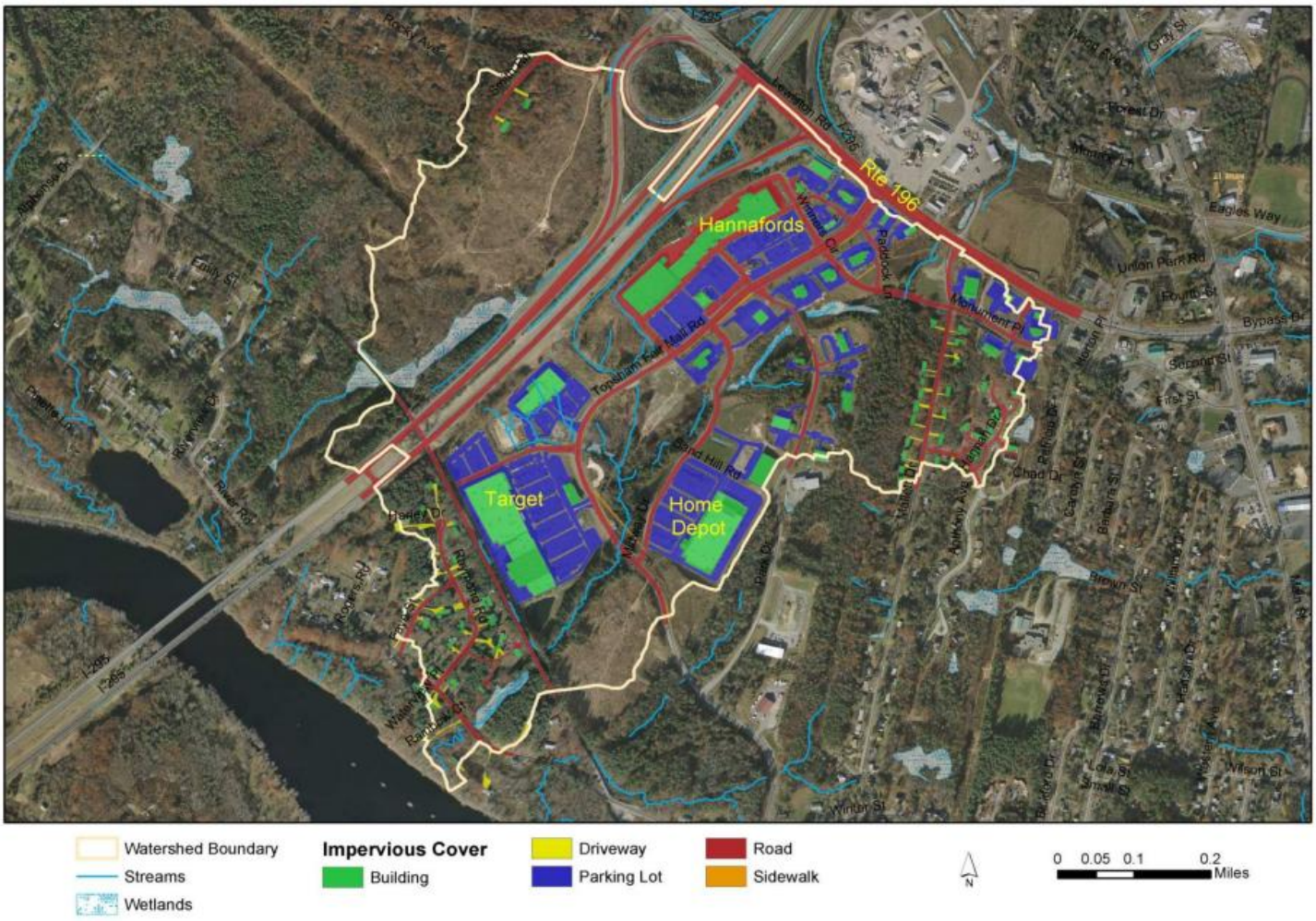

Figure 15: Map of impervious cover by category.

4. Restoration Strategies

Watershed studies and community stakeholder involvement provide an excellent framework for identifying and understanding the sources of pollution and habitat impairment in the Topsham Fair Mall Stream. This information has led to the development of locally-driven solutions, organized and prioritized in an action plan (Section 4.3). Successful restoration of the stream requires setting goals and developing objectives to help meet those goals. The following Restoration Plan provides key actions needed to restore the stream, the timing of these actions, and the mechanisms by which these actions will be accomplished.

4.1. Goals and Objectives for Restoration

The purpose of the Topsham Fair Mall Stream Watershed Restoration Project is to improve watershed and in-stream conditions so that the stream will attain water quality classification standards. This can only be achieved with the commitment of a coordinated group of local community leaders, conservation groups, state and federal partners, and citizens of the watershed working together to accomplish common goals and objectives (Table 3).

Table 3: Topsham Fair Mall Stream watershed restoration objectives (adapted from FBE, 2009).

Goals	Watershed Restoration Objectives
Improve Water Quality	Urban Pollutants: manage sources and transport of urban stormwater pollutants and nutrients to restore and protect watershed health and achieve applicable water quality standards (which includes supporting diverse, healthy aquatic communities).
	Macroinvertebrates: improve stream conditions, protect watershed health, and achieve applicable water quality standards (which includes supporting diverse, healthy aquatic communities).
Improve Physical Habitat	Aquatic Habitat: improve the quality and extent of aquatic, riparian, and floodplain habitat to support the return and persistence of diverse native fish and macroinvertebrate communities.
	Terrestrial Habitat: improve and protect riparian habitat extent and quality to support the persistence of native terrestrial communities and connectivity to aquatic and riparian habitats.
Improve Hydrology	Stream Flow: Protect and increase runoff infiltration and detention areas of non-chloride impacted water to normalize stream hydrographs and reduce stormwater flow to the stream. Stormwater with high salt levels can pollute groundwater if infiltrated.
	Channel and Floodplain Functions: protect and restore the extent, connectivity, and functions of streams, drainage ways, wetlands, riparian areas, and floodplains to improve bank stability and natural hydrologic functions and reduce risk to the built environment and human safety.

4.2. Structural and Non-Structural Restoration Approaches

The two major categories of stream restoration activities are structural and non-structural best management practices (BMPs). Structural BMPs are those which involve construction, installation, or other physical changes to the built environment or landscape. Typically, structural BMPs focus on reduction or treatment of stormwater by redirecting piped stormwater drainage to engineered soil and/or vegetative filter systems or natural vegetated areas, pervious pavement, or detention or retention ponds. Non-structural BMPs are those which involve a operational changes, such as allowing natural vegetation to grow along stream banks rather than aggressively mowing, reducing fertilizer application, optimizing de-icing procedures to use the minimum amount of salt necessary, relocating snow dumps to less sensitive areas, regular street sweeping, and maintaining existing stormwater treatment systems. A combination of structural and non-structural BMPs is usually the most effective.

4.3. Prioritization of Retrofit Sites

The Topsham Fair Mall Stream Stormwater Retrofit Reconnaissance Inventory (RRI Survey) was designed to serve as preliminary investigation of potential retrofit sites in the highly impervious portions of the Topsham Fair Mall Stream watershed, and to help prioritize sites for the restoration plan. As previously noted, 34 individual parcels were included in the RRI; however, some of these parcels were combined and considered as one site, given their connectivity to each other or their common stormwater system. For the purposes of this report, 31 sites were evaluated for the potential for both structural and non-structural BMPs, and an overall priority was determined based on both the value to the stream and the ease of implementation for the potential retrofits. Several members of the TAC discussed the list of prioritized retrofit sites. The group assign a value to two ranking parameters: 1) value to the stream; and 2) ease of implementation.

V**alue to the stream** was assigned by considering the likely contribution of pollutants from the site and the potential of removing stormwater pollutants from the site, and is based on the following factors:

- Use of the parcel (high vs. low turnover),
- Existing treatment,
- Directly vs. Indirectly connected impervious cover,
- Proximity of the site to the stream,
- Conductivity data provided by Maine DEP,
- Future development potential at or near the site, and
- Snow storage areas and parking usage.

E**ase of implementation** anticipated the site constraints that could be encountered when implementing the retrofit, and primarily considered:

- Access,
- Potential for conflicts with existing utilities, and
- Likely cost of construction.

Several sites exhibited the potential for multiple retrofits with varying prioritization.

Highest priority was given to projects that will provide the greatest value to the stream and show reasonable ease of installation.

The ranking system resulted in a determination of low to high potential. Out of the 31 sites visited, 24 sites were identified as exhibiting potential for retrofits and five sites were identified as having no potential retrofits. Of the 24 sites with potential retrofits, 49 individual retrofits were identified; 11 were ranked as high, five were ranked as moderate-high, 13 were ranked as moderate, and 20 were ranked as low overall priority. It should be noted that two of the potential retrofits apply to multiple sites. Although closed-circuit television (CCTV) inspection of storm drain piping was specifically identified for catch basins on two separate sites, it was suggested at the TAC meeting that the video inspection be expanded to include the tributary area to the Monument Place and Midway Drive outfalls (which encompasses several sites). It was also recommended that select catch basins located in the Topsham Fair Mall parking lot, Winners Circle, and at entrance intersections be equipped with catch basin inserts. For purposes of this report, these catch basins are considered as one retrofit, although it applies to several sites. The highest priority potential retrofits in the Topsham Fair Mall Stream watershed are included in Table 4 and shown in Figure 16. For a complete summary of the potential retrofits, refer to Appendix 1.

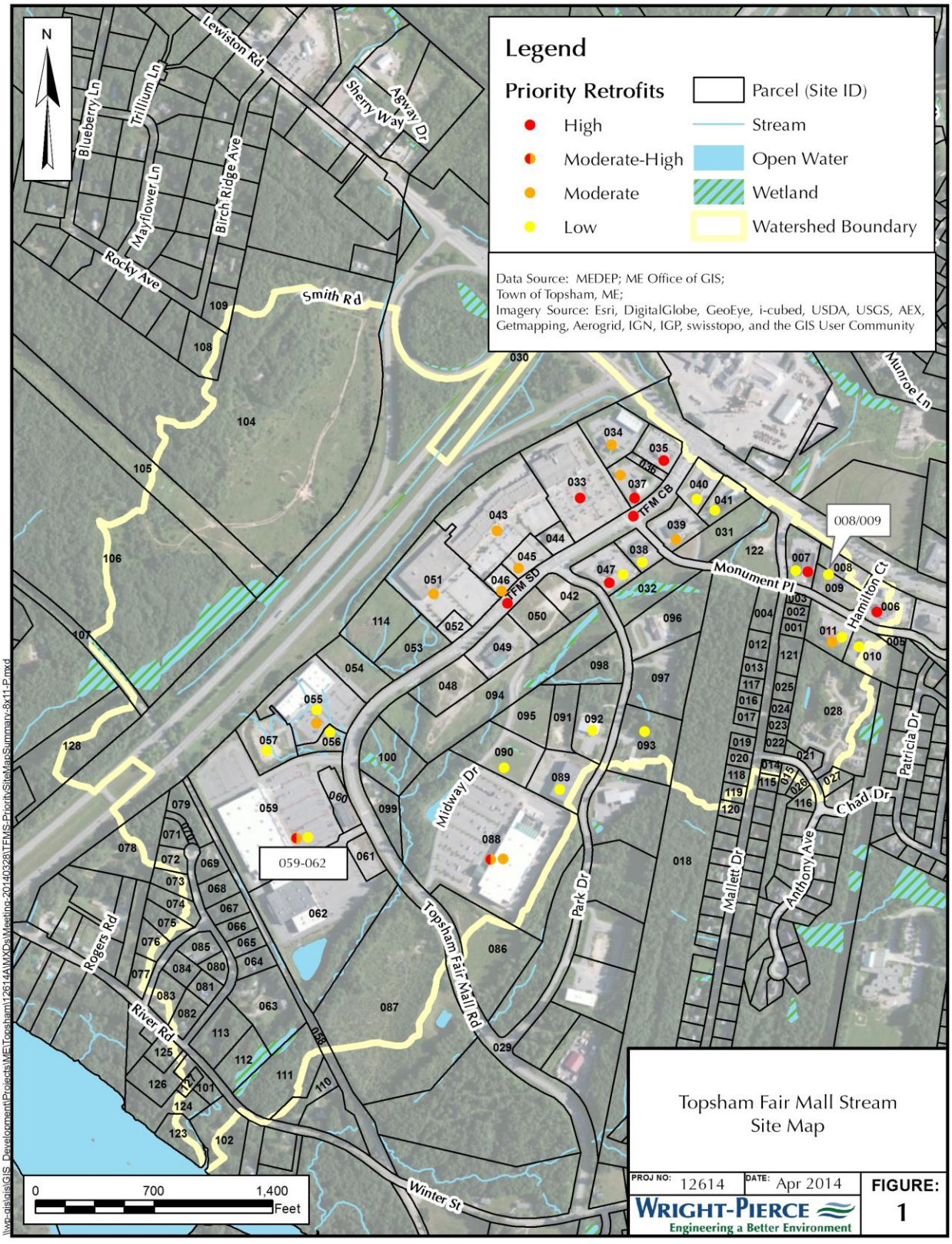

Figure 16: Map of High Priority Stormwater Retrofit Sites.

Table 4: High Priority Stormwater Retrofits.

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority
6	Install proprietary system to address high sediment and hydrocarbons from paved areas.	High	Moderate	High
6	Implement Good housekeeping and maintenance for dumpsters and catch basins.	High	Easy	High
7	Reshape low spot adjacent to northeast parking lot, and install outlet control structure with underdrain to address quantity and erosion issue.	Moderate	Easy	High
33	Install tree box filters at two catch basin located in parking spaces.	High	Moderate-Hard	High
33	Disconnect roof drains from collection system and infiltrate in subsurface system in coordination with Site 43/51.	High	Hard	High
35	Install filter system in low areas near high traffic areas at drive thru.	High	Hard	High
37	Install proprietary catch basin to address fats-oils-grease (FOG), hydrocarbons, and sediment in an existing catch basin.	High	Moderate	High
37	Implement good housekeeping and maintenance for dumpsters and catch basins.	High	Easy	High
47	Address snow storage location (currently piled over bank). Collect snow and allow to drain directly to catch basin (collect sand in sump to eliminate sand from washing over bank).	High	Easy	High
TFM SD	CCTV storm drain piping to determine potential inflow and infiltration in area tributary to Park Drive, Monument Place, and Midway Drive outfalls.	Unknown	Easy	High
TFM CBs	Install catch basins inserts in select catch basins. Estimate based on eight catch basins.	High	Moderate	High

4.4. Pollutant Removal

The pollutants that are present in the Topsham Fair Mall Stream watershed are similar to those found in other urban settings and comprise a mixture of nutrients, heavy metals, hydrocarbons, and chloride. The proposed retrofits are targeted for hot spot areas with high use, such as high turnover of parking or other activities. Based on discussions with the Maine DEP, it was decided that evaluating the net reduction in annual phosphorus load would be an appropriate method for projecting the effectiveness of retrofits within this watershed. Phosphorus is considered a reasonable surrogate to use because it typically results in lesser of a reduction than other pollutants (i.e. heavy metals and hydrocarbons), and therefore is a conservative approach.

The pollutant load analysis focused on the net reduction in pounds per year of algal-available phosphorus that would result from the implementation of the moderate to high priority structural retrofits, since the action plan (Section 4.5) includes those items. The analysis used a generalized approach by defining the pollutant load as a function of land use area. To determine the net reduction in phosphorus, the first step was to determine the pretreatment export by multiplying the treated area (in acres) by the export coefficient for the land use under consideration (expressed as pounds phosphorus

per acre per year). Once the pretreatment export was determined, the net reduction was achieved by multiplying the removal efficiency by the pretreatment export value. Both the reduction efficiencies and area export coefficients were developed using guidance provided by the Maine DEP.

The total annual net reduction in phosphorus export for the moderate to high priority structural retrofits is estimated to be just over seven pounds, which is an approximate 55 percent reduction. It is anticipated that there will be at least an equivalent percent reduction for other pollutants, such as heavy metals and hydrocarbons as well, but not necessarily for chloride. The estimated load reduction for moderate to high priority structural stormwater retrofits in the watershed is presented in Table 5.

Table 5: Estimated Load Reduction for Moderate to High Priority Structural Retrofits.

Site ID	BMP Type	Removal Efficiency	Area Treated (acres)	Export Coefficient (lb/acre/yr)	Pretreatment Export (lb/yr)	Net Reduction (lb/yr)
6	Proprietary Filter	0.60	0.45	2.5	1.12	0.67
33	Tree Box Filter	0.50	1.09	2	2.19	1.09
33/43/51	Subsurface Infiltration	0.85	4.60	0.5	2.30	1.95
35	Soil Filter	0.60	0.35	2.5	0.87	0.52
37	Proprietary Filter	0.60	0.51	2	1.01	0.61
TFM CBs	Catch Basin Inserts	0.40	1.04	2	2.08	0.83
34	Tree Box Filter	0.50	0.10	2.5	0.26	0.13
37	Soil Filter	0.60	0.08	2.5	0.20	0.12
39	Bioretention	0.60	0.24	1.25	0.30	0.18
43	Tree Box Filter	0.50	0.60	1.75	1.04	0.52
43	Tree Box Filter	0.50	0.09	0.5	0.04	0.02
45	Tree Box Filter	0.50	0.42	1.75	0.73	0.37
46	Tree Box Filter	0.50	0.19	1.25	0.24	0.12
55	Vegetative Filter	0.05*	0.57	1.25	0.72	0.04
				Total	**13.11**	**7.18**
					Percent Reduction	**55%**

* For Site 55, removal efficiency of 5% is based on modifications to improve sediment forebay.

In addition, there are several operation and maintenance retrofits proposed that were not directly accounted for in the pollutant analysis. In particular, street sweeping and catch basin cleaning were suggested for the two sites with proposed proprietary retrofits. By incorporating operation and maintenance practices on a regular frequency, further reduction in phosphorus can be expected.

It should be noted that there are a handful of retrofits that provide zero phosphorus reduction, however, they provide other benefits to the stream, such as cooling of stormwater, providing channel protection, reducing the impoundment of stormwater upstream of a stream crossing, or more importantly, recharging groundwater or reducing chloride contamination of groundwater.

It is suspected that the mechanism by which chloride is entering the stream is via groundwater contamination from the application of salt during the winter and spring months. Chloride is thus discharged to the stream year round, including during critical periods in mid-late summer where the chloride-laden groundwater may represent a relatively high percentage of the base flow in the stream. To help alleviate this problem, retrofits that directly infiltrate "clean" water, such as rooftop runoff, into the ground would help recharge groundwater. For example, the retrofit of disconnecting the roof top drainage at Site 33/43/51 and infiltrating it into the subsurface would result in a 75 percent to 95 percent reduction in phosphorous; however, the greater value may be groundwater recharge and dilution of any chloride "plume" that it could provide. Another option would be to quickly convey chloride-laden stormwater directly to the stream during periods of high flow.

There is a clear need to reduce chloride loading in the Topsham Fair Mall Stream. An estimate of how much salt reduction is needed can be a valuable aid in stream restoration planning. There has been an intense data collection effort aimed at chloride in the past two years by Maine DEP and FB Environmental. These data clearly show that chloride levels spike far above the acute water quality standards during winter storms. They also show that chloride levels remain above the chronic water quality standard for weeks at a time in both winter and summer. Still, it must be acknowledged that this relatively brief data collection period cannot fully account for variations in storm conditions and salt application patterns from year to year. Ongoing sampling will be needed to quantify with greater certainty chloride dynamics in the watershed.

Using the available data, correlating specific conductance levels to chloride grab samples in Topsham Fair Mall Stream taken in winter and summer in 2013 ($n=10$, $r^2=0.89$) provides an initial estimate of chloride levels during two data sonde sample periods. Chloride levels were highest in the middle reach of the stream (sample site TMD, Midway Drive crossing) during winter and summer. The peak one-hour average chloride concentration at this site was estimated to be 3,644 mg/L during the winter storm of March 20, 2013. From that concentration, meeting the acute water quality standard of 860 mg/L would require a 76% source reduction. Similarly, during the period of August 16 to 27, 2013, the maximum four-day average chloride level was estimated to be 328 mg/L, compared to the chronic water quality standard of 230 mg/L, which suggests a 43% reduction would be necessary to meet the standard. These data are merely preliminary, and further sampling is needed to determine if they are typical, yet they provide a starting point for planning purposes.

Figure 17: Rock salt applied to a watershed parking lot. Photo, J. Edgerton.

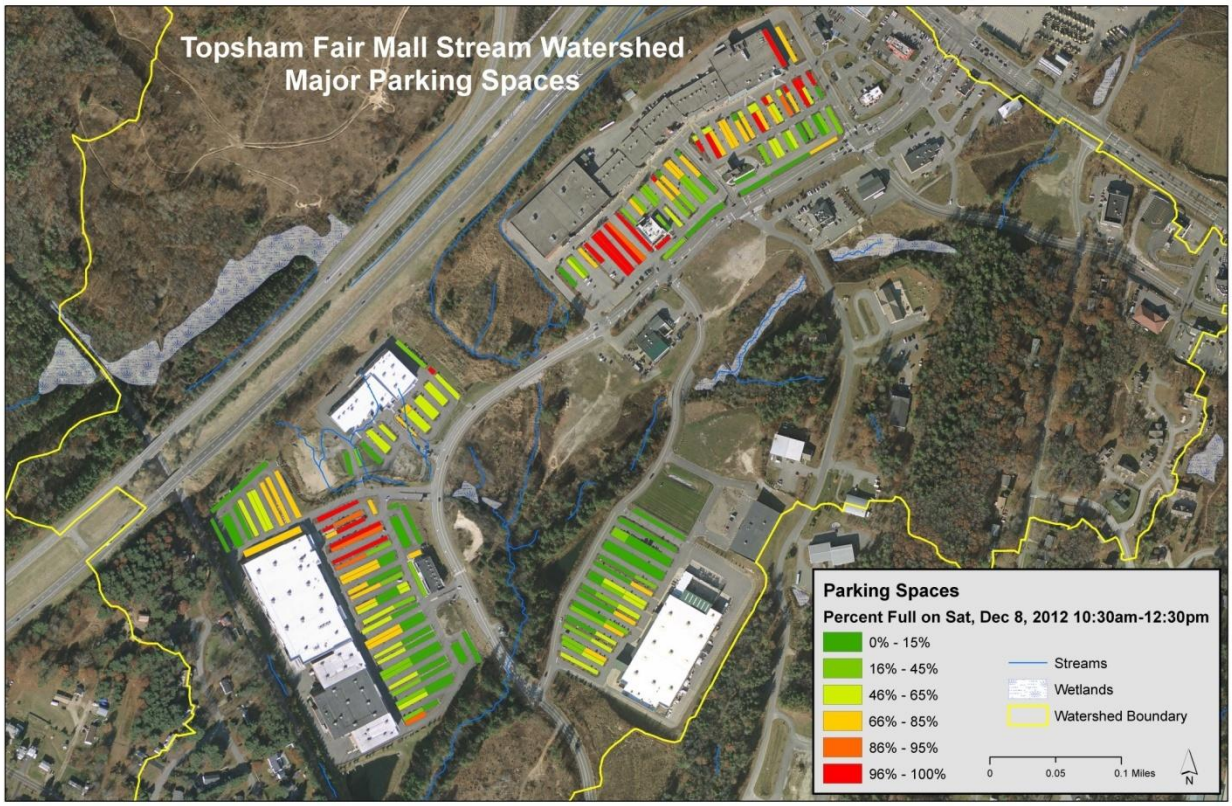

Figure 18: Map showing unused parking spaces in the watershed.

It is difficult to quantify the reduction of chloride pollutant loadings from specific future retrofits within the watershed. While several retrofits are proposed to try to lessen the effect that chloride has on the water quality of the stream, the best way to reduce its impacts is to control it at its source during application and limit its use. Limiting parking lot usage during winter months in particular is one management practice that is easily quantifiable, because the pollutant reduction is directly related to the reduction in salt application. Overall, there are many options for reducing salt application, while still maintaining safe and effective de-icing practices. These include:

- Overall reduction in salted area by keeping parking lots as small as possible or by making parking areas which receive less use, particularly from January through March, unavailable for parking. (Figure 18).
- Use of calibrated salt spreaders, which reduce wasted salt by matching application rates to vehicle speed.
- Pre-storm application of salt brine (liquid form), which eliminates wasteful bouncing and scattering of rock salt, and works quickly because it's already dissolved.
- Inspecting and upgrading the storm drain network to ensure that salt-laden water from runoff does not infiltrate through cracked or broken pipes (or other defects) into the groundwater.
- Placement and management of snow dumps and snow piles in ways which protect the groundwater from salt-laden runoff or meltwater. For example, do not pile snow on pervious areas, or areas which drain to pervious areas.
- Pervious pavements which require far less salt for many reasons, including the elimination of refreezing water.
- Greater emphasis on mechanical removal of snow and/or sand for traction rather than salt for de-icing.
- Training and/or certification programs for salt applicators to ensure best practices are consistently applied.

- State-level limits on liability for ice-related claims for salt applicators who attend qualified training programs and document their use of best management practices. Limited liability can reduce excessive salt application due to fear of unfounded lawsuits.

4.5. Action Plan

The following tables outline the Action Plan for implementing this watershed based plan. Additional possible best management practices and stormwater retrofits were identified during the development of this plan, and are presented in Appendix 1. An adaptive approach is recommended, so that stream restoration activities in future years will be determined by what has proven successful in prior efforts. Table 6 outlines structural best management practices, and Table 7 outlines non-structural practices. For additional discussion of who will undertake the actions below, see section 5.1 "Implementing the Plan" on page 31.

Table 6: Structural restoration recommendations for Topsham Fair Mall Stream

ACTION	WHO	WHEN	COST
FLOW			
Protect against catastrophic road washouts, task 1: Conduct a hydrologic rainfall-runoff model	Town of Topsham with hydraulic engineer	2016	$10,000-$14,000
Protect against catastrophic road washouts, task 2: Conduct HEC-RAS hydraulic modeling	Town of Topsham with hydraulic engineer	2016	$10,000-$14,000
Protect against catastrophic road washouts, task 3: Install relief culverts	Town of Topsham (DPW and/or contractors)	2017	$70,000-$100,000
Unblock floodplain, task 1: Review transportation planning options for removing road crossing(s).	Town of Topsham (DPW with transportation engineer)	2018	$3,000
Unblock floodplain, task 2: Prioritize road crossings for removal.	Town of Topsham (DPW with transportation engineer)	2018	$3,000
Unblock the floodplain, task 3: Remove fill, replace with bridges as needed.	Town of Topsham (DPW and/or contractors)	TBD	TBD
STORMWATER			
CCTV storm drain piping to determine potential inflow and infiltration in area tributary to Park Drive, Monument Place, and Midway Drive outfalls. Develop cost estimate to eliminate leaks based on results.	Landowners, coordinated by Town of Topsham	2016	$15,000-$18,000
Install filter system in low areas near high traffic areas at drive thru. (Site 35).	Landowners, coordinated by Town of Topsham	2016	$26,000-$31,000
Reshape low spot adjacent to northeast parking lot, and install outlet control structure with underdrain to address quantity and erosion issue (Site 7).	Landowners, coordinated by Town of Topsham	2016	$5,200-$6,400
Redirect outfall to discharge downstream of Midway Drive crossing. (Site 88).	Landowners, coordinated by Town of Topsham	2016	$15,000-$18,000
Modify wet pond to include underdrained gravel trench, and modification of underdrain outlet for channel protection volume control. (Site 59).	Landowners, coordinated by Town of Topsham	2017	$26,000-$32,000

ACTION	WHO	WHEN	COST
Modify wet pond to include underdrained gravel trench, and modification of underdrain outlet for channel protection volume control. (Site 88).	Landowners, coordinated by Town of Topsham	2017	$20,000-$25,000
Install tree box filters at two catch basin located in parking spaces. (Site 33).	Landowners, coordinated by Town of Topsham	2017	$80,000-$100,000
Install proprietary catch basin to address fats-oils-grease (FOG), hydrocarbons, and sediment in an existing catch basin. (Site 37).	Landowners, coordinated by Town of Topsham	2018	$33,000-$40,000
Install catch basins inserts in select catch basins. Estimate based on eight catch basins. Cost reflects installation only. Inserts will need ongoing maintenance, replacement and/or cleaning. (TFM CBs)	Landowners, coordinated by Town of Topsham	2018	$12,000-$15,000
Disconnect roof drains from collection system where possible and infiltrate in subsurface system. (Site 33, 43, and 51).	Landowners, coordinated by Town of Topsham	2019	$275,000-$336,000
Install proprietary system to address high sediment and hydrocarbons from paved areas. (Site 6).	Landowners, coordinated by Town of Topsham	2019	$64,000-$79,000
HABITAT			
Eliminate the barrier to fish passage at River Road caused by the perched culvert.	Town of Topsham	2017	$100,000
Stream habitat restoration projects in tributary arriving from western portion of watershed	Town of Topsham, in collaboration with Maine DEP, and contractor(s)	2018	$24,000
Evaluate further options for in-stream habitat improvement, once floodplain relief has been addressed (or determined to be not feasible); e.g., establishing low flow channels through wetlands.	Town of Topsham	2019	TBD

Table 7: Non-structural restoration recommendations for Topsham Fair Mall Stream

ACTION	WHO	WHEN	COST
ADMINISTRATION & FUNDING			
Identify who "owns" the Topsham Fair Stream Watershed Based Plan.	Town of Topsham	2014	N/A
Develop a long-term sustainable funding plan and apply for funds, establish a Funding Committee.	Town of Topsham	2014	$4,000
Consider forming a management district or stormwater utility.	Town of Topsham	2015	N/A
Reassess progress, set schedule for remaining action items after initial four years.	Town of Topsham	2018	TBD

ACTION	WHO	WHEN	COST
EDUCATION & OUTREACH			
Educate business owners on stormwater treatment and minimization of salt use, through printed outreach and an annual meeting on stream restoration efforts.	Town of Topsham	Annually	$1000/year (four years)
Maintain a page on the municipal website with access to Watershed Based Plan, data and maps, meeting dates and minutes, and other information pertaining to Topsham Fair Mall Stream restoration.	Town of Topsham	Annually	$600/year (four years)
Engage school groups from elementary through high school in watershed education in schools, stream clean-ups, and stormwater sampling.	Maine DEP, Town of Topsham, Topsham Public Schools MSAD 75, and volunteers	Annually	$2,500 total
Create a stream-oriented walking path with educational signage to promote use, understanding, and appreciation of the stream as a valuable community asset. Include dog-clean up station(s).	Topsham Planning, DPW, and Parks and Recreation, with contractor support for signage	2017	$8,000 - $15,000
LAND USE PLANNING			
Adjust municipal planning ordinance and incentives to discourage oversized parking lots. For example, current minimum parking guideline of 1 space per 250 sq. ft. of building can become a maximum parking guideline, with an impact fee paid by developer if exceeded. Additional incentives for efficient, minimal use of overall impervious coverage can also be incorporated.	Topsham Planning Department and Planning Board, with input from business and development community	2016	$1,000 for initial review
More clearly define applicability of Topsham Performance Standards §225-34 "Water Quality."	Topsham Planning Department and Planning Board, with input from business and development community	2017	$4,000
Develop provisions for post-construction maintenance plans and inspections for stormwater BMPs, including ensuring that existing systems are mapped and cataloged.	Topsham Planning Department and Planning Board, with input from business and development community	2017	$4,000
MUNICIPAL MAINTENANCE PRACTICES			
Review salt application practices, and where possible, implement low-salt techniques. See "Salt Reduction" section below.	Topsham DPW	2016	$700 for initial review, then TBD
SALT REDUCTION EFFORTS			
Use calibrated salt spreaders, which adjust application rates based on vehicle speed.	Business owners, salting contractors, Topsham DPW, Maine DOT	Annually	$25,000 for equipment upgrades, if needed

ACTION	WHO	WHEN	COST
Apply liquid brine before storms when conditions allow, which uses less salt than rock salt.	Business owners, salting contractors, Topsham DPW, Maine DOT	Annually	N/A
Emphasize mechanical removal of snow and/or use of sand for traction, to limit the need for salt.	Business owners, salting contractors, Topsham DPW, Maine DOT	Annually	N/A
Create pervious pavement areas in the future when possible, reducing salt by eliminating re-freezing.	Business owners, Topsham Planning, Maine DOT	TBD	TBD
Training and/or certification programs for salt applicators to ensure best practices are consistently applied.	Maine DEP and/or DOT.	TBD	TBD
Support state-level limits on liability for ice-related claims for salt applicators who attend qualified training programs and document their use of best management practices. Limited liability can reduce excessive salt application due to fear of unfounded lawsuits.	Maine DEP, interested business owners and citizens	TBD	TBD
During low seasons (January – April), assign "no plow – no salt" areas in outlying areas of existing oversize parking lots.	Business owners	Annually	Savings
SOURCE CONTROL & OTHER RESTORATION EFFORTS			
Meet with individual landowners to discuss recommended BMPs and options for moving toward implementation.	Town of Topsham, Maine DEP	2016	$1,500
Implement good housekeeping and maintenance for dumpsters and catch basins. (Site 6 and Site 37).	Landowners, coordinated by Town of Topsham	Annually	N/A
Address snow storage location (currently piled over bank). Collect snow and allow to drain directly to catch basin (collect sand in sump to eliminate sand from washing over bank). (Site 47).	Landowners, coordinated by Town of Topsham	Annually	N/A
Review connection of catch basins in garden center, and review policy and procedures for storage of pesticides/fertilizers, spill response, and management of water in this area. (Site 88).	Landowners, coordinated by Town of Topsham	Annually	$1,000 for technical review
Maintain rip rap areas at property boundary, and remove built up sediment. (Site 11).	Landowners, coordinated by Town of Topsham	Annually	N/A
Implement good housekeeping, and review storm drain and grease collection system. (Site 46).	Landowners, coordinated by Town of Topsham	Annually	N/A
Review snow storage options, and implement good housekeeping along slope adjacent to access drive. (Site 51).	Landowners, coordinated by Town of Topsham	Annually	$700 for technical review
Maintain existing stormwater pond. (Site 88).	Landowners, coordinated by Town of Topsham	Annually	N/A
Continue to support existing source reduction programs, such as street sweeping, erosion and sediment control practices, and good housekeeping.	Topsham DPW, business owners, Maine DEP	Annually	N/A

ACTION	WHO	WHEN	COST
STREAM AND HABITAT MONITORING PROGRAM			
Conduct monitoring focusing on key parameters such as chloride, impervious surface, and benthic macroinvertebrates. See Section 6.2.	Town of Topsham, contractor, Maine DEP	Annually	$5,000 – $10,000

5. Implementing the Plan

5.1. Plan Oversight & Adoption

This plan will be presented to the Topsham Board of Selectmen in 2014 following review by the TAC, Maine DEP and local stakeholders. Formal adoption of the plan by the Town is highly recommended to help raise local awareness about the need for restoration efforts and to garner support needed to implement various aspects of the plan. Recommended actions to restore the Topsham Fair Mall Stream to Class B water quality standards are presented in Section 4 of this plan. If Class B standards are met before implementation of recommended actions are complete, then the goal of the plan has been met.

Designating an effective coordinating person or group to carry out the environmental restoration activities presented in this plan is a crucial step in achieving real success. The coordinator must have authority and resources that are well matched to the job. Sustainable funding, a good administrative process, and collaboration with landowners, local businesses, and residents are all variables that will lead to the success of the plan. There are several options designating a coordinator, many of which have been successfully adopted in various watersheds in Maine:

1. The **Town of Topsham**, via its Planning Department or Selectboard. Examples: South Portland's Trout Brook, Kittery's Spruce Creek, and York's Cape Neddick River.
2. A new **Watershed Management District** or **Stormwater Utility**. Examples: Long Creek Watershed Management District in Portland, South Portland, Westbrook, and Scarborough; Lewiston's Stormwater Utility; Bangor's Stormwater Utility (in progress).
3. **Topsham Conservation Commission**. Examples: Skowhegan's Whitten Brook, and Ogunquit's Ogunquit River.
4. A dedicated **Technical Advisory Committee**. Example: Early stages of Long Creek restoration in Portland, South Portland, Westbrook, and Scarborough.

Developing the Action Plan to this point has been accomplished through a mix of options one and four above, with the Town of Topsham initiating the creation of a watershed based plan, and a strong Technical Advisory Committee reviewing data and restoration options. Options one and two are reviewed in greater detail below. Additional details and case studies on funding structures are described in the EPA document "Funding Stormwater Programs" (EPA 2009), available at http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf.

5.1.1. Option One: Coordination by Town of Topsham

The first option, and the one assumed in this plan, is for the Topsham Fair Mall Stream Restoration Plan to be carried out by the Town of Topsham, advised by a Technical Advisory Committee (TAC) consisting of representatives from the Topsham Conservation Commission (TCC), Maine DEP, Maine DOT, local businesses and residents. The TAC will meet

regularly to coordinate resources and implement practices that will reduce the effects of urbanization in the Topsham Fair Mall Stream watershed.

Given the involvement of the TCC, if this option is ultimately implemented, Topsham town officials are encouraged to review Topsham Ordinance Chapter 104 which in 2007 created the TCC and defines its powers and duties[1]. Section Three, Powers and Duties, establishes under point 1 that the TCC may acquire land, conservation interests, development rights or other lesser interests or easements, upon approval of the Selectmen; under point 7 that the TCC may coordinate research into local land and water; and under point 8 that it may seek to coordinate the activities of other conservation bodies. These authorities may be used to assist the Town of Topsham in carrying out this plan.

5.1.2. Option Two: Management District or Stormwater Utility

The creation of a Management District or Stormwater Utility is generally a stable and cost efficient method of achieving environmental restoration. Participation may be either voluntary (Management District) or required (Stormwater Utility). Under either program, landowners pay an annual fee to the organization, usually based on size of impervious surface. The organization then engages in planning, permitting, construction, maintenance, and monitoring at the watershed-wide level on behalf of its members.

There are several examples of stormwater utilities and management districts in Maine to serve as an example. These include Long Creek Watershed Management District in Portland, South Portland, Westbrook, and Scarborough; Lewiston's Stormwater Utility; and Bangor's Stormwater Utility (in progress). These examples have varying executive and legal structures and a wide range in cost to the landowners. The Town of Topsham can benefit from the experience and precedent that these existing programs provide.

The characteristics of this option are:

- Professional management with skills and expertise in stormwater management.
- Predictable, long-term source of funding.
- Watershed-wide approach concentrates resources on tasks with optimal cost-efficiency.
- Allows for a general stormwater permit (if and where required) that covers all participants, reducing paperwork and administrative effort by individual landowners. This can mean a single point of contact between regulators and many landowners.
- Fees can be proportional to environmental impact, creating an incentive to reduce stormwater sources.
- Requires significant start-up effort.

5.2. Estimated Costs and Technical Assistance Needed

5.2.1. Estimated Budget

The estimated costs of implementing the Topsham Fair Mall Stream Watershed Restoration Plan is presented in following outline. These costs do not include items marked as TBD (e.g., opening the floodplain if ultimately necessary), and do not account for savings due to salt reduction efforts.

[1] Online at: http://www.topshammaine.com/vertical/sites/%7B95A28B10-4485-4BEC-B8FC-5E8BF056A147%7D/uploads/%7BAC10ECF9-3DB5-4EEE-AF22-8CB5E6CEE6E0%7D.DOC

Structural BMPs Cost Estimate (Table 6)	
Flow Tasks	$96,000 – $134,000
Stormwater Retrofit Sites	$571,200 – $700,400
Habitat Restoration Tasks	$124,000
STRUCTURAL TOTAL	**$791,200 – $958,400**

Non-Structural BMPs Cost Estimate (Table 7)	
Administrative & Funding	$4,000
Education & Outreach	$16,900 – $23,900
Land Use Planning	$9,000
Municipal Maintenance	$700
Salt Reduction Efforts	$25,000
Source Control/Other	$3,200
Monitoring Program	$5,000 – $10,000
NON-STRUCTURAL TOTAL	**$63,800 – $75,800**

COMBINED TOTAL	**$855,000 – $1,034,200**

**Note: These costs do not include the restoration efforts labeled TBD in the action plan in Section 4 or for long-term water quality monitoring (Section 6.2). Therefore, the estimated costs are anticipated to exceed the projected total once additional knowledge is gained about the costs of these activities.*

5.2.2. Funding Sources

A diverse source of funding and a sustainable funding plan is needed to match desired goals and objectives for restoration.

Developing a funding plan which garners the approval of the community is essential to success. A community restoration effort should include the collaboration and support of the entire community including local businesses and property owners; community groups; conservation groups; corporate sponsors; and the municipality. In some cases, it may be possible to attain state or federal grants to help implement the Action Plan. Broad community support is a major strength when applying for such funding.

Stormwater Retrofits: State and federal agencies such as Maine DEP, Maine DOT, and EPA offer competitive grant programs to implement high priority stormwater retrofits in the watershed and in-stream restoration efforts, as well as select education and outreach activities. The Maine State Revolving Fund is also a potential source. Funding may come from a stormwater utility or a management district, if one is created.

Municipal Maintenance: Actions such as culvert repair, enhanced storm drain cleanout and street sweeping programs, and ordinance revisions should be supported by the Town through tax dollars, permit fees, or fees collected as a result of ordinance violations. Other funding sources such as local planning grants may help supplement these projects. The Topsham Fair Mall is within a Municipal Tax Increment Funding (TIF) area, which may further offer funding opportunities.

Land Conservation: Conserving land in the Topsham Fair Mall Stream Watershed is a high priority given the current lack of shoreland zoning and high levels of development. Ongoing land conservation efforts will need the support of local conservation groups, conservation enthusiasts, and individual donors in order to prevent poorly planned development and long-term degradation in this portion of the watershed. Options such as obtaining easements within the buffer areas on the

brook, and other areas near proposed development where intermittent channels have formed that flow to the stream, should also be considered in lieu of outright purchase.

Monitoring and Assessment: Future monitoring and assessment efforts will require a variety of sources of funding. Federal Clean Water Act Section 319 money may be used to monitor the impact of stormwater retrofits or other restoration implementation. Other funding such as municipal government, and private foundation grants, should be considered. The Maine Volunteer River Monitoring Program or other volunteers could potentially assist with general stream monitoring.

6. Methodology for Measuring Success

Successful restoration of the Topsham Fair Mall Stream requires setting goals and developing objectives to help meet those goals. The participation of landowners, local engineering and development experts, Town of Topsham planning and public works staff, Maine DEP and DOT staff members are vital to a realistic plan. The action plan developed here provides key actions and milestones toward stream restoration, but it is inevitable that new information, technology, and techniques will be developed in the years to come.

6.1. Adaptive Management Components

An adaptive management approach is widely recommended when implementing environmental restoration programs. Adaptive management refers to an approach which incorporates a systematic re-evaluation of action items as new information continues to be gathered, and when necessary, adjusting the order, timing, or other aspects of the restoration program to achieve the ultimate goal of water quality attainment. This approach requires several elements:

- An initial schedule for implementing restoration actions, including periodic re-evaluation of the plan;
- A program to collect and analyze new data, especially regarding the stream's response to the restoration actions taken; and
- An entity with expertise to evaluate new information and the authority to adjust the plan in response to that information.

The adaptive management approach recognizes that the entire watershed cannot be restored with a single restoration action or within a short-time frame (e.g., 2 years). Rather, adaptive management establishes an ongoing program that provides adequate funding, stakeholder guidance, and an efficient coordination of restoration activities. This approach will ensure that restoration actions are effective over the long term.

6.2. Monitoring Program

6.2.1. Overview

A well designed monitoring program is a critical component of the Topsham Fair Mall Stream watershed plan. It will provide information about the relative success of restoration efforts, provide ongoing feedback on pollutants and other stressors, and complement ongoing Maine DEP assessment efforts. Ideally, monitoring should occur before and after each major restoration action to the stream. To the extent practical, monitoring should target the specific catchment areas within the watershed which are targeted for improvement, in order to provide an adequately detailed understanding of the changes made.

Monitoring program results will be analyzed on an ongoing basis in order to optimize the restoration process by implementing the most effective mitigation actions. This plan recommends numerous restoration actions in a phased

approach beginning with the highest priority BMPs first, such as the installation of stormwater BMPs to treat stormwater in most critical areas, followed by BMPs elsewhere. Data from the monitoring program can be used to re-prioritize future efforts.

The monitoring program will be developed in coordination with the Maine DEP's efforts. Close communications between watershed managers and Maine DEP will enhance the value of all monitoring data. On occasion, coordination may also present cost-saving opportunities by preventing the collection of duplicate data. Maine DEP typically conducts bioassessment monitoring (benthic macroinvertebrates) once every five years, which is a core measure of stream impairment. This five-year period is a suitable timeframe to consider major milestones in stream condition.

6.2.2. Monitoring Program Description

Based on current understanding of the impairment in the Topsham Fair Mall Stream, there are several elements that should be part of the monitoring program. The following sections discuss these elements.

Location: Upper and lower watershed show large differences in water quality, with the lower portion apparently attaining water quality standards much of the time. At a minimum, upper and lower monitoring stations will be adopted. Additional catchment-specific locations, to the extent feasible, will enhance understanding of specific stream restoration activities.

Timing: Winter storms appear to be a critical period of pollutant loading in the Topsham Fair Mall Stream. Salt applied during these winter storms results in short-term (hours to days) spikes above the acute water quality standards for chloride, followed by year-round impairment at chronic water quality levels. By contrast, it is expected that nutrients, metals, hydrocarbons, and other pollutants arrive in the stream in high levels during storms throughout the year. Therefore, both winter and summer are critical periods, as are storms and baseflow. This would imply two periods of monitoring each year. Each period will aim to collect storm and baseflow conditions, and therefore will last between one and four weeks.

Parameters: Stormwater runoff contains a wide range of pollutants, and it is prohibitively expensive to test for all possible pollutants. Development patterns suggest very clearly that these pollutants are present at elevated levels. Impervious cover, especially where there is high vehicle turnover, is a reasonably good proxy for a broad range of nutrients, metals, and hydrocarbons (in fact, the stormwater TMDL for the stream is expressed in terms of impervious cover). Impervious cover is a good proxy for general stormwater pollution, and can be measured economically using aerial photos and GIS mapping. Aquatic macroinvertebrates are also an excellent proxy for stormwater pollution, and in fact the macroinvertebrate community is a key parameter used by Maine DEP to determine attainment of water quality standards.

For more detailed stormwater monitoring, selected nutrients and indicator metals can be measured in both baseflow and storm conditions. These more detailed parameters may be worthwhile before and after a series of large-scale structural BMPs, but are not recommended on an ongoing basis due to high cost per sample and the need for a large number of samples to overcome the variability in storm events. Dissolved oxygen, temperature, and pH are not considered problematic for the stream. They should be monitored once every three to five years in summer, baseflow conditions to ensure levels remain acceptable.

Chloride from road salt is a key pollutant in the stream. Specific conductance is a good proxy for chloride, as discussed in Section 3.3.1, and can be economically measured using in-stream data loggers or handheld meters. Data collected so far indicate that the lower and western (undeveloped) portions of the stream meet water quality standards for at least part of the year. Additional monitoring of this parameter will provide excellent short and medium term feedback on efforts to reduce salt loading to the stream. Occasional direct measurements of in-stream chloride concurrent with specific

conductance and hardness, especially during high-salt winter runoff periods, will improve the correlation between specific conductance and chloride.

Stream habitat and geomorphic conditions are also critical parameters for the stream, due to the major effects of seven road crossings which completely block the flood plain. Targeted habitat and geomorphic assessments may be used to evaluate effects of BMPs such as installation of large woody debris, unblocking of the floodplain, or other relevant actions.

Flow is a key parameter for every stream. Typically, flow in highly developed impaired streams is characterized by higher and more rapid peak flows during storms. Structural BMPs aim to slow and moderate these peak flows, and measuring flow dynamics provides valuable feedback in assessing their success. However, in the Topsham Fair Mall Stream, according to the Rapid Geomorphic Assessment (Section 3.3.2), flow dynamics have been severely altered by the blocked floodplain and small culverts. Some flow assessment may be needed as part of flood hazard assessment, but it is not recommended that flow associated with stormwater be measured, unless associated with a specific structural BMP at the catchment level. If and when the floodplain is unblocked, flow will become a candidate for general stormwater monitoring.

6.2.3. Summary of Monitoring Program

The following outlines a proposed monitoring program for Topsham Fair Mall Stream, incorporating the elements in the above discussion:

- Watershed percent impervious surface, assessed on a biannual basis (once every 2 years).
- Three monitoring sites: TMN (upper watershed), TMD (mid watershed), RR (lower watershed).
- Specific conductance dataloggers annually for two weeks, once for winter storms and once for late summer low-flow conditions.
- Chloride and hardness should be sampled occasionally to confirm (or refine) the chloride-specific conductance relationship which allows specific conductance to be used as a proxy for road salt pollution. Four to six samples per year are recommended, divided as evenly as possible among summer and winter, storm and baseflow conditions.
- One summertime baseflow sonde deployment including dissolved oxygen, pH, and temperature, for two weeks once every three to five years.
- Macroinvertebrates by ME DEP on their regular assessment cycle, or more frequently, if possible.
- Flow, habitat, and geomorphic assessment if and when progress occurs to unblock the floodplain.
- Grab sampling for nutrients and metals is not recommended due to high per-sample costs and high variability of storm events which would require a large number of samples to identify trends. Benthic macroinvertebrates and impervious cover provide a proxy for general stormwater pollution, including nutrients and metals.

6.3. Measurable Milestones

It is critically important that a watershed restoration project schedule be established that provides clear and measurable milestones for success. These include programmatic indicators, which measure actions taken (Table 8), as well as environmental indicators, which measure response of the stream (Table 9). Once funding mechanisms and oversight authority have been established for the Topsham Fair Mall Stream restoration effort, a more detailed list and schedule of measureable milestones may be developed.

Table 8: Programmatic Milestones.

Programmatic Indicators of Progress	**Timeline**
The Town of Topsham Selectboard adopts the Watershed Based Plan, or identifies an alternative governing entity.	2014
Funding plan created.	2014
Initial funding obtained for major stormwater retrofits (grants, user fees, or other appropriate channel).	2015
Town of Topsham has met with at least 80% of commercial land owners with priority sites in watershed to discuss BMP installation options.	2015
CCTV reconnaissance of storm drain piping to assess inflow complete.	2016
Initial steps taken to protect against catastrophic road washouts: rainfall-runoff and HEC-RAS hydraulic modeling completed.	2016
Town of Topsham has reviewed and updated municipal salt application procedures to reduce chloride pollution.	2016
Town of Topsham has reviewed land use ordinances and performance standards relating to parking, applicability of "water quality standards" under zoning §225-34 "Water Quality," and developed provisions for post-construction maintenance of BMPs.	2016
Town of Topsham has coordinated a salt application plan for watershed in collaboration with landowners.	2017

Table 9: Environmental Milestones.

Environmental Indicators of Progress	**Timeline**
Four year monitoring plan established for chloride (in-stream and groundwater) and other parameters.	2015
First two new structural stormwater BMPs installed under plan.	2016
Relief culverts installed in major road crossings.	2017
Fish passage created from Androscoggin River to above River Road.	2017
Additional two structural stormwater BMPs installed under plan.	Annually 2017-2019
In-stream and groundwater chloride assessment and review.	Annually
Reduction in duration and frequency of peak flows assessed via flow data or data-based modeling.	Every two years
Macroinvertebrate stream assessments by Maine DEP indicate improvement toward attainment of water quality standards.	TBD, based on ME DEP assessment schedule

Environmental Indicators of Progress	**Timeline**
In-stream chloride levels remain below acute and chronic water quality standards throughout the year.	TBD
Floodplain is unblocked.	TBD
Fish passage enabled throughout stream reach.	TBD

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8. Appendices

8.1. Appendix 1. Stormwater Retrofit Reconnaissance Inventory (RRI)

See Figure 16 for site ID and locations.

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority	Budget Level Cost[1]
6	Install proprietary system to address high sediment and hydrocarbons from paved areas.	High	Moderate	High	$64,000-$79,000
6	Implement good housekeeping and maintenance for dumpsters and catch basins.	High	Easy	High	NC
7	Reshape low spot adjacent to northeast parking lot, and install outlet control structure with underdrain to address quantity and erosion issue.	Moderate	Easy	High	$5,200-$6,400
33	Install tree box filters at two catch basin located in parking spaces.	High	Moderate-Hard	High	$80,000-$100,000
33	Review opportunities to disconnect roof drains from collection system and infiltrate in subsurface system in coordination with Site 43/51.	High	Hard	High	$275,000-$336,000
35	Install filter system in low areas near high traffic areas at drive thru.	High	Hard	High	$26,000-$31,000
37	Install proprietary catch basin to address fats-oils-grease (FOG), hydrocarbons, and sediment in an existing catch basin.	High	Moderate	High	$33,000-$40,000
37	Implement good housekeeping and maintenance for dumpsters and catch basins.	High	Easy	High	NC
47	Address snow storage location (currently piled over bank). Collect snow and allow to drain directly to catch basin (collect sand in sump to eliminate sand from washing over bank).	High	Easy	High	NC
TFM SD	CCTV storm drain piping to determine potential inflow and infiltration in area tributary to Park Drive, Monument Place, and Midway Drive outfalls.	Unknown	Easy	High	$15,000-$18,000

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority	Budget Level Cost[1]
TFM CBs	Install catch basins inserts in select catch basins. Estimate based on eight catch basins.	High	Moderate	High	$12,000-$15,000
59-62	Modify wet pond to include underdrained gravel trench.	High	Hard	Moderate-High	$26,000-$32,000
88	Modify wet pond to include underdrained gravel trench.	High	Hard	Moderate-High	$20,000-$25,000
88	Redirect outfall to discharge downstream of Midway Drive crossing.	High	Hard	Moderate-High	$15,000-$18,000
88	Review connection of catch basins in garden center, and review policy and procedures for storage of pesticides/fertilizers, spill response, and management of water in this area.	High	Moderate	Moderate-High	NC
88, 59-62	Review parking use and the potential for "no use" areas during portions of the winter months.	High	Moderate	Moderate-High	NC
11	Maintain rip rap areas at property boundary, and remove built up sediment.	Low	Easy	Moderate	NC
34	Install tree box filter in drive thru area along curb line.	High	Moderate-Hard	Moderate	$20,000-$25,000
37	Convert a catch basin to an underdrained, inlet filter area.	Moderate-High	Hard	Moderate	$3,700-$4,600
39	Convert lawn area to an underdrained, bioretention / filtration basin.	Moderate	Moderate	Moderate	$12,000-$15,000
43	Install tree box filters at one catch basin located in parking space.	High	Moderate-Hard	Moderate	$40,000-$50,000
43	Convert existing tree boxes to tree box filters collecting roof runoff from existing, external downspouts, or collect runoff in rain barrel or cistern to use in watering landscape areas (estimate based on one to three boxes).	Moderate	Hard	Moderate	$23,000-$85,000
45	Install tree box filters at one catch basin located in parking space.	High	Moderate-Hard	Moderate	$40,000-$50,000
46	Install tree box filter at one catch basin located in landscape island.	Moderate	Hard	Moderate	$20,000-$25,000

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority	Budget Level Cost[1]
46	Implement good housekeeping, and review storm drain and grease collection system.	Moderate	Easy	Moderate	NC
43/51	Review opportunities to disconnect roof drains from collection system and infiltrate in subsurface system in coordination with Site 33.	Moderate	Hard	Moderate	See Site 33.
51	Review snow storage options, and implement good housekeeping along slope adjacent to access drive.	Moderate	Easy	Moderate	NC
55	Retrofit vegetative filter field to reduce erosion.	Moderate	Hard	Moderate	$5,000-$20,000
88	Maintain existing stormwater pond.	Moderate	Easy	Moderate	NC
7	Potential for filter basin or water quality storage with outlet control.	Low	Moderate	Low	NC
8-9	Review parking lot usage and pavement areas for possible green space areas to reduce impervious surfaces.	Low	Easy	Low	NC
10	Upgrade containment at car wash exit to eliminate spillover of washwater and potential trackout (i.e. potential berm along concrete pad). Good housekeeping and maintenance related to disposal of residuals from trench drain.	Low	Moderate	Low	NC
11	Review potential for filtration/treatment areas at end of parking lots (sheet flow).	Low	Hard	Low	NC
38	Redirect gutter on northeast corner of building to grassed or stone-lined ditch area to promote better infiltration of roof runoff.	Low	Easy	Low	NC
38	Create bioretention area on northern side of site (adjacent to parking area) to receive and provide treatment from parking lot area.	Low	Hard	Low	NC
38	Coordinate with property owner on the potential to reduce impervious surface on the back side of the building.	Low	Moderate	Low	NC

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority	Budget Level Cost[1]
40	Modify existing drainage basin receiving runoff from drive thru and upgradient parking lot to filter basin. Extend swale to provide pre-treatment from parking lot runoff.	Low	Moderate-Hard	Low	NC
41	Look at potential to remove pavement along the northeast side of the building and install roof edge drip line.	Low	Easy	Low	NC
47	Replace existing catch basin locations along front of building with tree box filter and tie into storm drain piping.	Moderate	Hard	Low	NC
47	Remove concrete pad, and reuse location for tree filter in lieu of a catch basin.	Moderate -Low	Moderate-Hard	Low	NC
55	Maintain existing BMPs on a frequent basis.	Low	Easy	Low	NC
56-57	Promote appropriate snow storage areas and stormwater design recommendations during future development on Sites 56 and 57.	Low	Easy	Low	NC
55	Disconnect roof drain system from catch basin system at rear of store.	Low	Hard	Low	NC
59-62	Review option to disconnect roof drain runoff from SD system and look to infiltrate or separate from wet pond system.	Low	Hard	Low	NC
89	Review potential to revegetate gravel area (future overflow parking area).	Low	Easy	Low	NC
90	Potential to modify swale/pond to offer water quality volume/storage. May affect potential to develop site and should be considered if adjacent lots are developed with outfall relocation associated with Home Depot wet pond.	Low	Moderate-Hard	Low	NC
92	Site was designed with future expansion. Stormwater treatment associated with any expansion should be reviewed, and opportunities for installation of water quality treatment be implemented.	Low	Easy	Low	NC

Site ID	Proposed BMP	Value to Stream	Ease of Implementation	Overall Priority	Budget Level Cost[1]
93	Improve roof runoff through the installation of roof drain infiltration.	Low	Easy	Low	NC
93	Improve runoff from parking lot and provide pretreatment prior to stormwater entering the stormwater basin/created wetland area.	Low	Moderate	Low	NC
49	None	N/A	N/A	N/A	N/A
52	None	N/A	N/A	N/A	N/A
96	None	N/A	N/A	N/A	N/A
97	None	N/A	N/A	N/A	N/A
98	None	N/A	N/A	N/A	N/A

[1] NC = Budget-level cost not calculated for non-structural or low overall priority retrofits

8.2. Appendix 2: Geomorphic Assessment

See attached file “Topsham Fair Mall Geomorph Report.pdf”