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November 13, 2019
File No. 09.0025977.02

Mr. Peter Carney
Executive Director
Long Creek Watershed Management District
c/o Cumberland County Soil and Water Conservation District
35 Main Street
Windham, Maine 04062

Re: Long Creek Watershed Data Analysis
Task 2: Preparation of Explanatory and Other Variables

Dear Peter:

In our proposal for services approved by Long Creek Watershed Management District (LCWMD) on June 3, 2019, GZA GeoEnvironmental, Inc. (GZA) agreed to perform services in response to LCWMD's *Request for Proposals* (RFP)*: Watershed Monitoring Data Analysis Services*. As described in the Watershed Monitoring Data Analysis Services RFP, LCWMD requested the services of a qualified consultant to provide monitoring data analysis services to assess the effectiveness of ongoing watershed restoration efforts and help direct future work of LCWMD. As outlined in LCWMD's RFP, GZA's scope of services included the following tasks:

- Task Number 1: Comprehensive Summary of Existing Data
- Task Number 2: Preparation of Explanatory and Other Variables
- Task Number 3: Exploratory Data Analysis
- Task Number 4: Statistical Analysis
- Task Number 5: Hydrology and Flow
- Task Number 6: Documentation

Consistent with Task 2 in LCWMD's RFP and GZA's scope of services, GZA has prepared this letter report containing a summary of existing water quality stressors in the context of land cover, best management practices, physical parameters and explanatory relationships that are important variables to the watershed and implementation of the management plan. GZA provided a comprehensive summary of the observed record from the Long Creek Watershed Monitoring program in a technical letter report dated August 15, 2019. The following sections describe GZA's analyses on water quality stressors and basic descriptive statistics of the existing data.

LAND COVER ANALYSIS

Land Cover

Percentage and spatial distribution of various land covers have a profound impact on the water quality of a natural stream. For this phase of the project, GZA obtained the Long Creek geodatabase provided by Cumberland County Soil and Water Conservation District

(CCSWCD) and extracted sub-watershed delineations from this geodatabase. Land cover geospatial data was obtained from the National Land Cover Database (NCLD). Since NLCD data is available for years 2001, 2003, 2006, 2008, 2011, 2013, and 2016, we focused on the land cover change that happened between 2011 and 2016. A total of 15 land cover types were used to characterize various land covers within the Long Creek Watershed (see **Table 1**). In this analysis, we treated the four developed categories (i.e., high, medium, and low intensities and developed open space) as one group and the remaining categories including barren, cultivated, and other types of open green spaces as another group. Area of the total watershed, 2304.7 acres (or 3.6 square miles) remains unchanged. For the total watershed area, developed land cover increased by approximately 12 acres (from 1522.2 acres to 1534.2 acres) between 2011 and 2016. The Long Creek watershed consists of a significant portion of heavily developed areas with an overall development percentage of 66 percent in 2011, which increased to 67 percent in 2016. The 12-acre increase (from 2011 to 2016) in the developed area originated primarily from the Blanchette Brook subwatershed, where the developed area increased by 10.3 acres (see **Figure 1**). Upper Main Stem and North Branch Tributary had an approximate 1-acre increase in development each, whereas South Branch had a minor increase of 0.2 acre. Lower Main Stem subwatershed did not undergo new development; Middle Main Stem and East Branch subwatersheds had a slight decrease in development. A simplified breakdown per each subwatershed is provided below. Refer to **Table 1** for additional details. **Figure 1** presents the change in development between 2011 and 2016.

Summary of Land Cover Change between 2011 and 2016

Subwatershed	Subwatershed Area (acres)	Percent of Developed Area as of 2016 (%)	Increase in Developed Area 2011 - 2016 (acres)
Lower Main Stem	105.06	99%	0.0
Middle Main Stem	278.63	60%	-0.1
Upper Main Stem	623.37	41%	0.9
Blanchette Brook	434.13	51%	10.3
North Branch Trib	298.76	98%	0.9
East Branch Trib	137.36	87%	-0.3
South Branch Trib	427.37	89%	0.2

Impervious Cover

Impervious cover is the leading contributor to the surface runoff and hence a key factor in water quality in the stream. For Long Creek Watershed, due to its high developed area to total watershed area ratio, impervious cover values are high overall. GZA performed a simple analysis on impervious cover within the watershed. The base dataset was the 2009 Long Creek Watershed Management Plan (Figure 3b) and the updated dataset was extracted from the Long Creek Geodatabase provided by CCSWCD in July 2019. The analysis is presented in **Table 2**. The results are overall fairly consistent with the land cover change (see below). Blanchette Brook seems to have undergone the most significant change compared with other subwatersheds. Upper Main and North Branch have an increase equal to or over 2 percent, whereas Lower Main and East Branch subwatersheds experienced a relatively minor increase of approximately equal to or less than 1 percent. Middle Main and South Branch subwatersheds experienced a decrease in impervious cover. **Figure 2** presents the change in impervious cover between 2009 and 2019.

Summary of Impervious Cover Change between 2009 and 2019

Subwatershed	Impervious Cover 2009 (%)	Impervious Cover 2019 (%)	Change (%)
Lower Main Stem	61.8%	62.0%	0.2%
Middle Main Stem	19.5%	19.3%	-0.2%
Upper Main Stem	10.6%	12.9%	2.3%
Blanchette Brook	16.8%	20.2%	3.4%
North Branch Trib	39.2%	41.2%	2.0%
East Branch Trib	31.4%	32.6%	1.1%
South Branch Trib	57.1%	56.1%	-1.0%

Best Management Practices (BMP) Projects

LCWMD has implemented several BMP projects since 2009, which were intended to improve the overall health / water quality of the Long Creek watershed. **Table 3** summarizes LCWMD's BMP construction projects between 2009 and 2017. Project types vary between locations and include BMPS such as gravel wetlands, riparian corridor planting, proprietary structures that treat stormwater runoff, as well as bank stabilization. Objectives of this current data analysis project are to evaluate the BMP effectiveness and provide useful information for future improvements. **Figure 3** presents the locations of LCWMD's BMP construction projects.

Summary

Overall, the Long Creek watershed did not experience a surge in developed area between 2011 and 2016. The watershed land cover has been fairly stable, with the possible exception of the Blanchette Brook area. GZA will use the available information from the land cover and impervious cover analysis for the subsequent tasks to help analyze and interpret the statistics and long-term trends of the observed watershed monitoring data.

PREPARATION FOR EXPLORATORY DATA ANALYSIS

As summarized in our Task 1 report (Comprehesive Summary of Existing Data dated August 19, 2019), GZA uploaded monitoring data to EQuIS and provided a comprehensive summary of the available database. In preparation for the subsequent data analysis (Tasks 2 through 4 of the proposal), GZA exported data from EQuIS and extracted data for each monitoring station based on "Task Code". A total of five (5) task codes were identified and used: Baseflow, Spring Melt, Stormwater, Pressure, and Sonde. To create a standardized format across all stations, every analyte with available data for at least one station was included as a column header in the workbook for each station.

While including processing the data to resolve anomalies, non-detect data points, and/or inconsistencies:

- For each station, analytes without detections above the laboratory reporting limit or analytes with no results available at that station, were disregarded;
- Analytes not measured consistently throughout the period of the monitoring program were not used for further analysis (e.g., aluminum, nitrogen, etc.);
- For data points below their corresponding reporting limits associated with analytes for which at least one result was detected above the reporting limit, 50 percent of the laboratory reporting limit was included in the data set;

- Units Inconsistency: Several records had results in micrograms per liter (ug/L). GZA updated these records to reflect the appropriate units of milligrams per liter (mg/L).
- For Baseflow, Spring Melt, and Stormwater data, a total of 12 parameters were identified as the key parameters to focus our analytical efforts, which include Chloride (in mg/L), Dissolved Oxygen (DO, in mg/L), Dissolved Oxygen Saturation (DOS, in %), Hardness (in mg/L), Copper (in mg/L), Lead (in mg/L), Nickel (in mg/L), Zinc (in mg/L), pH (--), Phosphorus (in mg/L), Specific Conductivity (SC in uS/cm[1]), and Temperature (°Celsius).
- Data from the continuous data loggers will be analyzed separately due to the size of the available data in comparison with the laboratory tested samples.

Data extracted from the EQuIS database and organized for these analyses has been documented in a Microsoft Excel spreadsheet that is available to LCWMD upon request.

BASIC DESCRIPTIVE STATISTICS OF SUBWATERSHEDS

For this phase of the project, we focused on the six (6) primary stations of the monitoring program: S01, S03, S05, S06B, S07, and S17. These stations represent the long-term monitoring results for the Long Creek watershed. Each station is associated with a distinctive subwatershed (see **Figures** and **Table 2**).

Table 4 presents the all-flow (Baseflow, Spring Melt, and Stormwater) mean and coefficient of variation (CV) at the primary stations based on the available record between August 2010 through June 2019. Note that mean was calculated as the unweighted arithmetic average, and CV was calculated as the ratio of the standard deviation and mean. Main takeaways of the summary table are:

- The results indicate that there is significant spatial variability within the watershed. For example, measured average Chloride concentration at S01 (South Branch) is approximately three times the Chloride concentration at S06B (Upper Main Stem).
- In terms of the calculated CV values, the spatial variability across the watershed is not significant. The CVs for each analyte are mostly within a tighter range, compared to the calculated means. This indicates that shapes (wide or pointy) of the distributions of each parameter are similar between different locations, assuming that they conform to the standard normal distribution.
- Some analytes exhibit a greater variation than others across the watershed. For example, the acidic/basic metric, pH, varies slightly among the dataset at each station, with a CV mostly below 10 percent. This is likely because pH is a log-scaled metric. Metal concentrations such as copper or lead are associated with CV values ranging between 100 percent to 200 percent, which indicates that these analytes have a much wider

[1] uS/cm = 10^{-6} Siemens per centimeter

distribution, most likely due to their overall low concentration and commonality in terms of use and therefore prevalence in the environment.

- Among the different stations (i.e., geographic locations, see **figures**), the upstream stations S06B, S07, and S05 generally have lower concentration compared with the more downstream locations such as S17. S01 and S03 are located at the downstream of heavily developed areas, which leads to an overall high concentration in most selected analytes such as Chloride, SC, and metals.
- It is interesting to note that S01 and S03 also have the highest mean dissolved oxygen levels, compared to the other stations.

CLOSING

We will explore additional descriptive statistics per each flow type (Baseflow, Spring Melt, and Stormwater) and long-term temporal trends in Tasks 3 and 4. Continuous data will be analyzed and correlations such as relationships between different analytes, between flow and precipitation, and between analytes and BMP activities will be explored.

Please don't hesitate to contact me at 207-358-5116 if you have any questions or need additional information regarding this letter report.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

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Attachments: Table 1 – Land Cover Change between 2011 and 2016
Table 2 – Impervious Cover Change between 2009 and 2019
Table 3 – Summary of Best Management Practice Construction Projects
Table 4 – Summary of Mean and Coefficient of Variation (All Flow Types)
Figure 1 – Long Creek Watershed Land Cover Change 2011 to 2016
Figure 2 – Long Creek Watershed Impervious Cover Change 2009 to 2019
Figure 3 – Long Creek Watershed Best Management Practices Project Locations

Table 1: Land Cover Change Analysis between 2011 and 2016

Sub-Watershed	Sub-basin Total	Barren Land	Cultivated Crops	Deciduous Forest	Developed, High Intensity	Developed, Low Intensity	Developed, Medium Intensity	Developed, Open Space	Emergent Herbaceous Wetlands	Evergreen Forest	Hay / Pasture	Herbaceous	Mixed Forest	Open Water	Scrub / Shrub	Woody Wetlands	Developed Area (% of Subwatershed)
2011																	
Lower Main Stem	105.04	0.0	0.0	0.0	52.1	14.1	25.1	12.3	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	103.6 (99%)
Middle Main Stem	278.63	2.0	0.0	21.2	17.7	40.5	45.4	62.6	10.9	2.7	1.1	0.4	39.8	0.0	4.6	29.7	166.2 (60%)
Upper Main Stem	623.37	13.0	0.8	30.9	21.7	73.1	44.1	113.5	20.9	22.8	100.7	12.3	99.4	10.9	4.5	54.8	252.4 (40%)
Blanchette Brook	434.13	0.0	0.0	28.0	25.3	73.6	58.6	52.4	8.0	14.4	51.1	9.0	40.5	0.0	2.5	70.8	210.0 (48%)
North Branch Trib	298.76	0.0	0.0	0.0	76.2	79.2	73.2	62.8	5.3	0.0	0.0	0.0	0.7	0.0	0.0	1.4	291.5 (98%)
East Branch Trib	137.39	0.0	0.0	1.9	22.5	24.3	39.4	33.1	0.0	0.0	0.0	0.0	1.2	0.0	0.0	15.0	119.3 (87%)
South Branch Trib	427.37	1.1	0.0	13.1	180.6	79.5	88.6	30.7	7.5	0.0	4.3	9.7	3.3	0.4	0.0	8.6	379.4 (89%)
2016																	
Lower Main Stem	105.06	0.0	0.0	0.0	51.7	14.0	26.0	12.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	103.6 (99%)
Middle Main Stem	278.63	2.6	0.0	22.9	17.6	38.2	45.5	64.7	10.9	2.8	2.8	0.2	40.0	0.0	0.9	29.5	166.1 (60%)
Upper Main Stem	623.37	15.8	0.6	30.9	19.0	77.0	45.6	111.7	16.3	22.4	101.1	15.8	100.2	4.0	4.6	58.4	253.3 (41%)
Blanchette Brook	434.13	0.0	0.0	26.2	27.6	77.8	61.3	53.5	6.6	13.8	50.7	2.0	40.3	0.0	2.8	71.5	220.2 (51%)
North Branch Trib	298.76	0.0	0.0	0.0	77.3	80.6	71.6	63.0	4.6	0.0	0.0	0.0	0.6	0.0	0.0	1.2	292.4 (98%)
East Branch Trib	137.36	0.0	0.0	1.8	22.7	25.2	39.4	31.8	0.0	0.0	0.0	0.0	1.3	0.0	0.0	15.3	119.0 (87%)
South Branch Trib	427.37	1.2	0.0	12.7	179.7	76.0	92.9	31.0	7.8	0.0	3.9	10.1	3.5	0.4	0.0	8.2	379.6 (89%)
Land Cover Change between 2011 and 2016																	**Increase in Developed Area**
Lower Main Stem	--	0.0	0.0	0.0	-0.4	-0.1	0.9	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Main Stem	--	0.6	0.0	1.7	-0.1	-2.2	0.2	2.1	-0.1	0.0	1.7	-0.2	0.2	0.0	-3.7	-0.2	-0.1
Upper Main Stem	--	2.8	-0.2	0.1	-2.7	3.9	1.5	-1.8	-4.6	-0.4	0.4	3.5	0.8	-6.9	0.0	3.6	0.9
Blanchette Brook	--	0.0	0.0	-1.8	2.3	4.2	2.7	1.1	-1.3	-0.6	-0.4	-7.0	-0.2	0.0	0.3	0.8	10.3
North Branch Trib	--	0.0	0.0	0.0	1.1	1.3	-1.7	0.2	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	-0.2	0.9
East Branch Trib	--	0.0	0.0	-0.1	0.2	0.9	0.0	-1.4	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	-0.3
South Branch Trib	--	0.1	0.0	-0.4	-0.9	-3.5	4.4	0.3	0.4	0.0	-0.3	0.4	0.1	0.0	0.0	-0.4	0.2
	Total Change	***3.4***	***-0.2***	***-0.5***	***-0.5***	***4.5***	***8.0***	***0.1***	***-6.4***	***-0.9***	***1.4***	***-3.3***	***1.0***	***-6.9***	***-3.3***	***3.7***	***12.0***

Note: All areas in acres.

Table 2: Summary of Impervious Cover Analysis between 2009 and 2019

Sub-Watershed	Primary Station	Area (acres)	Impervious Cover (acres)	Percent of Impervious Cover 2009
Lower Main Stem	S17	105.1	64.9	61.8%
Middle Main Stem	S05	284.7	55.4	19.5%
Upper Main Stem	S06B	620.6	65.5	10.6%
Blanchette Brook	S07	435.6	73.2	16.8%
North Branch Trib	S03	308.5	120.9	39.2%
East Branch Trib	--	109.7	34.5	31.4%
South Branch Trib	S01	377.7	215.5	57.1%

Sub-Watershed	Primary Station	Area (acres)	Impervious Cover (acres)	Percent of Impervious Cover 2019
Lower Main Stem	S17	105.0	65.1	62.0%
Middle Main Stem	S05	278.6	53.6	19.3%
Upper Main Stem	S06B	623.3	80.2	12.9%
Blanchette Brook	S07	434.1	87.7	20.2%
North Branch Trib	S03	298.5	123.0	41.2%
East Branch Trib	--	137.3	44.7	32.6%
South Branch Trib	S01	427.4	239.7	56.1%

		Change between 2009 and 2019		
Sub-Watershed	Primary Station	Area (acres)	Impervious Cover (acres)	Percent of Change
Lower Main Stem	S17	0.0	0.2	0.2%
Middle Main Stem	S05	-6.1	-1.8	-0.2%
Upper Main Stem	S06B	2.7	14.7	2.3%
Blanchette Brook	S07	-1.5	14.5	3.4%
North Branch Trib	S03	-10.0	2.1	2.0%
East Branch Trib	--	27.6	10.2	1.1%
South Branch Trib	S01	49.7	24.2	-1.0%

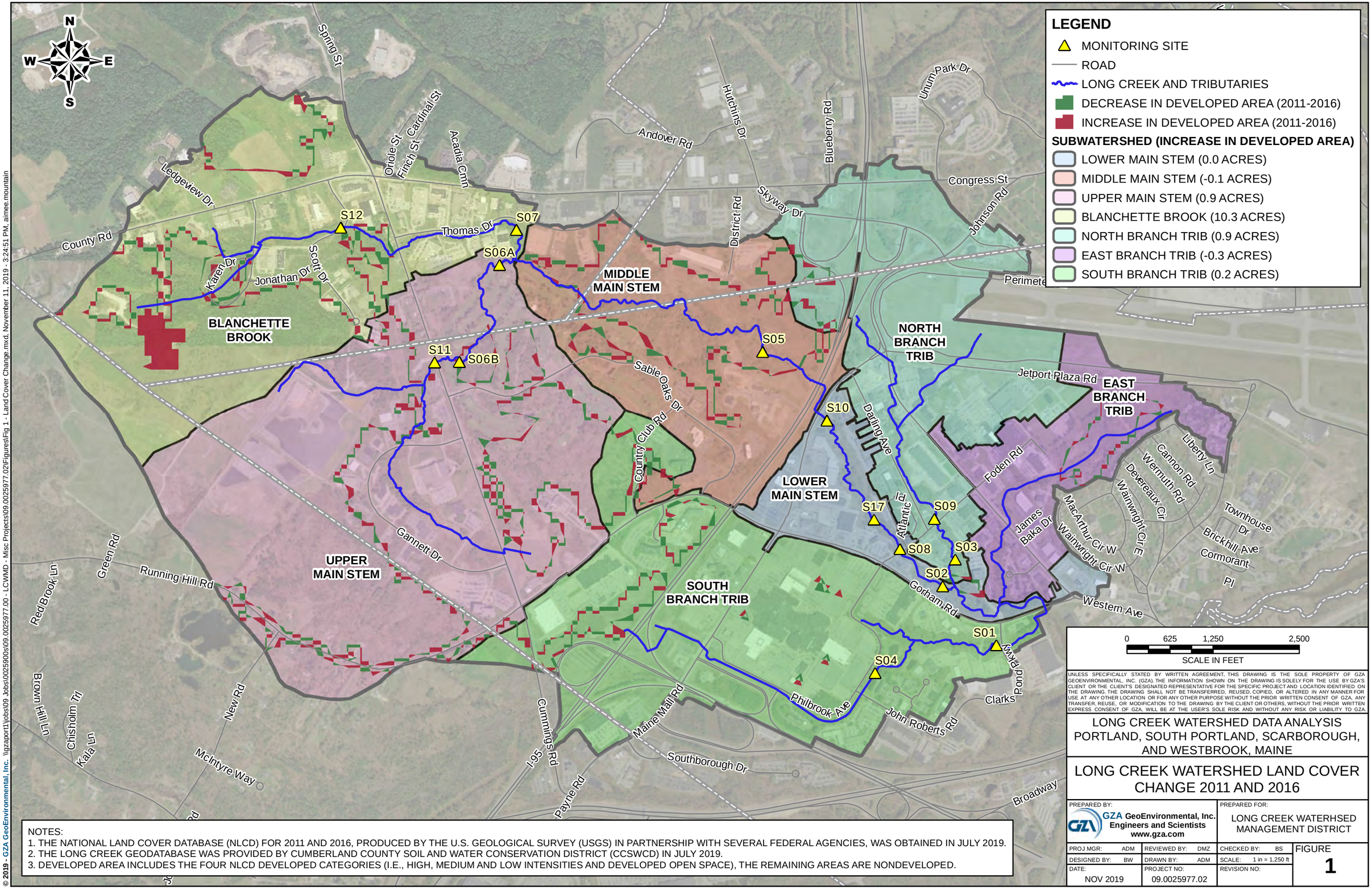
Table 3: Summary of Best Management Practice Construction Projects

Subwatershed	Classification	Site(s)	BMP Construction Project	BMP Install Year
Blanchette Brook	Class B	S12 and S07	Thomas Drive - Retrofits and Gravel Wetland	2012
Blanchette Brook	Class B	S12 and S07	Thomas Drive - Planting	2011
Upper Main Stem	Class C	S11 and S06B	Gannett Drive	2012
Upper Main Stem	Class C	S11 and S06B	Cummings Road	2017
South Branch Trib	Class C	S04 and S01	Cummings Road	2017
South Branch Trib	Class C	S04 and S01	Philbrook Ave - Retrofits & Planting	2009
South Branch Trib	Class C	S04 and S01	Maine Mall Gravel Wetland	2015
Lower Main Stem	Class C	S10, S17, S08, and S02	Gorham Road & Maine Mall Road Retrofits	2014
Lower Main Stem	Class C	S10, S17, S08, and S02	220 Maine Mall Road - Retrofits and USF	2010
Lower Main Stem	Class C	S10, S17, S08, and S02	S02 Bank Stabilization and Floodplain Improvements	2014
North Branch Trib	Class C	S09 and S03	5 Foden Road and 333 Western Ave - Retrofits and Gravel Wetland	2013
North Branch Trib	Class C	S09 and S03	Darling Avenue - Retrofits & USFs	2010

Table 4: Summary of Mean and Coefficient of Variation (All Flow Types)

		All Flow Mean upstream ---> downstream						All Flow Coefficient of Variation upstream ---> downstream					
Parameters	**Unit**	**S06B**	**S07**	**S05**	**S17**	**S03**	**S01**	**S06B**	**S07**	**S05**	**S17**	**S03**	**S01**
CHLORIDE (AS Cl)	mg/L	168	212	128	247	359	484	63%	63%	51%	33%	64%	51%
Dissolved Oxygen	mg/L	7.1	7.5	7.8	7.7	8.4	8.0	37%	37%	37%	33%	28%	31%
Dissolved Oxygen Saturation	mg/L	71	73	74	77	83	79	30%	30%	27%	23%	16%	22%
Hardness (As CaCO3)	mg/L	118	122	116	149	159	126	51%	51%	34%	27%	53%	33%
Copper	mg/L	0.004	0.005	0.005	0.004	0.006	0.005	142%	142%	146%	134%	192%	128%
Lead	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	162%	162%	134%	141%	166%	143%
Nickel	mg/L	0.003	0.004	0.004	0.004	0.004	0.004	99%	99%	129%	96%	137%	89%
Zinc	mg/L	0.034	0.037	0.032	0.026	0.058	0.042	144%	144%	193%	124%	148%	122%
pH	--	7.2	7.2	7.4	7.5	7.4	7.1	10%	10%	8%	4%	7%	9%
Phosphorus	mg/L	0.07	0.06	0.09	0.09	0.11	0.06	104%	104%	127%	102%	122%	150%
Specific Conductivity	uS/cm	706	867	615	890	1439	1772	56%	56%	38%	32%	53%	43%
Temperature	°C	13.7	13.3	14.3	12.2	11.5	12.7	63%	63%	52%	69%	59%	57%
Total Dissolved Solids	g/L	0.3	0.4	0.3	n/a	0.9	1.0	38%	38%	24%	n/a	39%	26%

Figure 1: Long Creek Watershed Land Cover Change 2011 to 2016



NOTES:
1. THE NATIONAL LAND COVER DATABASE (NLCD) FOR 2011 AND 2016, PRODUCED BY THE U.S. GEOLOGICAL SURVEY (USGS) IN PARTNERSHIP WITH SEVERAL FEDERAL AGENCIES, WAS OBTAINED IN JULY 2019.
2. THE LONG CREEK GEODATABASE WAS PROVIDED BY CUMBERLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT (CCSWCD) IN JULY 2019.
3. DEVELOPED AREA INCLUDES THE FOUR NLCD DEVELOPED CATEGORIES (I.E., HIGH, MEDIUM AND LOW INTENSITIES AND DEVELOPED OPEN SPACE), THE REMAINING AREAS ARE NONDEVELOPED.

LONG CREEK WATERSHED DATA ANALYSIS PORTLAND, SOUTH PORTLAND, SCARBOROUGH, AND WESTBROOK, MAINE

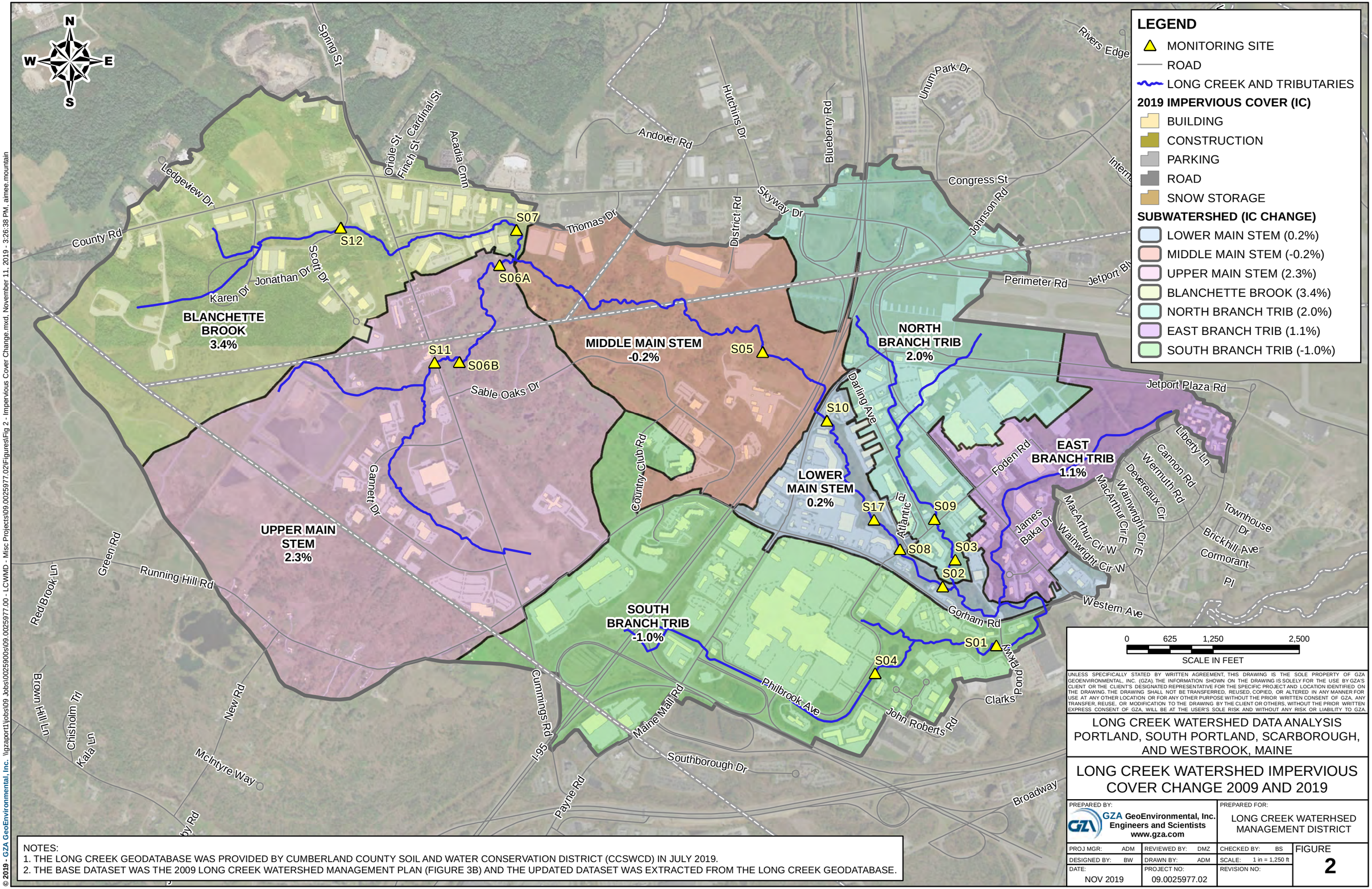
LONG CREEK WATERSHED LAND COVER CHANGE 2011 AND 2016

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
LONG CREEK WATERHSED MANAGEMENT DISTRICT

PROJ MGR: ADM	REVIEWED BY: DMZ	CHECKED BY: BS	FIGURE 1
DESIGNED BY: BW	DRAWN BY: ADM	SCALE: 1 in = 1,250 ft	
DATE: NOV 2019	PROJECT NO: 09.0025977.02	REVISION NO:	

Figure 2: Long Creek Watershed Impervious Cover Change 2009 to 2019



LONG CREEK WATERSHED DATA ANALYSIS PORTLAND, SOUTH PORTLAND, SCARBOROUGH, AND WESTBROOK, MAINE

LONG CREEK WATERSHED IMPERVIOUS COVER CHANGE 2009 AND 2019

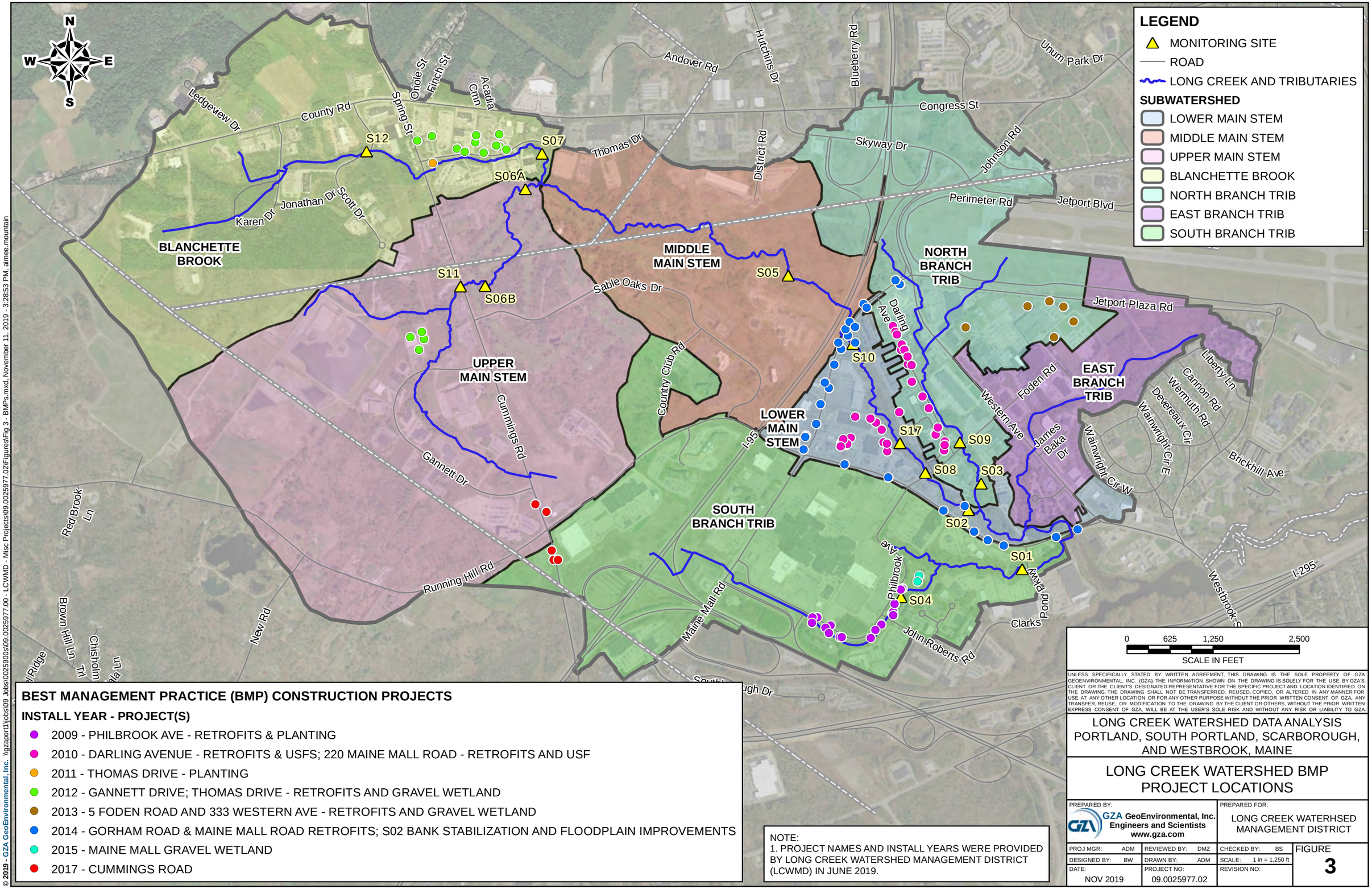
NOTES:
1. THE LONG CREEK GEODATABASE WAS PROVIDED BY CUMBERLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT (CCSWCD) IN JULY 2019.
2. THE BASE DATASET WAS THE 2009 LONG CREEK WATERSHED MANAGEMENT PLAN (FIGURE 3B) AND THE UPDATED DATASET WAS EXTRACTED FROM THE LONG CREEK GEODATABASE.

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
LONG CREEK WATERHSED MANAGEMENT DISTRICT

PROJ MGR: ADM	REVIEWED BY: DMZ	CHECKED BY: BS	FIGURE
DESIGNED BY: BW	DRAWN BY: ADM	SCALE: 1 in = 1,250 ft	2
DATE: NOV 2019	PROJECT NO: 09.0025977.02	REVISION NO:	

Figure 3: Long Creek Watershed Best Management Practices Project Locations



BEST MANAGEMENT PRACTICE (BMP) CONSTRUCTION PROJECTS

INSTALL YEAR - PROJECT(S)

- 2009 - PHILBROOK AVE - RETROFITS & PLANTING
- 2010 - DARLING AVENUE - RETROFITS & USFS; 220 MAINE MALL ROAD - RETROFITS AND USF
- 2011 - THOMAS DRIVE - PLANTING
- 2012 - GANNETT DRIVE; THOMAS DRIVE - RETROFITS AND GRAVEL WETLAND
- 2013 - 5 FODEN ROAD AND 333 WESTERN AVE - RETROFITS AND GRAVEL WETLAND
- 2014 - GORHAM ROAD & MAINE MALL ROAD RETROFITS; S02 BANK STABILIZATION AND FLOODPLAIN IMPROVEMENTS
- 2015 - MAINE MALL GRAVEL WETLAND
- 2017 - CUMMINGS ROAD

NOTE:
1. PROJECT NAMES AND INSTALL YEARS WERE PROVIDED BY LONG CREEK WATERSHED MANAGEMENT DISTRICT (LCWMD) IN JUNE 2019.

LONG CREEK WATERSHED DATA ANALYSIS
PORTLAND, SOUTH PORTLAND, SCARBOROUGH, AND WESTBROOK, MAINE

LONG CREEK WATERSHED BMP PROJECT LOCATIONS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
LONG CREEK WATERHSED MANAGEMENT DISTRICT

PROJ MGR: ADM	REVIEWED BY: DMZ	CHECKED BY: BS	FIGURE
DESIGNED BY: BW	DRAWN BY: ADM	SCALE: 1 in = 1,250 ft	3
DATE: NOV 2019	PROJECT NO: 09.0025977.02	REVISION NO:	