LONG CREEK
Watershed Management District

ANNUAL REPORT 2022

LONG CREEK WATERSHED MANAGEMENT DISTRICT
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LONG CREEK
WATERSHED MANAGEMENT DISTRICT

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Introduction and Background

This report has been prepared in fulfillment of Part IV.A of the Maine Department of Environmental Protection's ("Maine DEP") *General Permit — Post-Construction Discharge of Stormwater in the Long Creek Watershed*, Waste Discharge License #W-9052-5Y-B-N, dated April 15, 2015 (hereinafter referred to as the "Long Creek General Permit"), which states as follows:

> *"Annual progress reports shall be submitted by the permittee no later than May 31st of each calendar year and will include activities of the previous calendar year. The Long Creek Watershed Management District may submit an annual report on behalf of all permittees participating in the Plan."*

Where is Long Creek?

Long Creek is a meandering urban stream system with four primary branches that converge before flowing into Clark's Pond in South Portland, Maine. The Long Creek Watershed encompasses 3.5 square miles in a commercial, residential, retail, and recently, increasingly residential, district located in four municipalities: Portland, Scarborough, South Portland, and Westbrook. The watershed with respective landmarks is illustrated in **Figure 1**.

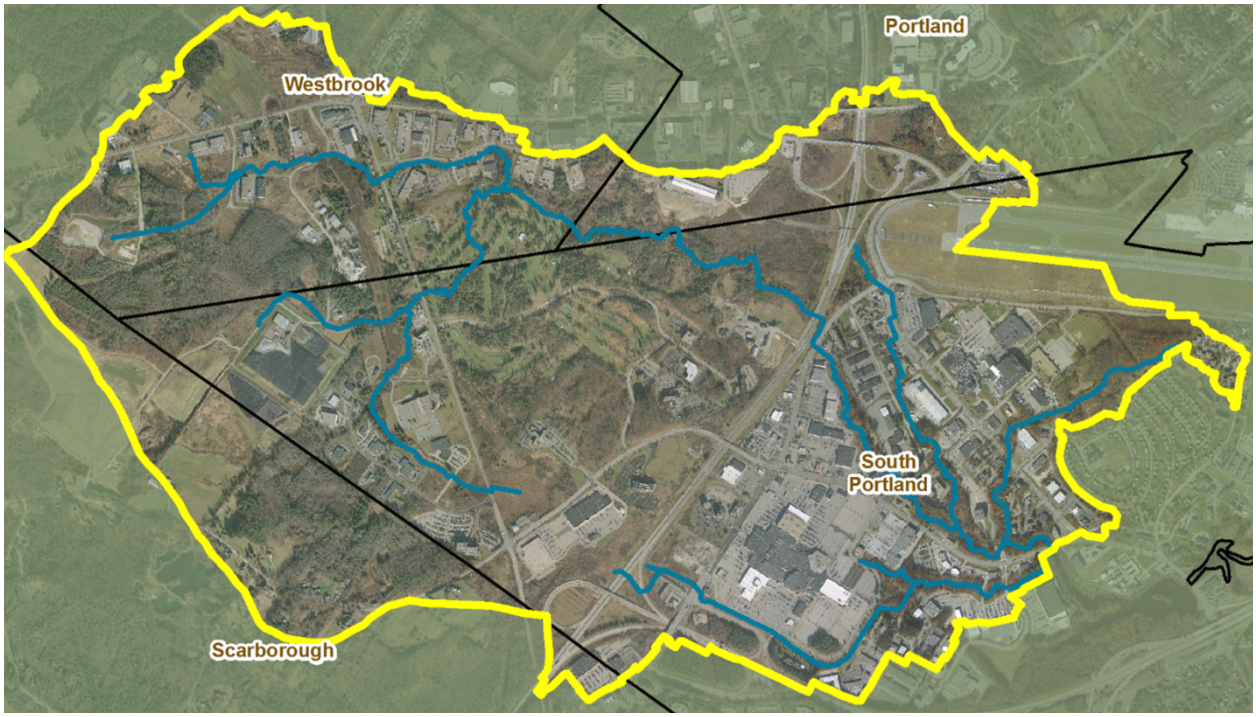

Figure 1 *Long Creek Watershed Overview Map*

Why is Long Creek Regulated?

Long Creek is an urban stream system that is classified by the Maine Water Classification Program as partially a Class B, and primarily a Class C, stream. Portions of Long Creek currently do not meet state water quality standards established for Class B streams which,

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

and Class C Streams, which,

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

as provided for in Maine law, 38 M.R.S.A § 465(3)(A) & (4)(A).

Long Creek has been the subject of many studies and reports. What the data suggests is twofold:

1. As stated in the Long Creek Restoration Project Executive Summary, *"[y]ears of urbanization have significantly impaired the stream's health, as well as its ability to support recreation and wildlife, such as brook trout."*
2. The Long Creek Watershed Management Plan ("LCWMP") identified that water quality impairments are a result of increased concentrations of metals, chloride, phosphorus, nitrogen, polycyclic aromatic hydrocarbons, and reduced dissolved oxygen concentrations.

Historically, there have been very few regulated point source discharges and stormwater controls (*i.e.*, water quantity and quality) in the watershed. Over the years, increasing stormwater discharges from the built environment have contributed to degraded water quality. Increased water temperatures from lack of shading in certain areas and altered hydrological conditions have also adversely affected stream health and water quality.

In 2009, the U.S. Environmental Protection Agency ("EPA") exercised its authority under a provision in the Clean Water Act, known as Residual Designation Authority ("RDA"), requiring a permit for the discharge of stormwater for designated discharges in the Long Creek Watershed. The EPA's designation requires permits for *"[s]torm water discharges from properties on which there are impervious surfaces or areas equal to or greater than one acre in the Long Creek watershed."* This precedent-setting use of the RDA provision led to the establishment of the Long Creek Watershed Management District ("LCWMD") to implement the LCWMP and to a corresponding annual fee paid by permittees to fund implementation of the plan.

Impervious Cover

As defined in EPA's designation, "impervious surface" or "impervious area" (hereinafter collectively referred to as "Impervious Cover" or "IC") means:

> *"the total area of a parcel or right-of-way that consists of building and associated constructed facilities; areas that are covered with a low-permeability material such as asphalt or concrete; or areas such as gravel roads and unpaved parking areas that are compacted through design or use to reduce their permeability. Common impervious areas include, but are not limited to, roads, rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, packed earthen materials, and macadam or other surfaces which similarly impede the natural infiltration of storm water."*

In the Long Creek Watershed, the amount of IC on a property is used to determine whether a discharge of stormwater is regulated and, if so, to assess annual fees for implementation of the LCWMP under the Long Creek General Permit. In general, IC is also used as a measure of watershed and stream health. Key figures for the watershed are as follows:

- Watershed size is 2,305 acres (3.5 square miles)
- Length of stream is approximately 10 miles
- Total IC is 736 acres (32% of watershed)
- Regulated IC is 615 acres (84% of IC in watershed)[1]

Regulated IC includes parcels with one acre or more of IC. Parcels with less than 1 acre of IC are not required to obtain a permit.

[1] There is a discrepancy in in the amount of regulated IC identified through permits and the amount of regulated IC determined using GIS methods. The regulated IC figures used in this report is the amount identified using GIS methods. In anticipation of the third permit cycle of the Long Creek General Permit, LCWMD is working on reconciling different methods of determining IC.

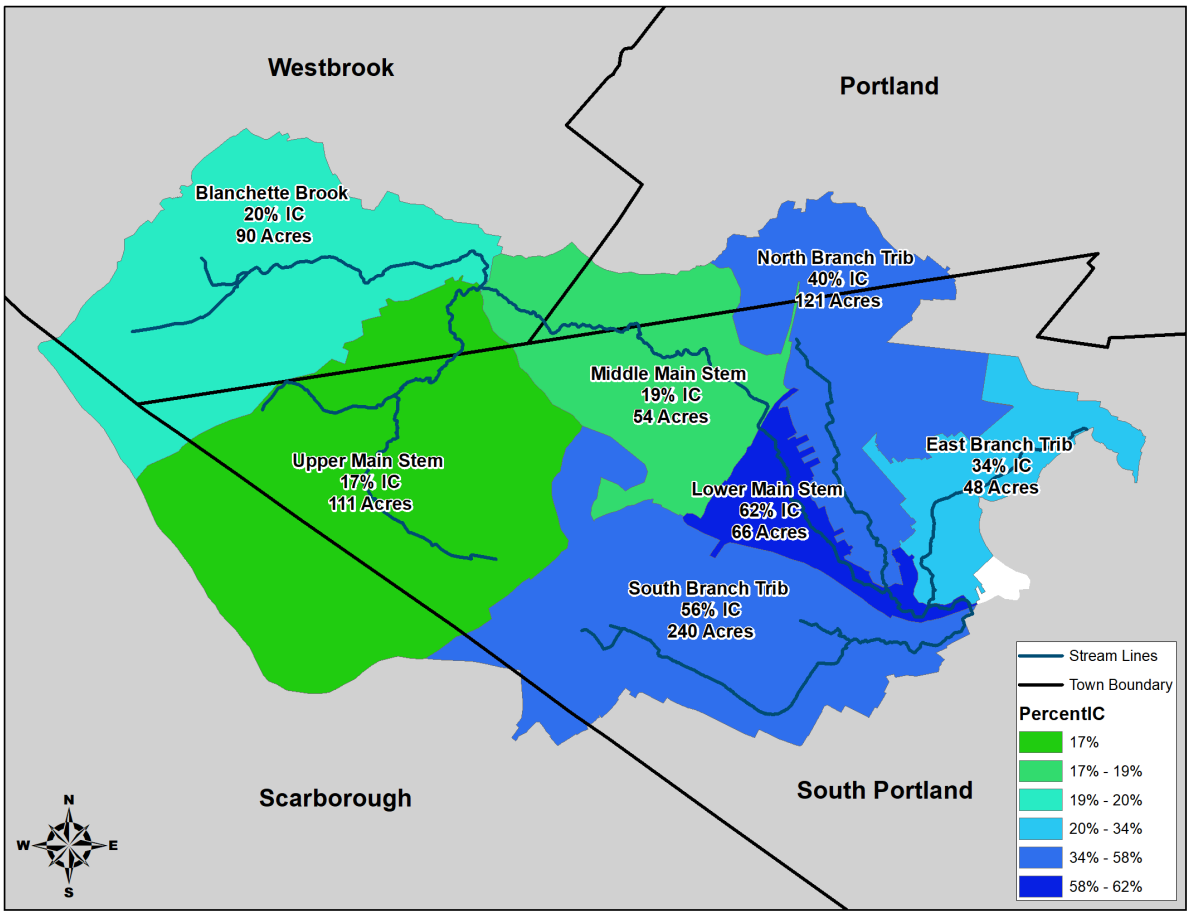

Figure 2 *Impervious Cover by Subwatershed*

General or Individual Permit Requirement

Following EPA's designation, affected landowners and operators in the Long Creek Watershed had two permitting options: (1) participate in implementation of the LCWMP being managed by LCWMD via the filing of Notice of Intent to Comply with the Long Creek General Permit or (2) obtain an individual permit. Individual permit holders are required to meet current stormwater management law requirements for development, as well as waste discharge requirements (*i.e.*, Maine DEP, Chapter 500 and Chapter 523, standards). Approximately 81% of the watershed's total IC, and approximately 96% of the regulated IC in the watershed, is managed under the LCWMP. Six landowners or operators within the universe of owners and operators of regulated IC do not participate in implementation of the LCWMP through the Long Creek General Permit and, therefore, are subject to individual permit requirements. Approximately 22 acres (4%), out of a total of 615 acres of regulated IC, are managed outside of the Long Creek General Permit under individual permits.

Long Creek Watershed Management Plan

Operators of properties who file a notice of intent to comply with the Long Creek General Permit are required to demonstrate that they have entered into a binding agreement with LCWMD which provides for participation in the implementation of the LCWMP. Operators that

obtain permit coverage under the Long Creek General Permit are referred to as "Participating Landowners" and the agreements they enter into with LCWMD are referred to as "Participating Landowner Agreements." As stated in the Long Creek General Permit, the LCWMP was:

> *". . . developed jointly by the municipalities of South Portland, Portland, Westbrook and Scarborough, along with other entities, and approved by the Maine Department of Environmental Protection, for the purpose of restoring the water quality of Long Creek . . ."*

As stated in Participating Landowner Agreements:

> *". . . cooperative implementation of the Long Creek Watershed Management Plan, which includes but is not limited to design, engineering, construction, reconstruction, installation, operation, modification, alteration, use, maintenance, repair, replacement, inspection and monitoring of public and private stormwater management structures, facilities and improvements and in-stream and riparian restoration in and along Long Creek and within the Long Creek Watershed, is likely to reduce the cost and time for Long Creek to comply with Water Quality Standards . . ."*

Participating Landowners

LCWMD implements the LCWMP on behalf of 96 Participating Landowners. The Participating Landowners include:

- 90 private landowners, primarily commercial and retail properties with IC from rooftops, driveways, sidewalks, and parking lots.
- Three municipal entities, whose IC primarily consists of roads and sidewalks.
- Two state entities, which are both transportation agencies:
    - the Maine Department of Transportation ("Maine DOT"), and
    - the Maine Turnpike Authority ("MTA").
- One quasi-municipal entity, Eco Maine — a regional waste management facility providing recycling and waste-to-energy services to a number of southern Maine municipalities.

Administration

LCWMD was established by "Interlocal Agreement" among the municipalities of Portland, Scarborough, South Portland, and Westbrook, of which portions of each lie within the Long Creek Watershed, to oversee LCWMD activities. In accordance with the Interlocal Agreement and Participating Landowner Agreements, implementation of the LCWMP has been primarily delegated to LCWMD. LCWMD's Executive Director manages the day-to-day implementation of the LCWMP. LCWMD maintains a broad-based Services Agreement with the Cumberland County Soil & Water Conservation District ("CCSWCD") to provide administrative and technical support services to LCWMD concerning implementation of the LCWMP.

LCWMD Board of Directors

The Interlocal Agreement provides for up to sixteen Board members, which were apportioned in the Interlocal Agreement to represent private and public stakeholders relative to their respective amount of IC in the watershed. The landowners and organizations represented on the LCWMD Board of Directors in 2022 are shown in **Table 1**.

Table 1 *LCWMD Board of Directors in 2022*

ORGANIZATIONAL REPRESENTATION		BOARD MEMBER
Portland	1 municipal representative	**Doug Roncarati**, City of Portland, Vice Chair
Portland	1 private Participating Landowner or non-profit representative	**Curtis Bohlen**, Treasurer, Casco Bay Estuary Partnership
Scarborough	1 municipal representative	**Angela Blanchette**, Town of Scarborough
Scarborough	1 public or private Participating Landowner	**Jason Kenney**, Eco Maine
South Portland	2 municipal representatives	**Fred Dillon**, Chair, City of South Portland **Susan Henderson**, City of South Portland
South Portland	4 private Participating Landowners	**Ed Palmer**, Portland Marriott at Sable Oaks **Brian Goldberg**, Secretary, The Bramlie Corporation **Craig Gorris**, GGP-Maine Mall L.L.C. (1) Vacant
South Portland	1 non-profit representative	**Will Haskell**, Gorrill-Palmer Consulting Engineers, Inc., on behalf of the South Portland/Cape Elizabeth Community Chamber of Commerce
Westbrook	1 municipal representative	**Eric Dudley**, City of Westbrook
Westbrook	2 private Participating Landowners	(2) Vacant
State	1 Maine DOT representative	**Cindy Dionne**
State	1 MTA representative	**Sean Donohue**

More information on Board members and Board activities are posted on LCWMD's website under "District Management."

Board Meetings

LCWMD's Board of Directors met on the following dates in 2022. Minutes and other information are available on the Long Creek website.[2] Board meetings are open to attendance and public comment by Participating Landowners and the general public.

- January 19, 2022
- April 8, 2022
- June 23, 2022
- September 13, 2022
- October 26, 2022
- November 22, 2022

Fiscal Summary

LCWMD maintains its accounting on a fiscal year basis that runs from July 1 to June 30 each year. An estimated budget for the subsequent fiscal year is provided to Participating Landowners in February and the Board must adopt a final budget for the ensuing fiscal year no later than July 1 of each year. LCWMD's revenue generated from fees paid by Participating Landowners is approximately $1.5 million annually.

As of the end of December 2022, LCWMD had current assets of approximately $4.17 million and was carrying approximately $4.61 million worth of fixed assets (primarily LCWMD-constructed BMPs) on its books. The $4.17 million in current assets includes approximately $1.45 million that is budgeted for design and construction of a gravel wetland BMP project. Long-term liabilities were approximately $0.68 million and are related to LCWMD's Maine Municipal Bond Bank loan.

Structural Management Opportunities

Implementation of the structural aspects of the LCWMP includes, but is not limited to, design, engineering, construction, and reconstruction of public and private stormwater management structures. Section 5.2 of the LCWMP identifies and recommends "structural management opportunities for the built environment" which are prioritized by catchment area. The goal of the structural management opportunities is to provide treatment for up to 150 acres of IC within the Long Creek Watershed, of which approximately 102 acres has been addressed by structural management projects to date.

Completed Projects

A summary of the structural management projects completed in the watershed to date is identified in **Table 2.**

[2] Board agendas and minutes are available on LCWMD's website at: https://www.restorelongcreek.org/documents.

Table 2 *Summary of Structural Project Construction to Date*[3]

Branch	Date	Catchment	Best Management Practice(s) Installed	Acres IC Treated	Other Total	LCWMD Total	Total Cost
South Branch	2009	E-07, 14, 16, 18, 20, 22, 24 (Philbrook Avenue)	Filterra tree box filters, Stormtreat filter units, and Stormtech storage chambers	2.12	$445,324[4]	0	$445,324
South Branch	2009	E-02 (Maine Mall Road)	Credits to Maine DOT for pervious asphalt project	2.95		$368,112	$368,112
North Branch	2010	C-03, 05, 07, 11 (Darling Ave I &II)	Filterra tree box filters, soil media filters, landscaped media filters	7.21	$596,387[4]		$596,387
Lower Main Stem	2010	A1-05, 06 (Mall Plaza Phase I & II)	Multi-cell soil media filter to collect and distribute stormwater to seven treatment cells, underground Stormtech chambers installed to store runoff, Stormtreat systems installed to treat runoff	16.41	$995,906[4]	$257,617	$1,253,523
Blanchette Brook	2012	B-21, 22 (Colonel Westbrook)	Gravel wetland, soil media filters, Stormtech chambers, and Brentwood Units	16.39		$615,796	$615,796
Upper Main Stem	2012	Port Resources	Installation of bioretention cells as part of a grandfathered addition to an industrial park	1.97	$57,145	0	$57,145

[3] Additional details on each construction project are available on LCWMD's website at: https://www.restorelongcreek.org/plan-implementation.

[4] American Recovery & Reinvestment Act Funds; 0% Interest loan, 27.7% principal forgiveness.

North Branch	2013	C-08 (Fairchild and Texas Instruments facilities)	Fairchild: basin retrofitted as a gravel wetland, removed IC and installed nine tree islands. Texas Instruments: installed one wet pond, one wet vegetated treatment system, and three bioretention cells	17.47	$200,000[5]	$323,484	$523,484
Lower Main Stem	2014	Gorham Road	Redesign of medians to provide shade, aesthetics, and treatment where the road drains to median	1.06	$150,000[6]	$476,348	$626,348
Lower Main Stem	2014	A1-03, 14 (Maine Mall Road, Western Avenue to Gorham Road)	Redesign and treatment of road segment	8.42		$682,564	$682,564
South Branch	2015	E-24 (Maine Mall)	Detention basin retrofitted to a gravel wetland	28.29		$651,373	$651,373
South Branch	2020	E-02 (Maine Mall Road)	Credits to Maine DOT for repaving of pervious asphalt project	2.95		$112,062	$112,062
Totals				**102.29**	**$2,444,762**	**$3,119,244.00**	**$5,932,118.00**

Current Project

South Branch BMP Retrofits

The LCWMP identified expansion and enhancement of the *"Hannaford Shopping Plaza's existing stormwater detention basin to provide improved water quality treatment"* as a structural management opportunity. Design of this project is complete, and construction is anticipated to take place in 2023. This project was originally scheduled to be constructed in 2020, however, geotechnical slope stability concerns raised by one of the landowners has delayed the project so that a geotechnical analysis could be performed.

[5] Estimated costs of retrofits installed and paid for by Texas Instruments.

[6] City of South Portland contribution to the project.

The project's primary objective is to implement stormwater BMP retrofits within a 48-acre catchment in order to address water quality concerns in Long Creek including temperature, dissolved oxygen, chlorides, nutrient levels, metal concentrations, and runoff volume. The project will retrofit an existing stormwater detention area with the construction of a new gravel wetland stormwater BMP. In addition to the gravel wetland, the project includes the construction of modular wetland BMP units which will allow stormwater from approximately 3.3 acres of impervious surface within the 48-acre catchment area to be redirected from the gravel wetland to these proprietary systems. The modular wetlands will provide water quality treatment for the smaller subcatchment area and will allow the gravel wetland to achieve a higher level of water quality treatment.

A summary of current structural management projects identified to be completed in the watershed is identified in **Table 3.**

Table 3 *Current Structural Projects Estimated Timeline*

Branch	Date	Catchment	Best Management Practice(s) Proposed	Acres IC Treated	Estimated LCWMD Total	Total Cost
South Branch	2023	E-24	Gravel Wetland; Modular Wetland System	47.4	$1,446,640	$1,446,640
Totals				**47.4**	**$1,446,640**	**$1,446,640**

Structural BMP Inspection and Maintenance

Inspection and maintenance of structural BMPs continues to be a substantial ongoing effort and cost. LCWMD presently inspects and maintains 96 LCWMD-owned-or-operated structural BMPs in the Long Creek Watershed. Inspections and routine maintenance of structural BMP are completed throughout the year. Inspection and maintenance reports are reviewed by LCWMD's Executive Director, in consultation with CCSWCD's District Engineer, who assigns non-routine maintenance for structural BMPs.

Each BMP has been assigned an individual BMP number to allow for the inspection and maintenance costs of individual BMPs to be tracked. This information is used to project future inspection and maintenance schedules and budgets and guides LCWMD's decision-making process should additional structural BMPs be considered. In addition to BMP inspection and maintenance, landscaping services for constructed BMPs requires significant ongoing effort and financial resources. Landscaping includes services such as mowing, mulching, weeding, trash removal, seeding, and cutting of vegetation for winter dormancy.

During 2022, 94 BMPs were inspected and routine maintenance was performed on 88 BMPs. In addition, the frequency of annual inspections and routine maintenance was doubled, or in some cases, tripled. Increasing the frequency of inspection and maintenance activities is anticipated to lessen the likelihood that "nonroutine" maintenance will be required, while keeping BMPs at a consistent, high level of function. The revisions to annual inspection and maintenance frequencies are summarized in the following tables:

Table 4 *Annual Structural BMP Inspection Frequencies*

Structural BMP Inspection	Units	Old Frequency	New Frequency
CONTECH Filterra® Bioretention System Inspection	22	2	3
Vegetated Swale Inspection	3	1	2
Underdrained Soil Filter Inspection	9	1	3
Gravel Wetland Inspection	3	1	2
Bioretention Cell/Rain Garden Inspection	23	1	2
ADS Storm-Pure™ Catch Basin Insert Inspection	2	12	2
CONTECH Jellyfish® Filter Inspection	3	1	2
Hydro First Defense® Catch Basin Insert Inspection	1	1	2
Hydro Downstream Defender® Catch Basin Insert Inspection	4	1	2
ADS StormTech® Infiltration and Treatment BMP Inspection	9	1	2
StormTreat Bioretention and Treatment BMP Inspection	15	1	2
Brentwood StormTank® Subsurface Retention BMP Inspection	1	1	2

Table 5 *Annual Structural BMP Maintenance Frequencies*

Structural BMP Maintenance	Units	Old Frequency	New Frequency
CONTECH Filterra® Bioretention System Maintenance	22	2	2
Vegetated Swale Maintenance	3	1	2
Underdrained Soil Filter Maintenance	9	1	2
Gravel Wetland Maintenance	3	1	1 @ 2 2 @ 1
Bioretention Cell/Rain Garden Maintenance	23	1	3
ADS Storm-Pure™ Catch Basin Insert Maintenance	2	12	2
CONTECH Jellyfish® Filter Maintenance	3	1	1
Hydro First Defense® Catch Basin Insert Maintenance	1	1	1
Hydro Downstream Defender® Catch Basin Insert Maintenance	4	1	1
ADS StormTech® Infiltration and Treatment BMP Maintenance	9	1	1
StormTreat Bioretention and Treatment BMP Maintenance	15	1	1
Brentwood StormTank® Subsurface Retention BMP Maintenance	1	1	1

Restoration Opportunities for the Aquatic Environment

In addition to the structural management activities implemented to treat pollution for improved stormwater quality, the LCWMP calls for restoration measures to improve the aquatic environment. Section 5.4 of the LCWMP identifies in-stream habitat, riparian habitat, and floodplain restoration recommendations. These projects include improvements to riparian and in-stream habitats to mitigate damage that has been caused to aquatic habitats over time. As

identified in the LCWMP, undertaking these projects will encourage the habitat conditions needed for the re-colonization of Long Creek by aquatic species more indicative of a healthy stream such as pollution-sensitive macroinvertebrates and brook trout.

Completed Projects

The stream restoration projects identified in the LCWMP, as amended, have been constructed. A summary of in-stream and riparian projects completed in the watershed to date is identified in **Table 6.**

Table 6 *Summary of Restoration Projects to Date*[7]

Branch	Date	Catchment	Restoration Project Implemented	Other Total	LCWMD Total	Total Cost
South Branch	2009	Upper South Branch	Vegetation	Included as part of 2009 Philbrook Avenue Structural BMP Project		Included as part of 2009 Philbrook Avenue Structural BMP Project
Blanchette Brook	2011	B-21 (Colonel Westbrook)	In-stream and riparian enhancement	$29,480[4]	$163,735	$193,215
Main Stem	2014	Lower Main Stem	In-stream and stream bank stabilization		$39,258	$39,258
Main Stem	2019	Middle Main Stem	In-stream structures to improve aquatic habitat, floodplain restoration, bank stabilization, replant floodplain with native plants		$981,425.13	$981,425.13
Totals				**$29,480**	**$1,184,418**	**$1,213,898**

Nonstructural Management Opportunities

Implementation of the non-structural aspects of the LCWMP include but are not limited to *"stormwater runoff management techniques that do not require extensive construction efforts and either limit the generation of stormwater runoff or reduce the amount of pollutants contained in the runoff."* In 2022, LCWMD implemented its standard operating procedure that applies to LCWMD's nonstructural obligations including pavement sweeping on Participating Landowner parcels, annual inspection and maintenance of LCWMD-owned-or-operated BMPs, annual inspection of Participating Landowner parcels as related to "pollution prevention" and "good housekeeping," and annual catch basin cleaning on Participating Landowners parcels.

[7] Additional details on each restoration project are available on LCWMD's website at: https://www.restorelongcreek.org/plan-implementation.

Pollution Prevention

As identified in the LCWMP, pollution prevention is aimed at reducing or eliminating waste at the source, promoting the use of non-toxic or less-toxic substances, implementing conservation techniques, and re-using materials rather than putting them into the waste stream. Pollution prevention includes activities such as pavement sweeping, catch basin cleaning, parcel inspections, and education and outreach.

Pavement Sweeping

Pavement sweeping was completed by LCWMD on private parking lots and roads by a third-party contractor for most properties managed under the Long Creek General Permit. Solids collected through sweeping are designated for disposal at an identified solid waste handling facility.

In addition to general parcel sweeping, "hot spots" are identified on a site-specific basis based on known high-traffic areas (high-turnover [8]parking lots, drive-thru windows, and other high usage areas) and observations of areas where street dust tends to accumulate. Specifics pertaining to sweeping in 2022 include the following:

- Spring cleanup, large particle collection, approximately **287 acres swept**
- Spring cleanup, collection of fines, approximately **287 acres swept**
- Hotspot sweeping event #1, approximately **58 acres swept**
- Hotspot sweeping event #2, approximately **58 acres swept**
- Fall sweep, collection of fines, approximately **293 acres swept**[9]

In addition, Participating Landowners will receive credits against their annual assessments for sweeping approximately **75 acres of additional impervious area**.

A total of **107.37 tons of sweepings** were collected by LCWMD's contractor in 2022. **Figure 3** shows the total acreage and total tons of sweeping collected by LCWMD's annual sweeping events from 2015 to 2022.

[9] The Hot Spot #3 sweeping event was converted to a full sweep in calendar year 2018 and is now referred to as the "fall sweep."

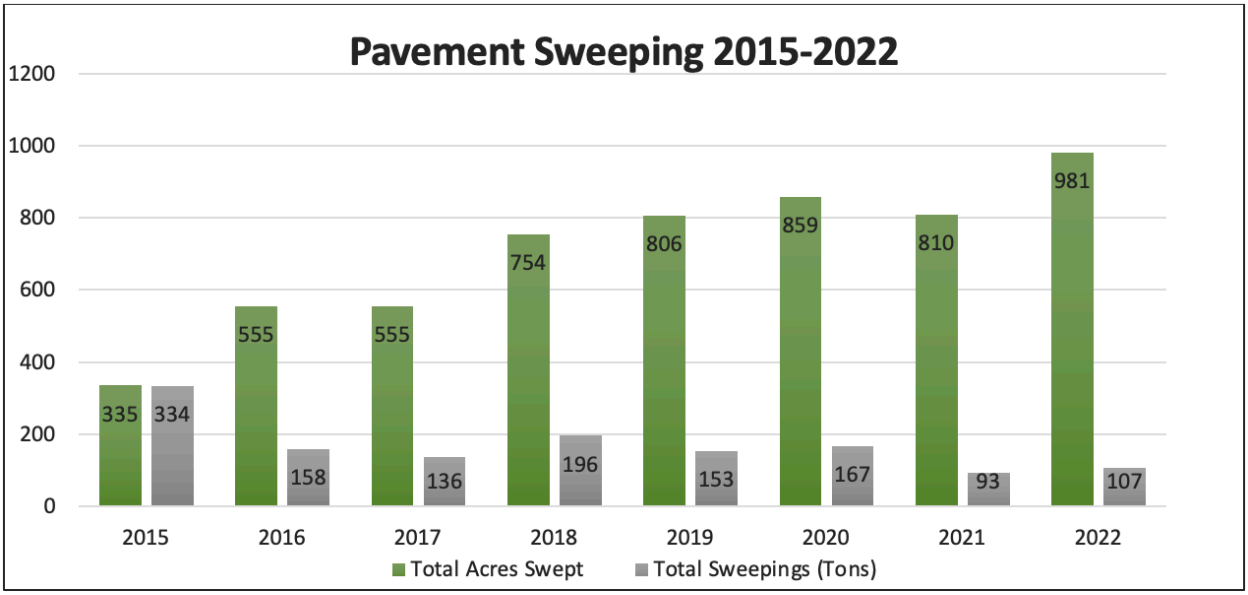

Figure 3 *Tons of Sweepings Collected by Year*

Catch Basin Cleaning

Catch basin maintenance including inspection and cleaning are completed by a third-party contractor for properties managed under the Long Creek General Permit. Solids collected through catch basin cleaning are designated for disposal at an identified solid waste handling facility.

In 2022, **693 catch basins were inspected and/or cleaned** which is a decrease from 695 in 2021. Approximately **25.15 tons of catch basin grit was collected**, an increase from 23.79 tons in 2021. In addition, Participating Landowners received credits against their annual assessments for cleaning an **additional 355 catch basins**.

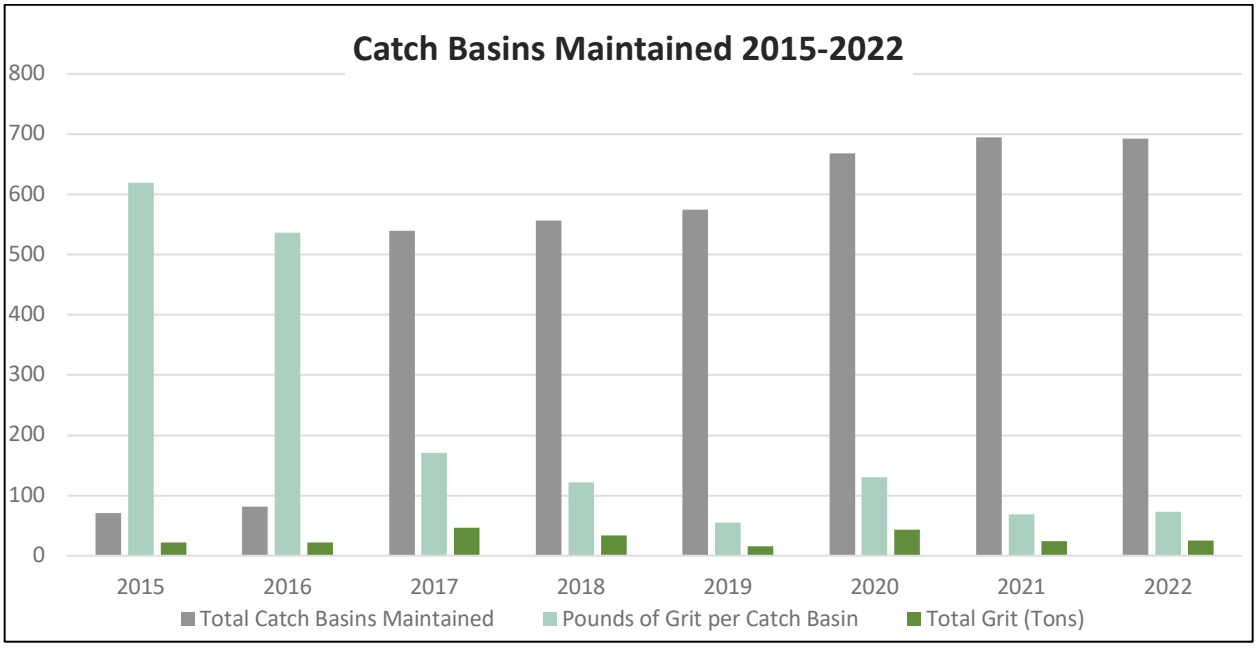

Figure 4 *Catch Basins Maintained by Year*

Sustainable Winter Management (SWiM®)

The water quality monitoring program for Long Creek implemented by LCWMD has identified chlorides from the application of winter dicing salt as a significant impairment of water quality in Long Creek. Elevated chloride levels are known to impact the growth and reproduction of aquatic organisms. As a result, LCWMD has identified the reduction in the use of chlorides as a necessary element to meeting water quality standards in Long Creek.

In 2022, LCWMD continued working with its chloride reduction consultant, WIT Advisers, to develop and implement a local program for adopting Sustainable Winter Management (SWiM®) guidelines throughout the Long Creek Watershed. Key stakeholders and property owners within the watershed (one municipality and two private landowners) were identified as the initial participants for this program, which begins with a stakeholder engagement process followed by a future needs assessment process that helps participants identify opportunities to save money, manage risk, and reduce de-icing salt outputs entering the watershed.

Work during the 2022-2023 winter season primarily included engaging with the initial landowners and their snow removal contractors responsible for winter snow and ice management operations. Engagement with participants included installation of webcams and weather monitoring stations to monitor ground conditions, installation of GPS trackers on snow removal equipment, measuring output and calibration of snow removal equipment, and analysis of salt application rates throughout the winter season.

Parcel Inspections

During 2022, LCWMD's parcel inspection program was carried out by staff from CCSWCD who conducted 106 inspections of Participating Landowner properties in the watershed. "Parcels" that are municipal or state roads are not inspected. The parcel inspection program is the primary means for LCWMD to conduct outreach with Participating Landowners. CCSWCD staff makes a concerted effort to engage Participating Landowners in the inspection process to ensure that landowners are aware of site-specific operation and maintenance plans and to accomplish timely resolution of issues identified during inspections.

Subsequent to parcel inspections, Participating Landowners were sent annual inspection reports detailing follow-up actions requested by inspection staff. **Table 7** illustrates the relative frequency of the common issues identified during parcel inspections as needing corrective action. Outreach to landowners was conducted to follow up on corrective actions and to provide technical assistance. LCWMD works with municipalities, and sometimes Maine DEP, to rectify issues identified during parcel inspections.

Table 7 *Common Issues Identified During Parcel Inspections as Needing Corrective Action*

Operation and Maintenance Inspection Element	Corrective Action Needed
Swales or Ditches in Poor Condition	24
Landscaping Debris	18
Poorly Vegetated or Bare Areas (Grass or Landscaped)	16
Dumpster Management	15
Poor Outfall Stability	13
Culverts in Poor Condition	12
Armored Areas	9
Trash/Litter	8
Pavement in Poor Condition	8
Catch Basin Structural Maintenance Needed	7
Hazardous Materials Storage or Oil Spill or Leak	5
Unauthorized Dumping	5
Fats, Oils, Grease	3
Snow Storage Area in Poor Condition	0

Education and Outreach

Fact Sheets

A primary focus of LCWMD's pollution prevention initiatives is distribution of fact sheets to Participating Landowners, all of which are available on LCWMD's website.[10] Distribution of these fact sheets allows LCWMD to efficiently address the most commonly encountered issues in the Long Creek Watershed. Fact sheets have simplified to rely less on text and more on simple infographics.

Communications with Participating Landowners

Specific outreach communications to update Long Creek Participating Landowners and subscribers to the Long Creek list serve included the following:

- **March 25, 2022 – Spring Cleanup Starts on March 28, 2022.** After another long Maine winter spring has arrived! The District is excited to start the annual spring cleanup on March 28th with our pavement sweeping and catch basin cleaning contractors.
- **March 30, 2022 – Annual Property Inspections Are Starting Soon.** Each year we inspect properties in the Long Creek Watershed to help landowners improve their

[10] Fact sheets are available on LCWMD's website at: https://www.restorelongcreek.org/landowner-resources.

properties and reduce stormwater pollutants. Our inspection kit includes waterproof boots (sometimes waders), an orange safety vest, a giant magnet, a powerful flashlight, a camera, and maps of the underground pipe network. If you would like to join us during your inspection, please respond to the email from our inspectors.

- **June 2, 2022 – 2021 Annual Report Available.** We recently submitted the 2021 Annual Report to the Maine Department of Environmental Protection highlighting activities conducted during 2021.
- **July 20, 2022 – Funds Available to Participating Landowners for Water Quality Projects.** The District's Board of Directors is pleased to reissue the Private BMP Incentive Program which provides financial assistance to Participating Landowners that invest in activities that will improve water quality in Long Creek. Eligible project examples include: structural stormwater BMPs such as gravel wetlands, underdrained soil filters, vegetated swales, and rain gardens; stream and wetland protection or restoration; establishment or enhancement of vegetated buffers to capture and filter stormwater; good housekeeping and pollution prevention projects; implementation of snow removal practices or acquisition of snow removal equipment that will result in reduced salt use; heated sidewalks; and green roofs. Details concerning the program can be found in the Request for Proposals on LCWMD's website.

Conferences, Meetings, and Events

- **South Portland Land Trust, West End Trails Committee: January 20, February 17, March 17, April 21, June 16, July 21, August 18, September 15, October 20, and November 17, 2022.**
  Stakeholder on the West End Trails Committee of the South Portland Land Trust. The West End Trails Committee provides input to the South Portland Land Trust on the implementation of their plans to make the west end of the city (the Maine Mall area) more pedestrian friendly and help protect pockets of natural areas.
- **Interlocal Stormwater Work Group, Ordinance Committee: March 24, 2022, April 1, 2022, April 21, 2022, June 6, 2022, and July 14, 2022.**
  Working as a partner to the Interlocal Stormwater Work Group on the development of model Erosion and Sedimentation Control and Low Impact Development model ordinance for adoption by Maine MS4 communities.
- **Maine Stormwater Conference: November 2, 2022.**
  Presenter on BMP Long Term Cost Estimates for Long Creek Watershed Management District.

Monitoring

LCWMD has been implementing the *Long Creek Monitoring Plan*[11] ("Monitoring Plan") and associated *Long Creek Quality Assurance Project Plan*[12] ("QAPP") since late summer 2010. Detailed information about the various aspects of the Long Creek monitoring program is provided in the Monitoring Plan and QAPP.

[11] The Monitoring Plan is available on LCWMD's website at: https://www.restorelongcreek.org/documents.
[12] The QAPP is available on LCWMD's website at: https://www.restorelongcreek.org/documents.

Monitoring Locations

The monitoring locations for 2022 are identified in **Figure 5**, which are consistent with prior years.

Goals of Monitoring

Monitoring of conditions in the Long Creek Watershed reflects specific regulatory and management needs. These are: to determine whether or not Long Creek meets applicable water quality standards; to gather information to improve management of Long Creek; and, to document effectiveness of restoration programs and progress towards meeting standards. The Monitoring Plan was developed in order to evaluate baseline chemistry and flow conditions and monitor stream recovery at predetermined points across the watershed. The Monitoring Plan is focused on gathering the information needed to monitor Long Creek restoration efforts.

Figure 5 *Long Creek Monitoring Locations*

Monitoring Plan and Quality Assurance Project Plan

The Monitoring Plan requires water quality monitoring, biological monitoring, habitat assessment, and physical (geomorphic) assessment to determine the effectiveness of stormwater BMPs and watershed restoration projects on water quality, habitat, and the health of biological communities.

Monitoring Plan Implementation

The Monitoring Plan and QAPP were implemented in 2022 by LCWMD's monitoring contractor with support provided by CCSWCD and oversight provided by LCWMD. Long Creek's monitoring program includes primarily continuous monitoring, collection of grab samples, hydrologic

monitoring, and biomonitoring. LCWMD's monitoring contractor provided a monitoring services summary report to LCWMD for the 2022 calendar year on January 30, 2023.[13]

Water Quality Monitoring Data Summary

LCWMD has identified water quality criteria for general water chemistry in Long Creek based on Maine DEP and U.S. Environmental Protection Agency water quality standards and recommendations for freshwater or urban streams. Specific conductance (used as a proxy for chloride), dissolved oxygen ("DO"), and temperature are measured nearly continuously with water quality data loggers. Phosphorus, metals (cadmium, copper, lead, nickel, and zinc), chloride, and Polycyclic Aromatic Hydrocarbon levels are measured periodically by in-stream grab sampling. These water quality parameters are monitored as ongoing indicators of water quality in Long Creek and its ability to support aquatic life. Long Creek's ability to support aquatic life, such as macroinvertebrates and fish, is ultimately determined through periodic biomonitoring (described below).

LCWMD uses the Criteria Continuous Concentration ("CCC") and Criteria Maximum Concentration ("CMC") as comparative criteria for contaminant concentrations in surface water. The CCC, or chronic criterion, is the highest in-stream concentration to which organisms can be exposed indefinitely without causing unacceptable effect (typically the four-day average concentration that should not be exceeded more than once every three years on the average), 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 (typically the one-hour average concentration that should not be exceeded more than once every 3 years on the average). LCWMD has developed a color-coded screening system to track each stream reaches' conformity with quality criteria referred to as "stoplights." **Table 8** reflects the structure of the stoplights system. The subsequent tables are the outcomes of the stoplights at the identified monitoring locations.

Table 8 *Monitoring Criteria for Ranking*

Color Codes	Dissolved Oxygen	Chloride	Metals	Nutrients	Calculated Chloride
RED	Failed for more than 21 days	CMC exceeded or CCC exceeded for >50% samples			
ORANGE	Failed for 7-21 days	CCC exceeded for 30-50% of samples			
YELLOW	Failed for 1-6 days	CCC exceeded for 25% of samples (and not during baseflow)			
GREEN	Meets classification				

[13] *See* GZA GeoEnvironmental, Inc. January 2023. 2022 Annual Monitoring Services Summary Report— Long Creek Watershed — Portland, South Portland, Westbrook, and Scarborough, Maine. Edited portions reproduced for this report.

Blanchette Brook

Blanchette Brook Monitoring Summary (Secondary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S12	2011	GREEN	—	YELLOW	—	ORANGE
S12	2012	GREEN	—	YELLOW	—	RED
S12	2013	GREEN	GREEN	YELLOW	RED	RED
S12	2014	YELLOW	GREEN	YELLOW	RED	RED
S12	2015	GREEN	GREEN	YELLOW	RED	RED
S12	2016	GREEN	GREEN	YELLOW	RED	RED
S12	2017	GREEN	GREEN	YELLOW	RED	RED
S12	2018	ORANGE	ORANGE	YELLOW	RED	RED
S12	2019	GREEN	GREEN	GREEN	RED	RED
S12	2020	GREEN	GREEN	YELLOW	RED	RED
S12	2021	GREEN	GREEN	YELLOW	ORANGE	RED
S12	2022	ORANGE	ORANGE	YELLOW	RED	RED

Blanchette Brook Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S07	2010	ORANGE	RED	RED	RED	RED
S07	2011	ORANGE	GREEN	RED	RED	RED
S07	2012	ORANGE	ORANGE	RED	RED	RED
S07	2013	YELLOW	GREEN	RED	RED	RED
S07	2014	YELLOW	ORANGE	RED	RED	RED
S07	2015	RED	ORANGE	RED	RED	RED
S07	2016	RED	RED	RED	RED	RED
S07	2017	RED	RED	RED	RED	RED
S07	2018	RED	RED	RED	RED	RED
S07	2019	ORANGE	RED	RED	RED	RED
S07	2020	RED	RED	RED	RED	RED
S07	2021	RED	RED	RED	ORANGE	RED
S07	2022	RED	RED	RED	RED	RED

Main Stem

Upper Main Stem Monitoring Summary (Secondary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S11	2011	ORANGE	—	YELLOW	—	ORANGE
S11	2012	GREEN	—	YELLOW	—	ORANGE
S11	2013	GREEN	GREEN	YELLOW	RED	RED
S11	2014	ORANGE	YELLOW	YELLOW	RED	RED
S11	2015	ORANGE	ORANGE	YELLOW	RED	RED
S11	2016	ORANGE	RED	YELLOW	RED	YELLOW
S11	2017	ORANGE	ORANGE	YELLOW	ORANGE	RED
S11	2018	ORANGE	ORANGE	YELLOW	RED	RED
S11	2019	RED	GREEN	YELLOW	RED	RED
S11	2020	GREEN	GREEN	YELLOW	ORANGE	RED
S11	2021	ORANGE	ORANGE	YELLOW	ORANGE	RED
S11	2022	ORANGE	ORANGE	YELLOW	ORANGE	GREEN

Upper Main Stem Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S06	2010	GREEN	GREEN	RED	RED	RED
S06	2011	ORANGE	GREEN	RED	RED	RED
S06	2012	YELLOW	GREEN	RED	ORANGE	RED
S06B	2013	YELLOW	GREEN	RED	RED	RED
S06B	2014	ORANGE	YELLOW	RED	RED	RED
S06B	2015	ORANGE	ORANGE	RED	RED	RED
S06B	2016	ORANGE	ORANGE	RED	RED	RED
S06B	2017	ORANGE	ORANGE	RED	ORANGE	RED
S06B	2018	ORANGE	ORANGE	RED	RED	RED
S06B	2019	ORANGE	ORANGE	RED	RED	RED
S06B	2020	YELLOW	YELLOW	RED	ORANGE	RED
S06B	2021	ORANGE	ORANGE	RED	GREEN	RED
S06B	2022	ORANGE	ORANGE	RED	ORANGE	RED

Middle Main Stem Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S05	2010	GREEN	GREEN	RED	RED	RED
S05	2011	YELLOW	GREEN	RED	RED	RED
S05	2012	GREEN	GREEN	YELLOW	RED	RED
S05	2013	GREEN	GREEN	RED	RED	RED
S05	2014	YELLOW	YELLOW	RED	RED	RED
S05	2015	ORANGE	GREEN	YELLOW	RED	RED
S05	2016	RED	GREEN	YELLOW	RED	RED
S05	2017	ORANGE	ORANGE	YELLOW	RED	RED
S05	2018	ORANGE	ORANGE	YELLOW	RED	RED
S05	2019	ORANGE	YELLOW	YELLOW	RED	RED
S05	2020	ORANGE	YELLOW	YELLOW	ORANGE	RED
S05	2021	ORANGE	YELLOW	YELLOW	RED	RED
S05	2022	ORANGE	YELLOW	YELLOW	RED	RED

Lower Main Stem Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S02	2010	YELLOW	GREEN	RED	RED	RED
S02	2011	ORANGE	GREEN	RED	RED	RED
S02	2012	ORANGE	ORANGE	RED	RED	RED
S02	2013	ORANGE	GREEN	RED	RED	RED
S02	2014	ORANGE	RED	RED	RED	RED
S17	2015	RED	ORANGE	RED	RED	RED
S17	2016	RED	RED	RED	RED	RED
S17	2017	ORANGE	RED	RED	RED	RED
S17	2018	RED	RED	RED	RED	RED
S17	2019	ORANGE	RED	RED	RED	RED
S17	2020	RED	YELLOW	RED	RED	RED
S17	2021	RED	ORANGE	RED	RED	RED
S17	2022	RED	RED	RED	RED	RED

South Branch

Middle South Branch Monitoring Summary (Secondary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S04	2010	RED	RED	ORANGE	RED	RED
S04	2011	RED	RED	RED	RED	ORANGE
S04	2012	RED	RED	YELLOW	RED	ORANGE
S04	2013	RED	RED	YELLOW	RED	YELLOW
S04	2014	RED	RED	YELLOW	RED	RED
S04	2015	RED	RED	YELLOW	RED	ORANGE
S04	2016	RED	RED	YELLOW	RED	ORANGE
S04	2017	RED	RED	YELLOW	RED	RED
S04	2018	RED	RED	YELLOW	RED	ORANGE
S04	2019	RED	RED	YELLOW	RED	ORANGE
S04	2020	RED	RED	YELLOW	RED	RED
S04	2021	RED	RED	YELLOW	RED	RED
S04	2022	RED	RED	YELLOW	RED	YELLOW

Lower South Branch Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S01	2010	RED	RED	RED	RED	RED
S01	2011	RED	RED	RED	RED	RED
S01	2012	RED	RED	RED	RED	RED
S01	2013	RED	RED	RED	RED	ORANGE
S01	2014	RED	RED	RED	RED	ORANGE
S01	2015	RED	RED	RED	RED	RED
S01	2016	RED	RED	RED	RED	RED
S01	2017	RED	RED	RED	RED	ORANGE
S01	2018	RED	RED	RED	RED	RED
S01	2019	RED	RED	RED	ORANGE	GREEN
S01	2020	RED	RED	RED	GREEN	ORANGE
S01	2021	RED	RED	RED	GREEN	GREEN
S01	2022	RED	RED	RED	GREEN	GREEN

North Branch

North Branch Monitoring Summary (Primary)

Location	Year	Calculated Chloride	Chloride	Dissolved Oxygen	Metals	Nutrients
S03	2010	RED	RED	RED	RED	ORANGE
S03	2011	RED	RED	RED	RED	ORANGE
S03	2012	RED	RED	RED	ORANGE	ORANGE
S03	2013	RED	RED	RED	RED	ORANGE
S03	2014	RED	RED	RED	RED	RED
S03	2015	ORANGE	ORANGE	RED	RED	RED
S03	2016	RED	ORANGE	RED	RED	RED
S03	2017	RED	RED	RED	RED	RED
S03	2018	RED	RED	RED	ORANGE	RED
S03	2019	RED	RED	RED	GREEN	GREEN
S03	2020	RED	RED	RED	GREEN	RED
S03	2021	RED	RED	RED	GREEN	GREEN
S03	2022	RED	RED	RED	GREEN	GREEN

Biomonitoring

Pursuant to the Monitoring Plan, invertebrate monitoring utilizing rock bags is performed at primary monitoring locations twice in every five-year period (*e.g.,* 2020, 2023, 2025, 2028), with the work alternatingly being performed by Maine DEP or LCWMD. Fish monitoring is performed once every five years.

Rock Bags

The macroinvertebrate community is sampled by deploying standardized sampling devices (rock bags or rock baskets) on the stream bottom for a period of four weeks and collecting the organisms that colonize the bags. The collected organisms are identified and quantified. The resulting data is used to calculate 23 variables that are used in linear discriminant models which predict the probability that the community will meet the aquatic life criteria for a given stream classification (A, B, C, or Nonattainment).

Maine DEP was scheduled to deploy rock bags in 2020, however, due to the monitoring season being limited in 2020 due to COVID-19, deployment of rock bags was deferred to 2021. In 2021, Maine DEP determined that rather than deploying rock bags at the traditional primary monitoring locations, biomonitoring should focus on documenting the effectiveness of the Main Stem Restoration Project. As a result, biomonitoring was limited to the "reference" and "restoration" reaches. Maine DEP deployed one set of rock bags at monitoring station S05, the "reference" reach, and three sets of rock bags in the "restoration" reach, with one set being deployed at monitoring station S17, and two addition sets being deployed, one upstream of S17 and one downstream of S17, both in the "restoration" reach.

Table 9 summarizes biomonitoring outcomes based on Maine DEP evaluations of rock bag data.

Table 9 *Summary of Aquatic Life Classification Attainment Reports*

Date	Biomonitoring Station	Monitoring Station	Statutory Class	Determination
8/18/2010	S-409	**S07** (Blanchette Brook)	B	NA
8/18/2010	S-411	**S06A** (Main Stem just above Blanchette)	B	NA
8/18/2010	S-570	**S05** (Main Stem above Turnpike)	C	C
8/16/2010	S-414	**S03** (North Branch)	C	NA
8/16/2010	S-752	**S17** (Main Stem just above Foden Road)	C	NA
8/13/2010	S-415	**S02** (Main Stem below Foden Road)	C	NA
8/13/2010	S-753	**S01** (South Branch above Clark's Pond)	C	NA
9/9/2013	S-409	**S07** (Blanchette Brook)	B	C
9/9/2013	S-1015	**S06B** (Main Stem Sable Oaks just below Cummings)	C	NA
9/9/2013	S-570	**S05** (Main Stem above Turnpike)	C	C
9/9/2013	S-414	**S03** (North Branch)	C	I
9/9/2013	S-581	**NONE** (South Branch below S-408)	C	NA
9/9/2013	S-415	**S02** (Main Stem below Foden Road)	C	NA
8/27/2015	S-411	**S06A** (Main Stem just above Blanchette)	B	C
8/27/2015	S-414	**S03** (North Branch)	C	NA
8/27/2015	S-408	**NONE (**South Branch above S-581)	C	NA
8/27/2015	S-752	**S17** (Main Stem just above Foden Road)	C	NA
8/1/2018	S-409	**S07** (Blanchette Brook)	B	NA
8/1/2018	S-1015	**S06B** (Main Stem Sable Oaks just below Cummings)	C	NA
8/1/2018	S-411	**S06A** (Main Stem just above Blanchette)	B	NA
8/1/2018	S-570	**S05** (Main Stem above Turnpike)	C	NA
8/1/2018	S-414	**S03** (North Branch)	C	NA
8/1/2018	S-752	**S17** (Main Stem just above Foden Road)	C	NA
8/1/2018	S-415	**S02** (Main Stem below Foden Road)	C	NA
8/1/2018	S-753	**S01** (South Branch above Clark's Pond)	C	NA
8/13/2019	S-409	**S07** (Blanchette Brook)	B	NA
8/13/2019	S-570	**S05** (Main Stem above Turnpike)	C	NA
8/13/2019	S-752	**S17** (Main Stem just above Foden Road)	C	NA
9/3/2021	S-570	**S05** (Main Stem above Turnpike)	C	NA
9/3/2021	S-1196	**NONE** Close to S-410	C	NA
9/3/2021	S-1197	**NONE** Upstream of S-752 (adjacent to **S17**)	C	NA
9/3/2021	S-752	**S17** (Main Stem just above Foden Road)	C	NA

Fish Monitoring

Fish monitoring was conducted at the six primary monitoring sites as described in Section 7 of the Monitoring Plan. Fish monitoring notes and field observations are noted in the summary table below. Deviations, if any, from the Monitoring Plan, Maine Department of Environmental Protection (DEP) QAPP, and/or Scope of Services have been noted in the Fish Monitoring Report dated December 10, 2022.

On July 20, 2022, fish monitoring was completed in reaches originating at monitoring stations S01, S03, S05, S06B, S07, and S17 to identify fish species present in Long Creek. Characterization of stream habitats, water quality parameter measurements, and documentation of electrofishing were completed and recorded on the Maine DEP Stream Electrofishing Field Data Sheets.

Fish were observed and collected from each sampling station. Species richness ranged from two species at station S07 to five species at stations S03 and S06B (**Table 10**), with the highest fish abundance observed at station S06B (76 fish) and the lowest abundance observed at station S01 (11 fish), and an average of 28.5 fish per sampling site. In adjusting the raw abundance for seconds of electrofishing, the highest catch per unit effort (CPUE) occurred at station S06B with 0.097 fish/sec (**Table 10**).

Ninespine stickleback observed at station S17.

Ninespine stickleback (*Pungitius pungitius*) were collected at all six sampling locations, with fourspine stickleback (*Apeltes quadracus*) and white sucker (*Catostomus commersonii*) present in five of the sampling locations (**Table 10**). Additional species captured via electrofishing include blacknose dace, American eel (*Anguilla rostrata*), and pumpkinseed (*Lepomis gibbosus*). Two incidental species observed during the survey include larval two-lined salamander (*Eurycea bislineata*) at station S01 and grooved fingernail clam (*Sphaerium simile*) at station S17. Introduced or invasive fish species were not observed during fish surveys. The adult and juvenile ninespine stickleback, fourspine stickleback, blacknose dace, and white sucker, as well as breeding male blacknose dace indicate spawning populations of these species within the Long Creek watershed.

Table 10. *Summary of 2022 Electrofishing Results*

Site	White sucker	Four-spine stickleback	Nine-spine stickleback	Blacknose dace	American eel	Pumpkinseed	Total abundance	Species richness	Electrofishing seconds	CPUE (fish/ sec)
S01	3	-	5	3	-	-	11	3	488	0.023
S03	11	8	5	3	1	-	28	5	522	0.054
S05	7	2	16	-	-	-	25	3	537	0.047
S06B	19	30	25	1	-	1	76	5	781	0.097
S07	-	9	6	-	-	-	15	2	424	0.035
S17	5	6	5	-	-	-	16	3	517	0.031

Breeding male blacknose dace observed at station S03

Brook trout or other cold-water sensitive species were not observed during electrofishing surveys, however fish ranging from tolerant to moderately intolerant to impaired waters were observed. In impaired watersheds, brook trout may be replaced by a greater dominance of other species including white sucker and blacknose dace (Adamus and Brandt 1990), which were observed in relatively moderate-to low-abundance in the sampled reaches. White sucker was observed in five of the six sampling locations and is considered highly tolerant of pollution, capable of occupying habitats ranging from cold, clear streams to murky, anoxic, or otherwise impaired waters (Page and Burr 2011). Blacknose dace, observed in three of the six sampled reaches, is a cool-water species considered to be moderately tolerant of impaired waters, occupying clear streams and high quality or marginal habitats (summarized in Trial 1983, Grabarkiewicz and Davis 2008, Adamus et al., 2001). Additionally, pumpkinseed are tolerant to intermediately tolerant to acidic waters and high temperatures (Grabarkiewicz and Davis 2008). Ninespine stickleback, observed at all sampling locations, and pumpkinseed, observed at sampling station S06B, are also considered moderately tolerant of impaired waters.

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