Quality Assurance Project Plan (QAPP) for Field Assessments and Analysis

in support of

Bantam Lake Watershed Based Plan Addendum

EPA Contract No. 68HE0118A0001
Order Number 68HE0119Q0023

February 26, 2020

Prepared for:

United States Environmental Protection Agency Region 1 – New England
5 Post Office Square, Boston, MA 02109

Prepared by:

Comprehensive Environmental Inc. (CEI)
41 Main Street, Bolton, MA 01740

REVIEWED BY:

U.S. EPA Quality Assurance Manager: JESSICA IVERSON Digitally signed by JESSICA IVERSON Date: 2020.03.26 10:07:25 -04'00'

Signature/Date
Jessica Iverson, U.S. EPA New England

U.S. EPA Team Leader and
Contracting Officer Representative: 3/27/20

Signature/Date
Steven Winnett, U.S. EPA New England

CEI Task Order Manager: 3/13/2020

Signature/Date
Robert Hartzel, Comprehensive Environmental Inc.

CEI Quality Assurance Coordinator: 3/13/2020

Signature/Date
Emily DiFranco, Comprehensive Environmental Inc.

TABLE OF CONTENTS

List of Figures

List of Tables

Appendices

A. PROJECT MANAGEMENT

A.1 Distribution List

This Quality Assurance Project Plan (QAPP) will be distributed to the key project personnel listed in Table 1, and to all contractor and subcontractor personnel involved in the project, including those who may join the project after approval of the QAPP.

Table 1. QAPP Distribution List

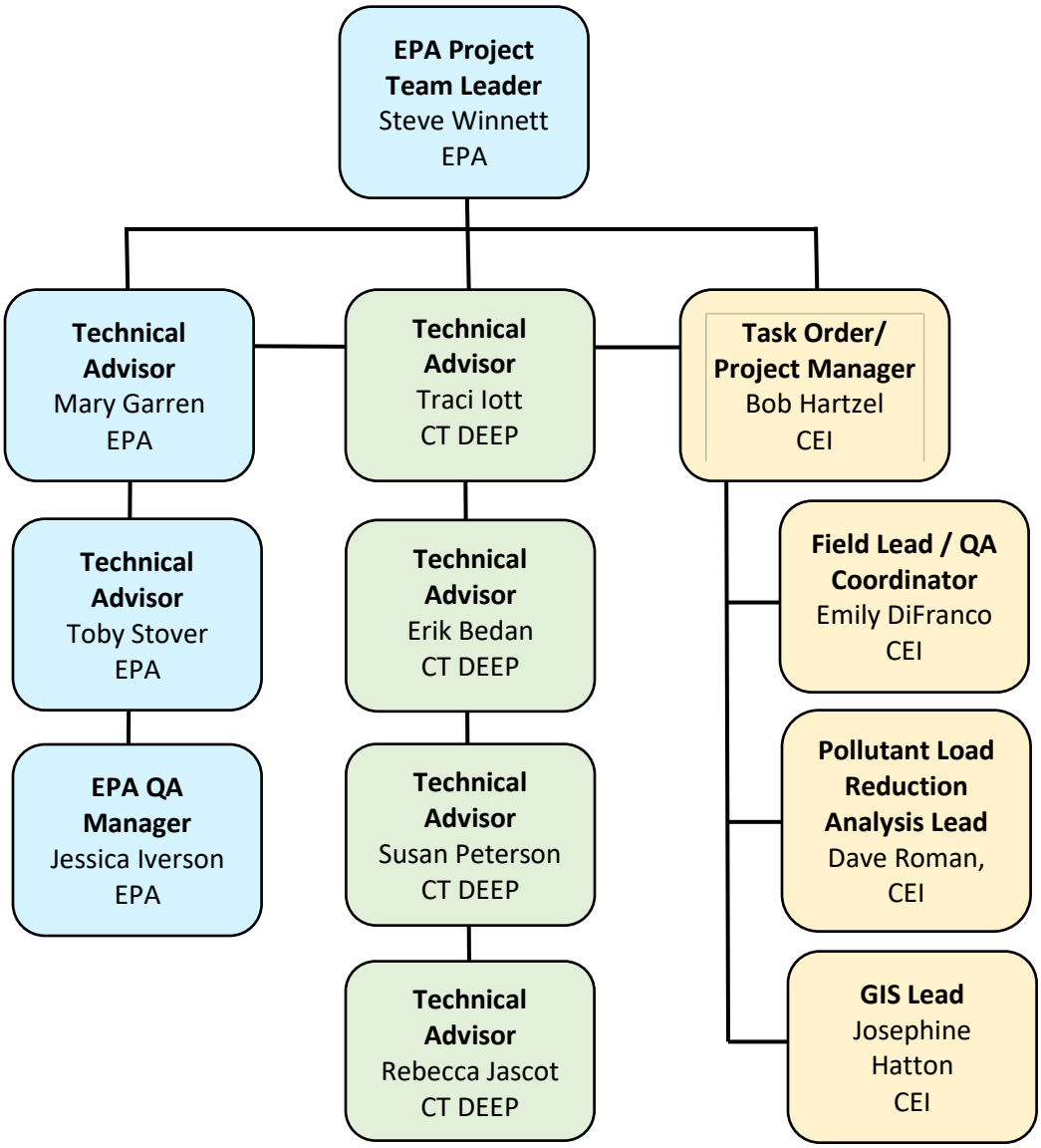
Name, Agency, Role	Contact Information	Mailing Address
Steven Winnett EPA New England – Region 1 Project Team Leader and Contracting Officer Representative (COR)	617-918-1687 winnett.steven@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Mary Garren EPA New England – Region 1 Project Technical Advisor	617-918-1322 garren.mary@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Toby Stover EPA New England – Region 1 Project Technical Advisor	617-918-1604 stover.toby@epa.gov	5 Post Office Square, Suite 100 (OEP06-2) Boston, MA 02109
Jessica Iverson EPA New England – Region 1 Quality Assurance Manager	617-918-8630 iverson.jessica@epa.gov	5 Post Office Square, Suite 100 (EQA) Boston, MA 02109
Traci Iott CT DEEP Project Technical Advisor	(860) 424-3082 traci.Iott@ct.gov	79 Elm Street Hartford, CT 06106
Erik Bedan CT DEEP Project Technical Advisor	(860) 424-3386 erik.bedan@ct.gov	79 Elm Street Hartford, CT 06106
Susan Peterson CT DEEP Project Technical Advisor	(860) 424-3854 susan.peterson@ct.gov	79 Elm Street Hartford, CT 06106
Rebecca Jascot CT DEEP Project Technical Advisor	(860) 424-3865 Rebecca.Jascot@CT.gov	79 Elm Street Hartford, CT 06106
Bob Hartzel Comprehensive Environmental, Inc. Task Order/Project Manager	508-281-5201 rhartzel@ceiengineers.com	41 Main Street Bolton, MA 01740
Emily DiFranco Comprehensive Environmental, Inc. Field Lead / Quality Assurance Coordinator	603-365-4300 edifranco@ceiengineers.com	41 Main Street Bolton, MA 01740
Dave Roman Comprehensive Environmental, Inc. Pollutant Load Reduction Analysis Lead	508-281-5176 droman@ceiengineers.com	41 Main Street Bolton, MA 01740
Josephine Hatton Comprehensive Environmental, Inc. GIS Lead	800-725-2550 jhatton@ceiengineers.com	41 Main Street Bolton, MA 01740

A.2 Project Organization

Comprehensive Environmental, Inc. (CEI) has been contracted by the U.S. Environmental Protection Agency (EPA) Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to develop the Bantam Lake Watershed Based Plan Addendum. Figure 1 provides an organizational chart for the project team, and includes the relationships and lines of communication among all key project personnel. The roles and responsibilities of key project personnel are summarized below.

EPA	**Steve Winnett** is the EPA Project Team Leader and Contracting Officer Representative (COR), and will provide overall project and budget oversight for the task order. Mr. Winnett will review and approve the QAPP and ensure that all contractual issues are addressed as work is performed on this project.
	Mary Garren is a Project Technical Advisor and will assist with the review of project deliverables developed by the contractors to ensure technical quality and contract adherence.
	Toby Stover is a Project Technical Advisor, and will assist with review of project deliverables developed by the contractors to ensure technical quality and contract adherence.
	Jessica Iverson (EPA) is the EPA Quality Assurance Manager, and will be responsible for reviewing and approving this QAPP. In addition, Ms. Iverson will conduct external performance and system audits, as needed, and participate in any EPA reviews of work performed. Ms. Iverson will remain independent from the project.
CT DEEP	**Traci Iott** (CT DEEP) is a Project Technical Advisor and will assist with the review of project deliverables developed by the contractors to ensure technical quality.
	Erik Bedan (CT DEEP) is a Project Technical Advisor and will assist with the review of project deliverables developed by the contractors to ensure technical quality.
	Susan Peterson (CT DEEP) is a Project Technical Advisor and will assist with the review of project deliverables developed by the contractors to ensure technical quality.
	Rebecca Jascot (CT DEEP) is a Project Technical Advisor and will assist with the review of project deliverables developed by the contractors to ensure technical quality.
CEI	**Bob Hartzel** (CEI) is the Task Order/Project Manager, and is responsible for overall management of the contract team, including overseeing CEI staff and subcontractor staff and coordinating with the EPA TOCOR. Mr. Hartzel will review project deliverables and ensure the completion of high quality work within the established budget and schedule.
	Emily DiFranco (CEI) is the Field Lead and the Quality Assurance Coordinator. She will prepare and conduct the field assessments, prepare the QAPP, and perform monitoring of quality control (QC) activities to determine conformance with quality assurance and quality control (QA/QC) requirements.
	Dave Roman (CEI) is the Load Reduction Analysis Lead and will develop analysis input data sets, perform the analysis, and prepare project deliverables. Mr. Roman will implement the QA/QC program related to load reduction analysis tasks, complete work on schedule and with strict adherence to the established procedures, and complete required documentation.
	Josephine Hatton (CEI) is the GIS Lead and will develop all watershed-specific maps.

Figure 1. Project Organizational Chart



A.3 Problem Definition and Background

Excess nutrients can lead to eutrophication and potential formation of Harmful Algal Blooms (HABs) in lakes and impoundments. Addressing nutrient impacts to water quality has been identified as a high priority for the state by the CT DEEP. In order to address the impact of nutrients on lakes and impoundments in Connecticut and the potential for development of HABs within these waterbodies, CT DEEP is developing a statewide TMDL to address nutrient loading and HAB formation. The statewide TMDL will include a core document and watershed specific appendices to address site-specific conditions. The core document will provide background information on the water quality impacts associated with nutrients and HABs and include a general TMDL and discussion of implementation resources. Nutrient loads will be evaluated against changes in lake trophic status, as defined in Section 22a-426-6 of Connecticut's Water Quality Standards Regulations. The watershed specific appendices will provide site-specific information to document existing nutrient loads and conditions contributing to HABs for specific waterbodies as well as identify necessary nutrient load reductions and other actions to prevent HABs formation in the future. Bantam Lake has been selected to be the first appendix to accompany the statewide Nutrient TMDL. This project will create a 9-Element Watershed Based Plan Addendum (WBPA) for Bantam Lake, and a template for development of future lake WBPAs.

With a surface area of 947 acres, Bantam Lake is Connecticut's largest natural lake. Bantam Lake is an important local resource for public recreation, including boating and swimming. Bantam Lake has a history of frequent blooms of cyanobacteria due to eutrophication of the lake from external and internal loading of nutrients. Bantam Lake was listed on CT DEEP's 2018 Integrated Water Quality Report as impaired for recreation with chlorophyll-*a*, algae, and nutrients identified as the causes of impairment.

CEI has been contracted by EPA Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to provide support in developing the watershed-based plan for Bantam Lake. The specific project objectives are as follows:

1) Identify specific sources of nutrients to Bantam Lake through field assessment and the manipulation of secondary data of the Bantam Lake watershed;

2) Develop pollutant load reductions of potential implementation locations of NPS management measures through the use of EPA's Opti-Tool; and

3) Develop an approved watershed-based plan for Bantam Lake.

This QAPP provides a framework for assessing the quality of data obtained from visual assessment surveys and manipulation of secondary data (i.e., data collected for another purpose or collected by an organization not under the scope of this QAPP) to support the development of a watershed-based plan for Bantam Lake. This plan will be consistent with the CT DEEP and EPA criteria for a Nine-Element Watershed Based Plan.

This QAPP was developed in accordance with EPA guidance documents for QAPPs, including *EPA Guidance for Quality Assurance Project Plans* (EPA QA/G-5) (EPA, 2002), *EPA New England Environmental Data Review Program Guidance* (EPA, 2018), EP*A New England Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data* (EPA, 2009), and the EPA New England templates and checklist for modeling QAPPs.

A.4 Project and Task Description

A.4.1 Project Tasks

CEI has been contracted by EPA Region 1 (through a task order under EPA Contract No. 68HE0118A0001 with PARS Environmental) to provide support in developing the Bantam Lake Watershed Based Plan. This QAPP addresses field assessments (collection of direct measurements), manipulation of existing data (secondary data), and load reduction analyses to identify causes of water quality impairments and assist in targeting best management practices in the Bantam Lake watershed. A detailed schedule for these tasks is provided in A.5. Data collection efforts will begin following the approval of the QAPP. The schedule may be adjusted as the project progresses.

Applicable project tasks covered by this QAPP are described in detail below. These tasks include:

- Pollutant source evaluation: Identification of potential Nonpoint Source Pollution (NPS) pollution causes.
- Pollutant load reduction evaluation: Evaluation of potential combinations of NPS management measures that could be implemented to achieve watershed-wide load reduction goals.
- Watershed field investigation: Identification of potential site-specific NPS management measures for future implementation.

A.4.2 Identification of Potential NPS Pollution Sources

A preliminary desktop analysis will first be conducted using multiple data sources to assist in identifying potential sources of NPS pollution in the Bantam Lake watershed. The preliminary analysis will include the following:

1. The maps listed below will be either produced from readily available data sources or complied and reviewed. Where maps and related information listed below are available from the ongoing Statewide (CT) Lake Nutrient TMDL project, CEI will coordinate with EPA to obtain the maps and data for use in the Bantam Lake WBPA project.
    - **Land Use:** A watershed land use map will be developed to help prioritize field assessment activities towards areas with the highest anticipated nutrient loads. Land uses depicted will include categories such as forest, developed land (low, medium, high intensity), agriculture (cultivated crops, pasture/hay), open space/land, and water/wetlands.
    - **Soils:** A watershed soils drainage class map will be developed to identify potential NPS management measure implementation locations (e.g., well drained soils may be suitable for NPS management measures that rely on infiltration).
    - **Impervious Cover:** A watershed impervious cover (IC) map will be developed to identify areas of the watershed with concentrated IC. This map will depict the IC % for each subwatershed in the Bantam Lake watershed. Water quality and biological integrity of waterbodies declines with increased watershed IC. Connecticut data indicates that impacts to waterbodies is generally observed when watershed IC exceeds 12% (https://www.ct.gov/deep/cwp/view.asp?A=2719&Q=567354). The subwatershed IC map will allow for identification of these areas and associated locations for potential BMPs.

- **Sewer / Septic Systems:** A watershed-specific map showing areas serviced by public sewer and those with no access to sewer (assumed to be on septic systems), will be developed. Understanding the locations and types of wastewater treatment in a watershed will allow for an assessment of wastewater as a source of NPS pollution. For instance, understanding the locations of septic systems will allow for a targeted education program to be developed for residents.
- **Vegetated Buffer Zones:** A map will be developed to depict shoreline areas with limited vegetated buffers that could potentially be improved to increase pollutant attenuation. This map, which will be developed with vector files prepared by UConn CLEAR and provided by CT DEEP, will show the location and size of vegetated buffers (e.g., existing forest, shrub, or other natural vegetation vs. maintained lawn or other developed land) within 200 feet of surface waters throughout the Bantam Lake watershed.
- **High Intensity Land Uses:** A map will be produced to depict the locations of land uses with the potential to produce high nutrient loads. This map will include the locations of potential pollutant sources such as agriculture, landfills, wastewater treatment facilities, Superfund sites, and others to be identified.

2. Review of existing water quality and watershed-specific reports, such as studies conducted by or on behalf of municipal, state, and federal agencies, studies by local lake and watershed organizations, etc.

3. Meetings and other communication (e.g., phone calls, email) with local stakeholders to identify known or potential problem areas for field assessment, such as:
    - Areas of suspected septic system failure;
    - Areas prone to flooding and any associated areas of erosion;
    - Developed areas either lacking adequate stormwater management measures or with good potential for retrofits (e.g., infiltration techniques in areas with well-draining soils) to improve stormwater pollutant attenuation;
    - Agricultural activities within or close to poorly drained or somewhat poorly drained soils;
    - Evaluation of agricultural manure management practices;
    - Evaluation of manure management practices on horse farms and other facilities with livestock;
    - Location, maintenance and containment of garbage disposal receptacles and facilities (including municipal and commercial facilities, and transfer stations);
    - Municipal, commercial, residential practices for maintaining playing fields, lawns, golf courses and related;
    - Municipal and commercial housekeeping practices regarding street sweeping, leaf disposal, etc.
    - Public areas near watercourses that are popular for dog walking where proper disposal of pet waste may be a concern;
    - Grassy areas adjacent to waterbodies (e.g., concerns related to use of lawn fertilizers, limited shoreline buffers, waterfowl activity, etc.); and

- Eroding streambank and riparian areas.

Results from the preliminary desktop analysis will inform the pollutant load reduction evaluation (A.4.3) and the watershed field investigation (A.4.4).

A.4.3 Pollutant Load Reduction Evaluation

Once potential NPS pollutant sources are identified, a desktop-based optimization analysis will be performed to evaluate and identify the best mixture of nonpoint source (NPS) management measures (i.e., BMPs) that could most effectively achieve watershed-wide total phosphorus and total nitrogen load reduction goals at the most reasonable cost. Results from the analysis will be used to assist in identifying, prioritizing, and evaluating potential watershed pollution control strategies.

Key assumptions for this analysis include:

- Load reduction goals will be obtained directly from the ongoing Bantam Lake TMDL modeling effort, assumed to be completed in January 2020.

- Pollutant load reductions and costs for each BMP type will rely whenever possible on EPA approved performance curves and EPA approved methods. Use of any other BMP performance information (e.g., peer-reviewed literature and other appropriate sources of information) will be based on approval from the Project Advisory Team.

- The planning level analysis module of version 2 of EPA's Opti-tool will be used for analysis and optimization of structural BMPs. The following structural BMPs are currently included as options with associated performance curves in the Opti-tool: biofiltration with internal storage reservoir, bioretention, dry pond, gravel wetland, infiltration basin, infiltration trench, sand filter, and wet pond.

- Opti-tool does not currently support evaluation of non-structural BMPs. However, it is possible to estimate potential pollutant load reductions for select non-structural BMPs (i.e., street sweeping, catch basin cleaning) using EPA-approved methods in the NPDES MS4 permits in other New England states. Therefore, potential load reductions for these select non-structural BMPs will be calculated based on available data in accordance with EPA-approved methods. EPA-approved cost data are currently not available for non-structural BMPs. Potential annual costs will be estimated for these activities based on order-of-magnitude estimates of level of effort (time), potential equipment rental charges, and potential labor charges. Where available and applicable, these cost estimates will be supported with information from watershed municipalities.

- There are currently no available pollutant load reduction or cost performance curves for education and outreach BMPs; therefore, these BMP types will not be included in the optimization analysis. Although these BMPs won't be included in the optimization analysis, their potential implementation extent will be estimated as described below. These BMP types may also be considered during the field investigation (A.4.4).

The optimization analysis will be performed based on the following steps:

1. A list of up to ten (10) potential structural, non-structural, and educational BMPs that could potentially be broadly applicable to reduce nutrient loads to Bantam Lake will be developed. This list will be developed based on results from the preliminary desktop analysis (A.4.2).

2. A GIS spatial data analysis will then be performed to identify potential suitable planning level watershed-wide implementation locations (i.e., opportunity areas) of selected BMPs as follows:

    a. Unsuitable Areas: Potentially unsuitable areas for broad BMP implementation will be screened and removed based on land use data. The following land use type types will be removed from further analysis: 1) open water, 2) wetlands, 3) forest.

    b. Structural BMPs: Soils data will be used to identify potential structural BMP implementation locations. Well drained soils are expected to be suitable for infiltrating practices such as bioretention, infiltration basins, and infiltration trenches. Poorly drained soils are expected to be suitable for excavated or lined management measures such as gravel wetlands, dry ponds, wet ponds, or biofiltration with internal storage reservoir. Results from A.4.2 will also be used to identify developed shoreline and bank areas that could benefit from implementation of vegetated buffers. Consideration should be given to selecting BMPs under certain circumstances such as infiltration practices within an Aquifer Protection Area or similar scenarios.

    c. Institutional Practices: Impervious cover and roadway data will be used to identify paved streets that could potentially be suitable for improved non-structural institutional practices such as enhanced street sweeping, leaf litter collection programs, and other practices that are typically considered to meet the requirements of the MS4 General Permit. If available, GIS stormwater infrastructure data will be used to identify catch basins that could potentially be retrofit or maintained at an increased frequency.

    d. Agricultural BMPs: Land use data will be used to identify agricultural land that could potentially benefit from agricultural BMPs (i.e., manure management practices, livestock access limitation practices, conservation buffers, etc.).

    e. Other BMPs: Other potential site-specific BMPs will be identified based on findings from A.4.2 (e.g., armoring or stabilization of eroded streambanks, evaluation of potentially failing septic systems, etc.).

    The outcome of this GIS analysis will be a map(s) and accompanying table of potential applicable implementation extent (i.e., opportunity area) of each selected BMP (e.g., 4,000 acres suitable for bioretention). Findings from this analysis will generally represent the maximum potential opportunity area of each selected BMP in the watershed and will not necessarily represent feasible opportunity areas in all cases (e.g., public vs. private land, high groundwater, etc.). A select subset of these potential implementation areas will be evaluated for feasibility during the during the field investigation (A.4.4).

3. Opti-Tool will then be populated with input data for available structural BMPs. Required inputs include:

a. Total phosphorus load reduction target: To be obtained from the ongoing Bantam Lake TMDL Modeling effort.

b. Watershed land use data: To be compiled from the land use layer, then classified to match Opti-Tool land use classifications (i.e., Opti-Tool requires that each land use type be classified as impervious vs. pervious).

c. Potential BMP drainage area: The potential drainage area of each structural BMP type will be calculated using methods that are consistent with EPA's Buzzards Bay Opti-Tool pilot report[1]. The total impervious area for each land use classification will be proportionally distributed to the maximum potential opportunity area of each available structural BMP. For example, if the potential opportunity area of gravel wetlands is 25% of the total available opportunity area of low-density residential land, then 25% of the low-density residential impervious area will be input as treated by gravel wetlands.

d. Watershed specific export rates: Default watershed-specific total phosphorus, total nitrogen and total suspended solids export rates (i.e., coefficients) for each land use classification will be modified to include export rates developed during the ongoing Bantam Lake TMDL Modeling effort.

e. Runoff Depth: Structural BMPs will be evaluated to capture a runoff depth of 1-inch. This is a commonly used design parameter which typically results in treatment of most annual precipitation events.

4. Up to three (3) planning level optimization scenarios will then be run to evaluate and identify the best mixture of structural and non-structural BMPs that achieve watershed-wide load reduction goals at the lowest cost. Each optimization scenario will include a mixture of up to five (5) BMPs that can potentially be broadly implemented throughout the watershed. For example, scenario 1 might heavily favor infiltrating structural BMPs, while scenario 2 might include a mixture of infiltrating and non-infiltrating structural BMPs alongside implementation of non-structural street sweeping practices.

The output of this exercise will be a table depicting the BMP type, potential implementation extent, cost estimate, and load reduction estimate for each scenario.

A.4.4 Watershed Field Investigation

A watershed field investigation will then be conducted to document sources of NPS pollution in the Bantam Lake watershed. The field investigation will be guided by use of the Watershed Assessment Field Survey Form which is provided as Appendix A of this QAPP. The field investigation will also be guided by previous desktop analyses to identify potential NPS pollution sources (A.4.2 and A.4.3) and identify potential BMP implementation types and areas (A.4.4).

The first step of the analysis will be to identify potential field visit locations. Potential field visit locations will be identified based on:

[1] EPA Opti-Tool Buzzards Bay Pilot:
https://www3.epa.gov/region1/npdes/stormwater/ma/opti-tool-case-study-demo-buzzards-bay-watershed.pdf

- Proximity to Bantam Lake and it's major tributaries (i.e., public roadway access); and
- Publicly owned parcels and/or open space (e.g., White Memorial Foundation trail network);
- Previously identified pollution sources and known problem areas (A.4.3);
- Potential implementation areas (A.4.4);

The watershed field assessment will then be conducted by a two-person team to identify potential BMP locations, select recommended BMP types, and gauge potential feasibility and site constraints. During the field assessment, the field team will assess the pre-identified locations as well as other locations identified in the field for space constraints, potential accessibility issues, presence of mature vegetation that may cause conflicts (e.g. roots), potential utility conflicts, site-specific drainage patterns, and other factors that may cause issues during design, construction, or long-term maintenance.

The watershed field investigation will result in identification of up to 20 potential BMP implementation sites. The following information will be compiled based on results from the watershed field investigation:

- A description of each site including potential implementation BMP(s) and accompanying photo(s);
- A map showing the location of each site;
- A summary table including key information for all potential sites, including general range of BMP size, cost, treated load, and limitations which can be used for prioritization. Potential BMP sizing, costing, and treated load will be calculated from the BMP Selector Tool from Massachusetts's Department of Environmental Protection's (MassDEP) Watershed Based Plans Tool (WBPT; BMP Selector Tool within Element C; http://prj.geosyntec.com/MassDEPWBP/Home) for applicable BMPs. Estimated costing from the WBPT will be adjusted to 2020 dollars based on Consumer Price Index information from the U.S Bureau of Labor Statistics. The parameters output by the WBPT (i.e., potential size, cost, and load reduction) have been previously reviewed and approved by EPA Region 1. Similar to the Opti-Tool, the BMP Selector Tool from the WBPT has only been configured for a subset of structural BMPs. Output parameters for BMPs not currently included in the WBPT will be calculated as feasible based on published information and professional judgement.

A.4.5 Secondary Data Manipulation

Existing data and previous studies (i.e. secondary data) that will be used for this project include, but are not necessarily limited to:

- Existing water quality data: Data for the watershed and impaired segments collected by other agencies, institutions, and companies such as the CT DEEP and the U.S. Geological Survey. Data sources include published reports and databases. The data may be used in its entirety or limited to a specific time period. All data will be assessed for adequate quality prior to being used.

- Land use and land cover data (either parcel-based land use available from the Northwest Hills Council of Governments (NHCOG) or University of Connecticut Center for Land Use Education and Research (CLEAR) satellite-derived land cover data).

- Pollutant Loading and BMP Effectiveness: Data taken from peer-reviewed literature values will be used to support the pollutant load reduction analysis to evaluate load reductions from BMPs and

BMP cost-effectiveness relative to load reduction goals established by the ongoing Bantam Lake TMDL modeling effort.

- Watershed Mapping Data: CT DEEP's Environmental GIS Data Set, UConn MAGIC, and UConn CLEAR will serve as the primary sources of data for watershed mapping. DEEP has updated GIS files from DEEP and CLEAR that are not available on the websites, and as such the contractor will coordinate with DEEP for GIS files the contractor intends to use. The GIS data will be augmented by GIS mapping available from the watershed municipalities and theNHCOG (https://northwesthillscog.org/), as necessary.

All data sources will be identified and fully referenced and all metadata, if applicable, will be included in the final report for the project.

A.5 Project Schedule

The project schedule for deliverables and other key milestones is provided below.

Milestone	Date
Notice to Proceed	October 2019
Technical Progress Reports & Invoices (Task 1)	Monthly
Kickoff Call (Task 1A)	November 2019
Kickoff Call Summary (Task 1A)	Within 7 days of call
Conference Calls (Task 1B)	To be scheduled as needed
Conference Call Summaries (Task 1B)	Within 7 days of each call
QAPP – draft (Task 2)	February 2020
QAPP – final (Task 2)	February 2020
Public Workshop draft plan and files (Task 3A)	February 2020
Public Workshop revised plan (Task 3B)	February 2020
Conduct Public Workshop (Task 3C)	March 2020
Public Workshop draft summary (Task 3D)	Within 1 week of workshop
Public Workshop revised summary (Task 3E)	April 2020
Watershed Template – draft (Task 4A)	April 2020
Watershed Template – final (Task 4B)	May 2020
Watershed Assessment – draft field (Task 5A)	June 2020
Watershed Assessment – final field (Task 5B)	June 2020
Watershed Assessment – database (Task 5C)	June 2020
Strategy for NPS Management Measures – draft (Task 6A)	July 2020
Strategy for NPS Management Measures – revised (Task 6B)	July 2020
Watershed Based Plan Addendum – draft (Task 7A)	September 2020
Watershed Based Plan Addendum – final (Task 7B)	October 2020
Public Meeting/Public Comment draft plan (Task 8A)	November 2020
Public Meeting/Public Comment final plan (Task 8B)	November 2020
Public Meeting/Public Comment Workshop (Task 8C)	November 2020
Public Meeting/Public Comment draft summary (Task 8D)	Within 1 week of workshop
Public Meeting/Public Comment final summary (Task 8E)	December 2020
Public Meeting/Public Comment draft summary (Task 8F)	Within 1 week of workshop
Watershed Based Plan Addendum – revised (Task 8G)	January 2021

A.6 Quality Objectives and Criteria for Measurement Data

This section describes the quality objectives for the project, including the performance and acceptance criteria to achieve the objectives. The QA process for this project consists of using data of acceptable quality, data analysis procedures, analysis tools, administrative procedures, and technical reviews. Project quality objectives and criteria for data will be addressed by: (1) evaluating the quality of the data used, and (2) assessing the results of the load reduction analysis application.

A.6.1 Direct Data Measurements

Data quality objectives for field assessments of watershed conditions rely on quasi-subjective assessments by field personnel. Accuracy, precision, completeness, representativeness, and comparability of visual assessments of watershed conditions will be assessed through the collaborative consensus of the staff performing those assessments consistent with the methodologies described in Section A.4.4 and as shown on the field data sheets for visual assessments which are provided in Appendix A of this QAPP.

A.6.2 Indirect Data Measurements

Assessing the data quality objectives for secondary data collection and analysis relies on documentation that the data meets the needs of the project and that data quality is high and data limitations are known. The usual data quality indicators (e.g., completeness, representativeness, comparability) can be met if metadata is available or if data were collected under a QAPP or SOP.

A.6.3 Indirect Data Measurements Acceptance Criteria

Field assessment preparation, load reduction evaluations, and application for this project will be accomplished using secondary data from qualified sources, including governmental agencies. Data of known and documented quality are essential components of the success of the analyses to be conducted under this project.

Table 2 summarizes the acceptance criteria for secondary data that will be used.

The organizations generating the secondary data that may be used in this project typically apply their own review and verification procedures to evaluate a dataset's integrity and conformance to QA/QC requirements. The quality of the data will be judged using information in source documents, from websites of origin, or directly from the authors. If the quality of the data can be adequately determined, the data will be used pending review and approval from EPA and DEEP. If it is determined that no quality requirements exist or can be established for a dataset that must be used for this task, a case-by-case basis determination will be made regarding the use of the data. Data of unknown quality will not be used if the use of such data is believed to have a significant or disproportionate impact on the project results.

The final source data will be documented in the final report. Any use of secondary data of unknown quality and any data gaps and the assumptions used in filling such gaps will also be documented in the final report.

Table 2. Data Acceptance Criteria for Secondary Data

Quality Criterion	Description
Reasonableness	Datasets will be reviewed to identify anomalous values that may represent data entry or analytical errors. Such values will not be used without clarification from the agency/entity providing the data.
Completeness	Datasets will be reviewed to determine the extent of gaps in space and time. It is likely that some data gaps will be evident. These gaps and the methods used to fill the gaps will be discussed in project deliverables.
Comparability	Datasets from different sources will be compared by checking the methods used to collect the data and that the units of reporting are standardized.
Representativeness	Datasets will be evaluated to ensure that the reported variable and its spatial and temporal resolution are appropriate for the project.
Relevance	Data specific to the study site will be used. If needed, regional data and information that most closely represent the study site will be used.
Reliability	Sources of data and information will be considered reliable if they meet at least one of the following acceptance criteria: • The information or data are from a peer-reviewed, government, industry-specific source. • The source is published. • The author is engaged in a relevant field such that competent knowledge is expected (i.e., the author writes for an industry trade association publication versus a general newspaper). • The information was presented in a technical conference where it is subject to review by other industry experts. • The information or data are from a lake association / watershed group, deemed credible by CT DEEP. Sources of data that use unknown collection and data review procedures are considered less reliable, and will be used only if needed to fill data gaps and following discussion with and approval by EPA and CT DEEP.

A.6.4 Load Reduction Performance and Acceptance Criteria

The pollutant load reduction analysis will identify potential mixtures of NPS management measures that can potentially be implemented to most effectively achieve pollutant load reduction goals in the watershed at the most reasonable cost. Results from the analysis will be tabulated based on normalized units of measure for cost (e.g., $ per pound of phosphorus and nitrogen load reduction) and pollutant removal (pounds of total phosphorus and total nitrogen removed per year) for each proposed NPS management measure. These normalized units of measure will be compared for consistency with available literature and EPA-approved sources such as the Opti Tool.

A.7 Special Training and Certification

Contractor personnel working on this project hold advanced degrees from universities that are well known for excellence in watershed management, planning, and assessments. Further, the contractor personnel all have multiple years of experience developing watershed-based plans including conducting field assessments similar windshield surveys and field assessment forms, and selecting NPS management measures to meet pollutant load reduction targets in numerous types of water bodies.

No special training or certification is required for personnel working on this project beyond the already high degree of academic training and professional experience that they have obtained in order to fulfill job requirements commensurate with their current assignments.

All project staff are required to be familiar with this QAPP. The CEI Project Manager will be responsible for assigning staff to individual tasks and for either training staff or ensuring that staff has adequate training for the assigned task.

A.8 Documentation and Records

The approved QAPP and any subsequent revisions will be distributed to all individuals identified on the distribution list. All data and information collected and generated during this project will be stored in a project folder area on CEI's network. At project completion, CEI will transmit a copy of all project files to EPA and CT DEEP through use of a Microsoft OneDrive folder created for this project. Project files will include unprotected MS Word, Excel or other files to be used as templates for future Watershed Based Plan Addendums. CEI will also maintain a copy of all project files on CEI's network for a minimum of five years following completion of the project.

The following deliverables will be prepared under this project:

- Quality Assurance Project Plan;
- Teleconference summaries;
- Public workshop summaries;
- Field assessment technical memorandum;
- NPS Management Measures technical memorandum;
- Draft Bantam Lake Watershed Based Plan; and
- Final Bantam Lake Watershed Based Plan.

A.8.1 Field Assessments

For the field assessment, CEI field staff will complete the Watershed Assessment Field Survey Form (see Appendix A) for each assessed site where a management measure is recommended. CEI will also maintain field notebooks to record supplemental information as needed. Potential locations for pollutant reduction management measures will be recorded with a handheld GPS unit. The field records will be maintained by the person recording the information and copies will provided to the Project Manager.

A.8.2 Load Reduction Analysis

Documentation of the pollutant load reduction analysis will be recorded in an analysis journal (in Microsoft Excel). The analysis journal will be kept by the CEI Load Reduction Analysis Lead. The journal will document all steps and assumptions made during the project along with the justification and professional reasoning behind any workflows. The level of detail in the analysis journal will be sufficient to allow another analyst to duplicate analysis steps. The analysis journal will include complete recordkeeping of each step of the analysis process. The documentation will consist of information addressing the following items:

- Source data with references;
- Analysis steps;
- Analysis assumptions;
- Parameter values and sources;
- Input file notations;
- Output file notations and analysis results; and
- Reasonableness review of analyses results;

The analysis journal and all data files will be retained by CEI for five years for auditing or post-project reuse.

The watershed-based plan will provide a complete and clear summary of the analysis methodology and all data and assumptions used in the analysis for the Bantam Lake Watershed such that the analysis can be easily reproduced by CT DEEP staff or hired contractors.

A.8.3 QAPP Modifications

Discussions involving changes to the QAPP may be initiated at any level. The scope of effect of the proposed change will determine the formality of the approval process. A formal QAPP revision will include reference to the section(s) of the text being modified or added to, the reason for the revision, and the actual replacement/additional language. It will be the responsibility of the CEI QA Manager to seek review and approval of the revision of all signatories of the original QAPP. Individuals listed in the Distribution List will receive notification of revisions once updates have been approved by QAPP signatories. Notification may be electronic.

A.8.4 QAPP Distribution

This QAPP will be implemented by CEI on behalf of EPA and CT DEEP. This QAPP is to be considered a working document and will be periodically revised as technology, policy, and protocol change. Upon approval and implementation, the original QAPP shall be kept at CEI's office in Bolton, Massachusetts and the signed original QAPP will be distributed by email to all partners on the signature page and distribution list. All personnel responsible for implementation will be required to review the QAPP within seven days of approval. As new staff or managers are hired by CEI, they will be required to review this QAPP within 14 days of their hiring date.

B. DATA GENERATION AND ACQUISITION

B.1 Data Acquisition Requirements

Visual field assessments will be conducted by CEI staff following the methods described in Section A.4.4. A copy of the Watershed Assessment Field Survey Form is provided as Appendix A of this QAPP. Locations of potential pollutant sources and associated management measures will be field-located with a handheld GPS unit and documented on a Watershed Assessment Field Survey Form. Digital photographs will be taken in the field to support the documentation process. Any problems encountered during the visual assessments will be reported to the CEI Project Manager and noted in the field log book. Corrective actions will be discussed between the CEI Project Manager, CEI QA Manager, and CEI field staff. These actions will be documented.

As conditions in the field may vary, it may become necessary to implement minor modifications to the visual assessment procedures and protocols described in the QAPP. If sites are inaccessible the day of visual assessments (due to inclement weather or other conditions), the CEI field crew will return when access is easier. Other variations in the field may arise that deviate from the QAPP. If this becomes necessary, the field crews will notify the CEI Project Manager and the CEI QA Coordinator of the situation and obtain verbal approval prior to implementing any changes. The approval will be recorded in the field log book.

This project will require the use of secondary data, also referred to as indirect measurements. Secondary data are data that were collected under a different effort outside of this project. Secondary data to be used in this project will be collected by CEI staff from government publications and databases, scientific literature, industry published studies, lake associations / watershed groups, and other organizations. It is expected that secondary data will be used for compilation of select Opti-Tool inputs (e.g., Bantam Lake-specific pollutant load export rates), calculation of potential pollutant removals for BMPs not supported by the Opti-Tool, or other analysis steps.

Table 2 summarizes the acceptance criteria for use of secondary data during analysis. The final report will include a summary of all data (including complete citations) used in the setup and evaluation of the load reduction analysis. The final report will also include a written summary of up to 20 implementation sites for management measures. In addition to providing a summary of each location and potential BMP types , as described above (including site photos), the report will include a map showing the locations of each site and a summary table including key information for all potential sites, including general range of BMP size, cost, treated load, and limitations which can be used for prioritization.

B.2 Sampling Methods

Not applicable. No environmental sampling will be conducted.

B.3 Sampling Handling and Custody

Not applicable. No environmental sampling will be conducted.

B.4 Analytical Methods

Not applicable. No environmental sampling will be conducted.

B.5 Quality Control

B.5.1 Field Assessments

Field assessments will consist of subjective evaluations by CEI field staff. Quality control of these field assessments will be performed in accordance with the method discussed previously (Section A.6).

The CEI Project Manager and QA Manager will conduct an internal review of the field forms for compliance with quality assurance requirements. This will consist of verifying that field data forms have been filled out consistently and completely and that field staff have followed the methods described in this QAPP. The field assessment technical leader will also check these forms on a daily basis to ensure they are filled out properly.

The professional judgement of the Project Manager and technical staff will be relied upon to evaluate the visual assessments of watershed conditions. These assessments may be rejected if the information in the field forms was record inaccurately or collected in a manner not in accordance with the methodology previously cited.

B.5.2 Secondary and Analysis Data

The CEI Project Manager and QA Manager will conduct an internal review of secondary and analysis data. This will include monitoring secondary data formatting to ensure that the data are consistent and appropriate for the load reduction analysis and overseeing the selection of appropriate analysis parameters and review of the input files to ensure that information is properly entered and formatted. Any deviations from the QAPP will be noted to determine if action is necessary to correct the problem or if the QAPP should be amended. The QA Officer will monitor the extent to which the QAPP is supporting its intended use.

The professional judgement of the Project Manager and technical staff will be relied upon in evaluating secondary data and analysis results. Rejecting secondary data or analysis results based on unreasonableness of the information (i.e. pollutant loading values unreasonably low or high, removal efficiencies significantly greater than report literature values) is a possibility. If the quality control review results in detection of unacceptable conditions or data, the Project Manager will be responsible for developing and initiating corrective action. Corrective responses may include review of original secondary data and re-processing to maintain data integrity, review of corroboration of analysis input and parameterization data, performing additional optimization analysis scenarios, and/or editing and modifying report deliverables. Notations of secondary data or analysis data failing to meet DQOs will be noted in the final deliverables.

B.6 Instrument/Equipment Testing, Inspection, and Maintenance

The CEI Field Lead will be responsible for noting and reporting issues or problems to the CEI Project Manager. Any routine maintenance will be performed by the CEI field assessment personnel. GPS equipment testing, inspection and maintenance will be performed according to manufacturer recommendations, as described in equipment manuals. Digital camera will be inspected before each use for battery life and sufficient storage.

Maintenance logs for field equipment will be submitted to and kept by the CEI QA Coordinator. The log entry will include the name of the person maintaining the instrument and equipment, the date and

description of the maintenance procedure, the date and description of any instrument and equipment problems, a list of follow-up activities after maintenance, and the date next maintenance is needed.

B.7 Instrument/Equipment Calibration and Frequency

Verification that the handheld GPS unit is operating properly will be done prior to each assessment.

B.8 Inspection of Supplies and Consumables

All supplies for field activities will be inspected by the CEI field assessment team prior to use for compliance with acceptance criteria. Supplies needed for field assessments include:

- Field data forms
- Maps
- Tape measure
- GPS unit
- Log books
- Digital camera
- Data cards
- Pens/Pencils

The Field Assessment Technical Lead is responsible for maintaining supplies needed for field assessments. Any equipment determined to be in unacceptable condition will be replaced. Any replacement parts for field equipment will be ordered and replaced by the Project Manager. Supplies and consumables will be stored in accordance with identified requirements of each item.

B.9 Indirect Measurements

Available information on water quality and land use within the Bantam Lake watershed will be complied, reviewed, and summarized by CEI. Both mapping and tabular/narrative information will be produced.

Secondary data will be obtained primarily from federal and state agencies, regional authorities and municipalities to characterize historic and existing conditions in the watershed. Pollutant load reduction analysis efforts will also utilize peer-reviewed data related to water quality associated with particular land uses and effectiveness and cost of various structural and non-structural management practices for total phosphorus, total nitrogen and total suspended solids load reductions. Secondary data sources include, but are not limited to the following:

- Land use and land cover data.
- Published, peer-reviewed studies of pollutant loads from different land uses.
- Published, peer reviewed studies of pollutant load reductions and costs for different NPS management measure types.

CT DEEP's Environmental GIS Data Set, the University of Connecticut (UConn) Map and Geographic Information Center (MAGIC) and UConn CLEAR will serve as the primary sources of data for watershed mapping. DEEP has updated GIS files from DEEP and CLEAR that are not available on the websites, and

as such the contractor will coordinate with DEEP for GIS files the contractor intends to use. The GIS data will be augmented by GIS mapping available from the watershed municipalities as necessary.

All data sets will be fully referenced and documentation of data quality supplied in the final report and project deliverables, including links to web-based data, where appropriate.

Secondary data sources preferred for use in the project will include existing data obtained from state and federal agencies, municipalities, and non-governmental organizations already conducting mapping and monitoring programs. Data sources with known and adequate quality control and quality assurance procedures will be preferred including data from state and federal agencies and data collected or generated under a QAPP. Any known data limitations or gaps will be disclosed in the final project report and in appropriate deliverables.

Given the specific secondary data needs for this project, there are, in some cases, only one or a limited number of data sources available. Where more than one data source is available, all available sources will be evaluated and the highest quality, most applicable data source will be used.

The sources of all secondary data used will be listed and described in the final project report and any applicable deliverables. Where appropriate, links to web-based data will be provided.

B.10 Data Management

B.10.1 Field Assessment Management

Items that require data management which are collected or generated in the field by the visual assessment team are field logbooks and field data forms. Following watershed assessment activities, field data (including field data forms and field staff logbook copies) will be forwarded to CEI's Project Manager and QA Manager, who are responsible for reviewing the field data for accuracy and completeness. If any field data forms are incorrect, incomplete, or missing, the package of data forms will be returned to the field personnel for completion and/or correction.

Hard copies of all data and field forms will be retained by the Project Manager. Copies of the data will be available to team members upon request.

B.10.2 Secondary Data and Analysis Management

Items that require data management which are used for secondary data and analysis management include the following:

- Desktop computers using the Windows operating system;
- Microsoft Office Excel 2010 or later version;
- ArcGIS software v10 or later version; and
- EPA's Opti Tool (Version 2)

All data and information collected and generated during this project will be stored in a project folder area on CEI's network. Original data sources will be documented to identify the website or contact person that

provided the data, data query parameters, and data request correspondence. Original (unaltered) copies of all sources of data used in the project will be retained in the project folder on CEI's network.

At project completion, CEI will transmit a copy of all of the project files to EPA. CEI will maintain a copy of the project files on CEI's network for a minimum of five years following completion of the project.

C. ASSESSMENT AND OVERSIGHT

C.1 Assessments and Response Actions

The QA program under which this project will operate includes surveillance, with independent checks of the data obtained from data-gathering and analysis activities to avoid or address data issues or problems. The essential steps in the QA program are as follows:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Investigate and determine the cause of the problem;
- Assign and accept responsibility for implementing appropriate corrective action;
- Establish the effectiveness of and implement the corrective action; and
- Verify that the corrective action has eliminated the problem.

If quality problems that require attention are identified, the appropriate CEI Technical Lead (defined as either the Pollutant Load Reduction Analysis Lead, Field Lead, or GIS Lead) will determine whether attaining acceptable quality requires either short- or long-term corrective actions. Many of the technical problems that might occur can be solved on the spot by the staff members involved, for example, by modifying the technical approach or correcting errors or deficiencies in documentation. Immediate corrective actions form part of normal operating procedures and are noted in records for the project (e.g., monthly progress reports). Problems that cannot be resolved in this manner require more formalized, long-term corrective action. Examples of major corrective actions may include the following:

- Reemphasizing to staff the project objectives, the limitations in scope, the need to adhere to the agreed upon schedule and procedures, and the need to document QC and QA activities.
- Securing additional commitment of staff time to devote to the project.
- Retaining outside consultants to review problems in specialized technical areas.
- Changing procedures (for example, replacing a staff member, if it is the best interest of the project to do so).

C.2 Reports to Management

The appropriate CEI Technical Lead has primary responsibility for monitoring the activities of this project and identifying or confirming any quality problems. These problems will also be brought to the attention of the CEI Task Order/Project Manager and CEI Quality Assurance Coordinator, who will initiate corrective actions described above, document the nature of the problem, and ensure that the recommended corrective action is carried out. The CEI Task Order/Project Manager and CEI Quality Assurance Coordinator have the authority to stop work on the project if problems affecting data quality that will require extensive effort to resolve are identified. The EPA Contracting Officer Representative (COR) and Project Team Leader will be notified of major corrective actions and stop work orders. The EPA COR and Project Team Leader have the authority to stop work on the project if there are QA concerns.

The CEI Task Order Manager and CEI Technical Leads will perform surveillance activities throughout the duration of the project to ensure that management and technical aspects are being properly implemented according to the schedule and quality requirements specified in this QAPP. These surveillance activities will include assessing how project milestones are achieved and documented, corrective actions are implemented, budgets are adhered to, technical reviews are performed, and data are managed. QA surveillance activities will be documented in monthly progress reports.

D. LOAD REDUCTION ANALYSIS APPLICATION

D.1 Data Review, Verification, and Validation

D.1.1 Field Assessments

Verification of the visual, field assessments will occur at the field level. The field data forms will be reviewed after the field assessment date by CEI's QA Coordinator and Project Manager using all available QC data. Deviations will be flagged and incomplete data will be noted. QC results that deviate from the data quality objectives will call into question the validity of the individual field data form or all related field data forms. The final decision on whether to include or reject the field data forms will be made by CEI's QA Coordinator and Project Manager.

D.1.2 Secondary Data

The review of secondary data will be conducted at the end of the background data collection process. The CEI QA Coordinator and CEI Project Manager will confirm that secondary data were collected in a manner consistent with the process described in this QAPP. Any data not meeting the criteria will be reviewed by the CEI Project Manager and CEI QA Coordinator and either removed from use or flagged in the dataset, with the appropriate qualifying description, for use in the report deliverables.

D.1.3 Load Reduction Analysis

The pollutant load reduction analysis will identify potential mixtures of NPS management measures that can potentially be implemented to achieve watershed-wide load reduction goals at the lowest cost. Results from the analysis will be tabulated based on normalized units of measure for cost (e.g., $/cubic foot) and pollutant removal (pounds of total phosphorus and total nitrogen removed per year) for each proposed NPS management measure. These normalized units of measure will be compared for consistency with available literature and EPA-approved sources such as the Opti Tool.

D.2 Verification and Validation Methods

D.2.1 Field Assessments

Data quality measures for field assessments will be compared to applicable data quality objectives. The verification process for the compiled field data forms of all visual assessments will involve the Project Manager and/or QA Manager visually comparing a hard copy of field data forms with the information scanned electronically into PDF format. This process will ensure that data have been accurately scanned into the CEI computer system.

D.2.2 Secondary Data and Pollutant Load Reduction Analysis

Raw (original) data will be entered into a standard database. All entries will be compared to the original data files to ensure no transcription errors. A screening process will be used to scan through the database and flag data that are outside typical ranges for a given parameter.

Data quality will be assessed by comparing entered data to original data, performing the data and analysis evaluations described in this QAPP, and comparing results with the measurement performance or acceptance criteria summarized in this QAPP. Results of the review and performance processes and results will be documented in the final report.

D.3 Reconciliation with User Requirements

The value of the information generated by this project will be determined by evaluating data quality and by comparing methods and results with published data and scientific literature and the data quality objectives identified in this QAPP. Confidence in analysis predictions can be limited by a number of factors including site-specific NPS management measure performance variation and site-specific suitability for implementation of NPS management measures.

To ensure reproducibility of the work by CT DEEP, the final report will identify sources of data, assumptions made during analysis setup, and calculations performed as part of input data pre- and post-processing.

D.4 Reports to Management

The following reports will be prepared under this project and submitted to EPA for review and approval:

- Quality Assurance Project Plan (draft and final)
- Monthly technical progress reports
- Teleconference summaries
- Public workshop summaries
- Field assessment technical memorandum
- NPS Management Measures technical memorandum
- Load reduction analysis methodology technical memorandum (draft and final)
- Final report (draft and final)

The final report will provide a complete and clear summary of the load reduction analysis methodology and all data and assumptions used in the analysis for the Bantam Lake Watershed such that the analysis can be easily reproduced by CT DEEP staff or other hired contractors.

E. REFERENCES

EPA. 2018. Region 1 - New England Environmental Data Review Program Guidance. U.S. Environmental Protection Agency Region 1 – New England. June 2018.

EPA. 2009. EPA New England Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data. U.S. Environmental Protection Agency New England. October 2009.

EPA. 2002. Guidance for Quality Assurance Project Plans (EPA QA/G-5). EPA/240/R-02/009. U.S. Environmental Protection Agency. December 2002.

Appendix A:

Watershed Assessment Field Survey Form

Watershed Assessment Field Data Form

Watershed / Subwatershed Name: _____ Field Crew: _____

Site # _____ Date:_____ Site Ownership (if known): _____

Weather Conditions: _____ Rain in last 48 hours (approx. total) _____

Location (*town, road name, house#, intersection)* _____

GPS Coordinates: _____ Photos Taken? _____

Site within an MS4 priority area: Y/N

General Site Description:

Land Use/Activity: *circle one*

State Road	*Driveway*	*Boat Access*
Municipal Road	*Residential*	*Agriculture*
Private Road	*Commercial*	*Construction Site*
Trail/Path	*Municipal/Public*	*Other: _____*

Description of Problems/Improvement Opportunities: *circle ALL that apply*

Problem Type	**Description (circle)**	**Notes/Description of Problem**	**Approx. Size** (length x width)
Surface Erosion	*Slight* *Moderate* *Severe*		
Road Shoulder Erosion	*Slight* *Moderate* *Severe*		
Soil	*Bare* *Uncovered Pile* *Winter Sand*		
Culvert	*Unstable Inlet/Outlet* *Clogged* *Crushed/Broken* *Undersized*		
Ditch	*Slight Erosion* *Moderate Erosion* *Severe Erosion* *Bank Failure* *Undersized*		
Parking Lot	*Drains Directly to Waterbody* *Evidence of Concentrated Flow*		
Shoreline	*Undercut* *Lack of Shoreline Vegetation* *Erosion* *Unstable Access*		
Agriculture	*Livestock Access to Waterbody* *Tilled Eroding Fields* *Manure Washing Off-Site* *Inadequate Buffer*		

Other (e.g., area to improve stormwater treatment)			

Recommended BMP(s): *circle ALL that apply*

Vegetated Filter Strip	*Deep Sump Catch Basin*	*Replace Culvert*
Bioretention	*Leaching Catch Basin*	*Enlarge Culvert*
Detention Basin	*Hydrodynamic Separator*	*Plunge Pool*
Retention Basin	*Establish Buffer*	*Conservation Tillage*
Infiltration Basin	*Enhance Buffer*	*Crop Nutrient Management*
Infiltration Trench	*Add New Surface Material*	*Livestock Access Limitation*
Gravel Wetland	*Bank Armoring*	*Pet Waste Station*
Sand Filter	*Bank Stabilization*	*Other: _____*
Grassed Swale	*Divert Runoff*	
Subsurface Structure	*Armor Inlet/Outlet (Culvert)*	

Description of Recommendation(s):

Potential Site Constraints: *circle ALL that apply*

Limited Space	*Crosses Property Lines*	*Difficult Access*
Utilities	*Permitting Issues (e.g., wetlands)*	*May Interfere with Snow Plowing*
Private Property	*Steep Slope*	*Other: _____*

Sketch of Site / Potential BMP(s):