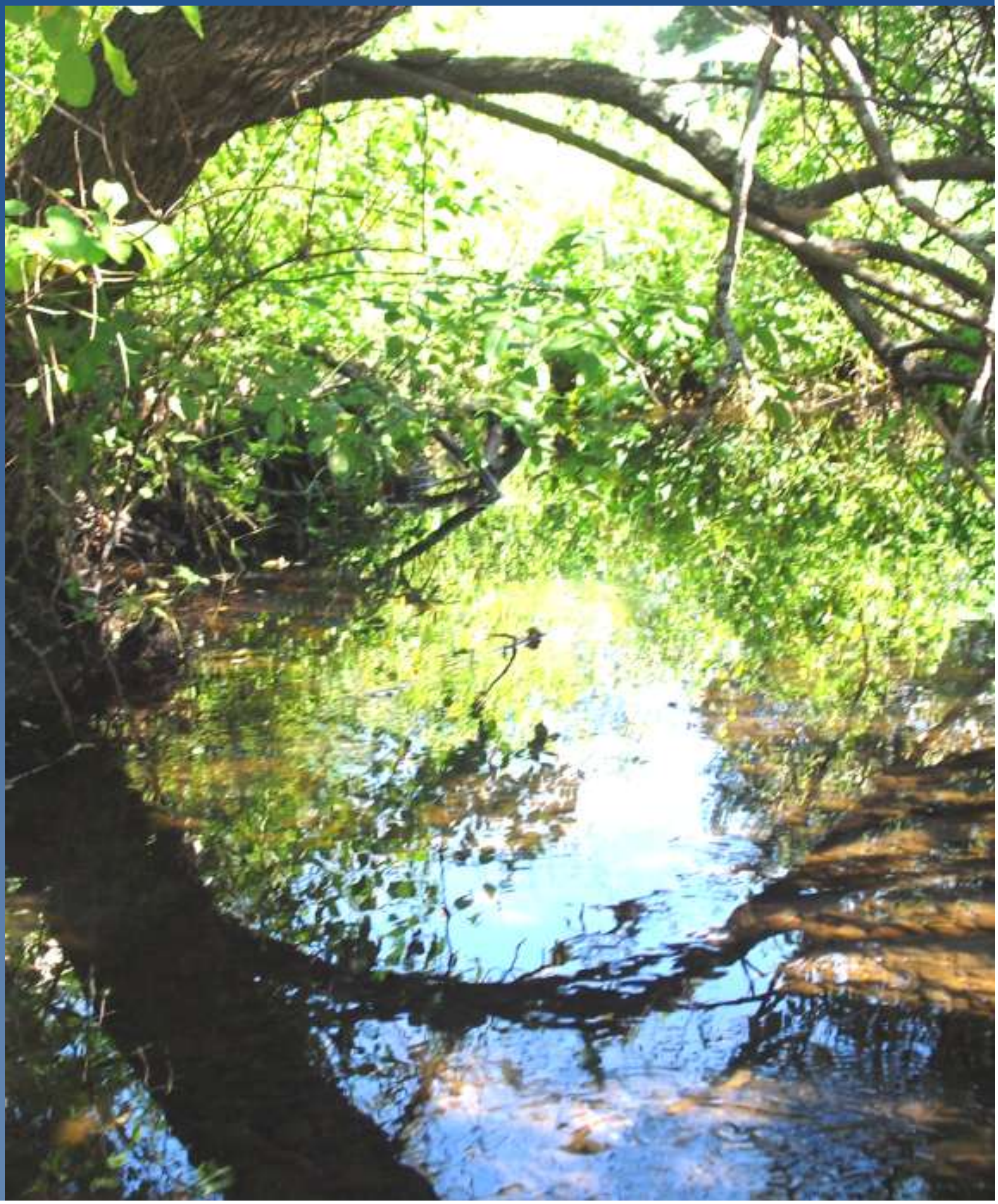
Trout Brook Watershed

Management Plan



Cumberland County Soil & Water Conservation District

Prepared for the City of South Portland
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A **WATERSHED** is the land area that drains to a river, stream, or other body of water.

A watershed is the land area that drains to a river, stream, or other body of water. The purpose of a Watershed Management Plan (WMP or Plan) is to document the sources of water pollution and present a course of action to improve water quality within an impaired watershed. The WMP provides a holistic approach to manage and restore the impaired waterbody to its designated uses. Community stakeholders play a critical role in plan development, and the final plan reflects the community's goals for their watershed.

The Trout Brook watershed encompasses 2.35 square miles in South Portland and Cape Elizabeth, Cumberland County, Maine. For the purposes of this Plan, the Trout Brook watershed includes Kimball Brook, a tributary of Trout Brook situated in the western portion of the watershed (Figures 1 & 2).

The United States Environmental Protection Agency (EPA) defines impaired waterbodies as any waterbody that does not meet water quality criteria that support its designated use (EPA, 2008). Impaired waterbodies are then placed on the Section 303(d) list. In 2004 Trout Brook was listed on the State of Maine's 303(d) list due to habitat and aquatic life use impairments.

This Plan describes the impairments and identifies the recommendations needed to restore Trout Brook's water quality. Furthermore, the Plan has considered the unique conditions within the watershed and developed suitable approaches to minimize future impacts to the Brook due to human activities within the watershed.

Trout Brook

1.1 How was the plan developed?

The plan was developed using a collaborative approach. This approach aimed to actively involve local stakeholders in selecting management strategies that may be implemented over time to solve problems in the watershed. On June 9, 2011, 49 people attended a community public meeting to learn about Trout Brook and provide input on stream and watershed issues. The two resulting subcommittees met a total of four times over the following eight months to develop and refine management strategies. This Plan incorporates this work as well as EPA guidelines that are required in watershed based management plans to restore impaired waters. This alignment with EPA guidance is intended to enable project partners to seek future EPA and Maine Department of Environmental Protection (MDEP) funding to help implement the plan. Phase I implementation activities have been funded through the MDEP Nonpoint Source Grants program for 2013-2014.

1.2 Who was involved?

The City of South Portland and the Cumberland County Soil & Water Conservation District (CCSWCD) partnered to implement the planning project. The Town of Cape Elizabeth, MDEP, Casco Bay Estuary Partnership (CBEP), watershed residents, and others were all active participants in the process.

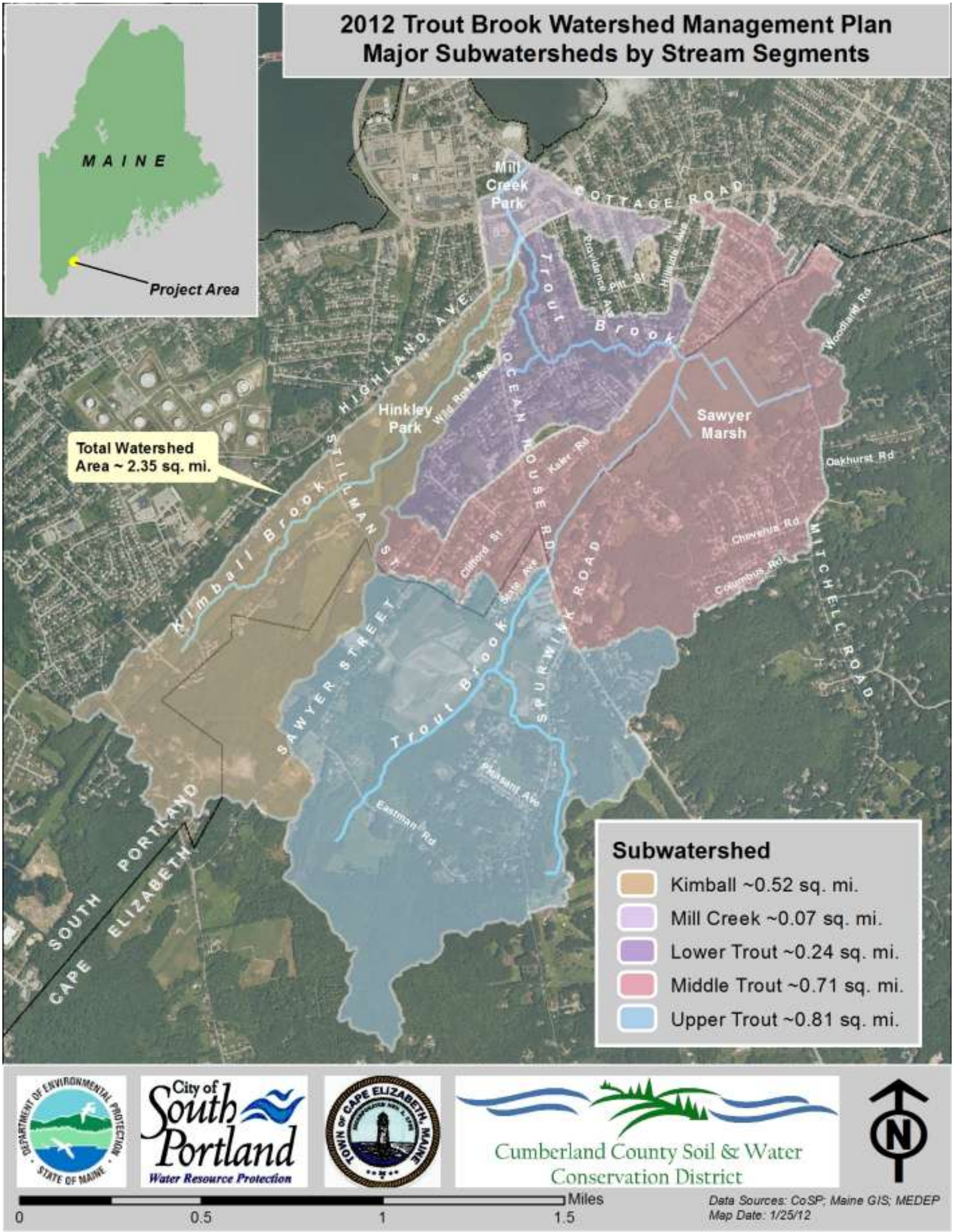


Figure 1. Trout Brook Major Subwatersheds

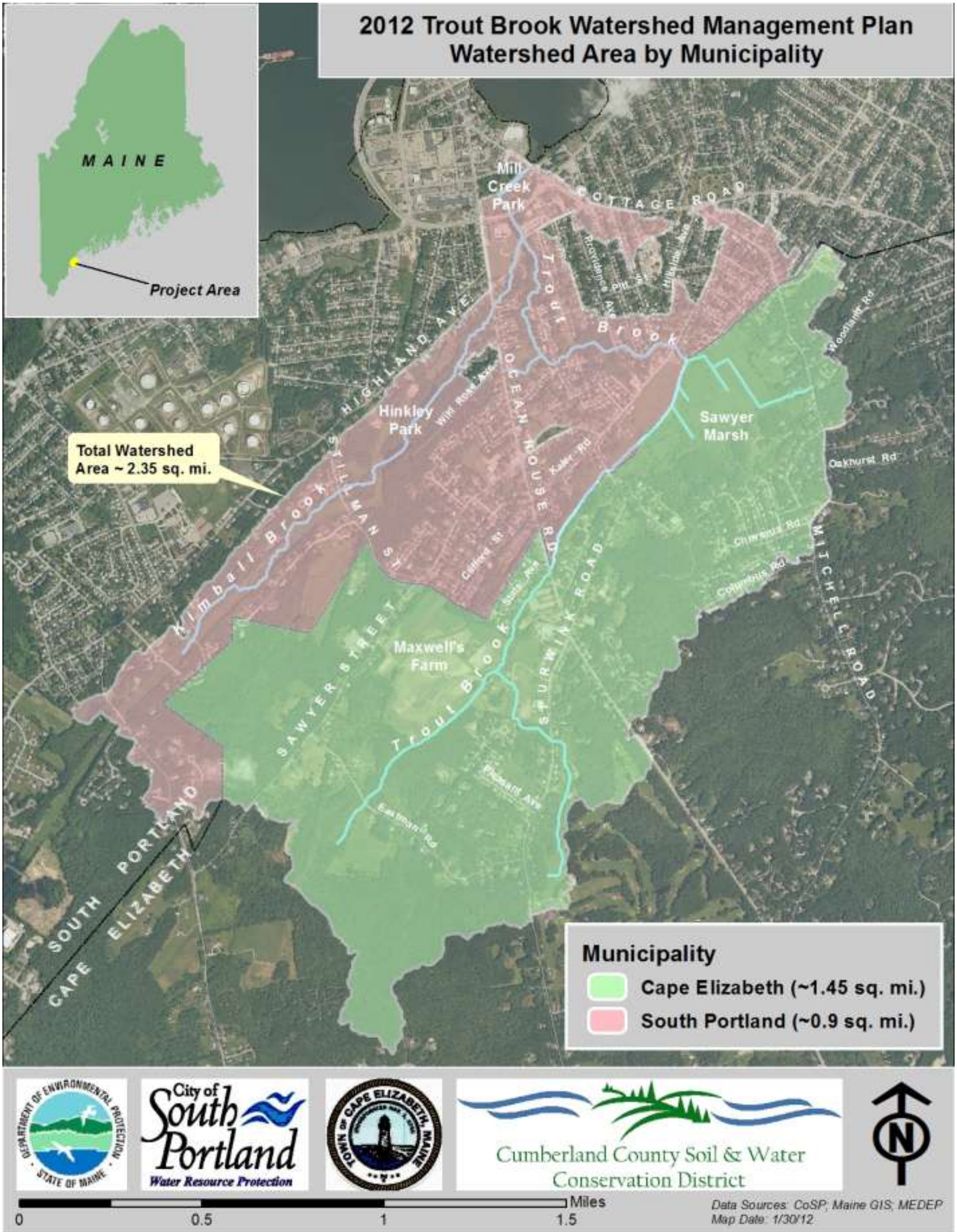


Figure 2. Trout Brook Area by Municipality

1.3 Who should read this plan?

Any group that influences or is affected by water quality, habitat management, and land use decisions should read this report. Municipalities and local groups in and around the Trout Brook watershed should use this plan as the foundation for local action and stream restoration. State and federal agencies can use this plan to enhance their understanding of local watershed conditions and as a basis for coordinating planning, permitting and regulatory decisions.

The **Trout Brook Watershed Management Plan** will be carried out by the City of South Portland and the Town of Cape Elizabeth with extensive involvement from private landowners within the watershed.

2.0 Executive Summary

- *Where is the watershed?*
- *What water quality concerns were identified?*
- *How was this plan developed?*
- *What actions are proposed to improve water quality?*
- *What funding mechanisms are available for restoration?*

Trout Brook is located in the City of South Portland and Town of Cape Elizabeth (Figure 2), on the southern coast of the State of Maine in the southeastern corner of Cumberland County, the State's most populous county. The Trout Brook watershed encompasses approximately 0.9 square miles in South Portland and approximately 1.45 square miles in Cape Elizabeth. In Cape Elizabeth, it is a Class B fresh water stream until the South Portland city line at Sawyer Marsh where it then becomes a Class C fresh water stream. Near Highland Avenue, the stream becomes tidally influenced and is referred to as Mill Creek. It then discharges into the tidal waters of Mill Cove and flows into the Fore River and Casco Bay. The Trout Brook watershed is a complex mix of land uses that includes dense residential, commercial, agricultural, public, and forest land. Up until 2005, there was a combined sewer overflow (CSO) that discharged into Trout Brook. The entire watershed is classified as a "regulated area" under the NPDES Phase II Stormwater Program.

2.1 Threats to Water Quality

Trout Brook and Kimball Brook are on Maine's **303(d) list,** meaning that they do not meet standards for aquatic life and habitat. Stream habitat and biomonitoring assessments found that Kimball Brook and Trout Brook did not support the aquatic macroinvertebrates or habitat that should be found in a Class C stream. Subsequent studies have confirmed that portions of Trout Brook in Cape Elizabeth do not meet Class B stream criteria. Trout Brook is also listed as an Urban Impaired Stream in MDEP's Chapter 502. Urban Impaired Streams are waterbodies that are not meeting state and federal water quality classifications due to polluted runoff from impervious surfaces such as rooftops, parking lots, and roads. In August 2005, the MDEP completed a Total Maximum Daily Load (TMDL) for Trout Brook that used impervious cover (IC) as a surrogate for a suite of pollutants commonly found in urban stormwater runoff.

The **303(d) List** identifies bodies of water that do not meet Maine's water quality criteria for their designated uses.

Grass clippings dumped on the banks of Trout Brook.

The threats to water quality identified during this Watershed Based Management Plan development were as follows:

- Stream bank erosion (many erosion sites are associated with inadequate buffers);
- Inadequate buffers;
- Yard waste dumping;
- Stream channel alteration and the resulting degraded habitat;
- Decreased dissolved oxygen (DO); and,
- Elevated chloride and specific conductance related to salt storage and application.

2.2 Plan Development and Community Outreach

Restoration is necessary because neither Trout Brook nor Kimball Brook meets state water quality classification standards. The health of both streams is also important to the health Mill Creek and ultimately, the Casco Bay Estuary. The goal of the Trout Brook WMP project is to develop a locally supported watershed based plan that outlines strategies to help restore the water quality of Trout Brook. Given existing conditions of the Trout Brook watershed, the continued goal is to enhance the quality of life and minimize impacts to the environment.

Altered stream channel

The City of South Portland partnered with the CCSWCD and MDEP to develop this Plan, which is intended to serve as a guide for restoring and protecting Trout Brook. Incorporating input from stakeholders, this plan identifies the most pressing problems in Trout Brook and establishes goals, objectives, and actions for resolving them. The management plan also contains strategies for monitoring progress and financing implementation.

2.3 Recommended Management Strategies

Adaptive management is the process by which new information about the health of the watershed is incorporated in the WMP. An adaptive management approach is widely recommended for restoring urban watersheds (CWP, 2003). The adaptive management approach recognizes that the entire watershed cannot be restored with a single restoration action or within a short-time frame. As new data, information, and/or technology become available, this approach establishes a mechanism for restoration efforts that can be adjusted to meet the current needs of the watershed over time.

2.4 Trout Brook Restoration Approach

The Trout Brook action plan builds upon strategies recommended by watershed stakeholders at the initial public meeting and four subsequent subcommittee meetings. A Trout Brook Workgroup will be established to implement this Plan. The following goals and objectives were established by the project steering committee and stakeholders at several public workgroup meetings:

Goal #1 - Improve Trout Brook water quality so that it meets State water quality standards

- Ensure that Trout Brook meets water quality standards for aquatic life and stream habitat.
- Continue to monitor water quality parameters to include DO, bacteria, chloride, and temperature.
- Ensure that Trout Brook watershed provides good habitat for fish and other wildlife so that it can provide a connection to nature for watershed residents.

Goal #2 - Protect and maintain water quality, aquatic and wildlife habitat to ensure the Brook continues to meet state water quality standards.

- Improve the management of stormwater runoff for existing development in an effort to improve stormwater quality.
- Ensure municipal ordinances and enforcement guide new development in a manner that protects the Brook.
- Coordinate efforts with other groups in the watershed focused on conservation and protection strategies.

Goal #3 - Build community support for the protection and enhancement of the land and water resources of the Trout Brook watershed.

- Develop an outreach program for citizens and businesses to promote and implement the WMP. Include one-on-one outreach and signage to educate residents on their role in implementing the WMP.
- Strengthen ties with the local schools and the Community College to enhance education and participation in opportunities for community action.
- Develop a Trout Brook Workgroup to oversee Plan implementation, and ensure that the Watershed Based Plan goals are achieved.

2.5 Trout Brook Restoration Strategies

The WMP has identified seven Restoration Actions (described in detail in Section 8.3 of the WMP) to ensure that Trout Brook meets its water quality objectives:

- **Nutrient Reduction** practices such as nutrient management systems, filter strips, and bioretention systems were modeled as solutions for nutrient (i.e., phosphorus) inputs to Trout Brook. The nutrient contributions come from commercial, agricultural, and residential sources, and therefore the WMP outlines a comprehensive approach to work with all property owners to address nutrient inputs to the stream. This work is being funded as part of Phase I Implementation (to be completed 2013-2014) through MDEP's Nonpoint Source Grants program.

- **Stream Habitat Restoration** will be completed at stream erosion sites. Phase I Implementation targets 22 of the sites that will likely reduce sedimentation and nutrient loading to the stream. Additionally, a habitat grant from CBEP in 2012 addressed some habitat degradation due to an impoundment in the Trout Brook Preserve.

- The **Chloride Reduction** approach is proposed to target municipal, commercial, and residential salt storage and application. The Plan promotes education for landowners, private contractors, and Public Works personnel on salt reduction strategies and techniques. Other actions proposed by the Plan include addressing groundwater contamination by reducing or eliminating the use of infiltration BMPs in areas underlain by permeable sand and gravel deposits. If infiltration BMPs are required in these areas, the Plan recommends implementing "reduced salt areas" as a last resort.

- **Stormwater Treatment and Impervious Cover Reduction** can be achieved by installing stormwater management systems to treat approximately 14 acres of existing IC and managing stormwater during the development of new impervious surfaces in the watershed.

- **Citizen Outreach** will be implemented as part of Phase I Implementation through both YardScaping (low-impact landscaping practices) and a Green Neighbor Pledge Drive to enlist landowners to pledge to implement pollution prevention practices on their properties. Eleven stream crossing signs are also included in the outreach program.

The plan also identifies a Trout Brook Workgroup and potential future protection strategies that can be undertaken by municipalities, conservation groups, and the Trout Brook Workgroup to ensure ongoing protection in the Trout Brook watershed.

2.6 Funding Strategies

Phased implementation is expected to occur for many of the restoration projects identified in the plan. Many of the listed actions will be implemented by the City of South Portland and the Town of Cape Elizabeth and interested landowners. Several of the restoration efforts identified in this plan will be implemented using MDEP NPS funds ("319 Grant Funds") beginning in 2013.

Project stakeholders recognize that grants alone cannot address all of the Trout Brook restoration process. The South Portland Conservation Commission has identified Trout Brook as an area where some of the City's Wetland Compensation Funds could potentially be used for restoration projects. The Town of Cape Elizabeth has an established a "Compensation Fee Utilization Plan" for the Trout Brook watershed. If milestones and goals are not met as anticipated, alternative funding sources will be explored due to the significantly higher levels of cost to implement large structural retrofits and stream crossing work.

3.0 Watershed Characteristics

- *What are the features of the surrounding landscape?*
- *What effect does hydrology and soil type have on the Watershed?*
- *What natural resources does the Watershed provide?*
- *How is land within the Watershed being used?*

3.1 Location

Trout Brook is located in the City of South Portland and Town of Cape Elizabeth, on the southern coast of the State of Maine in the southeastern corner of Cumberland County, the State's most populous county. The Trout Brook watershed encompasses approximately 0.9 square miles in South Portland and approximately 1.45 square miles in Cape Elizabeth. At its headwaters in Cape Elizabeth, it is a Class B fresh water stream until crossing the South Portland city line and entering Sawyer Marsh where it then becomes a Class C fresh water stream. Near Highland Avenue, the stream becomes tidally influenced and is referred to as Mill Creek. It then discharges into the tidal waters of Mill Cove and flows into the Fore River and Casco Bay. The Trout Brook watershed is a complex mix of land uses that includes dense residential, commercial, agricultural, public, and forest land. Up until 2005, there was a CSO that discharged into Trout Brook. The entire watershed is classified as a "regulated area" under the NPDES Phase II Stormwater Program.

3.2 Population & Demographics

Table 1. Population Demographics of Trout Brook's Watershed Communities, 2010

Municipality	2010 Population	Population Aged 0-24	Population Aged 25-64	Population Aged 65+	Median Household Income	Per Capita Income
South Portland	25,000	30%	55%	14%	$42,770	$22,781
Cape Elizabeth	9,000	33%	62%	15%	$86,500	$47,940

South Portland is a city that has approximately 25,000 residents, which is a 7.2% increase from the 2000 census. The City encompasses 12.93 square miles of land ranging from urban to suburban in character. South Portland is the fourth largest city in the state. Known for its working waterfront, South Portland is situated on Portland Harbor and overlooks the skyline of Portland and the islands of Casco Bay. Due to its close proximity to air, marine, and highway transportation options, the City has become a center for retail and industry in the region. South Portland offers an array of parks and open space including the Greenbelt walkway, Mill Creek Park, Trout Brook Nature Preserve, and Hinckley Park with two ponds. The City's waterfront has several recreational marinas **and is home to the last free beach in the area, Willard Beach.**

Cape Elizabeth is a town with approximately 9,000 residents as of the 2010 census and has land area of 14.7 square miles. Cape Elizabeth shares a border with South Portland to the north and Scarborough to the south. The Town includes two islands, Ram Island and Richmond Island. Cape Elizabeth is home to three coastal parks: Fort Williams, Two Lights State Park and Crescent Beach State Park. Cape Elizabeth is also the location of the "Beach to Beacon" 10k road race that starts at Crescent Beach State Park and ends at Portland Head Light. In 2012, the Town also had more parkland and permanently dedicated open space than any other municipality in Cumberland County.

3.3 Climate

Cape Elizabeth and South Portland have an average low temperature of 10 degrees Fahrenheit in the winter and an average high of 77 degrees Fahrenheit in the summer months. The annual average precipitation is 49 inches and 43.5 inches per year, for Cape Elizabeth and South Portland respectively, and the average yearly snowfall is approximately 70.5 inches. Cape Elizabeth has the longest growing season in the state.

3.4 Soils & Surficial Geology

3.4.1 Soils

There is a diversity of soil types in the watershed with three dominant major soil series: Hollis (~42% of total watershed area); Swanton (~12% of total watershed area); and Deerfield (~10% of total watershed area) (Figure 3). The Hollis series consists of shallow, somewhat excessively drained, gently sloping to steep, moderately coarse-textured soils that have a few to many outcrops. These soils formed in glacial till and are on uplands in the northern and central parts of Cumberland County and in the coastal areas. The Swanton series consists of deep, nearly level, poorly drained to somewhat poorly drained soils that were formed in moderately coarse textured sediment of glaciofluvial origin. They are depressions in the coastal part of the county. The Deerfield series consists of deep, moderately well drained, nearly level to gently sloping, coarse-textured soils that were formed in sands of glacial outwash origin. They are on terraces in the central and coastal parts of the county.

Additionally, approximately 8% of the Trout Brook watershed area is comprised of highly erodible soils, while approximately 45% is comprised of potentially highly erodible soils (Figure 3). Highly erodible soils have the potential to erode at a far greater rate than what is considered tolerable and therefore have a higher potential to negatively impact water quality. The potential erodibility of soil is dependent on a combination of factors including the extent and type of vegetative cover, rainfall and runoff volumes, and slope length and steepness (MEGIS, 2005 as cited in FBE, 2008).

The soil types in the watershed have a strong influence on the stream environment and its ability to support its designated uses in the face of external stressors. The stream corridor soils tend to be non-highly erodible (See Figure 3), and therefore are unlikely to enter the stream channel under undisturbed conditions. The watershed's soils allow for groundwater recharge into the stream and support stabilizing vegetation along the stream and within the floodplain.

3.4.2 Surficial Geology

The surficial geology in the watershed area is the result of the advance and retreat of glaciers at the end of the last glacial period (Figure 4). The major geological formation type in the watershed is the Presumpscot Formation, a fine-grained glaciomarine deposit with minor deposits of coarse-grained glaciomarine and till soils. The fine-grained glaciomarine sediments accumulated on the ocean floor when the lowland area of Southern Maine was submerged. T he coarse-grained glaciomarine sediments were deposited where glacial meltwater streams and currents entered the sea. These sediments formed deltas, fans, and kames and locally covered earlier glaciomarine deposits of silts and clays. Depending on their source rock, glacial deposits may contain higher levels of metals (including iron and copper) and anions such as chloride, sulfide/sulfate, phosphate, and nitrate/nitrite than the surrounding deposits. These compounds may enter stream system when the deposits are disturbed by erosion or anthropogenic (human-influenced) means.

> The soils and geology in the Trout Brook watershed were formed by the glaciers that covered the area until approximately 10,000 years ago. The glaciers deposited sand and gravel, and during their retreat, the coast of Southern Maine was covered by the Atlantic Ocean.

Glaciomarine fans are deposits of sand, gravel, and till that are formed when runoff from a glacier contacts standing water. Trout Brook flows adjacent to/through a glaciomarine fan deposit located in the vicinity of Meeting House Hill and Parrott Street in South Portland (Figure 4). The gravel outcrop at the base of Parrot Street served as a gravel pit for many years, but the area is now part of the City's Trout Brook Preserve.

As expected with this range in surficial geology, Trout Brook's stream bottom has both fine-grained and coarser (gravel and cobble) sediments. Under undisturbed conditions, the fine-grained (silt and clay) portions of the stream channel tend to be stable while the stream segments that flow through the coarser (sand and gravel) formations tend to be dynamic systems characterized by shifting banks and meanders.

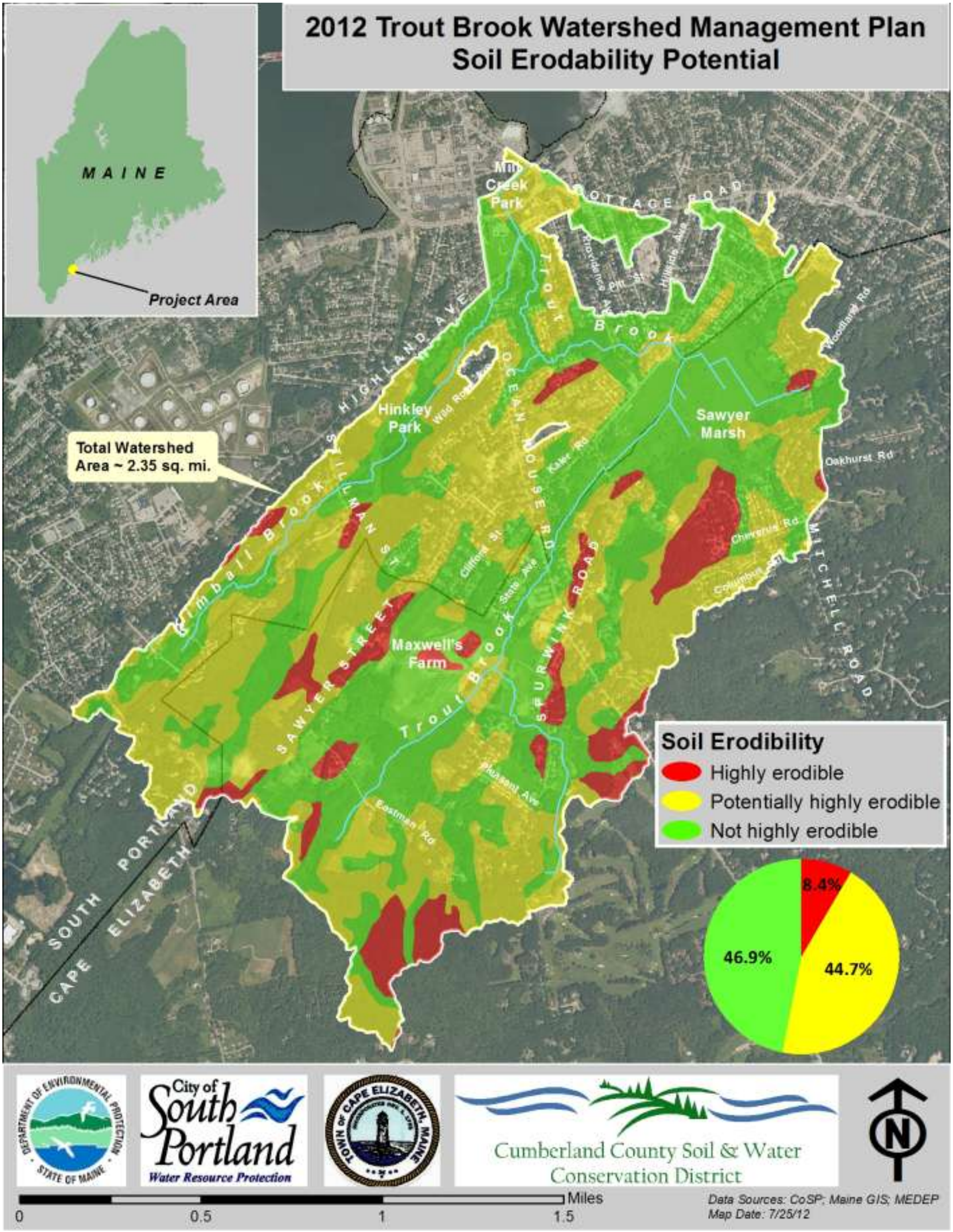


Figure 3. Soil Erodability Potential

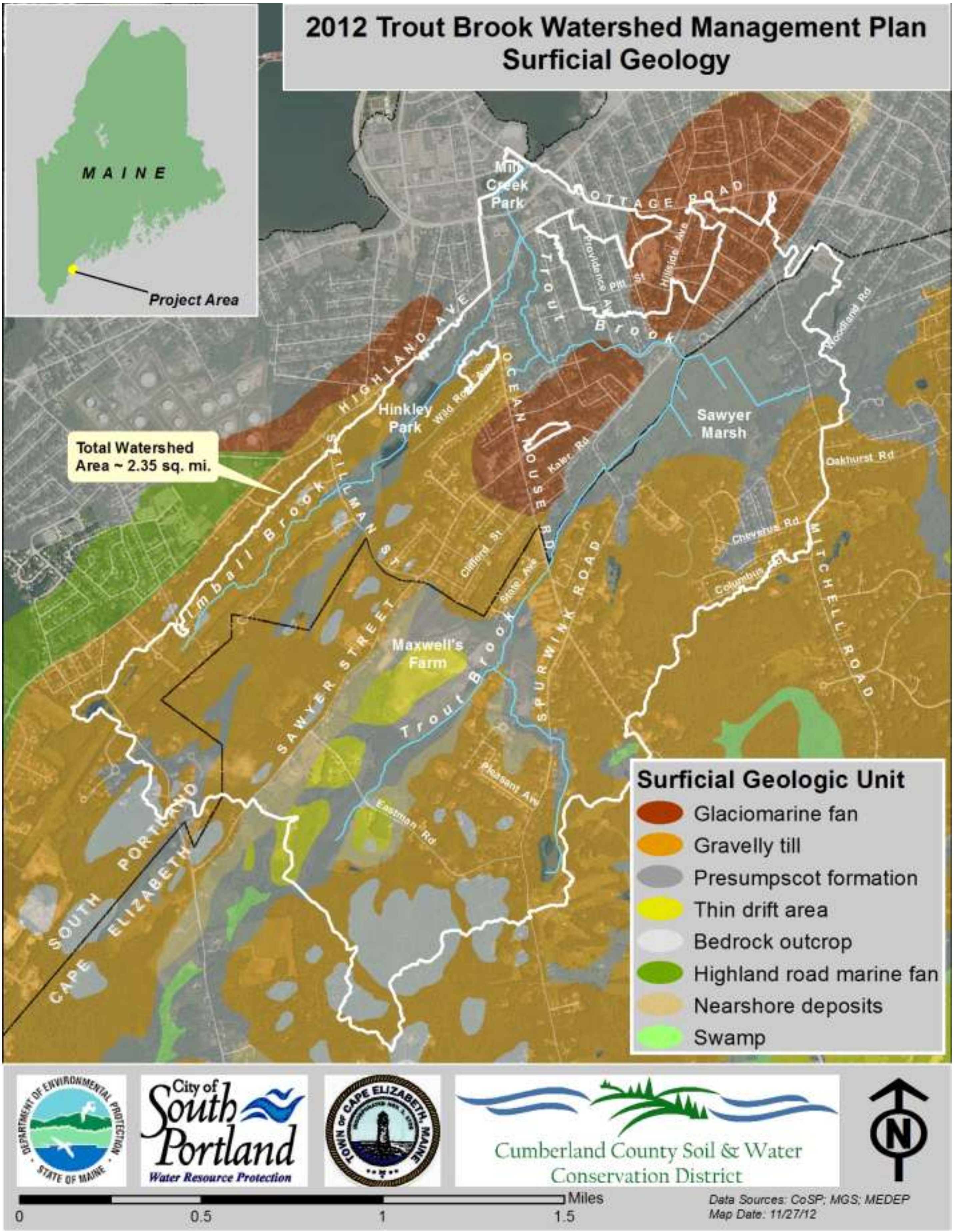


Figure 4. Trout Brook Watershed Surficial Geology

3.5 Land Use

3.5.1 Historical Land Uses

Pre-development land cover in the Trout Brook watershed consisted mostly of forested areas up until the time of European settlement in the 17th and 18th centuries. Early conversions of forested land into other uses consisted initially of sparse habitations with small subsistence farms. By 1775 Cape Elizabeth, which included present-day South Portland, was incorporated as a town. During this time, fishing and maritime trade had become thriving enterprises that promoted the development of ship building in Knightville and Ferry Village. Population increased significantly in response to these developments and by 1895 the more industrially-oriented residents of northern part of town decided to split from their farming neighbors to the south. The separate municipality of South Portland officially became a city in 1898.

Land use changes in the Trout Brook watershed proceeded through the 20th century, resulting in the continued conversion of forested areas to residential development and larger agricultural enterprises. World War II sparked another rapid growth of ship building in South Portland and housing increased to accommodate shipyard workers. Farming was also prevalent by the middle of the 20th century. Aerial photos from the period show large expanses of open fields with relatively sparse residential development in the central part of the watershed. However, by the latter part of the 20th century nearly all the developable land in the South Portland portion of the watershed had been converted from either farm or forest to residential development (Figure 5a & 5b). A similar trend occurred in Cape Elizabeth, though to a lesser extent since most residential development in the watershed is low intensity, and there are still several prominent agricultural operations.

3.5.2 Current Land Uses

The predominant land use type in the Trout Brook watershed (inclusive of Kimball Brook) today is primarily related to residential development, which extends across more than 755 acres or 50% of the total land area (Figure 6).

Table 2 summarizes the development intensity in the watershed. Most of the low intensity development occurs in Cape Elizabeth and consists mainly of residences. The majority of medium intensity development occurs in South Portland and also consists primarily of residences. High intensity development consists mainly of public roads with a few commercial and institutional land uses mostly located in South Portland.

Table 2. Development Summary

Development Type	Percent Buildings & Pavement	Acreage	Percentage of Watershed
Low Intensity	20-49%	408	27%
Medium Intensity	50-79%	204	14%
High Intensity	80-100%	38	7%

Forested areas in both South Portland and Cape Elizabeth are the next most prevalent land cover type and comprise approximately 449 acres (or 30%) of the watershed. Wetlands interspersed throughout both communities cover approximately 128 acres (or 8%) of the watershed with the largest wetlands complex, Sawyer Marsh, being located principally in Cape Elizabeth. Most of the agricultural land uses, which occupy about 104 acres (or 7%) of the watershed, are located in Cape Elizabeth in the area around Maxwell's Farm though there is one cultivated area in South Portland along Stillman Street. Scrub-shrub/grass and developed open space (Hinkley Park, the Purpoodock Club, Bay View Cemetery, and Mahoney Middle School) comprise about 59 acres (4%) and 38 acres (3%), respectively. The remaining 14 acres (1%) of land area is occupied by various other uses (gravel pit, Christmas tree farm, horse paddock, etc.).

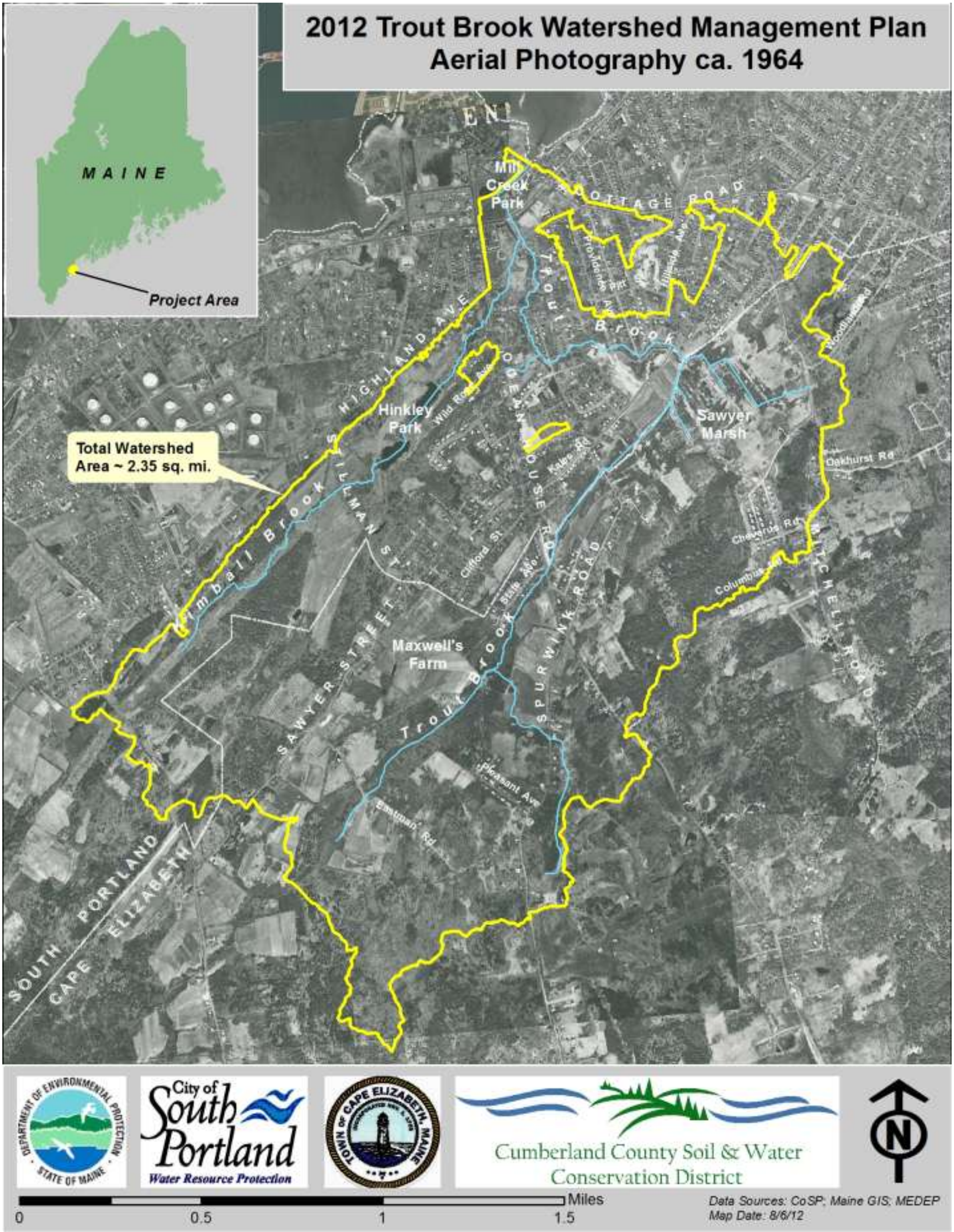


Figure 5a. Trout Brook Watershed Aerial Photography ca. 1964

Figure 5b. Trout Brook Watershed Aerial Photography ca. 2009

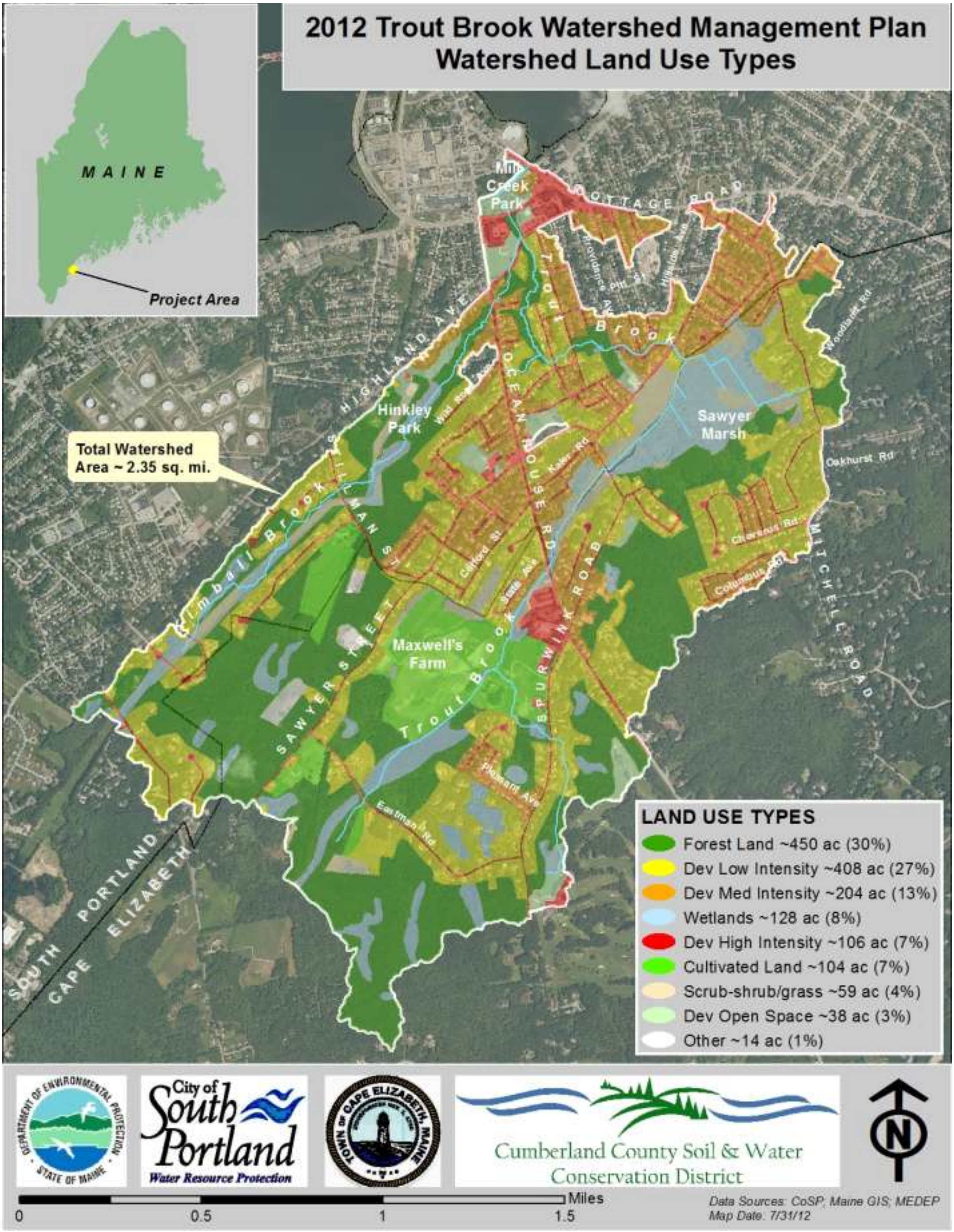


Figure 6. Trout Brook Watershed Land Use Types

3.5.3 Future Land Use

Both watershed communities have established zoning provisions that recognize the importance of protecting water quality while also promoting density as an antidote to more sprawling development patterns. Guiding growth to areas with existing infrastructure provides a regional environmental benefit by decreasing the likelihood that sparsely developed watersheds will become impaired.

Cape Elizabeth

The Cape Elizabeth portion of the Trout Brook watershed is located along the Town's northern boundary. This area consists of the Residence C (RC) district, Residence A (RA) district and the Residence B (RB) district (Figure 7). The RC district has a 20,000 sq. ft. minimum lot size and accounts for 18% of the watershed's land area. RC is characterized by the most densely settled neighborhoods in Cape Elizabeth and is served by public sewer. In contrast, the RA district has an 80,000 sq. ft. minimum lot size and represents the rural areas of the town where public sewer is not available. RA occupies approximately 15% of the watershed.

The RB district has been identified by the Comprehensive Plan as the Town's primary growth zone and is best suited to absorb the small amount of new growth anticipated while preserving community character. The RB district accounts for 5% of the watershed and is currently made up of large lots (10+ acres). Public sewer is extended on a project by project basis, and new development must be clustered with 40% of the gross land area set aside as permanently protected open space.

The remainder of Cape Elizabeth's portion of the Trout Brook watershed is zoned for Resource Protection (RP). The Town has one of the most stringent local wetland regulations in the State of Maine. Sawyer Marsh that sits between Cape Elizabeth and South Portland has been protected from encroachment on the Cape Elizabeth side since 1990. Other wetland complexes in the watershed are protected by 100' to 250' wetland buffers for very poorly drained soils and limited alteration allowances for poorly drained soils, subject to Planning Board review.

The largest undeveloped parcels in the watershed include Sawyer Marsh (zoned as RP1), the Maxwell Farm (predominantly in the RA District), Winnick Woods (a 71-acre town-owned nature preserve), the Blue Rock quarry, and the Purpoodock Club Golf Course. Based on the most recent growth estimates, the Town expects to have no more than 100 new homes built through the year 2020.

South Portland

The entire portion of the Trout Brook watershed located in South Portland is identified by the City's Comprehensive plan as a "Limited Growth Area." This area is nearly fully built out with established residential neighborhoods and has limited vacant, unutilized or unprotected land available for development. The City's development objectives for the Trout Brook watershed are to maintain the current pattern of single-family residences and limited infill or redevelopment that is consistent with the existing neighborhoods. The area consists of the Residential District AA, Residential District A, and Limited Business District (LB).

The AA district has 20,000 sq. ft. minimum lot size and comprises ~23% of the watershed's land area; its purpose is to provide low to medium density development of two single-family dwelling units per acre. The A zoning district is intended for denser development and allows up to four single-family dwelling units per acre with a 12,500 sq. ft. minimum lot size. The A district occupies ~16% of the watershed's land area. The LB zoning district occupies less than 1% of the watershed area and is considered a "Neighborhood Activity Center." LB provides mixed uses for the local neighborhoods consisting of service businesses and higher density housing.

There are several larger tracts of undeveloped land in the watershed. These include a 37 acre privately-owned parcel on Stillman Street, a 33 acre power line right-of-way and the 20 acre City-owned Hinkley Park, which is a popular recreational area for local residents. These parcels are located within the Kimball Brook watershed and AA zoning district. There are also two City-owned parcels abutting Trout Brook and along the Cape Elizabeth municipal boundary in the eastern part of the watershed. These include the 6.5 acre Trout Brook Nature Preserve and the Sawyer Marsh parcels, which comprise about 7.5 acres. These parcels are protected as open space for recreational uses.

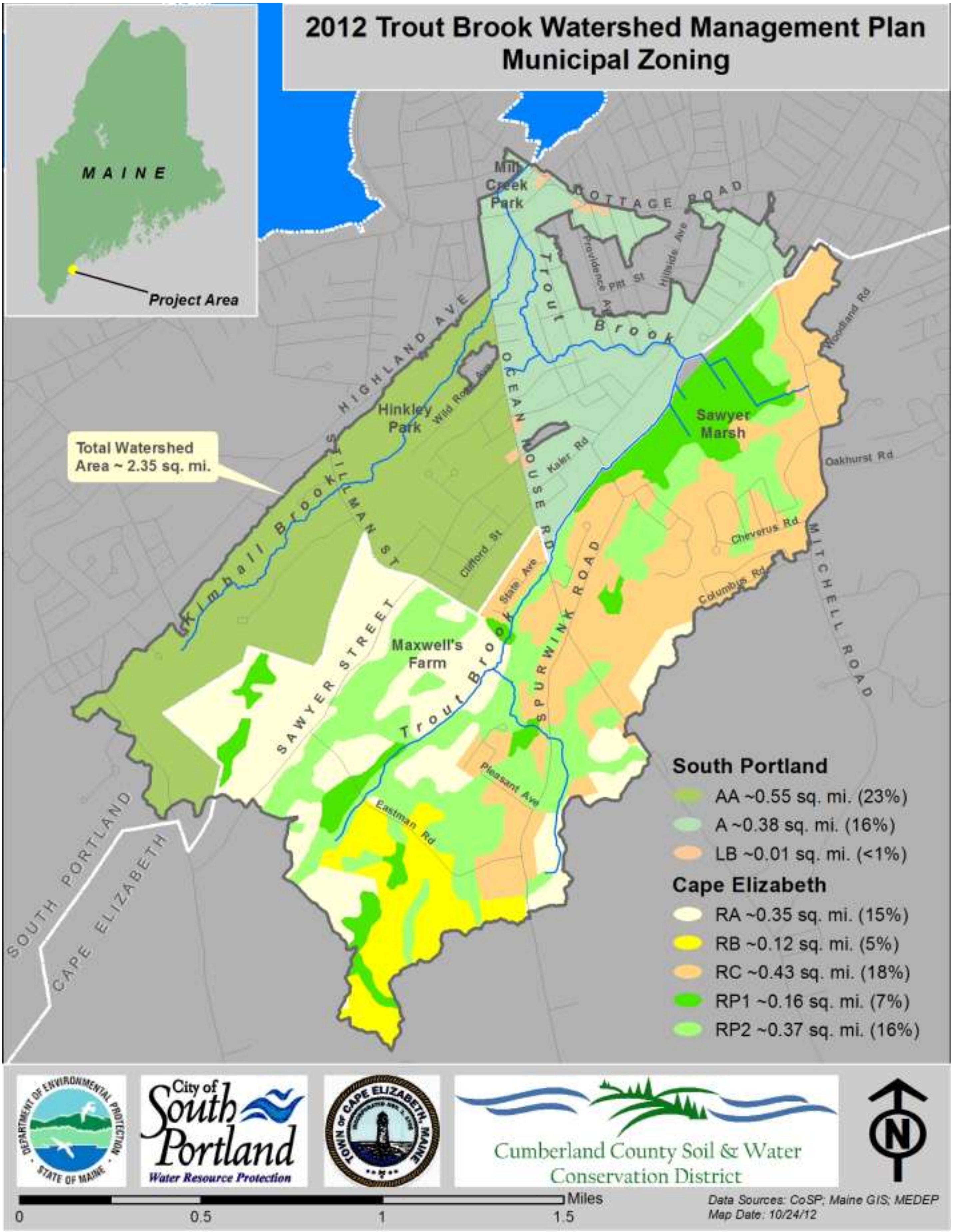


Figure 7. Trout Brook Watershed Municipal Zoning

There are many smaller parcels referred to as "lots of record" located in the area roughly bounded by Kaler Road, Spurwink Avenue, Ocean Street, and the Cape Elizabeth town line. These undeveloped parcels consist of approximately 6.5 acres and were recorded in older subdivision plans and plotted along with paper streets. While most of the lots are located within the 1981 FEMA 100 year floodplain, some of them are potentially developable as allowed under the AA district's zoning standards.


Sawyer Marsh

Trout Brook, Kimball Brook, and Mill Creek are also protected by the City's Shoreland Area ordinance. All land within seventy-five feet of the normal high water line is protected by the City's Stream Protection Overlay Subdistrict 1 (SP-1). The City's Freshwater Wetland ordinance also regulates all wetland alteration activities less than 4,300 sq. ft. (MDEP Permit by rule exemption) and all upland vegetative buffers within twenty five feet for the upland edge of a wetland.

3.5.4 Land Use Effects on Trout Brook

Over the past few decades, extensive research has established a very strong relationship between development intensity and adverse impacts to water resources. Beyond a certain critical threshold, landscape conversion from natural areas to more highly developed human land uses generally results in a deterioration of water quality and aquatic habitat. One of the primary drivers for this degradation is **impervious cover (IC)**, which consists of any hardened surface that prevents rain water or snow melt from soaking into the ground. Common examples of IC include roads, parking lots, driveways, sidewalks, and buildings. The types of pollutants that can be picked up from these surfaces during rain and snow melt events and carried to nearby surface waters include petroleum products, weed and bug killers, fertilizers, bacteria, and soil, among many others. Water quality and aquatic habitat can begin to show signs of stress when IC in a watershed reaches 8-10% because of increased amounts of polluted stormwater runoff or snow melt related to increasing development. The current IC for Trout Brook is 12% (Figure 8).

> **IMPERVIOUS COVER** is and surface areas that do not allow water to infiltrate into the ground such as paved areas, sidewalks and rooftops.

Since the Trout Brook watershed has already experienced considerable development, a variety of strategies can be employed to minimize the amount of pollutants generated from existing land uses. These strategies will be discussed in greater detail below, but for the most part they generally consist of reducing the amount of pollutants generated at the source and creating landscape features that allow developed areas to mimic more natural areas. For example, a homeowner might use less (or no) weed killer on a residential lawn and establish a vegetated buffer between the lawn and an adjacent stream or drainage way. Areas intended for future development or redevelopment also represent potential threats to water quality and aquatic habitat. State and local regulations now require that many new development / redevelopment projects must be designed to maintain pre-development conditions for the amount of pollutants and stormwater runoff generated from a particular project site. Ultimately, how and where landscape alterations occur is critically important for water resource protection.

3.5.5 Transportation Infrastructure

Public roads represent a significant proportion of IC in the Trout Brook watershed. They are also an essential component of the built environment and closely linked to adjacent land use development patterns. Much of the polluted stormwater runoff generated in the watershed is conveyed along transportation corridors, either through

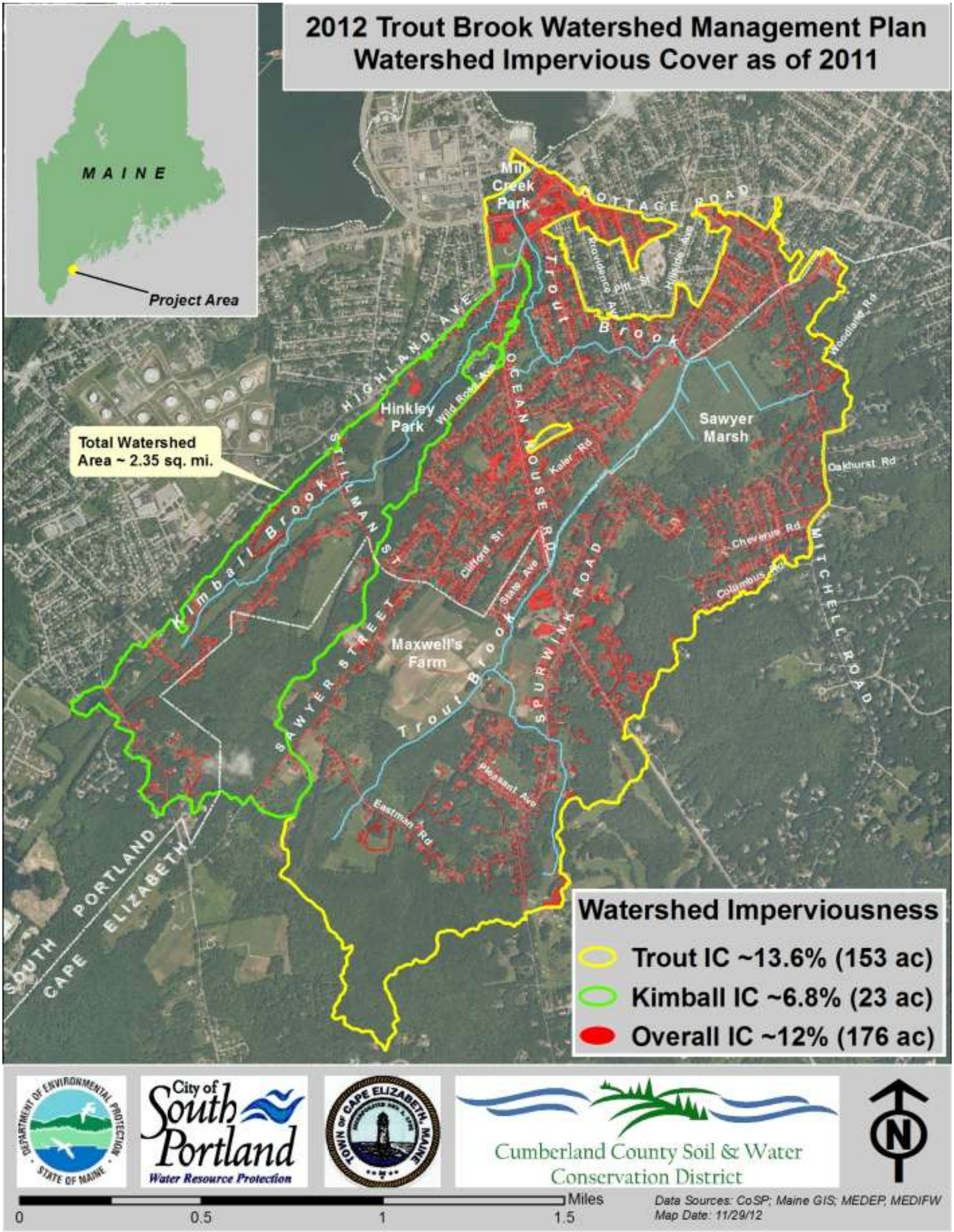


Figure 8. Trout Brook Watershed Impervious Cover as of 2011

underground stormwater systems or road side ditches. Public roads can also be a source of pollutants from vehicles (e.g., petroleum products, heavy metals, etc.) and winter maintenance activities (e.g., road salt and sand). There is a rough correspondence between traffic volumes and the amount of pollutants potentially generated from public roads. Increases in traffic volumes also increase the likelihood of pollutants from vehicles and winter maintenance activities (e.g., plowing, sanding/salting). Road salt is becoming a particular concern in freshwater streams due to its adverse impacts on aquatic organisms. More heavily traveled roads generally receive more salt application to meet public expectations for bare pavement in the winter.

There are currently just over 20 miles of public roads in the Trout Brook watershed and approximately 92% of them have relatively low traffic volumes (less than 10,000 vehicles per day). As such, these roads are less likely to generate stormwater pollutants than the three most heavily traveled roads in the watershed (Figure 9). Route 77, Cottage Road, and Broadway all have traffic volumes well in excess of 10,000 vehicles per day with Broadway approaching an annual average traffic count of 25,000 vehicles per day. While a traffic count of 30,000 vehicles per day is generally recognized as the threshold at which pollutants from public roads become problematic, lower traffic volumes can still contribute to water resource degradation (ODOT, 2006). Local and regional transportation plans do not anticipate the addition of new public roads over the next couple decades (PACTS, 2010). However, new development and redevelopment will occur within the region and potentially increase the amount of traffic on the roads that traverse the watershed.

In addition to winter maintenance activities, the City of South Portland and Town of Cape Elizabeth are responsible for maintaining all of the public roads in each respective municipality. These maintenance activities include:

- Street sweeping and catch basin cleaning
- Minor road surface repair
- Underground drainage infrastructure repair
- Surface drainage repair and maintenance (ditching)
- Signage and pavement markings
- Traffic signal repair and maintenance
- Road side grass and weed control

Heavily traveled roads are generally salted more in the winter

Many of these activities can help control and reduce the amount of pollutants in stormwater. Routine street sweeping and catch basin cleaning are of particular importance in removing the pollutants that accumulate on public roads and in the stormwater piping systems before these materials reach nearby surface waters.

3.6 Surface Water Hydrology

Trout Brook flows for nearly 2.9 miles through a variety of land uses. The stream originates from a wetland area above Eastman Road in Cape Elizabeth, travels through the agricultural fields of Maxwell's Farm for nearly a half mile, and then enters a short stretch of low and medium intensity residential development until it crosses under Ocean House Road / Route 77. It then runs for about 2,000 feet through Sawyer Marsh before entering the most heavily developed portion of the watershed in South Portland. From Sawyer Street below the marsh, Trout Brook flows through a fairly densely developed residential neighborhood. The section of Trout Brook from its confluence with Kimball Brook to Mill Cove is sometimes called Mill Creek. This tidally influenced section of stream runs between Mahoney Middle School and Brown Elementary School, under Broadway, and then through Mill Creek Park before entering the Fore River at Mill Cove.

Kimball Brook is the most prominent tributary to Trout Brook and originates from a wetland in the southwestern portion of the watershed above Stillman Street. Along the way, it travels for nearly 1.7 miles through a power line right of way, a low intensity residential area, two ponds in Hinkley Park, a short stretch of woods, and nearly 600' of underground pipe. Kimball Brook enters Trout Brook through a culvert on the northern (downstream) side of the

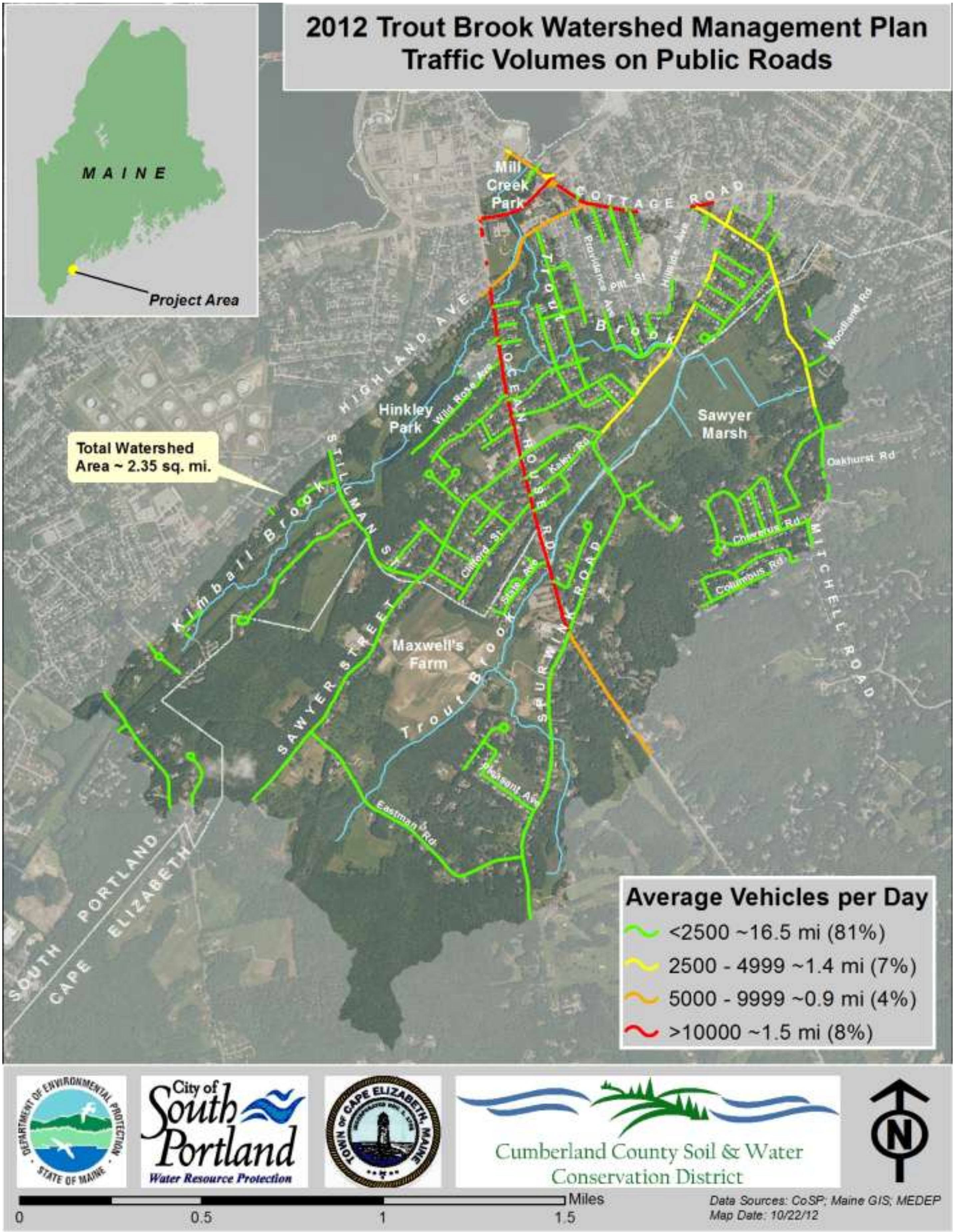


Figure 9. Trout Brook Watershed Traffic Volumes on Public Roads

Highland Avenue culvert crossing adjacent to the Mahoney Middle school athletic fields. There are several other unnamed tributaries, including several deliberately constructed ditches in Sawyer Marsh. Two other fairly prominent tributaries also flow from the Purpoodock Club along Spurwink Road in Cape Elizabeth and from the Simmons Road area in South Portland.

3.7 Groundwater Resources

In order to properly evaluate and protect surface water within the Trout Brook watershed, groundwater and subsurface hydraulic conditions must be considered. Groundwater and surface water interact in both recharge and discharge areas within the watershed (Figure 10). Groundwater recharge area protection is critical to restoring and maintaining water quality within Trout Brook and its tributaries.

In general, groundwater recharge areas are located in the topographic high areas on the periphery of a watershed. In watersheds where the boundary is affected by anthropogenic activities, groundwater recharge areas may be situated outside of the watershed boundary. Permeable geologic strata that do not follow local topography will also impact a watershed's groundwater recharge.

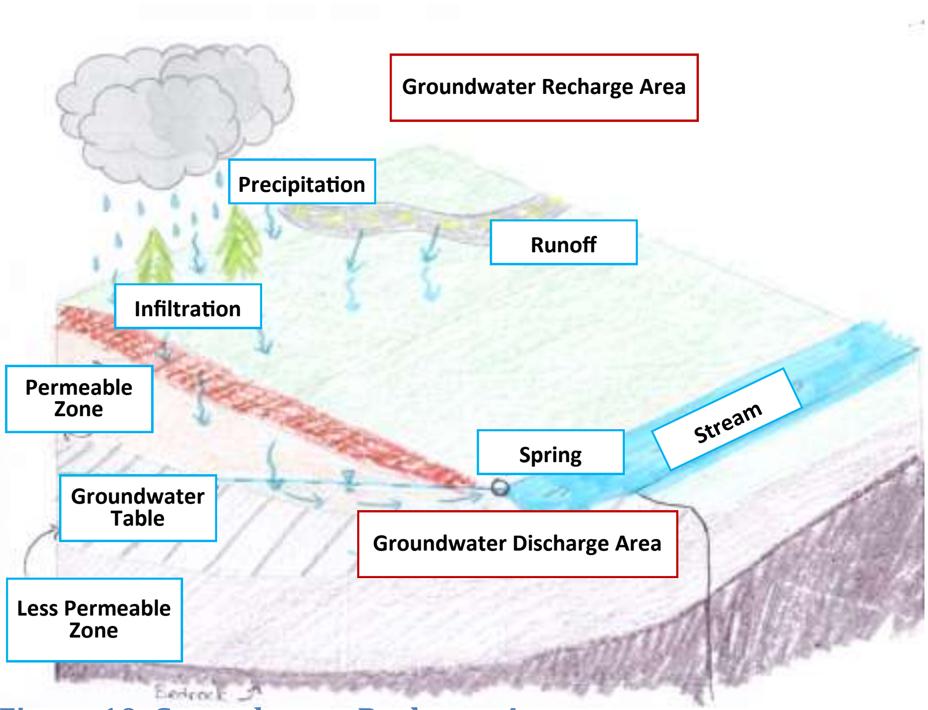


Figure 10. Groundwater Recharge Areas

In the case of the Trout Brook watershed, groundwater recharge areas are assumed to be located along the watershed boundary in and near Sawyer Marsh, Spurwink Road, Eastman Road, and Highland Avenue areas. There are numerous springs located in the Middle and Lower Trout Brook watersheds between the Sawyer Marsh and Highland Avenue. Field observations of flow in these springs indicate that during baseflow (e.g., "dry weather" conditions), Trout Brook is likely receiving significant groundwater recharge from the glaciomarine fan deposits that run generally parallel to Highland Avenue across the middle portion of the watershed (Figure 4). Since these deposits are typically sand and gravel and a higher hydraulic conductivity than the silts and clays of the surrounding Presumpscot Formation, it is likely that lower Trout Brook water quality is dominated by groundwater that may originate from outside of the delineated watershed during low flow periods.

The Maine Geological Survey has not identified any significant sand and gravel aquifers within the Trout Brook watershed, and there is no anticipated future drinking water exploration within the watershed. South Portland and Cape Elizabeth residents receive drinking water from Portland Water District, which sources its water from Sebago Lake in western Cumberland County.

4.0 Watershed Conditions

- *What are the designated and desired uses of our surface waters?*
- *What standards are used to judge water quality?*
- *What is the current condition of the Watershed?*
- *What are the impacts of pollutants on the Watershed?*

4.1 Stream Class & Criteria

The Maine Legislature (Title 38 MRSA 464-468) has established water quality classification standards for all surface waters in the State of Maine. This system provides water quality goals and criteria and guides management efforts so that individual water bodies can be protected and restored to meet these goals. Although all water bodies must meet fishable and swimmable goals in the Federal Clean Water Act, four classes of freshwater streams (AA, A, B, and C) have been established to reflect differences in risk. This ranges from Class AA streams, which are in the most natural condition and highest water quality criteria, to Class C streams, which are still good quality but have a higher risk of degradation.

The South Portland portion of Trout Brook and all of Kimball Brook are designated Class C, and the Cape Elizabeth portion of Trout Brook is designated Class B by the MDEP (MRSA Title 38, Chapter 3). Class C streams must support aquatic life and allow for other designated uses such as drinking water, fishing, and recreation. In addition, Class C streams must meet specific criteria for DO, bacteria, habitat, and aquatic life. These criteria are less stringent for Class C streams compared with Class B streams. The following table summarizes the Water Quality standards that are applicable to Trout Brook:

Table 3. Maine Streams Classifications, Designated Uses, and Criteria

	Designated Uses	Numeric Criteria	Habitat Narrative Criteria	Aquatic Life (Biological) Narrative Criteria
Class B	Aquatic Life; Drinking Water; Fishing; Recreation; Navigation, Hydropower; Industrial Discharge	Dissolved Oxygen 7 ppm and 75% saturation E. coli 64/100 ml (g.m.*) or 236/100 ml (inst.*)	Unimpaired	Discharges shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes to the resident biological community. **
Class C	Aquatic Life; Drinking Water; Fishing; Recreation; Navigation, Hydropower; Industrial Discharge	Dissolved Oxygen 5 ppm and 60% saturation E. coli 126/100 ml (g.m.*) or 236/100 ml (inst.*)	Habitat for fish and other aquatic life	Discharges may cause some changes to aquatic life, provided that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community. **

* "g.m." means geometric mean and "inst." means instantaneous level
**Determined using numeric biocriteria through MDEP's Biological Monitoring Program

According to the Integrated Water Quality Monitoring and Assessment Report (MDEP, 2010), Trout Brook and Kimball Brook do not meet Class C designated uses and criteria. (Table 3) Specifically, they are both listed as impaired because they do not provide for aquatic life based on stream habitat and benthic macroinvertebrate assessments.

4.2 Stream Assessments

Over the past several years, numerous assessments have been conducted in Trout Brook watershed. Table 4 provides a list of the assessments that have been completed for Trout and Kimball Brooks, and Appendix A summarizes the findings for each report reviewed as part of this Plan. The following sections summarize the available data, highlight the areas of impairment, and identify possible future problems. Figure 11 depicts the approximate locations of the monitoring sites used for these assessments.

Table 4. Assessments in the Trout Brook Watershed		
Assessment Type	**Completed By**	**Date**
Macroinvertebrate Monitoring	MDEP	1999, 2003, 2004, 2005, 2010
Fish Population Study	MDEP, MIF&W	1999, 2000, 2001, 2003
NPS Watershed Survey	South Portland Land Trust	2003
Culvert Capacity Analysis	Wright Pierce	2003
Urban Streams Project Report Fish Community Fluvial Geomorphology Stream Habitat Water Quality	MDEP	2005
TMDL Study	MDEP	2007
Fish Barrier Assessment	CBEP	2009
Stream Corridor Assessment	CCSWCD, MDEP, City of South Portland	2011
Water Quality Data Collection	CCSWCD, City of South Portland	2010-2012
Terrain Conductivity Assessment	MDEP	2012
Kimball Brook Iron Assessment	MDEP, University of Southern Maine	In progress, 2012

4.2.1 Biological Assessments

Trout Brook does not meet Class C for aquatic life. The stream appears to support a limited native brook trout population. However, the macroinvertebrate community is more severely impacted and does not meet Class C standards. The following sections detail the biological assessments completed in the Trout Brook watershed since 2000.

4.2.1.1 Aquatic Macroinvertebrate Assessments

The MDEP's Biological Monitoring Program (also known as the Biomonitoring Program) collects and analyzes aquatic macroinvertebrate samples from Maine's rivers and streams. The Program uses a statistical model to determine if rivers and streams are meeting the aquatic life criteria associated with their assigned legislative water quality classification (AA, A, B, or C).

The Biomonitoring Program collected macroinvertebrate samples from Stations S-302, S-454, and S-675 in Trout Brook and S-795 in Kimball Brook between 2000 and 2010. (Note that S-302 was discontinued as a monitoring site after it was discovered that saltwater periodically reaches this location during high tides). Based on this data and the model, none of the stations meet Class C standards for aquatic biota. All stations show a lack of species diversity, an abundance of tolerant species (e.g., amphipods, midges, and worms), and a scarcity of sensitive species.

Table 5. Summary of Biological Assessments within the Trout Brook Watershed			
Year	**S-454 (Trout Brook) Fessenden St.**	**S- 675 (Trout Brook) Providence St.**	**S-795 (Kimball Brook) Route 77**
2000	non-attainment		
2003		non-attainment	
2004		non-attainment	
2005		non-attainment	non-attainment
2010		non-attainment	non-attainment

4.2.1.2 Fisheries and Brook Trout Population

The aquatic life criterion requires that all stream classes support native indigenous fish species, and brook trout are considered indigenous to all flowing Maine streams. According to Jim Pellerin, associate regional biologist with the Maine Department of Inland Fish & Wildlife, Trout Brook has never been stocked by the State. However, in 1999 there were reports of anglers catching tiger trout, which is a hybrid between brook and brown trout. An electrofishing investigation revealed that the stream had likely been stocked illegally with both species. Follow-up sampling in 2000 and 2001 revealed a small, brook trout population consisting of two to three age classes. Spawning activity was documented; however, no young-of-the-year trout were observed.

The MDEP Urban Streams study also investigated the fish assemblage in Trout Brook in June 2003. Electrofishing at the Highland Avenue station found 23 brook trout ranging from 2 to 12 inches in length and including 4 young-of-the-year. It is unclear if the brook trout observed in 2000 - 2003 were stocked fish, wild fish from a pre-existing populations and/or wild progeny from stocked fish. However, there are numerous accounts from local residents of continued brook trout sightings. The likely reason brook trout are still present in this urbanized stream is the contributions of cold water from springs feeding Trout Brook (Pellerin, personal communication).

Brook Trout (Photo Credit: Jon Dore)

Due to local interest in the stream and its brook trout fishery, several South Portland schools and Portland Water District selected Trout Brook as the location to release brook trout that they had raised during the year. In May 2012, 300 elementary and middle school students released trout fry into Trout Brook just below the Providence Avenue culvert. While the survivorship of these fish was expected to be quite low, there were several anecdotal reports of trout sightings in the Brook throughout the summer of 2012.

In addition to brook trout, several other native fish have been documented in Trout and Kimball Brook. The 2004 Urban Stream Study found 19 American eels ranging in size from 3 to 20 inches in length at the Highland Avenue station (MDEP, 2004). Also, a 1987 IFW survey found eels and ninespine sticklebacks, but no trout, in Kimball Brook and in Trout Brook in Cape Elizabeth.

4.2.2 Stream Channel Assessments

Summaries of the stream channel assessments that have been completed in the Trout Brook watershed (inclusive of Kimball Brook) are presented in the following sections. Detailed discussion, links to other reports (where available), and assessment methodologies are presented in Appendix B.

4.2.2.1 Fish Barrier Assessment

CBEP conducted a fish barrier survey of the Trout Brook watershed in 2009 using the Maine Stream Road Crossing Survey Manual (2008). Details are provided in Appendix B, and Table 6 summarizes several of the most problematic barriers.

Table 6. Fish Barriers in Trout Brook			
Crossing	**Culvert Material**	**Culvert Type**	**Barrier Class**
Sawyer Street	Metal	Pipe Arch	Potential
Fessenden Avenue	Metal	Pipe Arch	Severe
Providence Avenue	Concrete	Round	Severe
Providence Avenue	Concrete	Round	Potential
Boothby Road	Metal	Round	Severe

The watershed's fish barriers noted above were also associated with flooding concerns and undersized culverts. The CBEP study found that all three severe barriers on Trout Brook were also considered flood hazards by Cumberland County Emergency Management Agency or CBEP analysis. Four additional culverts in the watershed were also mapped as flood hazards. Flooding issues related to Trout Brook culverts have been a chronic issue in South Portland (Appendix A).

4.2.2.2 Fluvial Geomorphology Assessment

Fluvial geomorphology is the study of the shape and stability of stream systems. Although all streams change over time, human disturbance can destabilize the natural equilibrium in stream systems. In-stream and bank erosion can increase dramatically with significant increases in the stream flow (by increasing impervious surfaces and runoff) or increases in the amount of sediment reaching the stream. This instability also directly affects stream habitat conditions. In addition, past alterations to stream channels (e.g., straightening and widening) can slow down stream flow, which can also impact stream habitat and DO levels.

Altered stream channel (also note shopping carts in stream)

In 2003, a fluvial geomorphic assessment was conducted on Trout Brook as part of the MDEP's Urban Streams Study (MDEP, 2004). Details are provided in Appendix B. The study found that nearly half of Trout Brook had been straightened, half was slightly or deeply entrenched, and about 20% of the stream had eroding or armored banks. Despite these alterations, most of Trout Brook received the second highest ranking in the Geomorphic Assessment (ranking scale is Poor, Fair, Good, Reference). The three segments rated as *Poor* received scores close to the Good rating.

According to the study, since the stream was channelized many years ago, it has had time to adjust to the alteration and is now approaching a new equilibrium. As a result, there are good opportunities to improve the geomorphology of the three segments currently rated as *Poor* (unless peak storm flows are expected to change significantly). The *Poor* sections identified in the Trout Brook Preserve and below Highland Avenue would be good candidates for reestablishing sinuosity and habitat with logs and/or boulders. The tributary at Simmons Street has a high potential for rapid natural recovery, but recovery could also be accelerated with restoration activities.

Project staff conducting Stream Corridor Assessment survey along Trout and Kimball Brooks

4.2.2.3 Stream Corridor Assessment Survey

In September 2011, project staff conducted a Stream Corridor Assessment (SCA) survey along most of Trout and Kimball Brooks. The SCA survey method (Maryland DNR, 2001) rapidly assesses the general physical condition of the stream and identifies the location of a variety of environmental problems and restoration opportunities within the stream corridor. A detailed SCA survey report is provided in Appendix B.

The primary types of problems sites documented in Trout Brook included erosion sites, inadequate stream buffers, yard waste dumping sites, stream channel alterations, and exposed or discharging pipes. Survey teams collected information about the size, location, and severity of each site and also rated the relative cost and feasibility of restoration.

Table 7. Summary of Stream Corridor Assessment Survey

Site Type	Number of Sites	Severity	Notes
Erosion Sites	66	• 11 high severity sites • 39 medium severity sites • 16 low severity sites	• Total length: > 4,700 feet • Many associated with inadequate buffers. • Others were associated with stormwater outfall pipes, road crossings, or footpath.
Inadequate Buffers	28	• 4 high severity sites • 12 medium severity sites • 12 low severity sites	• Total length: > 2,000 feet on each side of the stream. • 21 of the inadequate buffer sites were also associated with erosion • 7 of the sites were also locations with yard waste dumping.
Yard Waste Dumping	25	• 0 high severity sites • 14 medium severity sites • 10 low severity sites	• 24 sites were piles of grass clippings and leaves of varying sizes (small piles to several truckloads). • 1 site was a pile of sand and other debris behind a school and has since been addressed.
Stream Channel Alteration	17	• 0 high severity sites • 12 medium severity sites • 5 low severity sites	• 3 sites in the Trout Brook Preserve (significantly altered in the past), repaired in 2012. • 7 armored retaining walls & 1 with concrete abutments. • 2 sites with corroding metal pipes in the stream. • 1 channelized (Sawyer Marsh)
Sewer Pipes	3	No rankings completed.	• Stormwater outfall had gray discharge with sewage odor (addressed 2012) • 1 sewer crossing was missing several supports (addressed 2012). • 1 sewer crossing had liquid dripping from it (to be addressed by City).

4.2.2.4 Stream Habitat Survey

Class B and C streams must provide habitat for fish and other aquatic life. To support fish and other aquatic life, stream habitat should include the following components: a wide variety of pools, fast flowing riffles, large woody debris, overhead tree canopy, and a stable stream bottom. As watersheds become more urbanized, stream habitat is often degraded and destabilized.

Several assessments have been conducted to evaluate the quality of Trout Brook's stream habitat. The following section summarizes these assessments as they relate to proposed work in the watershed. Detailed information on the Stream Habitat Characterizations completed in the Trout Brook watershed is provided in Appendix B.

In contrast to the relatively good geomorphology ratings, Trout Brook only had only one segment with a *Good* rating in MDEP's 2003 Rapid Habitat Assessment (RHA). The remaining 10 segments were rated as having *Poor* habitat. Approximately 95% of the stream was completely lacking in large woody debris (greater than 8" in diameter), and the remaining 5% of the stream only had 1-2 pieces of large woody debris per 100 feet.

Similar to the RHA study above, the MDEP Urban Streams (2004) study found that large wood was absent in their study reaches, but smaller pieces of wood (in both the > 5 cm. and 2-5 cm. size classes) were moderately abundant in both reaches. A separate Habitat Assessment also evaluated ten habitat parameters important for aquatic life (scoring fell into categories *Poor*, *Marginal*, *Suboptimal,* and *Optimal*). Both stream segments received ratings of *Suboptimal* or worse in 9 of the 10 categories (Table 8).

Table 8. Rapid Habitat Survey

Habitat Parameter	Downstream Station (below Highland Ave.)	Upstream Station (Trout Brook Preserve)
Stream substrate	Suboptimal	Suboptimal
Pool substrate	Suboptimal (mostly mud)	Suboptimal (mostly mud)
Pool variability	Suboptimal (mostly deep pools)	Suboptimal (mostly shallow pools)
Sediment deposition	Suboptimal	Marginal
Channel Flow Status	Optimal	Marginal (riffle substrates exposed)
Channel Sinuosity	Suboptimal	Marginal
Channel Alteration	Suboptimal	Suboptimal
Bank stability	Suboptimal/Marginal	Suboptimal
Vegetative Protection	Suboptimal/Poor	Suboptimal
Riparian Vegetative Zone	Suboptimal/Poor	Suboptimal/Optimal

4.2.3 Water Quality Assessments

The following sections summarize the data that has been collected in the Trout Brook watershed and made available as part of the Plan. The Criterion Chronic Concentration (CCC) and Criteria Maximum Concentration (CMC) are used as comparative criteria for contaminant concentrations in site surface water. The CCC is the highest in-stream concentration to which organisms can be exposed indefinitely without causing unacceptable effect (generally represented in the regulations as a maximum duration of 4 days every 3 years), and the CMC, or acute criterion, is the highest concentration to which organisms can be exposed for a brief period of time without causing an acute effect (represented in the regulations as a maximum duration of 1 hour every 3 years) (EPA, 2012). The CCC and CMC for each constituent are provided on the applicable data tables. Sample locations are provided on Figure 11.

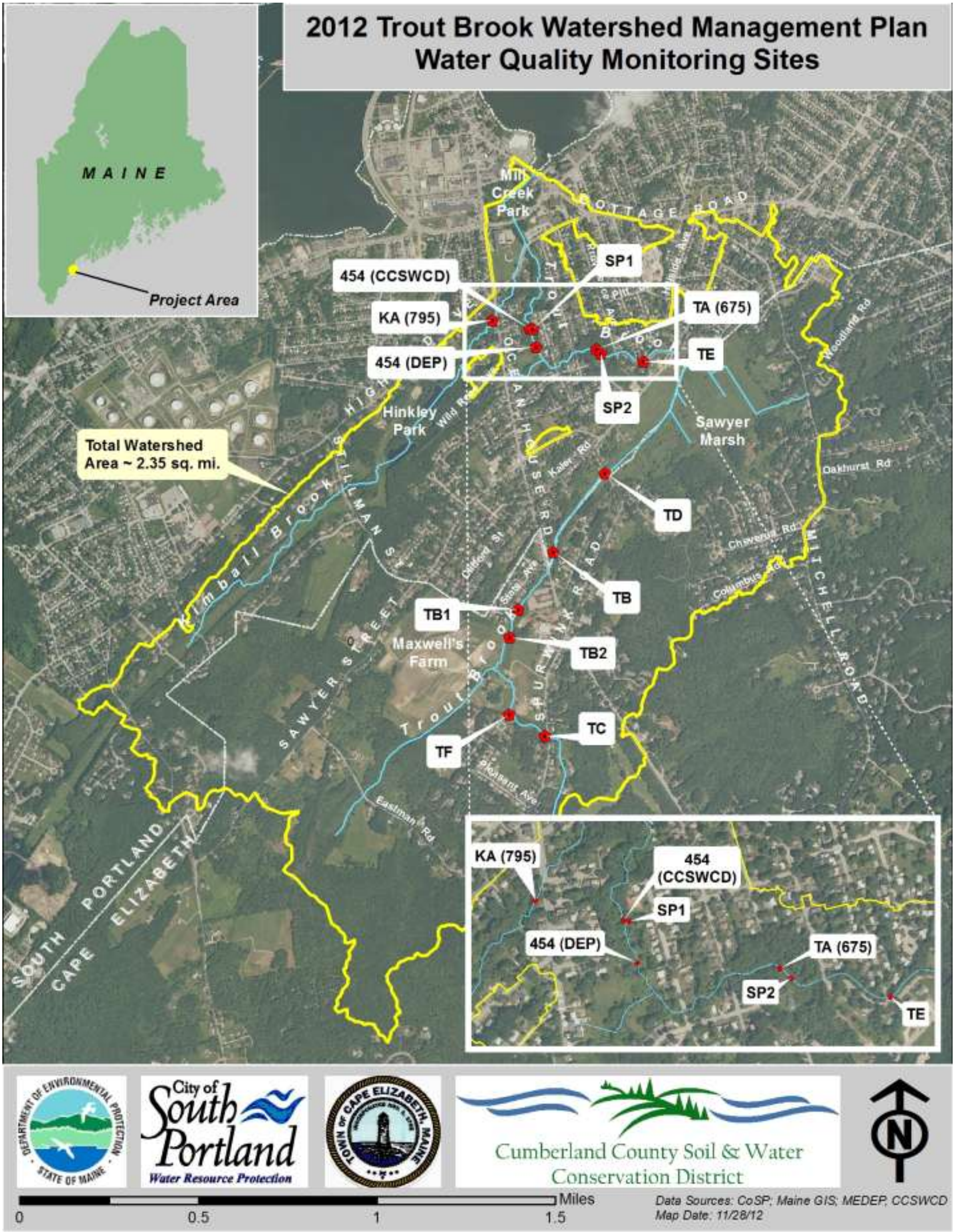


Figure 11. Trout Brook Monitoring Sites

4.2.3.1 Dissolved Oxygen

Continuous monitoring of DO in 2010 and 2012 indicates that DO fails to meet water quality criteria much of the time at monitoring sites 675 (Class C) and TB (Class B). Site TB typically contains its highest DO concentrations in the evening when the plant community has been producing oxygen throughout the day and low concentrations in the morning following a night of no oxygen production. Diurnal DO variation is normal in all streams, but large swings between the daily highs and lows (similar to that observed at TB) is typical of systems with nutrient enrichment. Nutrient enrichment is discussed in more detail in Section 4.2.3.3.

At Site 675, the continuous data sonde measurements showed DO above the 5 milligram per liter (mg/L) Class C DO criterion during the periods of continuous monitoring in 2012; however, the measurements are frequently below percent saturation criterion of 60% at Site 675. The continuous sonde data downstream of Route 77 (also downstream of TB) showed low percent saturation (between 55 and 59%) during one period on July 16 and 17, 2012; however, the remainder of the data passed the Class C DO criteria for both percent saturation and concentration. This suggests that this portion of the stream (which is classified as Class B) is not a major source of low-DO water to Site 675, and the source of reduced DO at Site 675 is likely located downstream of Site TB.

These data support data provided in the MDEP Urban Streams Report that suggests that the low DO in the lower part of the watershed (i.e., within the Trout Preserve) is due to low DO groundwater inflow (as evidenced by several visible springs along this stretch of Trout Brook) and contribution of low DO surface water from the wetland area upstream of Site 675.

4.2.3.2 Chloride & Specific Conductance

Chloride was identified as a possible constituent of concern in the stream due to elevated (greater than 0.100 milliSiemens per centimeter [mS/cm]) specific conductance readings identified at MDEP Monitoring Site S-454 (located by the footbridge near Fessenden Avenue) as well as from several springs located between Providence Avenue and S-454. Monitoring at S-675 (located downstream of two springs that discharge into the stream) measured chloride at less than 50 mg/L in June and July 2012 and less than 150 mg/L in August 2003 and July 2003. The two springs were sampled in July 2012 and Spring 1 contained chloride at concentrations slightly above the CCC during two baseflow monitoring events.

Water quality testing identified chloride as a possible constituent of concern in the stream

Table 9. Chloride Samples Exceeding Criterion

Sample Location	Sample Date	Chloride
	units	(mg/L)
	Criterion Continuous Concentration	**230**
Spring 1	7/26/2012	250
Spring 1	7/31/2012	260

Specific conductance is the ability of water to conduct an electrical current at 25 degrees C. The specific conductivity measures the ionic content of water, and, in a stream with certain water chemistry, can be used as a surrogate for chloride measurements. Chloride and specific conductance data collected during summer 2012 demonstrated that specific conductance measurements correlate closely with chloride concentrations in Trout Brook for specific conductance values below 0.8 mS/cm. The current data set underestimates chloride concentrations for specific conductance values above 0.8 mS/cm. A detailed chloride regression analysis is provided in Appendix C.

SPECIFIC CONDUCTANCE is the ability of water to conduct an electrical current at 25 degrees C.

Table 10 presents the range of mean chloride values calculated from continuous monitoring data collected from monitoring sites S-675 and TB through August 2012 (see Figure 11). Data collection is ongoing through 2012.

These data suggest that Trout Brook itself likely exceeds the chloride criterion during some summer baseflow conditions at Site 675 since the stream chemistry is dominated by groundwater (with high chloride). Conditions were exceeded for an extended period during 2010 (maximum calculated concentration 506.25 mg/L), but only for two days in 2012. In contrast, chloride was not exceeded at all at Site TB. In addition to summer chloride issues, it is likely that runoff from winter salt application to municipal roads and private driveways causes elevated chloride in the late winter/early spring runoff period, and if monitoring were conducted during a period of time where chloride dominates the groundwater chemistry from SP-1 and SP-2, then it is possible that these locations would exceed the chloride criterion.

Table 10. Range of Mean Chloride Values Calculated from Specific Conductance Data (2010 & 2012)

Site	Number of Data Points	Mean Minimum Chloride (mg/L)	Mean Maximum Chloride (mg/L)
675	6436	2.20	506.25
TB	4135	7.23	158.12

The chloride and specific conductance data suggest that there may be a chloride source located hydrogeologically upgradient of site S-454. There has been speculation that the municipal salt storage facility (located outside of the watershed to the northwest) may be a source. More details on the municipal sand/salt storage area are provided in Section 4.3.3.

4.2.3.3 Phosphorus

Total phosphorus was collected throughout the watershed in order to evaluate nutrient impacts to Trout Brook. The water quality criterion for phosphorus is 0.030 mg/L, which was derived from the 25th percentile of EPA's *Reference Conditions for Aggregate Ecoregion XIV Streams* (EPA, 2000).

> **STANDARD DEVIATION** is a statistical measure of how much the data varies from the average.

Total phosphorus data collected between 2000 and 2004 ranged from 0.011 mg/L to 0.22 mg/L with an average concentration of 0.05 mg/L (standard deviation of 0.05 mg/L). The 2012 total phosphorus data was collected over a variety of hydrological conditions (stormflow and baseflow), and from a variety of locations within the watershed. The data reflected this differing sampling strategy. In 2012, the total phosphorus concentrations ranged from 0.01 to 0.79 mg/L with an average concentration of 0.09 mg/L (standard deviation of 0.14 mg/L). The relatively high **standard deviation** means that there is considerable variability in the phosphorus concentrations. This is due to a small dataset collected over a short period of time, and therefore these data cannot be used to draw definitive conclusions about phosphorus trends in the watershed. The recommendations and actions provided herein take the sample variability and data limitations into account.

Figure 11 depicts the sampling locations, and Table 11 summarizes the phosphorus data collected within the watershed. Each site had at least one sample that exceeded the phosphorus criterion of 0.03 mg/L and the average total phosphorus for each site also exceeded the criterion. For all sites except for site TF (located in the Upper Subwatershed), the maximum phosphorus concentration was observed during stormflow conditions. Site TF was not sampled during stormflow conditions.

The elevated phosphorus concentrations observed at sample site TB during stormflow sampling prompted additional stormflow sampling in early October 2012. The summer 2012 stormflow samples were collected on the rising stage to ascertain "first flush" conditions (i.e., the period when the highest concentrations of contaminants enter the stream).

The October 2012 storm samples were collected after the first flush and when ground conditions were saturated. The saturated ground provided conditions to observe phosphorus concentrations that might typically enter the stream during a prolonged rain event rather than the "worst case scenario" observed with the first flush samples. The October 2-3, 2012 storm event experienced 0.7 inches of rain over approximately 48 hours. Approximately 0.5 inches of rain had fallen at the time of sampling. There was no channelized runoff observed during sampling. Table 12 summarizes the data collected during the October 2-3, 2012 storm event.

The supplemental data suggest that during certain types of storm events, the horse paddocks located southeast of the brook are a source of nutrients in the stream. Overall, the sampling data suggest that the high concentrations observed in stormflow pass through the system quickly. The stream also appears to have persistent elevated phosphorus (i.e., above 0.03 mg/L) even during baseflow conditions. The elevated phosphorus concentrations are likely contributing to depressed DO within Trout Brook.

A technical memorandum summarizing the phosphorus sampling within the watershed is provided in Appendix D.

Table 11. Total Phosphorus Data Summary

Site ID	Sample Date	Maximum Phosphorus Concentration (mg/L)	Average Phosphorus Concentration (mg/L)	Standard Deviation	Maximum Storm Concentration (mg/L)	Maximum Baseflow Concentration (mg/L)
S-302*	5/27/2003	0.15	0.04	0.04	n.s.	n.s.
S-454	6/13/2012	0.10	0.05	0.03	0.10	0.04
S-675	6/25/2012	0.35	0.09	0.10	0.35	0.06
KA	6/13/2012	0.07	0.03	0.03	0.07	0.02
TB	6/25/2012	0.79	0.146	0.201	0.79	0.05
TC	6/25/2012	0.30	0.09	0.11	0.30	0.05
TD	6/13/2012	0.06	0.05	0.004	0.06	0.05
TE	6/25/2012	0.29	0.10	0.09	0.29	0.05
TF	7/31/2012	0.05	0.04	0.02	n.s.	0.05
W-093	6/12/2003	0.04	0.04	--	n.s.	n.s.

* Site 302 was discontinued by MDEP when it was discovered that it is tidally influenced at times.
n.s.: Not Sampled

Table 12. Supplemental Phosphorus Sampling

Site ID	Sample Date	Sampling Conditions	Phosphorus Concentration (mg/L)
TB	10/3/12	End of storm	0.09
TB1	10/3/12	End of storm	0.08
TB1 (duplicate)	10/3/12	End of storm	0.09
TB2	10/3/12	End of storm	0.04

4.2.3.4 Other Constituents

The DEP sampling program detected aluminum, copper, and zinc above the CCC at two sampling locations during May and November 2003. Exceedances of the criterion are red/bold text. Subsequent metals sampling has not been performed in Trout Brook.

The Maine Board of Pesticide Control conducted limited sediment sampling in 2009. The results of this sampling are summarized in Appendix B.

Table 13.Metals Concentrations Exceeding Criterion in Trout Brook

Sample Location	Sample Date	Aluminum	Copper	Zinc
	units	(mg/L)	(mg/L)	(mg/L)
Criterion Continuous Concentration		0.087	0.00236	0.0306
S-675	5/27/2003	**2.000**	**0.007**	**0.031**
S-302	5/27/2003	**0.970**	**0.006**	0.022
S-675	11/21/2003	**0.850**	ND	0.016
S-302	11/21/2003	**0.500**	ND	0.010

4.3 Other Assessments

Other assessments have also been completed in the Trout Brook watershed since the early 2000s. Data and recommendations provided by these assessments as well as actions taken by stakeholders as a result have been considered as part of this Plan. The following sections summarize other studies completed within the Trout Brook watershed that are relevant to this Plan.

4.3.1 Culvert Capacity Analysis

In 2003, the City hired Wright-Pierce to conduct a culvert analysis for the five culverts between Sawyer Street and Fessenden Ave. Based on modeling of peak flows associated with a 25-year rainfall event, it was determined that four of the five culverts were undersized; and only the Sawyer Street culvert was sized adequately. Culvert capacity would need to be increased from 1.7 times (Boothby Ave.) to 4.9 times (Fessenden Ave.) to accommodate the 25 year storm. Figure 12 depicts the culvert locations.

Figure 12. Trout Brook Culvert Crossings

4.3.2 Chloride Source Investigations

Field investigations were conducted in June and September 2012 to investigate the hypothesis that chloride observed in the springs discharging to Trout Brook near S-675 and S-454 may be originating from the South Portland Public Works facility at O'Neil Street. This facility is not located in Trout Brook's watershed since its stormwater flows into the combined sewer system that ultimately discharges to the City's wastewater treatment plant. Site visits were conducted, however, to determine if any salt might be bypassing the stormdrain system or infiltrating into the groundwater to reach the stream. Project staff walked the site in heavy rain and observed surface runoff draining to the stormdrain system. However, much of the ground underneath the sand-salt pile and a small area behind this pile are currently unpaved, which allows chloride-laden runoff to infiltrate and reach the groundwater.

MDEP geologist, John Hopeck, led terrain conductivity field studies to screen for possible chloride plumes between the sand-salt pile and Trout Brook. Terrain conductivity (also known as electromagnetic conductivity) measures the conductivity of the soil, groundwater, rock, and objects buried in the ground. Survey lines (in green on map) were located adjacent to the sand-salt pile and along the streets running parallel between the pile and Trout Brook. Measurements were logged every 20 feet along these lines, and spikes in conductivity (in red on map) were plotted on GIS maps (Figure 13).

The study found numerous areas with elevated conductivity, starting adjacent to the sand-salt pile and on most streets between O'Neil Street and Fessenden Street. The sashed blue line indicates the inferred flow paths of salt-laden groundwater between the sand-salt pile and Trout Brook. The plume on Fessenden Street appears to be intercepted by the stormdrain system, which drains directly into Trout Brook. Water quality monitoring of this spring below the pipe outfall supports this idea, since the SP1 sampling station had consistently high specific conductance measurements. Likewise, the elevated terrain conductivity on the southern end of Providence Avenue is located adjacent to the SP2 spring, which also had elevated specific conductance measurements.

Surficial geology and soil data collected in the region suggest that the O'Neil Street Public Works Facility is underlain by a glaciomarine fan deposits, which consist of sand, silt, and gravel that was deposited during the last glacial period (MGS, 2012). The surrounding deposits are the silt and clay deposits of the Presumpscot Formation. These subsurface conditions result in preferred groundwater flow through the more permeable glaciomarine fan deposits, and the springs in the Trout Preserve suggest that the Brook cuts through the glaciomarine fan deposits.

Treatment options for this potential source of chloride include paving under and adjacent to the sand-salt pile and relocating the storage facility (currently under discussion in South Portland). Although the runoff from the pile drains to the combined sewer system and wastewater treatment plant, there is also some possibility that the existing pipes are leaky since the stormwater infrastructure in this area is quite old. The pipe condition should also be explored to ensure that paving under the pile will be adequate to stop the delivery of salt to groundwater and the stream.

4.3.3 Other MDEP Studies and Municipal Activities

In addition to information included in other sections of this Plan, the 2005 Urban Streams Report identified the remedial actions for Trout Brook. These actions were included in the 2007 Trout Brook TMDL report. Specific actions included:

- Reduce impervious surfaces & stormwater runoff
- Improve stormwater treatment practices on existing developments
- Reduce hazardous substance/toxic spills and illicit discharges
- Reduce air pollution
- Improve channel morphology
- Replant riparian shoreland buffers
- Reduce or eliminate fertilizer use
- Minimize bacterial contributions (pet waste, sewage)

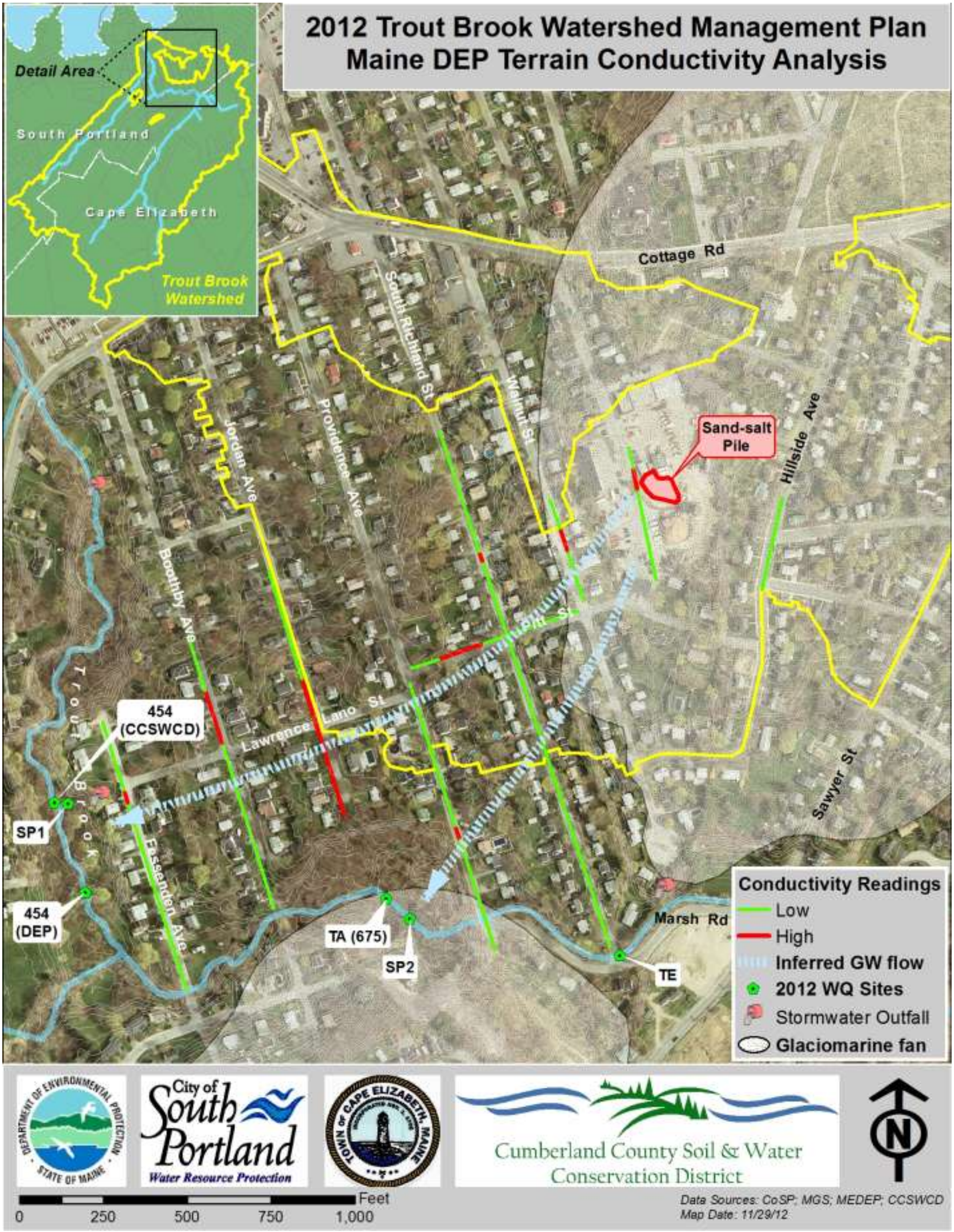


Figure 13. Trout Brook Terrain Conductivity Mapping

To date, the CSO has been removed and both South Portland and Cape Elizabeth have implemented Illicit Discharge Detection & Elimination (IDDE) programs as part of their MS4 permits. Additionally, in 2009 the City of South Portland enacted Stormwater Management Performance Standards (Ch. 27-1536) that exceed MDEP Chapter 500 provisions. The City's stormwater ordinance requires the use of Low Impact Development (LID) practices for new development or redevelopment projects that disturb 15,000 square feet (0.34 acre) to one acre of land. The Town of Cape Elizabeth also adopted a Compensation Fee Utilization Plan (CFUP) that requires a fee or the use management practices to reduce stormwater impacts for any qualifying construction projects in the Trout Brook watershed.

5.0 Pollutant Identification Methodology

- *What is the process for identifying and prioritizing pollutants in the Watershed?*
- *What are the sources/causes of the major pollutants in the Watershed?*

Section 4 summarizes the pollutants and environmental factors that are preventing Trout Brook and Kimball Brook from achieving their respective legislative water quality classifications. This section describes the possible sources and causes of the impacts. These were identified by reviewing the studies and reports, as previously discussed in Section 4 and conducting supplemental field investigations as further described in Section 4. Technical advisors and community members also provided input on the sources and causes of pollutants throughout the project. By identifying the cause of the pollutant source, implementation efforts can focus on remedying conditions leading to stream impairment. This will ensure that stream restoration efforts will be completed efficiently and effectively.

5.1 Identifying Stream Habitat Problems

As discussed in Section 4.2.3, the SCA survey was conducted in general accordance with Maryland DNR's 2001 SCA guidance. This survey documents the general physical condition of the stream and identifies the location of a variety of environmental problems and restoration opportunities within the stream corridor. The primary stream habitat issues identified in the Trout Brook watershed (inclusive of Kimball Brook) included inadequate buffers, stream corridor and bank erosion, yard waste dump sites, and stream channel alterations (e.g., bank armor, structures in stream, channel widening). Several additional stream habitat problems and restoration opportunities were also identified in the CBEP fish barrier assessment and MDEP Urban Streams study. These sites were all compiled and prioritized (Appendix B) based on impact/severity, benefit (related to stream stressor in that stream segment), restoration feasibility, and cost. Points were assigned for each category (ranging from 1 to 4) and totaled for each site. Phase I (high priority) sites scored 12 points or higher. Phase II sites scored lower than 12 points. Details are provided on the tables included in Appendix B.

5.2 Identifying Nonpoint Sources

Nonpoint source pollution was identified as a likely cause of impairment during previous studies conducted in the watershed (see Section 4). The two primary sources of nonpoint source pollution in the watershed are stormwater discharges from impervious surfaces and agricultural contributions. Chloride related to groundwater discharge is a third nonpoint source that is proposed to be addressed under this plan.

NONPOINT SOURCE POLLUTION is contamination that does not come from a direct discharge into a water body.

5.2.1 Stormwater Infrastructure & Impervious Surfaces

In addition to the physical alterations to the actual stream channel and corridor, stormwater from development adjacent to the stream corridor has also impacted Trout Brook's habitat. Much of the residential, commercial, and institutional development near the stream was completed between the 1940s and 1970s. As a result, the highly impervious areas in the lower part of the watershed have changed stream flows by directing large volumes of runoff directly to the stream. Some of the stormwater discharges directly into the stream by way of outfall pipes. Other outfalls flow into road ditches, which in turn flow into the stream.

Studies in Maine and around the country show strong connection between stream health and the amount of development in a watershed. IC is a measure of watershed development and includes parking lots, roads, rooftops, and other paved areas. A direct correlation has been established between IC and the health of aquatic ecosystems, specifically that as IC increases above 10% there is a corresponding increase in stormwater flows and degradation in water quality, stream habitat, and diversity of aquatic life (CWP, 2003).

Trout Brook's watershed boundary was field checked and refined by MDEP staff as part of the project. Developed parts of the watershed that drain directly into the stream via stormwater outfall pipes, ditches, or other concentrated runoff were more closely examined as well since these areas likely have a greater potential impact on the stream's water quality. In total, 31 outfall catchments were mapped in the watershed (Figure 14). The City of South Portland and MDEP staff created more detailed IC delineations in tandem with the field mapping. Together, this work allowed for an analysis of IC for the entire watershed and each catchment area and prioritization of catchments based on potential impact and retrofit options.

Trout Brook's total watershed imperviousness was found to be 12% due to the large tracts land in agricultural, forest, or wetland cover. However, the 31 individual outfall catchments were significantly higher, with an average catchment IC of 39%. 25 of the 31 catchments contributed less than 2% of the watershed total imperviousness; but the remaining six outfall catchments were larger and comprised between 2.6% and 11.6% of the watershed total imperviousness. (See Appendix E for outfall analysis table.)

Potential retrofit opportunity areas were identified through preliminary analysis of high-resolution aerial photography, review of existing development stormwater infrastructure, in-field inspections and surveys, as well as consultations with representatives of the Town of Cape Elizabeth and the City of South Portland.

The retrofit opportunities primarily focused in the areas that exhibit the greatest amount of IC and that receive little or no stormwater treatment prior to discharging to Trout Brook and its tributaries. The overall goals of the stormwater retrofit analysis were to identify structural stormwater retrofit opportunities that could be implemented:

- With limited impact on existing infrastructure;
- To attenuate some of the primary contributors of untreated stormwater pollution in the watershed; and,
- In a cost effective manner (e.g., BMPs that provide the highest level of treatment for the lowest installation cost per acre).
- Stormwater Retrofit Recommendations

Table 14. Phase I Catchment Scoring

Map ID	Outfall Catchment	Cost	Priority Ranking	Description of Potential Retrofits and Limitations
Phase I Retrofits				
M	29 Ocean House Road (near Site TB)	Medium	16	Connect runoff from upper parking lot and horse paddocks with existing stormwater pond and/or gravel wetland. Retrofit pond to provide better treatment
G	Rte 77 & Harrison	Low	14	Work with business owner to explore installing treatment/ infiltration system and/or using P-free products.
O	29 Ocean House Road (near Site TB)	Low	12	Create series of curb cuts and install wildflower buffer in grassed area to treat parking lot runoff.
Z	Office building on Spurwink	Medium	12	Possible bioretention cell; close off catch basin and install level spreader to grass filter strip; or remove berm adjacent to building to allow sheet flow into grass/field. Catchment needs to be delineated in the field.
Z2	Pleasant Ave. neighborhood	Medium	12	Large part of neighborhood drains to stream. Retrofit would be beneficial since impact to small stream could be significant. Catchment needs to be delineated in the field.

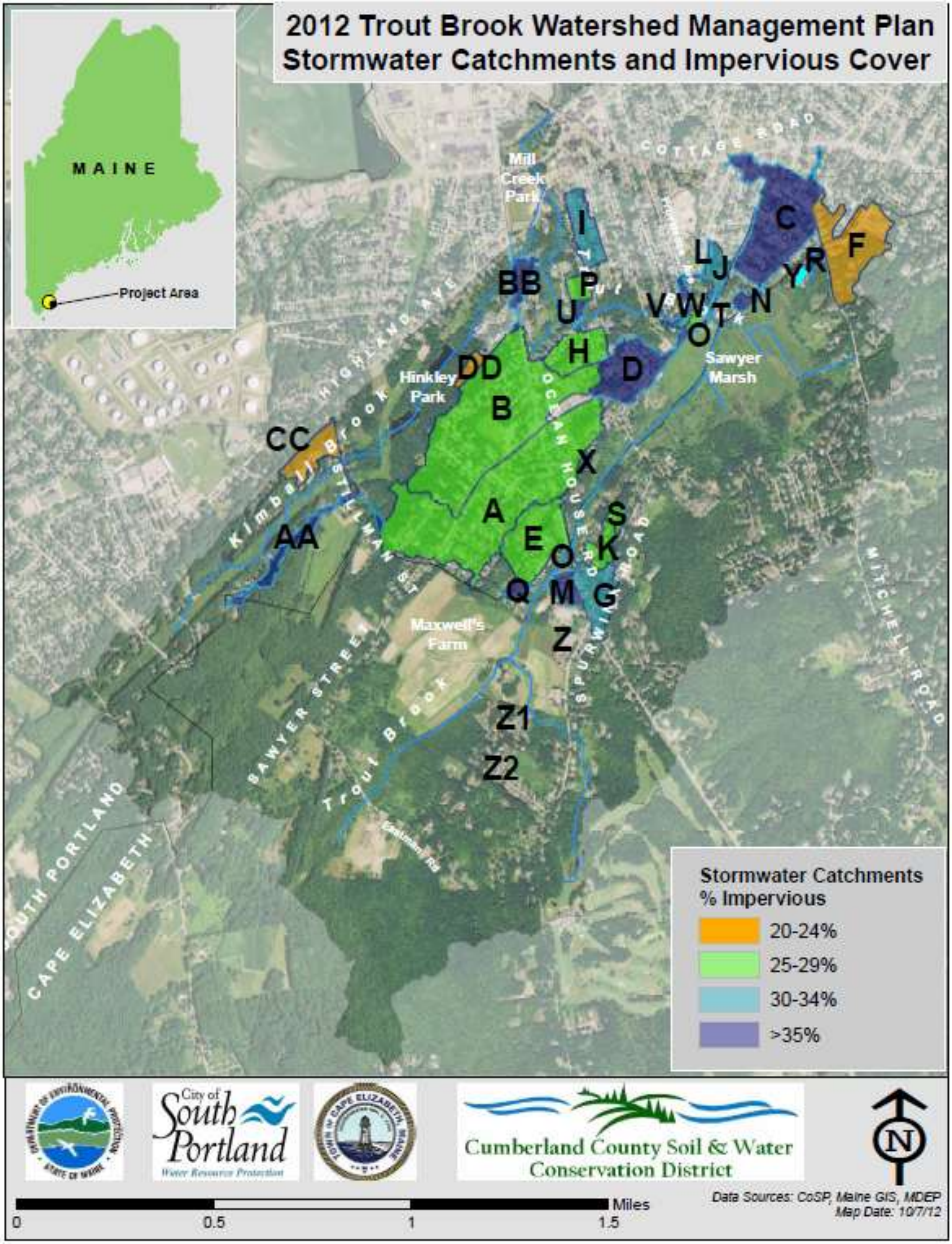


Figure 14. Trout Brook Watershed Outfall Catchments

Most of the outfall catchments were visited by project staff in the fall of 2011 and assessed for potential water quality impacts and stormwater retrofits. Watershed characteristics, available space, and landowner and permitting issues were considered when identifying possible stormwater BMPs. Each catchment was then scored in terms of the implementation priority based on impact of the catchment on stream conditions, potential benefit that BMPs would have on addressing the stream stressor(s), retrofit feasibility, and cost. Table 14 provides a summary of catchment rankings. See Appendix B for detailed catchment scores.

Tree box filter

The retrofits will be installed based on a phased approach. The priority ranking process is described in Section 5.1. Table 14 summarizes the retrofits identified, their ranking, and the priority order. Types of retrofits identified for the Trout Brook watershed include:

- Tree box filters (Filterra™ or similar);
- Vegetated buffers;
- Rain gardens;
- Gravel wetlands; and,
- Bioretention cells.

Residential rain garden treats stormwater prior to flowing into a catch basin

Each retrofit was selected to address the immediate needs of the catchments while considering cost and implementability. The overall purpose of these retrofits is to reduce nutrient loading and decrease stormwater contribution to the stream during high flow events.

If water quality goals are not met after completion of Phase I work, further stormwater retrofits on the Phase II list should be pursued. Also, if road reconstruction and other opportunities arise at any point in implementation, stormwater retrofits should also be considered and incorporated as much as possible.

5.2.2 Nutrient Contributions from Agriculture and Other Land Uses

Water chemistry data collected from the Brook during summer 2012 suggested that there was a nutrient source upstream of the Route 77 crossing (See Section 4.2.3 for details). Based on these data, nutrient enrichment was identified as a pollutant that should be addressed to the extent practicable during WMP implementation. Cape Elizabeth hosts the majority of the agricultural operations in the Trout Brook watershed, and many of these operations are located adjacent to Trout Brook. Since agricultural land uses typically export relatively higher amounts of nutrients than other land uses, working with agricultural landowners will be a focus of work in this part of the watershed. The WMP stakeholders are committed to supporting continued agricultural land use within the watershed. In addition to agricultural sources of nutrients, there are also numerous residential and commercial areas adjacent to the stream, and these sources will also be important areas for future work.

In order to align the needs of the agricultural community with stream restoration priorities, the following actions have been identified to address nutrient loading in Trout Brook and its tributaries:

- Outreach to agricultural landowners to ensure that they are receiving adequate support for nutrient management planning, manure storage, fertilizer BMPs, and farm conservation planning activities.
- Education and outreach to residential and commercial landowners to encourage proper fertilizer application techniques, appropriate yard waste disposal, and alternatives to chemical fertilizers.
- Provide additional support as necessary to ensure continued buffer protection and water quality protection.

In general the agricultural landowners are maintaining good-quality buffers along the stream on their property. Below the agricultural areas, however, there is a section of the flood plain between sample locations TB and TB2 (upstream of Route 77) with inadequate buffers and steep banks. This has resulted in channelized flow and erosion from the properties into the flood plain. Table 14 (discussed in Section 5.2.1) as well as the SCA Buffer Tables in Appendix B identify several Phase I projects in this area (Buffer Sites 18, 19, and 26). Addressing the runoff from properties along this stretch of stream would maintain and support current land use while minimizing nutrient contribution to this section of stream.

ADEQUATE BUFFER WIDTH can vary by site conditions. This plan recommends maintaining as wide a buffer as site conditions and land use will allow.

6.0 Identifying and Prioritizing Pollutants, Sources, and Causes

- *What are the impairments in the watershed?*
- *What are the sources (causes) of the major pollutants in the watershed?*
- *What are the potential solutions to improve water quality?*

Like other urban streams, Trout Brook is invariably impacted by a myriad of pollutants and stressors. There are also over a hundred potential storm water retrofit and restoration projects that could be pursued in the Trout Brook watershed. To create the most cost-effective and targeted restoration plan possible, technical staff reviewed all available data and identified and prioritized the specific impairments and stressors to different parts of Trout Brook. This stressor identification process (not the official EPA process) formed the basis of the action plan included in Section 8 with the highest priority projects tied directly to sites affecting stream conditions.

6.1 Upper Watershed Trout Brook

Biomonitoring has not been conducted in the upper sections of Trout Brook (Figure 15) because the low summer base flows would not allow the methods to be used in this area. Water quality monitoring in this part of the stream, however, indicates that the steam does not meet Class B or C standards for DO. Further, the high diurnal swings (between early morning and mid-afternoon) in DO indicate that nutrient enrichment is the cause of the depressed DO concentrations. Nutrients in the stream feed plants and algae in the water, which increase oxygen in the stream during photosynthesis in daytime hours. Overnight plant respiration uses up the oxygen in the stream, creating low oxygen conditions in the early morning. Bacteria testing completed periodically by the municipalities as part of their MS4 permit indicates that at least some of the nutrient source is likely associated with human and/or animal waste. Phosphorus testing in the area also suggests that animals and agriculture are likely contributors. Other sources of nutrients include fertilizers and soil erosion.

The strategy to address the impairment in this part of the stream is to identify and complete projects that mitigate nutrient delivery to the stream. This WMP includes recommendations for addressing all potential nutrient sources within the Upper Watershed. As discussed in section 5.3.3, the WMP stakeholders are committed to supporting continued agricultural land use within the watershed. The Plan seeks to work with these landowners to install new or maintain existing manure storage facilities, buffers, and other treatment practices. Other potential nutrient sources that the Plan targets for Phase I work include a residential subdivision and a commercial landowner.


Turtlehead (Chelone obliqua)

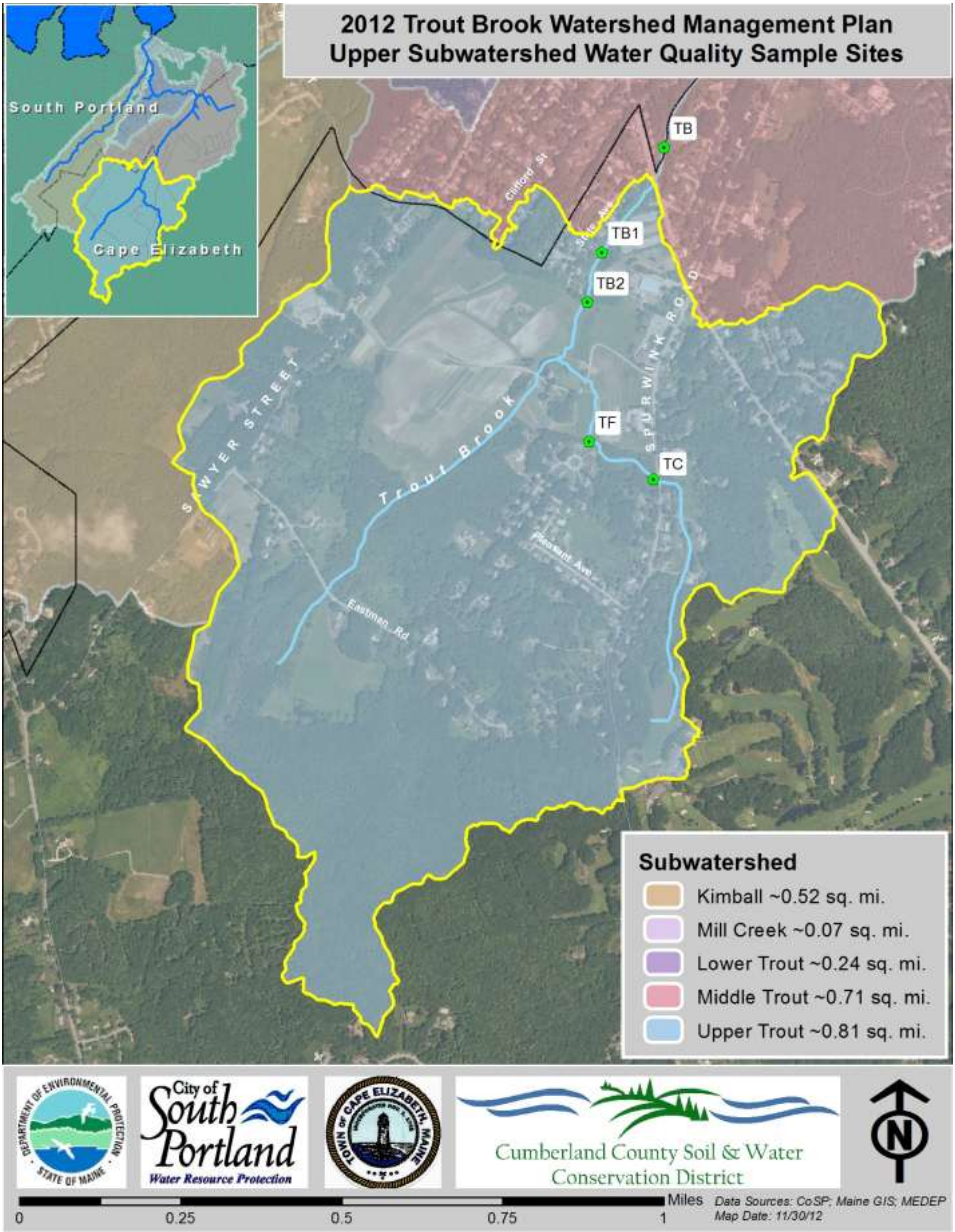


Figure 15. Upper Trout Brook Subwatershed

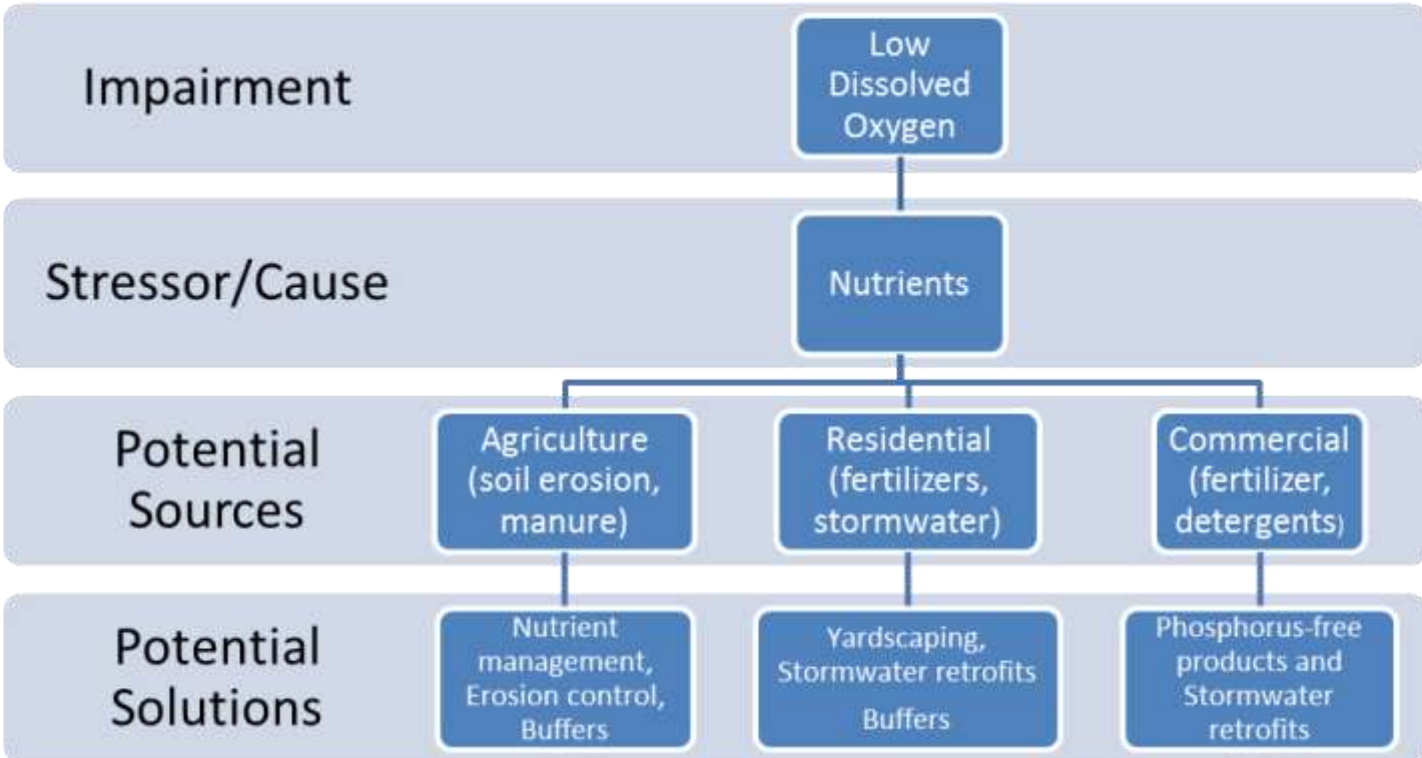


Figure 16. Impairments in the Upper Trout Brook Subwatershed

6.2 Middle & Lower Watershed

There is limited water quality data in the Middle Watershed (Figure 17). The available data suggests that there are nutrient-related DO issues in the portion of the middle watershed above Sawyer Marsh. These issues will be addressed by the nutrient management strategies outlined for the Upper Watershed.

Biomonitoring assessments indicate that macroinvertebrates do not meet Class C standards in the Lower Trout Brook watershed (Figure 18). Monitoring data revealed that there is low DO and periodic high chloride/conductivity levels in this part of the stream. This likely stresses the macroinvertebrate community.

Trout Brook is also listed as impaired for stream habitat. The middle section of the stream, which has been significantly channelized, widened, and impounded, rated lowest in terms of habitat quality in previous assessments. As a result, habitat restoration activities will be a priority in this area. Habitat problems are also linked, in part to DO issues. The DO problems appear to be partly natural due to the large inputs of groundwater (typically low in DO) from springs in this area, but poor habitat also likely exacerbates this problem.

The high conductivity in this part of the stream during low flow conditions has been tied to chloride in the springs feeding this section of the stream (See Section 4.3.3). Terrain conductivity work has identified the likely source as the sand/salt pile in the South Portland Public Works facility on O'Neil Street. Surface water from this facility drains to the South Portland Treatment Plant through the combined stormwater and sewer system. However, the sand/salt pile does not have pavement under it, and salt can infiltrate and drain to Trout Brook via groundwater. The short-term remediation plan for this impairment is to either pave under or cover the pile. The City will also be presenting a referendum to South Portland citizens in 2013 to build a new public works facility in another area of the City. If approved, the sand-salt pile would be moved to this new location by mid-decade.

Due to the permeable subsurface geology in portions of the watershed, roadway salt application should be managed as well, particularly for areas where snow melt is more likely to soak into the ground rather than discharge directly to the stream via stormwater outfalls. Specifically, salt reduction BMPs, such as those recommended by the New Hampshire DES Green SnowPro program, should be implemented on a watershed-wide basis.

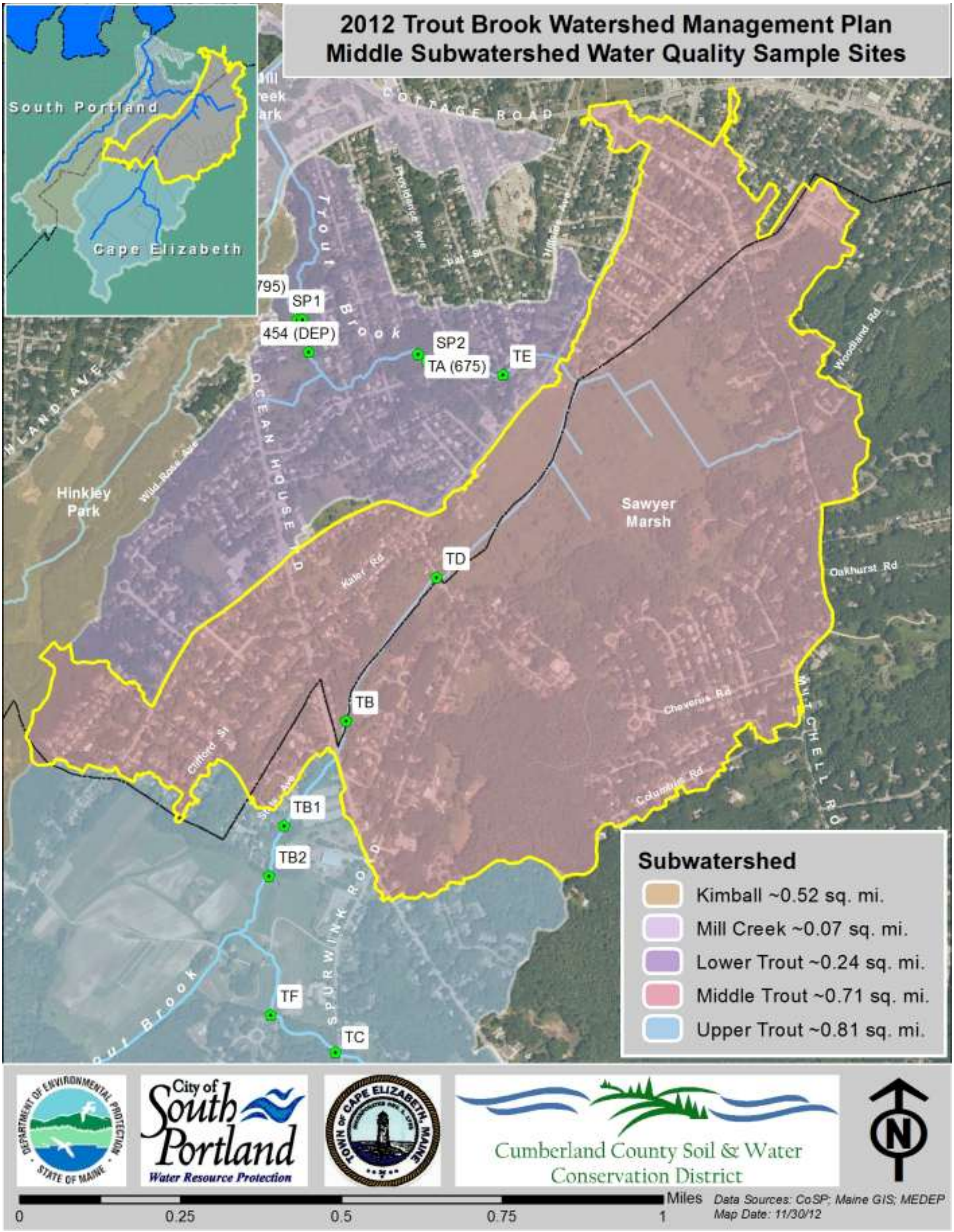


Figure 17. Middle Trout Brook Subwatershed

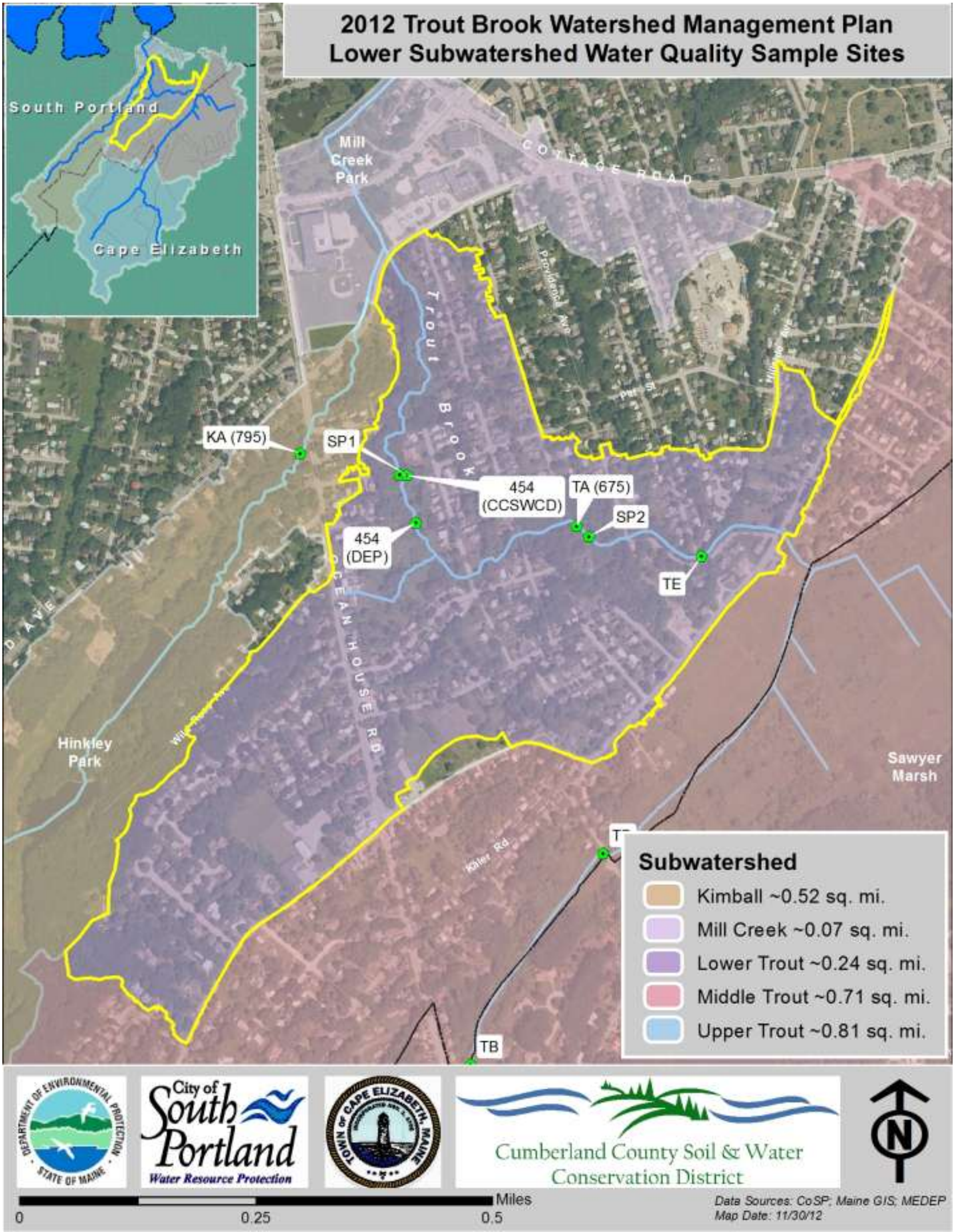


Figure 18. Lower Trout Brook Subwatershed

Figure 19. Impairments in the Lower Trout Brook Subwatershed

In terms of water quality, two bacteria issues were identified in the Lower Watershed during the stream corridor survey and were prioritized due to potential health concerns. However, the City of South Portland has already addressed these problems.

6.3 Mill Creek Subwatershed

Since Mill Creek is influenced by marine tides and is not considered a fresh surface water, it does not currently have a listed water quality impairment. That said, there are stream habitat problems in this section of stream due to channel alterations (e.g., widening, channelization), erosion issues and inadequate buffers. Although restoration actions might not be high priorities for attainment purposes, these actions should nonetheless be considered as Phase II priorities to meet the Plan's goal of providing good habitat for fish and wildlife.

Mill Creek flowing into Casco Bay

6.4 Kimball Brook

Water quality issues in Kimball Brook (Figure 20) appear to be significantly different than in Trout Brook. Monitoring data does not show problems with DO or conductivity, and the stream receives limited stormwater input above the monitoring site. The most recurring and striking observation is the abundance of iron flocculent and iron bacteria in the stream (Figure 21). Iron levels in the stream were also above the chronic toxicity standard on two of the three baseflow samples collected during the MDEP TMDL study (MDEP, 2004). In addition to the toxic impacts of dissolved iron, the iron floc can also have a physical impact on aquatic life by smothering habitat and food sources.

Iron floc in Kimball Brook

The high iron levels in the stream are likely due to the naturally high iron levels in the underlying bedrock, soils and groundwater. Maine Geological Survey found high levels of iron in the groundwater throughout coastal Cumberland County, particularly the Cape Elizabeth Formation (Lewis &

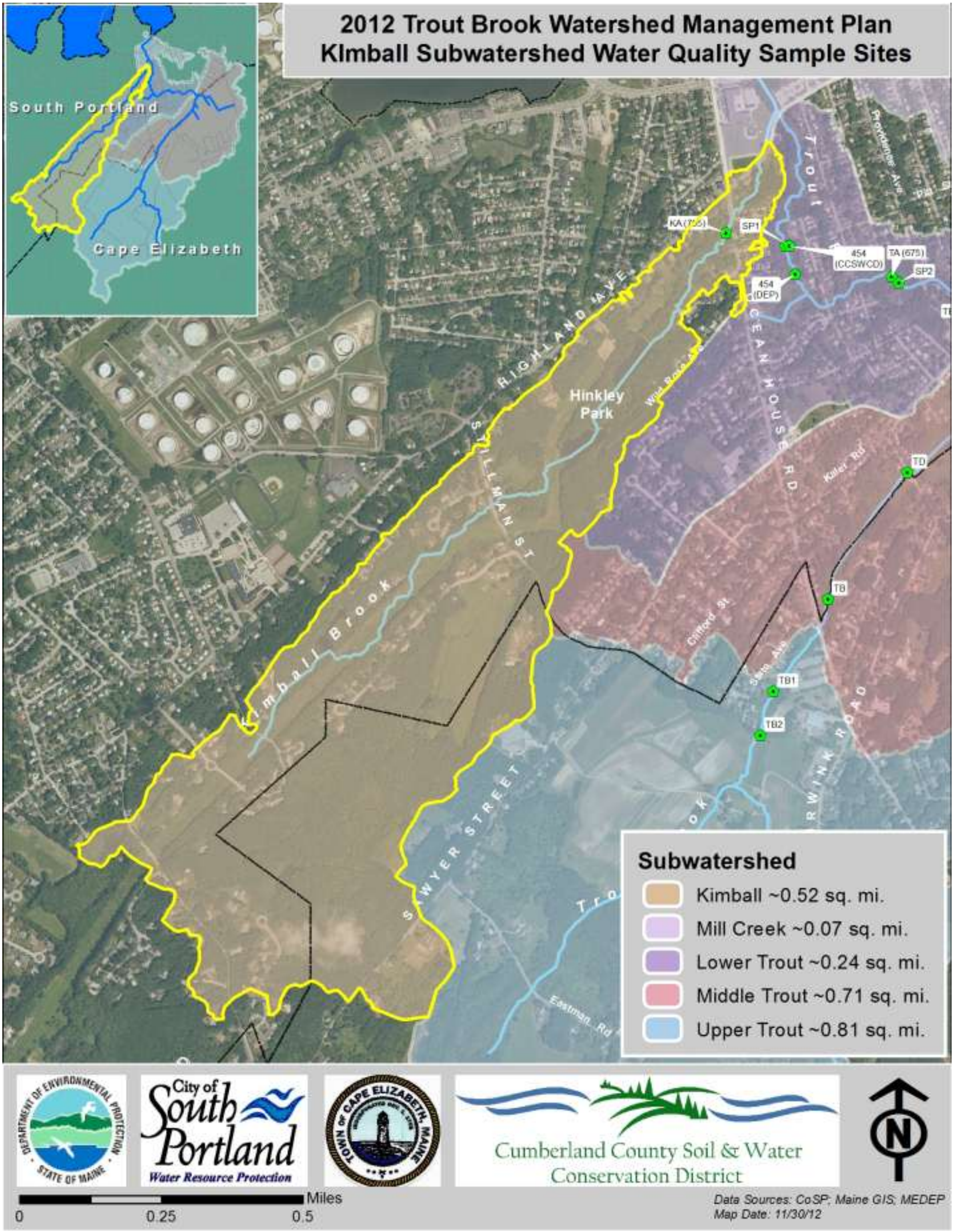
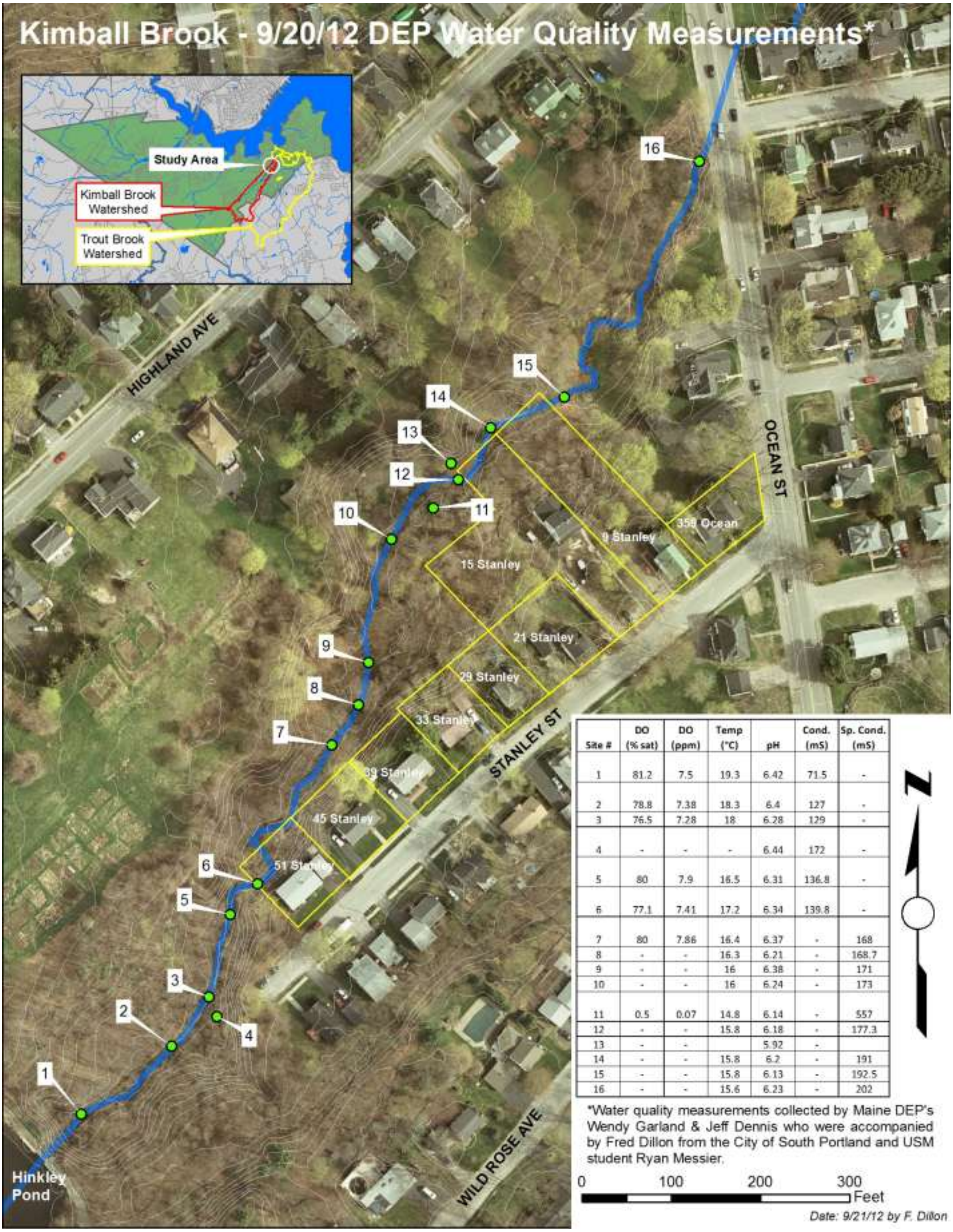


Figure 20. Kimball Brook Subwatershed



Site #	DO (% sat)	DO (ppm)	Temp (°C)	pH	Cond. (mS)	Sp. Cond. (mS)
1	81.2	7.5	19.3	6.42	71.5	-
2	78.8	7.38	18.3	6.4	127	-
3	76.5	7.28	18	6.28	129	-
4	-	-	-	6.44	172	-
5	80	7.9	16.5	6.31	136.8	-
6	77.1	7.41	17.2	6.34	139.8	-
7	80	7.86	16.4	6.37	-	168
8	-	-	16.3	6.21	-	168.7
9	-	-	16	6.38	-	171
10	-	-	16	6.24	-	173
11	0.5	0.07	14.8	6.14	-	557
12	-	-	15.8	6.18	-	177.3
13	-	-		5.92	-	
14	-	-	15.8	6.2	-	191
15	-	-	15.8	6.13	-	192.5
16	-	-	15.6	6.23	-	202

*Water quality measurements collected by Maine DEP's Wendy Garland & Jeff Dennis who were accompanied by Fred Dillon from the City of South Portland and USM student Ryan Messier.

Figure 21. Water Quality Measurements in the Kimball Brook Watershed (Fall 2012)

Ludwig, 1979). Screening level gain/lose data was completed by Unity College students in 2011 and by the CCSWCD intern in 2012. These data are not definitive, however, they suggest that there is groundwater entering the stream at the Route 77 crossing. Groundwater flows through these deposits and picks up iron which ends up in the stream. When the dissolved iron is exposed to air, it oxidizes and precipitates as an orange-colored "iron floc". In addition, certain bacteria use dissolved iron and transform iron into an insoluble form, which then becomes colonized by filamentous bacteria and creates an orange slime.

Project staff walked the stream from Hinckley Park to Route 77 in September 2012. Several water quality parameters (specific conductance, temperature and pH) were measured periodically along the stream to look for groundwater input and sources of iron. However, there were no significant changes in water chemistry, flow volume or iron bacteria to indicate a concentrated source. This supports the hypothesis that iron enters the stream via groundwater inflow along the entire length of the segment.

Although the primary cause of high iron levels in Kimball Brook appears to be natural, human activity could play a secondary role. First, soil disturbance can increase iron leaching from soils. The stream corridor survey identified numerous sites with soil erosion along Kimball Brook and throughout Hinckley Park. Therefore, while natural conditions cannot be remedied, erosion control projects should be considered to reduce the iron leaching from the soils into the Brook. Second, anecdotal accounts indicate that there are times when there is little or no flow leaving the dams in Hinckley Park. This altered flow regime could have some effect on the iron levels. The outlet of the Hinckley Pond dam(s) can also be investigated and possibly adjusted to allow increased flow to the stream during summer months.

Next Steps

A fall 2012 study by University of Southern Maine students will further investigate iron levels in Kimball Brook. The study will assess the effects of rainfall on iron levels to help understand the relative roles of groundwater, storm flow and erosion. If data continues to support the hypothesis that Kimball Brook's impairment is due to "natural" conditions, discussions about possible de-listing should be pursued with the MDEP.

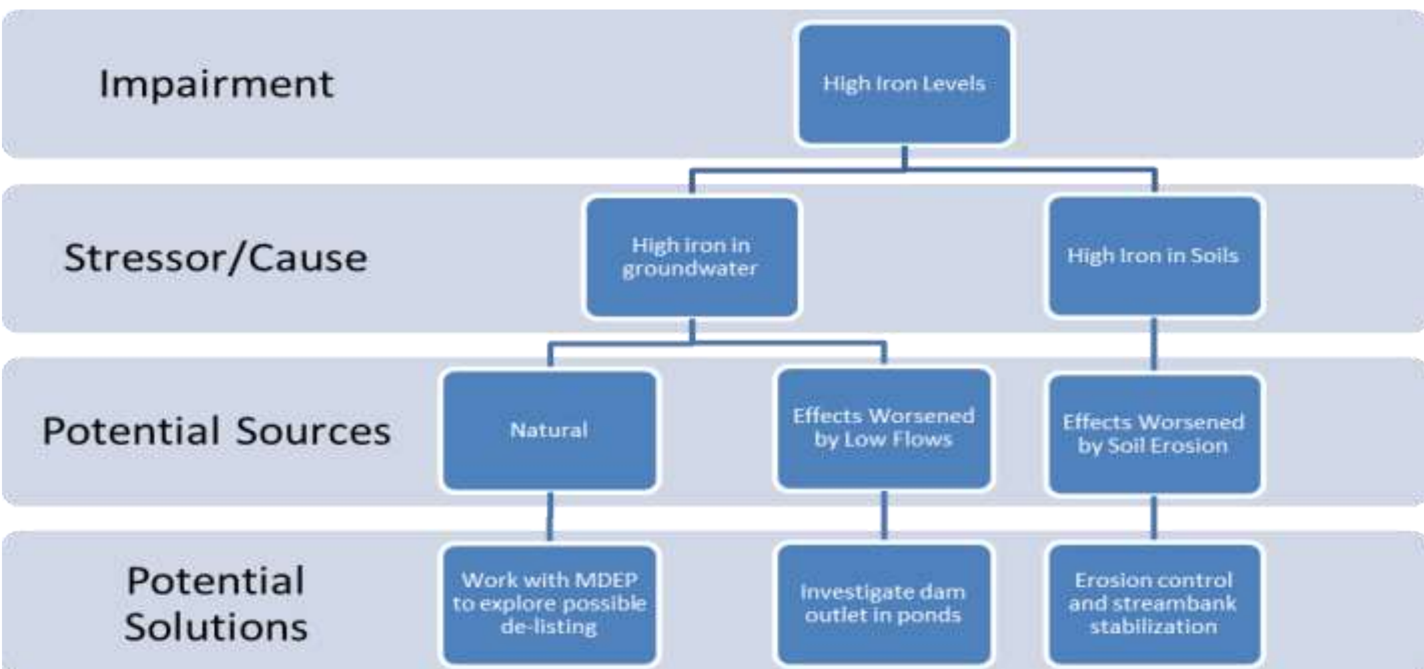


Figure 22. Impairments in the Kimball Brook Watershed

6.5 Secondary Stressors

Past stream assessments have identified numerous sites in or adjacent to the stream with inadequate buffers, soil erosion, yard debris dumping, and stream channel alterations. Stormwater outfalls also deliver untreated runoff directly into the stream in many places. While the remaining problems are not directly tied to the priority stressors described above, improvements in these areas will still provide benefits to stream habitat and health. High visibility stream restoration projects will also help raise awareness about stream protection and prevent further degradation to the stream.

Typical buffer impairment

The plan lists and prioritizes these specific Phase II stream corridor restoration opportunities and storm water retrofits. Many of these are inexpensive projects and can be pursued opportunistically. Others are more expensive and are ranked as lower priority projects that would only be pursued if the stream conditions and impairments do not improve after high priority stressors are addressed.

6.6 Fish Passage Restoration

After water quality and other habitat conditions are successfully restored, the final phase in the restoration plan is to provide fish passage through the Trout Brook system. Restoration will focus on improving passage at the three culverts on Trout Brook that CBEP rated as severe fish barriers. If these barriers are addressed, a significant length of stream would be opened up for trout.

Aluminum box culvert

Preliminary designs for the culverts call for aluminum box culverts that would be assembled on site to save on cost and partially buried to create a natural stream bottom. Since all three culverts as well as three additional downstream culverts are also mapped as flood hazards by Cumberland County Emergency Management Agency or CBEP, hydraulic modeling needs to be conducted to make sure that changes in culvert sizing will not create and can potentially alleviate documented flooding problems downstream.

7.0 Watershed Restoration Goals & Objectives

- *What are the restoration goals?*

There are both long and short term goals of the Trout Brook watershed Based Management Plan. The goals are to restore the stream to its statutory classification, protect the stream for the long term and involve stakeholders from the watershed. The following goals and objectives were established by the project steering committee and stakeholders at several public workgroup meetings:

Goal #1 - Improve Trout Brook water quality so that it meets State water quality standards

- Ensure that Trout Brook meets water quality standards for aquatic life and stream habitat.
- Continue to monitor water quality parameters to include DO, bacteria, chloride, and temperature.
- Ensure that Trout Brook watershed provides good habitat for fish and other wildlife so that it can provide a connection to nature for watershed residents.

Goal #2 - Protect and maintain water quality, aquatic and wildlife habitat to ensure the brook continues to meet state water quality standards.

- Improve the management of stormwater runoff for existing development in an effort to improve water quality.
- Ensure zoning and ordinances and enforcement guide new development in a manner that protects the brook
- Coordinate efforts with other groups in the watershed focused on land conservation and protection strategies.

Goal #3 - Build community support for the protection and enhancement of the land and water resources of the Trout Brook watershed.

- Develop an outreach program for citizens and businesses to promote and implement the WMP. Include one-on-one outreach and signage to educate residents on their role in implementing the WMP.
- Strengthen ties with the local schools and the Community College to enhance education and participation in opportunities for community action.
- Perform outreach to residents, businesses, and contractors within the watershed to encourage environmental stewardship within the Trout Brook watershed.
- Develop and establish a Trout Brook Workgroup to oversee Plan implementation and work towards long term health and ensure the Watershed Based Plan goals are achieved.

8.0 Trout Brook Action Plan

- *What actions should be taken to ensure stream restoration?*

The primary goal of the Trout Brook WMP is to have the stream support a community of aquatic organisms and habitat that meets water quality standards. There are several stressors affecting different parts of Trout Brook. The primary stressors include elevated nutrients, depressed DO, habitat alteration, and elevated chloride. It is not known exactly what level of load reduction or habitat improvements will be required to allow the biological communities and habitat to recover. That said, the following sections outline the action plan recommended to achieve restoration.

8.1 Adaptive Management & Project Phasing

Adaptive management is the process by which new information about the health of the watershed is incorporated in the Plan. An adaptive management approach is widely recommended for restoring urban watersheds (CWP, 2003). This approach recognizes that the entire watershed cannot be restored with a single restoration action or within a short time frame. As new data/information and or technology become available, this approach establishes a mechanism for restoration efforts that can be adjusted to meet the current needs of the watershed over time.

> **ADAPTIVE MANAGEMENT** incorporates new water quality data and improved understanding of conditions into Plan implementation.

As previously discussed, the restoration priorities were identified based on relative stressor and problem site rankings. This Action Plan proposes to complete work in three phases: Phase I addresses sources tied to priority stressors. Phase II targets secondary stressors and will be pursued if Phase I does not result in stream recovery. Phase III is intended to be implemented following completion of water quality and habitat restoration. Figure 23 depicts the phased restoration approach envisioned for Trout Brook.

8.2 Plan Oversight

It is important for local participants to take an interest and work together to improve water quality and stream habitat. The Trout Brook WMP will be carried out by the City of South Portland and the Town of Cape Elizabeth with extensive involvement from private landowners within the Watershed. It is envisioned that the plan will be approved by December 2012.

The City of South Portland will take the lead role in the Trout Brook Workgroup. Other participants serving on the workgroup may include CCSWCD, MDEP, City of South Portland (South Portland Land Trust and Trout Brook Preserve Committee), and watershed landowners. The Workgroup stakeholders would meet at least twice per year. One of these meetings may be structured as a public meeting to provide the community with updates about the Brook and implementation efforts.

Additional action groups may be necessary to provide more efficient implementation of the Action Plan. All groups may require interaction with each other and collaborative participation is necessary for the successful implementation of the plan. Possible sub-committees could include: Water Quality & Protection, Education and Outreach, Stream Habitat Restoration, and Wildlife Protection.

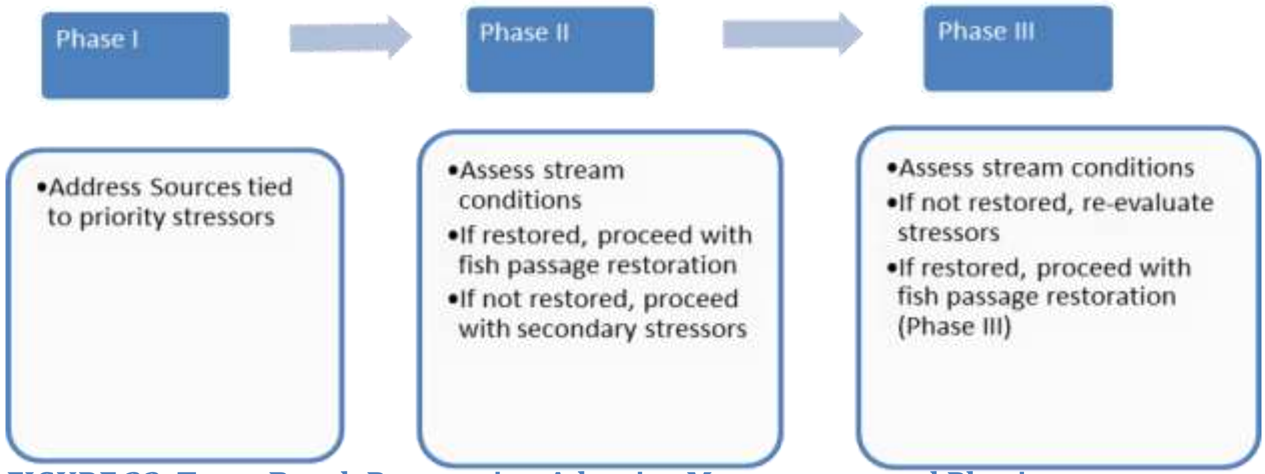


FIGURE 23. Trout Brook Restoration Adaptive Management and Phasing

8.3 Action Plan

The Trout Brook Action Plan identifies the contaminant reduction targets and recommended actions to achieve water quality objectives in the watershed. Table 15 depicts elements of the action plan discussed in the following sections.

8.3.1 Nutrient Reduction

EPA's Spreadsheet Tool for Estimating Pollutant Load (STEPL) was used to examine pollutant loading in Trout Brook's upper watershed, where nutrients appear to be the most significant stressor. STEPL uses simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). High resolution aerial photos, GIS, and best professional judgment were used to estimate acreages and management for different land uses (e.g., row crops, pasture, residential).

STEPL estimated that 335 pounds of phosphorus per year was exported from the land uses surrounding Trout Brook. Potential BMPs such as nutrient management systems, filter strips, and bioretention systems were then applied to the land uses. Nutrient loading following BMP installation was reduced by 65% to 117 pounds of phosphorus per year. This nutrient reduction is expected to result in appreciable improvement in stream water quality.

In addition to the BMPs identified in Table 14, the following actions should be incorporated as part of ongoing nutrient management and would result in further nutrient load reductions:

- Education and outreach to residential landowners to encourage proper fertilizer application techniques, appropriate yard waste disposal, and alternatives to chemical fertilizers.
- Outreach to agricultural landowners to ensure that they are receiving adequate support for nutrient management planning, fertilizer BMPs, and farm conservation planning activities. Provide additional support as necessary to ensure continued buffer protection and water quality protection (may include funding assistance through the Natural Resource Conservation Service).
- Outreach to other commercial property owners to encourage proper fertilizer application techniques, alternatives to chemical fertilizers, and low/no phosphorus detergents.

Table 15. Trout Brook Watershed Action Plan

Action Item	Priority	Responsible Party						Funding/Labor Source						Cost Estimate	Schedule
		SWCD	DEP	City of South Portland	Town of Cape Elizabeth	Landowners	Other	MDEP 319 Grant	NRCS Cost Sharing	Other Grants	Municipal	Landowner	Volunteer		
Restore Trout Brook to meet State water quality standards.															
1. Reduce nutrient loading from upper watershed.															
a. Work with farms to install nutrient and manure management BMPs.	H	X			X	X	X	X	X			X		$80,000	2013 - 2019
b. Catchment Mapping and preliminary designs (2 catchments)	H	X	X	X										$30,000	2014 - 2019
c. Install stormwater retrofits on Phase I catchments (5 catchments)	M			X	X	X		X			X	X	X	$100,000	2013 - 2019
2. Reduce chloride loading from middle watershed															
a. Pave under existing sand-salt pile or relocate facility	H			X										$20,000	2014
b. Evaluate groundwater contamination potential for infiltration BMPs	M	X	X	X				X		X	X	X		$2,000	2014 - ongoing
c. Salt reduction on municipal roads	M		X	X	X						X			$??	2014 - ongoing
d. Estimate plume reduction time (if needed)	L	X		X						X	X			$2500-??	2025
3. Improve stream habitat															
a. Implement Phase I buffer enhancement projects (15 sites)	M			X	X	X		X		X	X	X	X	$32,000	2013-2019
b. Restore stream habitat in Phase I channel alteration sites (2 sites)	M			X		X		X		X	X	X	X	$20,000	2013-2019
c. Address Phase I stream corridor erosion sites (22 sites)	M			X		X		X		X	X	X	X	$44,000	2013-2019
d. Remove Phase I yard waste dumping sites (8 sites)	L			X		X					X	X	X	$5,000	2013-2019
e. Hydrologic modeling and design	M			X										$40,000	2014 - 2019
g. Remove severe fish barriers (3 high priority culverts)	M			X					X	X	X			$150,000	2020-2025
Prevent further decline of water quality															
1. Encourage conservation of agricultural and undeveloped lands	H			X	X	X					X			--	ongoing
2. Enforce existing shoreland zoning and other ordinances	H			X	X						X			--	ongoing
Community Outreach and Education Program															
1. Conduct yardscaping education programs in target neighborhoods	H	X		X				X						$30,000	2013-2014
2. Urban Youth Conservation Corps	H	X		X				X						$30,000	2013-2015
3. Stream crossing signs	H	X		X				X						$2,000	2013-2017
4. Outreach & technical assistance to golf course and farms.	H	X			X			X						$25,000	2013-2014
Conduct Monitoring Program															
1. Work with MDEP to explore possible de-listing of Kimball Brook.	M			X										$500-??	2013
2. Start monitoring program with local secondary schools & colleges.	M	X		X						X	X		X	$2,000	2014-2019
3. Macroinvertebrate & limited water quality sampling	M	X	X	X						X	X		X	$75,000	2014-2026
4. Track completed sites, pollutant load reductions, and milestones.	M		X	X				X							ongoing
Trout Brook Workgroup															
1. Establish TB Workgroup to oversee Plan implementation.	H	X	X	X	X			X			X			$7,200	2013
2. Workgroup to meet at least twice per year	H			X	X		X							$6,000	2013-ongoing
3. Workgroup to seek funding for restoration projects	M			X	X		X							--	2013-ongoing
														$703,200	

8.3.2 Stream Habitat Restoration

The WMP identified 66 stream erosion sites covering 3,900 feet and delivering an estimated 66 tons of sediment and 56 pounds of phosphorus to the stream each year (STEPL and Region 5 Methods). Stabilization of these sites through buffer plantings and other conservation practices will help improve stream habitat conditions and reduce sedimentation and nutrient loading to the stream.

Phase I of the Plan targets 22 sites that will provide greatest benefits in meeting restoration targets (Table 14). These sites account for approximately 40% of the total annual sediment and phosphorus loading (27 tons sediment and 23 pounds of phosphorus) associated with all documented erosion sites. STEPL estimated that stabilization methods would reduce loading from these sites by 96%. If water quality and habitat restoration targets are not met after the Phase I sites are implemented, Phase II sites would then be pursued.

8.3.3 Chloride Reduction

The restoration target is to have chloride levels in Trout Brook below the CCC action level of 230 mg/L. Based on the preliminary data, this corresponds to a specific conductivity below approximately 0.8 mS/cm. Currently, chloride levels periodically exceed this level during summer baseflow conditions in parts of the stream. The primary management recommendation is to pave under or relocate the municipal sand-salt pile so it cannot contribute to groundwater chloride delivery to the stream. If this is indeed the primary chloride source, most of the excess loading to the stream will be removed, leading to eventual decreases in summer baseflow conditions closer to the levels measured upstream from the high chloride springs (0.3 – 0.4 mS/cm). Assuming that the chloride is located in the overburden soils (and not fractures in the bedrock), soil borings could be collected and analyzed to help develop a rough estimate for the time needed for the chloride to flush out of the system.

Chloride is also likely entering both groundwater and the stream from roadway, driveway, and parking lot applications throughout the winter months. Areas of the watershed underlain by glaciomarine fan deposits (e.g., sand and gravel) are at a higher risk of groundwater contamination from salt application. Contaminated groundwater ultimately discharges into Trout Brook thereby adding a baseload of chloride to the stream. The management recommendations for chloride related to salt application are threefold:

Educate landowners, private snow removal contractors, and Public Works personnel on appropriate salt application processes. Education component should encourage reduced use where appropriate, and targeted application. General guidelines are provided by the University of New Hampshire's Green SnowPro program.

Assess subsurface geology in areas where infiltration BMPs are proposed. Avoid infiltrating chloride-laden stormwater (from roadways, parking lots, and driveways) in areas where the water table is close to the surface (i.e., within 5 feet of grade) or where conditions suggest a direct pathway to groundwater (i.e., sand and gravel deposits or permeable strata).

If infiltration BMPs cannot be avoided in high-risk areas, institute a "reduced salt area" for the BMP's catchment. For roadways, this could involve reducing application rates (with appropriate signage), and for privately owned areas, this could include reduced application rates or frequencies and not allowing snowmelt to enter the BMP to the extent practicable. Reduced salt areas should be used as a last resort after other means have been ruled out.

8.3.4 Stormwater Treatment and Impervious Cover Reduction

A direct correlation has been established between IC and the health of aquatic ecosystems. Research has shown that when IC increases above 10%, there is a corresponding increase in stormwater flows and degradation in water quality, stream habitat and diversity of aquatic life (CWP, 2003). MDEP used the % IC Method to develop restoration targets for Trout Brook as part of the Trout Brook TMDL (PETE and MDEP, 2007). At the time of the TMDL study, the watershed was thought to have 15% IC, and a target of 11% IC was recommended for stream restoration.

DECREASING IMPERVIOUS COVER does not require removal of pavement or halting new development. Instead, the goal is to install conservation practices to treat stormwater runoff and reduce flows.

More accurate information has been developed over the past two years as part of this WMP project. Improved watershed mapping and IC mapping indicates that the watershed's IC is much closer to target conditions than previously thought. The overall watershed (including the Kimball Brook watershed) is approximately 12% IC and Trout Brook's direct watershed (without Kimball) is 13.6% IC. Trout Brook's action plan calls for Phase I activities targeting the most significant stressors: chloride contamination, nutrient runoff and habitat impairments. However, if restoration targets are not met after these sources are addressed, more widespread stormwater retrofits will be pursued in Phase II of plan implementation. To reach the 11% IC target, this would equate to approximately 14 acres of IC needing treatment (or 36 total acres assuming current IC of 13.6%). This TMDL target may be used to guide stormwater retrofits and other projects that reduce the impact of existing impervious surfaces.

8.3.5 Develop an Outreach Program for Citizens

Densely developed and highly managed residential areas have identified as a high priority for implementing a YardScaping campaign to reduce the use of fertilizers and pesticides, reduce yard waste dumping, and encourage landowners to install rain gardens and vegetated buffers.

Rain garden installed at residential property in Minnesota. (Source: www.apwa.net)

Phase I implementation will be starting in 2013. Each issue has been prioritized for each neighborhood area so that the approach can be targeted towards the highest priority behavior change. Project partners will implement a multifaceted approach to addressing the identified residential issues as follows:

- Develop and implement presentations for two active and cohesive neighborhoods that hold regular gatherings (e.g., State Avenue & Kaler Road). The presentations will be tailored to resonate with the audiences for each of the target neighborhoods.
- Host a rain garden installation workshop at a committee member's house to educate neighbors on what rain gardens are, what the benefits are, and how to install them in the Kaler Road neighborhood. The completed rain garden will provide a successful local example.
- Establish an Urban YCC program that will employ students to carry out conservation work. The Urban YCC will spend 3 to 4 weeks installing buffers and rain gardens.
- Carry out "I'm a Green Neighbor" pledge drive that will include developing maps and a notification postcard for targeted outreach. The Urban YCC will carry out the pledge drive in identified neighborhoods in South Portland and Cape Elizabeth over 2 to 3 weeks. The goal of the pledge drive will be to enlist landowners to pledge to implement pollution prevention practices and install a lawn sign.
- Project stakeholders will develop stream crossing signs to increase awareness of Trout Brook and install them at 11 locations.

Green Neighbor sign

8.3.6 Future Protection Strategies

Section 8.3 outlines restoration strategies for areas of the watershed identified during the SCA survey. The BMPs and restoration efforts discussed throughout this plan provide short-term solutions to encourage stream recovery; however, these solutions cannot be implemented in a vacuum. In order to ensure long-term success and viability of water quality improvements in the Trout Brook watershed, the following future protection strategies should also be included:

- Evaluate and address potential pesticide contamination within stream sediments (possible source of macroinvertebrate impairment not evaluated as part of this plan). Include pesticide awareness and education as part of the Community Outreach & Education Program.
- Monitor residential development plans throughout the watershed. Most of the lower and middle watershed is already built out. However, the Upper Watershed is largely undeveloped; therefore if large-scale development is proposed, stream protection strategies in the Upper Watershed should be reevaluated.
- Continue to support existing agricultural land uses in the watershed by encouraging appropriate nutrient and stormwater management strategies to minimize potential impact on water quality.

8.3.7 Develop a Trout Brook Workgroup to Oversee Plan Implementation

The final piece of the Trout Brook Action Plan is the Trout Brook Workgroup in order to ensure that Watershed-wide restoration goals are being met. The workgroup will:

- Ensure that all watershed stakeholders are represented.
- Conduct at least two meetings per year to oversee and guide plan implementation.
- Promote one of the meetings with the public and share information about the progress made in restoration efforts.
- Apply for grants and other funding to implement plan. (Section 11 provides more information about funding strategies).

9.0 Monitoring Plan

- *What is a Monitoring Plan?*
- *Why Monitor?*
- *What are the expected outcomes?*

Urbanization triggers major hydrologic changes in urban streams. In fact, Vermont's approach to monitoring and managing urban impaired watersheds focuses on comparing the hydrology of impaired versus non-impaired streams. Maine's approach to developing urban watershed TMDLs emphasizes control of directly connected impervious area, in large part because of the impact that impervious surfaces have on stream hydrology.

However, the impacts of urbanization on stream ecosystems are multifaceted. The ultimate goal of this Plan is to restore the stream conditions so that Trout Brook and its tributaries support aquatic life at its designated classifications. The sampling design presented herein takes into consideration stream hydrology, water chemistry, and habitat on the macroinvertebrate community. Figure 24 summarizes the relationship between the proposed monitoring components and the factors which impact the macroinvertebrate community. Ongoing monitoring within these four focus areas is needed to determine whether the actions identified in the Plan are effectively moving Trout Brook toward restoration and eventual removal from 303(d) list.

Dobsonfly larvae and other macroinvertebrates are used as indicators of stream health.

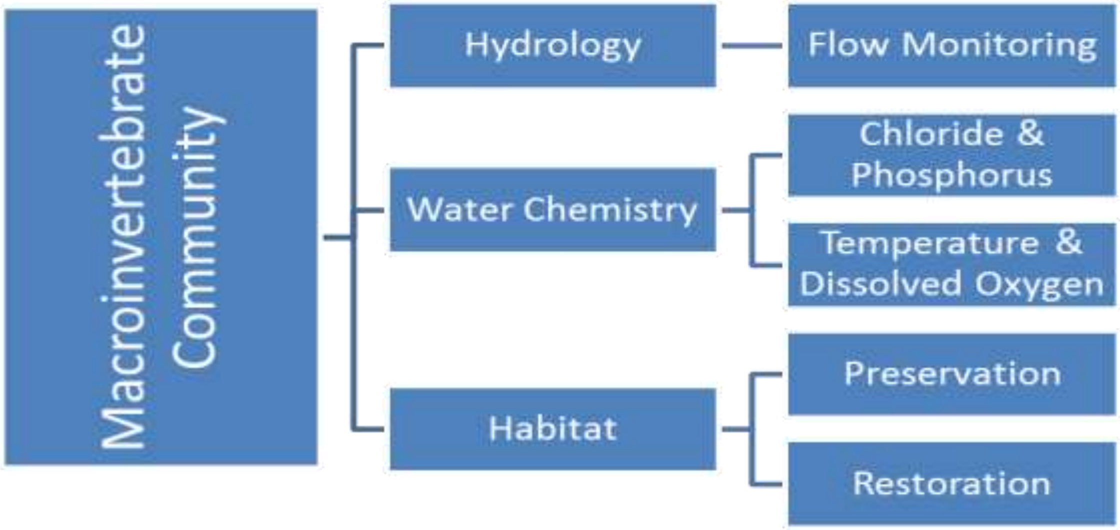


Figure 24. Monitoring Hierarchy

9.1 Macroinvertebrate Community

Currently MDEP's macroinvertebrate monitoring (or biomonitoring) program is the primary means used to assess whether Maine rivers and streams meet their designated uses. Benthic macroinvertebrates are useful indicators of the effects of a wide range of stresses on streams and are also used to determine whether Maine streams meet their aquatic life criteria. MDEP's past macroinvertebrate monitoring indicates that the stations on Kimball and Trout Brook do not meet the Class C standards for aquatic life. Since benthic macroinvertebrate sampling is MDEP's primary indicator for 303(d) listing, future monitoring in the watershed should include additional macroinvertebrate monitoring.

This Plan will utilize three levels of macroinvertebrate sampling to monitor water quality improvements within the Watershed. Table 16 summarizes the sampling levels.

Table 16. Biomonitoring Program Summary

Sample Frequency	Conducted by	Number of Sites	Protocol	Notes
Annual	Project Stakeholders	up to 3	MDEP Rock Bag, identification overseen by macroinvertebrate experts from local colleges/universities.	Locations to be determined based on where restoration work has been completed. Up to 3 sites sampled annually with 2 additional sites sampled every other year. Sites will rotate
Biennial	Project Stakeholders	up to 5	MDEP Rock Bag, identification overseen by macroinvertebrate experts from local colleges/universities.	
5-year	MDEP	3	MDEP Rock Bag, identification by state-approved macroinvertebrate experts.	MDEP Sites S-454, S-675, & S-795

Permanent biomonitoring sites will be installed downstream of each proposed restoration area (Table 14). Sites will be sampled on a rotating basis. Up to three sites will be sampled every year (depending on where restoration work is being completed) with an additional two sites sampled every two years (for a total of up to five sites sampled every two years). It is likely that MDEP will continue to implement its biomonitoring program in Trout Brook every 5 years.

MDEP's biomonitoring protocol specifies that identification must be performed by personnel under the supervision of a professional aquatic biologist, and sample taxonomy must be performed by a professional freshwater macroinvertebrate taxonomist (Davies and Tsomides, 2002) in order for the results to be used to determine compliance with state water quality criteria [i.e., to remove a stream from the 303(d) list]. This Plan proposes to complete the annual and biennial macroinvertebrate monitoring events using a modified protocol whereby the rock bags are deployed and retrieved in accordance with MDEP protocol; however, the macroinvertebrate identification is


Caddisfly larva in case

completed by local students who are overseen by a macroinvertebrate expert (i.e., a Ph.D. biologist or similar). These results will be used as screening level results to monitor stream recovery and guide future sampling events; however, the data will not be used to determine inclusion/ exclusion on the 303(d) list. If the screening data suggests that the stream is achieving its cleanup goals and could be de-listed, then additional sampling can be conducted following the complete MDEP protocol for sample collection and invertebrate identification.

The proposed macroinvertebrate approach is more cost-effective than collecting water chemistry and hydrology data alone. This approach also evaluates the cumulative stresses in the Watershed in a holistic way rather than attempting to identify each contaminant's effect on the macroinvertebrate community. If the macroinvertebrate communities do not show substantial recovery following implementation of the remedies identified in this Plan, then additional stressor analysis could be undertaken at a later date.

9.2 System Hydrology & Channel Geomorphology

When the macroinvertebrate sampling is conducted, field staff should also monitor stream hydrology conditions at the rock bag locations. Specifically, stream discharge can be calculated at each monitoring station using the cross-sectional flow method. Additionally, stream channel geomorphology conditions can be monitored in order to assess changes over the monitoring period. Examples of stream channel conditions include width, depth profile, and presence or absence of habitat for invertebrates or fish. This portion of the monitoring program can be completed during rock bag deployment and retrieval, and it provides valuable information for minimal time investment. Photo points should be established at each monitoring site to track hydrologic and geomorphologic changes.

9.3 Water Chemistry


Unity College students conducting water quality sampling

This Plan does not propose extensive water chemistry monitoring. Existing data (discussed in Section 4.2.3) documents that chloride, phosphorus, DO, and other constituents do not meet water quality criteria at various times within Trout Brook and its tributaries. Water chemistry can, however, provide insight into whether certain activities have had a positive effect on stream water quality. Specifically, periodic phosphorus measurements or continuous DO measurements downstream of identified nutrient source areas can provide insight into whether implemented BMPs are effective in addressing nutrient sources to the stream. Similarly, periodic chloride measurements or specific conductance monitoring in the springs in the Trout Preserve can evaluate groundwater plume attenuation. For these reasons, this Plan proposes to conduct periodic stormflow and baseflow sampling for phosphorus downstream of nutrient management BMPs as well as specific conductance and chloride sampling in the Trout Preserve springs. If water quality monitoring sondes are available, DO monitoring could be completed during the summer months in monitoring stations located downstream of nutrient management BMPs and other restoration areas. Specific conductance, pH, DO, and water temperature data (at a minimum) will be collected when rock bags are deployed and retrieved.

9.4 Stream Habitat

Finally, this Plan puts forth a plan for improving stream habitat so that it meets Class C standards. Monitoring is recommended for all in-stream restoration projects to make sure the projects are functioning as designed. Large wood placed in the stream should be regularly inspected to make sure it is stable and providing habitat benefits as planned. Photo points may be established at each restoration site. Upstream and downstream photos may be taken at each point before construction, immediately after construction and then annually to document effects on Trout Brook. MDEP staff may be included in habitat restoration project development, and consulted about how and when to conduct a follow up stream habitat assessment to determine if the stream is progressing toward or meeting stream habitat criteria.

10.0 Measures of Success

- *What are the milestones to ensure restoration success?*

Trout Brook does not currently meet State water quality standards due to and aquatic life use impairments. The goal of this plan is for Trout Brook to meet State water quality standards by 2023.

It is proposed that this goal be accomplished by implementing stream corridor and channel restoration projects, applying BMPs to reduce nutrient and chloride loading, and implementing nonstructural and structural measures to limit the impact of all IC.

Since it may take ten years for Trout Brook to meet State water quality standards, interim milestones may also be tracked to measure progress on Plan implementation. Interim and long term measurable milestones are discussed in the following sections.

Trout Brook

10.1 Organizational Milestones

- Establish Trout Brook Workgroup (See Section 8.3.7);
- Conduct bi-annual meetings of the Trout Brook Workgroup;
- Update Cape Elizabeth Town Council & South Portland City Council annually;
- Maintain and update Trout Brook Restoration Project web page;
- Develop an email listserve for watershed stakeholders; and,
- Secure funding adequate to complete restoration priorities identified in this Plan.

10.2 Environmental and Structural Milestones

- Number of nutrient and sediment load reductions associated with identified corridor sites;
- Number of stream corridor sites addressed;
- Number of impervious acres treated with stormwater retrofits;
- Number of fish passage barriers addressed; and
- Number of landowners participating in Landowner Outreach Programs (rain garden workshop, Urban YCC conservation work, and I'm a Green Neighbor pledge drive).

10.3 Water Quality Milestones

- Improved water quality measurements for DO, phosphorus, and chloride;
- Stream habitat restoration projects determined to be stable and functioning;
- Meets Class C standards for macroinvertebrates at designated sites; and,
- Removed from 303(d) list for stream habitat impairment and aquatic life impairments.

11.0 Funding Opportunities

- *What funding mechanisms are available for restoration activities identified in this plan?*

Several of the restoration efforts identified in this plan will be implemented using MDEP NPS funds ("319 Grant Funds") beginning in 2013. Project stakeholders recognize that grants alone are not the answer to the Trout Brook restoration process, and the following sections identify potential funding sources.

11.1 Grant Funding

Casco Bay Estuary Partnership (CBEP) Habitat Restoration Grants

Description: Open to non-profit conservation groups (landtrusts, watershed groups), towns, and state and federal conservation agencies. Project criteria includes land protections, acquisition of high value habitat, public access, level of threat, size of project, cost effectiveness, community support, matching funds and likelihood of implementation. Applications are processed when received with no deadlines. Submit electronic copies of proposal, budget and letters of support.

- Grant range from $1000—$20,000 but larger amounts are considered.
- In-stream habitat restoration projects, buffer enhancements.
- One grant already successfully implemented within the watershed in 2012 (cobble dam and floodplain berm removal as well as wood additions in the Trout Brook Preserve).

US EPA 5 Star Grants

Description: Open to any public or private entity engaging in community-based restoration. Projects must include a strong on-the-ground wetland, riparian or coastal habitat component and must also include a strong training, education, community stewardship and/or outreach component. Projects must involve diverse partnerships that contribute funding, technical assistance, workforce support and in-kind services.

- Urban Waters Focus Area grants available.
- Competitive—grants up to $500,000
- Applications due in March and June
- Projects must be complete in one year
- Stream Enhancement Buffers
- Yardscaping Outreach Program

Nonpoint Source Grants Programs 2014 (319 grants)

Description: The primary objective of NPS projects is to prevent or reduce nonpoint source pollutant loadings entering water resources so that beneficial uses of the water resources are maintained or restored. Maine public organizations such as state agencies, soil and water conservation districts, regional planning agencies, watershed districts, municipalities, and nonprofit (501(c)(3)) organizations are eligible to receive NPS grants from MDEP.

- Annual grant RFP issues in April with project commencing following April
- Town Roadway retrofits, private facility retrofits, stream enhancement-buffers, regional facilities.
- NPS Funding obtained for 2013 to implement buffer plantings, BMP installation, and community outreach.

Natural Resource Conservation Service Funding Opportunities

Wildlife Habitat Incentive Program (WHIP)

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. Provides funding to:

- Promote the restoration of declining or important native fish and wildlife habitats.
- Protect, restore, develop or enhance fish and wildlife habitat to benefit at-risk species.
- Reduce the impacts of invasive species on fish and wildlife habitats.
- Protect, restore, develop or enhance declining or important aquatic wildlife species' habitats.
- Protect, restore, develop or enhance important migration and other movement corridors for wildlife.
- WHIP funds could be used for habitat restoration and protection within Trout Brook, invasive species removal and buffer restoration, and preserve other wildlife habitat within the stream corridor.

Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations.

Agricultural producers within the watershed could access EQIP funds to implement BMPs on their properties that support stream restoration (such as nutrient management practices and buffer improvement or maintenance activities as needed).

Community Development Block Grant

Community Development Block Grants must meet one of the following objectives:

- Benefit to low and moderate income persons;
- Prevention and/or elimination of slum and blight conditions; and
- Meeting community development needs having a particular urgency.

And also:

- Are part of a long-range community strategy;
- Improve deteriorated residential and business districts and local economic conditions;
- Provide the conditions and incentives for further public and private investments;
- Foster partnerships between groups of municipalities, state and federal entities, multi-jurisdictional organizations, and the private sector to address common community and economic development problems; and
- Minimize development sprawl consistent with the State of Maine Growth Management Act and support the revitalization of downtown areas.

The most likely use for Community Development Block Grants in the Trout Brook watershed would be for public infrastructure or public facilities grants.

Letters of intent for 2013 are due January 18, 2013; there is currently no funding available for public facilities in 2013.

11.2 Private Foundation Funding

Davis Conservation Foundation

Description: Only open to organizations that are tax exempt under Section 501(c)(3) of the IRS code. The Foundation supports organizations whose primary interested are related to wildlife, wildlife habitat, environmental protection or outdoor recreation. Projects that strengthen volunteer activity and outreach/ community involvement are of particular interest.

- Grants range from $2,000 to $100,000
- Bi-annual submissions deadlines are April 10 and October 10
- Funding possible for monitoring Program, Yardscaping, Outreach Programs, Town Roadway retrofits, and stream enhancement-buffers.

John Sage Foundation

Description: Only open to organizations that are tax exempt under Section 501(c)(3) of the IRS code. Types of projects that have been funded include land acquisition and site evaluations, water testing programs, environmental education, and community garden programs.

- Grants range from $500 to $2500
- Bi-annual submission deadlines are February 15 and August 15.

Henry P. Kendall Foundation

Description: Open to non-profit organizations classified as public charities under Section 501(c)(3) of the IRS code. Funds are provided for general operating needs and for specific programs and initiatives. Previous projects funded include advocacy, public education, policy research and analysis, on-the-ground resource management experiments and institutional development.

- Grants range from $20,000 to $50,000
- Bi-annual submission deadlines in June and December

11.3 Community-Based Funding

South Portland Land Bank

The South Portland Land Bank provides seed money for the acquisition of open space. This City-managed account could possible accessed to protect land from development impacts in the South Portland portion of the Trout Brook watershed.

Cape Elizabeth Open Space Fund

The Town of Cape Elizabeth Conservation Commission participates in the decision-making for disbursement of these funds. They could possibly be accessed for improvements and managing open space in the Cape Elizabeth portion of the Watershed.

South Portland Wetlands Compensation Fund

The City of South Portland currently has $85,000 available for managing wetlands projects. These funds could possibly be accessed for wetlands and riparian corridor restoration projects within the Watershed.

MS4 Education Funding

Cape Elizabeth and South Portland are both participating in the Municipal Small Separate Stormwater System (MS4) permit with MDEP. Education is a component of this permit, and municipal staff education time could be used to implement targeted education (residential and within the schools) within the Trout Brook watershed.

11.4 Self-Supporting Funding

Cape Elizabeth Compensation Fee Utilization Plan

In an effort to preserve the town's growth areas strategy, the town has adopted a Compensation Fee Utilization Plan approved by MDEP. This plan provides for additional development in the watershed, subject to performance standards that enhance stormwater treatment and the payment of a fee. To eliminate the disincentive to locating in the growth area, the town has separately adopted the same fee amount for projects outside the urban impaired watershed boundary.

Stormwater Utility Fee

Self-supporting funding (such as a stormwater utility) is not currently envisioned although such mechanisms will be explored if milestones and goals are not met as anticipated since the large structural retrofits and culvert replacements would require significantly higher levels of funding.

A tree felled by a beaver near Trout Brook.

Acronyms

BMPs	Best Management Practices
CBEP	Casco Bay Estuary Partnership
CCC	Criterion Chronic Concentration
CCSWCD	Cumberland County Soil & Water Conservation District
CFUP	Compensation Fee Utilization Plan
CMC	Criterion Maximum Concentration
CSO	Combined Sewer Overflow
CWP	Center for Watershed Protection
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
IC	Impervious Cover
IDDE	Illicit Discharge Detection and Elimination
LID	Low Impact Development
MDEP	Maine Department of Environmental Protection
mg/L	milligrams per liter
mS/cm	milliSiemens per centimeter
MS4	Municipal Small Separate Stormwater System
Plan	Watershed Management Plan
RHA	Rapid Habitat Assessment
SCA	Stream Corridor Assessment
STEPL	Spreadsheet Tool for Estimating Pollutant Load
TMDL	Total Maximum Daily Load
WHIP	Wildlife Habitat Incentive Program
WMP	Watershed Management Plan

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