

EPA RFA No. 21059

**Quality Assurance Project Plan
Field Assessments, Modeling, and Analysis**

In support of:

**Pomperaug Watershed Based Plan Implementation Groundwork
CTDEEP NPS Grant Project No. 19-07**

**Pomperaug River Watershed Coalition
Woodbury, Connecticut**

May 17, 2021

Last modified: March 3, 2022



Pomperaug River Watershed Coalition
39 Sherman Hill Road, C103
Woodbury, CT 06798

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QAPP Modification Notes ~~12/2/2021~~ 1/18/2022

Modification #1

As a result of the QAPP being signed on 5/27/2021, the ambient water quality monitoring described herein did not begin until June 2021; April and May sampling for 2021 was excluded. The approved QAPP indicates that sampling will take place between April and October 2021. PRWC considered whether to collect additional samples during the remainder of the 2021 field season to satisfy Total Number of Field Samples completeness data quality objective (DQO) but decided against this option as the seasonal representation is important to making water quality determinations. Thus, PRWC proposes to include April and May 2022 in the monitoring season so the spring months will be represented in the dataset.

This change is reflected in Table 3 on page 16.

Modification #2

The term “Other Conditions” will be used to describe sampling events where the precedent rainfall criteria neither meet that for “wet weather” nor for “dry weather” which are defined herein. We found there was a “gray” area between the original definitions for “wet weather” and “dry weather” and a need to revisit this in effort to more clearly define events as wet or dry weather for summary and comparison purposes. Accordingly, the revised definitions are as follows: Wet Weather Conditions are defined as greater than 0.1" precipitation in 24 hours or greater than 0.25" precipitation in 48 hours or greater than 2.0" precipitation in 96 hours. All other conditions are dry weather.

This change is reflected in the last paragraph of section 1.3.2 Ambient Water Quality Monitoring on page 12. This change is also reflected in the definitions included on pages B-11 and B-23 in Appendix B which contain the detailed Ambient Monitoring Protocols.

Modification #3

PRWC had initially divided the monitoring stations into two sampling routes – a northern route and a southern route. After the first round of sampling in June, PRWC realized how challenging it was to meet the required hold time for the bacteria samples. As such, the route was divided into three routes for the remainder of June, July, and August to ensure that hold times were met. One site from the southern route, and two to three sites from the northern route were assigned to a central route. Field data sheets and chain of custody forms were created for the central route consistent with the format of those approved herein. As sampling proficiency improved throughout the season, PRWC returned to two sampling routes in September and October following all of the previously prescribed DQO's. When three field teams / sampling routes were used, two of the three field teams were charged with collecting duplicate samples while the third team was charged with preparing the field blank. The approved QAPP indicates that each field team (two teams) would collect a duplicate sample to satisfy the precision DQO and that one field blank would be submitted to satisfy the accuracy DQO. While one team did not collect a duplicate sample, preparation of the field blank should satisfy the precision DQO by testing how well the team does to not contaminate the sample in the process while still satisfying the accuracy DQO. PRWC deems two duplicates per sampling event enough to satisfy the precision objectives of this study.

This change is reflected in the Precision and Accuracy bullets within section 1.4 Quality Objectives and Acceptance Criteria starting on page 14. No changes have been made to the corresponding Table 6 within section 2.4 Analytical Methods on page 30 of the approved QAPP as the number of duplicates and blanks has not changed. A copy of the field data sheet for the central sampling route has been added to Appendix B along with a corresponding chain of custody sheet. Appendix B has also been updated on page B-17 to describe the procedures for collecting /submitting duplicates and blanks.

Pages 11 and 12...

1.3.2 Ambient Water Quality Monitoring

Ambient water quality samples will be collected at 15 fixed stations located throughout the watershed twice monthly between the period of April to October to better refine the extent of the impaired stream segments and bracket potential sources of pollution. PRWC's fixed stations will be selected with consideration to existing monitoring stations used by CT DEEP and PRWC for other sampling activities including macroinvertebrates sampling¹, stream temperature monitoring², fish community assessments, and ambient water quality monitoring. Sites will be chosen to reflect the stream segments on the Weekepeemee River, Pomperaug River, and Transylvania Brook that are listed as impaired as well as sites within segments on the Pomperaug River and Nonnewaug River which have not previously been assessed. Inclusion of areas not previously assessed is deemed important as there are unassessed areas between segments categorized as impaired (ex. Pomperaug-02 and Pomperaug-04 have not been assessed but flow between areas listed as impaired). Monitoring stations for the Nonnewaug River are deemed important to assess because the Nonnewaug contributes equally as much water as the Weekepeemee does to the Pomperaug and, as described in the WBP, the Nonnewaug has similar land uses and modeled pollutant loading as the Weekepeemee. Thus, it is expected to have elevated levels of bacteria. Stations will also be selected based on public access and include road crossings as well as parks and other designated open space.

Ambient water samples and associated field measurements and observations will be collected by two-person teams twice monthly following PRWC's Ambient Water Monitoring Protocol (**Appendix B**). Specifically, ambient water quality monitoring will include collecting samples and recording data for the following parameters:

- Bacteria (grab-sample)
- Nitrate (grab-sample)
- Conductivity (field meter)
- Air and Water Temperature (field meter)
- Wet vs. Dry weather sampling (based on previous 24-, 48-, and 72-hour rainfall observed at local precipitation gauge at USGS gaging station)
- Field observations (water color, water odor, water level, and weather conditions)
- Streamflow (from corresponding USGS gauging station)

Grab-samples collected by the field team will be delivered to a state-certified testing laboratory³ for analysis.

¹ PRWC participates annually in CT DEEP's Riffle Bioassessment by Volunteers program and adheres to their associated SOP's and QAPP (<https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Riffle-Bioassessment-by-Volunteers-RBV>).

² PRWC participates annually in CT DEEP's Volunteer Stream Temperature Monitoring program and adheres to their associated SOP's and QAPP (<https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Volunteer-Stream-Temperature-Monitoring-Network>).

³ In Connecticut, the Environmental Laboratory Certification Program (ELCP) registers and approves all environmental laboratories (private, municipal, and industrial non-commercial) granting certification for testing of drinking water, wastewater, sewage, solid waste, soils, and other environmental samples for microbiologicals, inorganics, organics, and radiochemicals. The authority for this function is found in the Connecticut General Statutes Sections 19a-29a and 25-40 and Public Health Code Regulations 19-4-1; 19a-36-a25 through A33; and 19a-36-A57 through A63. The ELCP office also

Hand-held meters will be used by the field team to measure conductivity, water temperature, and air temperature. All observations will be recorded on a printed field data sheet or using a digitized version as described in PRWC's Ambient Water Monitoring Protocol (**Appendix B**).

The ambient water quality monitoring data will help bracket pollutant sources and prioritize areas where corrective actions, such as runoff reduction and pollution prevention would be most appropriate to reduce bacteria and other pollutant loads to the impaired stream segments.

A combination of wet and dry weather sampling conditions will help characterize pollutant loading as well as to better understand if the stream reaches are unsafe for recreation only after rain events or if there are areas where bacteria levels are chronically unsafe without stormwater input. Local precipitation data as measured at the USGS Gaging Station on the Weekepeemee River at Hotchkissville, CT will be reviewed to designate the "dry" or "wet" sampling conditions. For the purposes of this project, wet weather conditions are defined as greater than 0.1" precipitation in 24 hours or greater than 0.25" precipitation in 48 hours or greater than 2.0" precipitation in 96 hours. All other conditions are dry weather.

~~wet weather conditions are defined as events where greater than 0.1 inch of rain falls within 24 hours prior to sampling. Dry weather conditions are designated when less than 0.1 inch of rain is observed across a minimum of 72 hours. To validate the wet weather and dry weather designations and for data comparability to other studies that may use alternate definitions, As there is a time gap for qualifying wet or dry conditions,~~ precipitation values for the previous 24-hours, 48-hours, ~~and 72-hours,~~ and 96-hours will also be recorded on the field data sheet for a quantitative measure that may be helpful in future studies and comparing data to datasets that may have used different wet/dry criteria. The QA Manager / Project Manager will refer to the precipitation data recorded at the USGS Gaging Station to confirm wet or dry sampling condition designations.

enforces U.S. Environmental Protection Agency regulations involving environmental laboratory testing (the Safe Drinking Water Act, the Clean Water Act and the Resource Conservation and Recovery Act). The Environmental Laboratory Certification Program mission is to promote the benchmark by which accurate, precise, and legally defensible analytical data is reported by the environmental laboratory industry for use in compliance and in accordance with federal and state law. This is accomplished by ensuring that environmental laboratories located in or doing business in CT meet all applicable EPA and CT standards.

(<https://portal.ct.gov/DPH/Environmental-Health/Environmental-Laboratory-Certification/Environmental-Laboratory-Certification>)

1.4 Quality Objectives and Acceptance Criteria

(Element A7)

1.4.1 Direct Data Measurements

Visual Assessment Surveys

Data Quality Objectives (DQOs) for visual 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 the Center for Watershed Protection Urban Subwatershed Restoration Manual Series (2005-2008). The Unified Stream Assessment (USA) and Unified Subwatershed and Site Reconnaissance (USSR) user's manuals and field data sheets are available for download at <http://owl.cwp.org/>. Field data sheets for the visual assessments that are proposed as part of this project are provided in **Appendix A** of this QAPP.

Ambient Water Quality Monitoring

Data Quality Objectives (DQOs) for ambient water quality monitoring rely on a combination of qualitative assessments by field personnel as quantitative measurements using field instruments and laboratory analysis of water samples collected in the field. Accuracy, precision, completeness, representativeness, and comparability of qualitative assessments of site conditions will be assessed through the collaborative consensus of the staff performing those assessments consistent with the Ambient Water Quality Monitoring Protocol provided in **Appendix B** of this QAPP. The qualitative assessments include recording observation codes pertaining to water color, water odor, water level, weather conditions, and precedent precipitation at the time of the sample on the field data sheet provided within the Ambient Water Quality Monitoring Protocol (**Appendix B**).

Quantitative measurements to be collected in the field include air temperature, water temperature, and conductivity. Water samples collected in the field will be submitted to a state-certified testing laboratory for analysis of Nitrate as N and bacteria as *Escherichia coli* (*E. coli*). Accuracy, precision, completeness, representativeness, comparability, bias, and sensitivity of ambient water quality monitoring are detailed below. Broadly, DOQs will be assessed through the regular calibration of field meters, collection and analysis of duplicate samples, and collection and analysis of field blanks before and during each round of sampling.

- **Precision** will be assessed by replicating sample collection procedures in the field to obtain a duplicate set of measurements and duplicate samples from a sample site to provide to the testing laboratory. ~~Two sets of~~ ~~One set of~~ duplicate samples will be collected ~~by each field team~~ for each sample round. Each round, the QA Manager will assign the sites ~~where the field team should collect~~ the duplicate samples should be collected. Over the course of the sampling season, at least one set of duplicates will be collected for each site. The sequence will be determined by assigning a random number each site. The random number will indicate which sampling round the duplicate should be collected for the corresponding site.
- **Accuracy** will be assessed through the calibration of meters which includes measuring against a standard with a known concentration. Accuracy will also be measured through the analysis of blanks (distilled water).

- **Representativeness** is addressed in the sample collection procedures which calls for the samples and readings to be collected from the center of the stream channel at mid-depth where the water is continually moving and mixing and not influenced by still water in the shallows or discharge from stormwater outfalls. Representativeness is also addressed through the use of multiple fixed stations on each stream (to the extent funding allows) to reflect the variations in contributing land use activities. Further, the study calls for a mix of wet and dry weather sampling conditions. Sampling during at least three wet weather events and three dry weather events will achieve representativeness criteria and allow for calculation of a geometric mean under each set of conditions.
- **Comparability** is also addressed in the sample collection procedures and field observations recorded when samples are collected. Tracking sample time, holding time, weather conditions, latitude and longitude, and taking digital photographs at a site ensure samples are collected in the same manner for any given site and that methods are transferable between sampling sites so that results may be compared when considering conditions under which data were collected.
- **Completeness** will be assessed through review of field data sheets to ensure all fields have been completed and that the number of samples collected reflects the number of sites while accounting for duplicate samples and blanks. Completeness also factors in the number of times in the season that sites are sampled, which recognizes that water depth, velocity and other safety hazards may impede sampling. With 12 sampling events planned between April and October, sites sampled at least 10 times will meet the completeness criteria. Completeness will also be considered achieved on the basis of duplicates and blanks prepared for a site. Each site will systematically be assigned for collection of a duplicate and/or field blank at some point in the sampling season. Further, the study calls for a mix of wet and dry weather sampling conditions. Sampling during at least three wet weather events and three dry weather events will achieve completeness criteria and allow for calculation of a geometric mean under each set of conditions. See **Table 3** for a summary of completeness criteria.
- **Sensitivity** of the conductivity meter and thermometer are accounted for in the technical specifications for devices which are included in Appendix C of this QAPP. For analyses performed by Hydro Technologies, LLC laboratory, the detection limits and methods used will be reflected in the results report provided back to PRWC. Laboratory standard operating procedures (SOPs) followed by Hydro Technologies, LLC are included in Appendix D of this QAPP. See **Table 4** for a summary of sensitivity criteria.
- **Bias** is addressed in a couple of ways. One way bias is addressed is through the analysis of blanks (distilled water) that will be submitted blindly to the testing laboratory. Sampler bias is addressed through standard operating procedures that prescribe the sample location and where within the stream channel to collect the sample. Rotating sites where the field team should collect their duplicate sample and blank helps eliminate bias of opting between a site that uses the bucket toss method or wading in the stream method to collect the duplicate sample. Sampler bias is further addressed by using a fixed schedule for collecting samples to help ensure a mix in the weather conditions and not skewing data in deciding between sampling in fair weather or wet weather.

Table 3. Completeness DOQ Criteria

Monitoring Parameter >	Bacteria as <i>Escherichia coli (E. coli)</i>	Nitrate as N
Sampling Period	April to October 2021 <u>June to October 2021, April to May 2022</u>	April to October 2021 <u>June to October 2021, April to May 2022</u>
Number of Sample Events	12 (twice per month; 10 events is acceptable; at least 3 wet and at least 3 dry weather events)	12 (twice per month; 10 events is acceptable; at least 3 wet and at least 3 dry weather events)
Number of Field Samples / Sample Event	13	13
Number of Field Duplicate Samples / Event	2	2
Number of Field Blanks / Event	1	1
Total Number of Field Samples	156 (10/site or a total of 130 is acceptable)	156 (10/site or a total of 130 is acceptable)
Total Number of Field QC Samples (Includes Duplicates & Blanks)	36 (10 sampling events or 30 field QC samples is acceptable)	36 (10 sampling events or 30 field QC samples is acceptable)
TOTAL Number of Samples	192 (160 is acceptable)	192 (160 is acceptable)

2.4 Analytical Methods

(Element B4)

Samples delivered to the state-certified testing laboratory will be tested utilizing the following analytical methods to measure bacteria and nitrate:

- Bacteria will be measured as *Escherichia coli* (*E. coli*) using method SM9223B
- Nitrate as N, EPA Method 353.2

Reporting from the laboratory will include the following detail: the parameter tested, the results, units, MDL, analysis date, Method used for the analysis, the Analyst initials, and the Lab ID.

Table 6. Analytical Methods Summary

Monitoring Parameter >	Bacteria as <i>Escherichia coli</i> (<i>E. coli</i>)	Nitrate as N
Sampling Period	April to October 2021	April to October 2021
Number of Sample Events	12 (twice per month; 10 events is acceptable)	12 (twice per month; 10 events is acceptable)
Number of Field Samples / Sample Event	13	13
Number of Field Duplicate Samples / Event	2	2
Number of Field Blanks / Event	1	1
Total Number of Field Samples	156 (10/site or a total of 130 is acceptable)	156 (10/site or a total of 130 is acceptable)
Total Number of Field QC Samples (Includes Duplicates & Blanks)	36 (10 sampling events or 30 field QC samples is acceptable)	36 (10 sampling events or 30 field QC samples is acceptable)
TOTAL Number of Samples	192 (160 is acceptable)	192 (160 is acceptable)
Analytical Method Reference	SM9223B	EPA Method 353.2
Laboratory SOP	“Bio-P/A & QT by 18h Colilert”	“Nitrate & Nitrite by FIA”
Sample Volume for Method	100 mL	100 mL
Sample bottle volume	250 mL	250 mL
Preservatives	Sodium Thiosulfate (tablet in sample bottle)	Sulfuric Acid (added upon arrival to lab)
Holding Times	6 hours	48 hours
Reporting Units	MPN/100mL	mg/L
Minimum Detection Level	1 MPN/100mL	0.05 mg/L
Maximum Detection Level	2420 MPN/100mL	20.0 mg/L (
Laboratory Reporting Limits	1 MPN/100mL	0.05 mg/L

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Pomperaug River Watershed Coalition
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QAPP Modification Notes 1/14/2022

Laboratory Logistics / Change in Laboratory Services

PRWC received a letter (included below) from the laboratory it has used for this project detailing a consolidation of lab testing services with its sister laboratory in Newburg, New York. PRWC has been in communication with the new leadership team to understand how this change might affect the Ambient Monitoring component of this project, particularly the ability to meet the required holding times for the bacteria analysis. The following is a summary of the change in services and logistics:

- The existing partnership between Hydro Technologies (New Milford, CT) and EnviroTest Laboratories (Newburg, NY) is expanding.
- The expanded partnership will consolidate most lab testing services to one location. Most analytical testing previously performed at Hydro Technologies (New Milford, CT) will be performed at the Newburgh NY facility of EnviroTest Laboratories.
- Billing and reporting will still be through the HydroTechnologies. In effect, the analyses are subcontracted by HydroTechnologies to EnviroTest Laboratories. Detail within the results report will contain a field displaying the Lab ID where the analysis was completed.
- EnviroTest Laboratories is a State of Connecticut Department of Public Health certified lab (PH-0554). Hydro Technologies will remain a Connecticut certified laboratory (PH-0787).
- Samples collected by PRWC will be delivered to the HydroTechnologies facility in New Milford, CT. From here, a courier will pick-up the samples and deliver them to EnviroTest Lab in Newburg (located one hour from New Milford). The courier picks up samples at 2:30 PM Monday thru Friday. The hand-off of samples from PRWC to HydroTechnologies to the Courier to EnviroTest will be tracked on the chain of custody form.
- EnviroTest ensures they will be able to satisfy the compliance monitoring requirement for a 6 hour hold time to begin incubation for E. coli analysis if PRWC is able to deliver samples to New Milford within 3.5 hours of collection time.

- EnviroTest Lab uses the same 18h Colilert method (SM9223) for analyzing *E. coli* as HydroTechnologies. EnviroTest also uses the same methods for Nitrate as N (EPA Method 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry) as HydroTechnologies.
- PRWC will continue to test twice a month for April and May 2022. Sample dates will be pre-determined and coordinated with the lab to ensure samples can expeditiously be processed upon receipt to meet the required hold time.

If necessary, PRWC will request the laboratory SOP's for the EnviroTest Lab facility to include in Appendix D of the QAPP to supplement those provided for the HydroTechnologies facility. PRWC can also request a letter from the EnviroTest facility that confirms their commitment to meeting the required 6 hour hold time to supplement the letter previously provided by HydroTechnologies.

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www.gohydro.com



December 27, 2021

To: Valued Commercial Clients of Hydro Technologies LLC ("Hydro")

We are writing to thank you for your business in 2021 and to provide you information on the expanding partnership between Hydro Technologies and EnviroTest Laboratories.

In order to further improve Test Report 'Turnaround Times' (TAT) and communication between our customers and our Technical Experts and Senior Project Management staff, Hydro Technologies is expanding its partnership with its sister lab, EnviroTest Laboratories LLC. This expanded partnership will consolidate most lab testing services to one location in order to improve turnaround times and to ensure that costs to you our clients do not increase at this time.

Importantly, EnviroTest Laboratories has been a fully certified Laboratory since 1974. Enviro Test is broadly certified to test Connecticut drinking water, waste water and soil samples for bacteria (total coliform, E. Coli, Fecal Coliform, heterotrophic plate count); heavy metals (lead, copper, iron, chromium, etc); wet chemistries (BOD, Nitrate, Ammonia, etc) and both Volatile and Semi Volatile organic compounds.

EnviroTest Laboratories is located right off highway 84 in Newburgh, NY, a short 1 (one) hour drive from Hydro's New Milford CT office. EnviroTest has been doing analytical work for Hydro's customers for the last 2 (two) years. EnviroTest is deeply integrated into Hydro's operations and there is a daily afternoon courier that delivers samples from Hydro New Milford to EnviroTest Newburgh.

As of January 3, 2021 most analytical testing previously performed at Hydro Technologies will be performed at the Newburgh NY facility of Enviro Test Laboratories. Hydro Technologies will remain and Connecticut certified laboratory. This is the 'last step' in the tight working relationship between the Hydro and Enviro Test teams will eliminate operational burdens from the two labs using two different laboratory management software systems. As a results of this final step, all analytical reports and invoices for samples received after Jan 3rd will bear the name of Enviro Test Laboratories. Again, Hydro Technologies will remain a certified Connecticut laboratory and will perform the testing for which it is certified by Connecticut. Like most certified laboratories, EnviroTest occasionally subcontracts some tests to third party subcontract labs. In these cases, EnviroTest will always subcontract to laboratories that are certified for this subcontracted test parameter by the State of Connecticut. You will see clearly noted on your test report if any subcontracting occurred and to which certified laboratory the occasionally subcontracted test was sent.

Hydro Technologies & EnviroTest Laboratories are extremely mindful of Test Report turnaround time as well the reporting of quality data. We feel the use of one central Laboratory Information Management Software (LIMS) system will ensure that both of these objectives are met. We will also implement the use of Colilert 18 Bacteria Media which will provide our customers with quick, next-business day verbal notifications of any failures.

Hydro Technologies will continue to provide the services you have come to value. These services include tracking and scheduling your CT required sampling as well as the reporting of these results to the State of CT.

During this transition period please do not hesitate to reach out to either myself or my team leaders in this endeavor Debbie Bayer and Meredith Ruthven with any questions or concerns.

With thanks and appreciation,

Ethan Einwohner, CEO, Head of Ownership Group - Ethan@specifiedlabs.com (646) 714-5651

KEY CONTACTS

Debra Bayer, Head of Client Services - Dbayer@gohydro.com (845) 562-0890 X 802

Meredith Ruthven, Quality Assurance Officer - Mruthven@gohydro.com (845) 562-0890 X 801

Renee Cusack, Lab Director - Rcusack@gohydro.com (845) 562-0890 X 803

Invoicing and payment

Kimberly Costello-Zapata, Operations Manager - Kcostello@specifiedlabs.com (845) 562-0890 X 806

Title and Approval Sheet

(Element A1)

Carol A Haskins 5/26/2021
Carol Haskins, PRWC, QA / Project Manager Date

ELIZABETH WRIGHT Digitally signed by ELIZABETH WRIGHT
Date: 2021.05.27 08:26:51 -04'00'

Steven Winnett, EPA Project Manager Date

NORA CONLON Digitally signed by NORA CONLON
Date: 2021.05.27 08:00:23 -04'00'

Nora Conlon, EPA QA Reviewer, QA Chemist Date

Susan C. Peterson 5-26-21
Susan Peterson, CTDEEP, Project Manager Date

Christopher Bellucci 5-27-2021
Christopher Bellucci, CTDEEP, QA Manager Date

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Distribution List

(Element A3)

Quality Assurance Project Plan – Pomperaug Watershed Based Plan Implementation Groundwork

The approved Quality Assurance Project Plan (QAPP), and any subsequent updates, will be distributed to the following individuals by electronic mail:

PRWC	Carol Haskins 39 Sherman Hill Road Suite C103 Woodbury, CT 06798 (203) 263-0076	Quality Assurance & Project Manager	chaskins@pomperaug.org
US EPA	Steven Winnett US EPA New England 5 Post Office Square – Suite 100 (OEP06-2) Boston, MA 02109-3912 (617) 918-1687	Project Manager	Winnett.Steven@epa.gov
US EPA	Nora Conlon US EPA New England 11 Technology Drive North Chelmsford, MA 01863-2431 (617) 918-8335	Quality Assurance Reviewer, Quality Assurance Chemist	conlon.nora@epa.gov
CT DEEP	Susan Peterson Environmental Analyst 3 79 Elm Street Hartford, CT 06106 Phone (860) 424-3854	Project Manager	Susan.Peterson@ct.gov
CT DEEP	Christopher Bellucci Supervising Environmental Analyst 79 Elm Street Hartford, CT 06106 (860) 424-3735	Quality Assurance Manager	Christopher.Bellucci@ct.gov
Hydro Technologies, LLC	Beth Dunn Laboratory Supervisor 62 Bank Street, 2nd Floor New Milford, CT 06776 (860) 355-8773	Laboratory Quality Assurance Manager	bdunn@gohydro.com

SECTION A – PROJECT MANAGEMENT

1.1 Project Task Organization

(Element A4)

The project that is the subject of this Quality Assurance Project Plan (QAPP) is being led by the Pomperaug River Watershed Coalition (PRWC). PRWC is responsible for the development of a QAPP and the execution of the project. Key individuals and an organizational chart are presented in **Table 1** and **Figure 1**. All references to “Project Staff”, “Project Managers”, and “Project QA Managers” are associated with PRWC staff throughout the document. CT DEEP is used in reference to Connecticut Department of Energy and Environmental Protection. EPA is used in reference to the United States Environmental Protection Agency.

Table 1. Project Team Responsibilities

Person/Entity	Project Title/Responsibility
Carol Haskins Pomperaug River Watershed Coalition	PRWC QA & Project Manager – Overall manager leading the project for the Pomperaug River Watershed Coalition (PRWC), review/approval of final work products. Oversight of all visual assessments, stream sampling, reporting activities, and data evaluation to ensure compliance with this QAPP. Maintains the official QAPP.
Seasonal Intern #1 Pomperaug River Watershed Coalition	Visual Assessments Team Leader. Responsible for organizing equipment and supplies, conducting visual assessment surveys, providing leadership for the crew members supporting this activity, reviewing completed field data sheets and compiling these data to support project reporting. Will also serve on the Ambient Water Quality Monitoring Team.
Seasonal Intern #2 Pomperaug River Watershed Coalition	Ambient Water Quality Monitoring Team Leader. Responsible for organizing equipment and supplies, conducting ambient water quality monitoring, providing leadership for the crew members supporting this activity, reviewing completed field data sheets and chain of custody forms and compiling these data to support project reporting. Will also serve on the Visual Assessments Team.
Seasonal Crew Members Pomperaug River Watershed Coalition	Visual Assessments Field Team and Ambient Water Quality Monitoring Field Team – Support field operations and data collection tasks associated with visual assessment surveys and ambient water quality monitoring.
Steven Winnett US EPA – Region 1	EPA Project Manager– General project oversight.
Nora Conlon US EPA – Region 1	EPA QA Reviewer / QA Chemist – Reviews and approves QAPP and subsequent revisions.
Susan Peterson CTDEEP	CTDEEP Project Manager – General oversight, final review/approval of all final work products.
Christopher Bellucci CTDEEP	CTDEEP QA Manager – Reviews and approves QAPP and subsequent revisions.
Beth Dunn HydroTechnologies, LLC	HydroTechnologies, LLC Laboratory Supervisor – Oversees quality assurance measures for analysis of water samples at the laboratory including reviewing completed chain of custody forms, bench sheets, and Reports of Analysis returned to PRWC. Maintains state certification of the laboratory and quality assurance plans in support of the same.

Staff members within each organization will report to their project manager for technical and administrative direction. Each staff member is responsible for the performance of any assigned duties in the course of completing identified sub-tasks within the overall project. Quality control duties include:

- Completing assigned tasks on or before schedule.
- Completing assigned tasks in accordance with established procedures.
- Assuring that the work performed is technically correct and conforms to the applicable requirements of this QAPP.

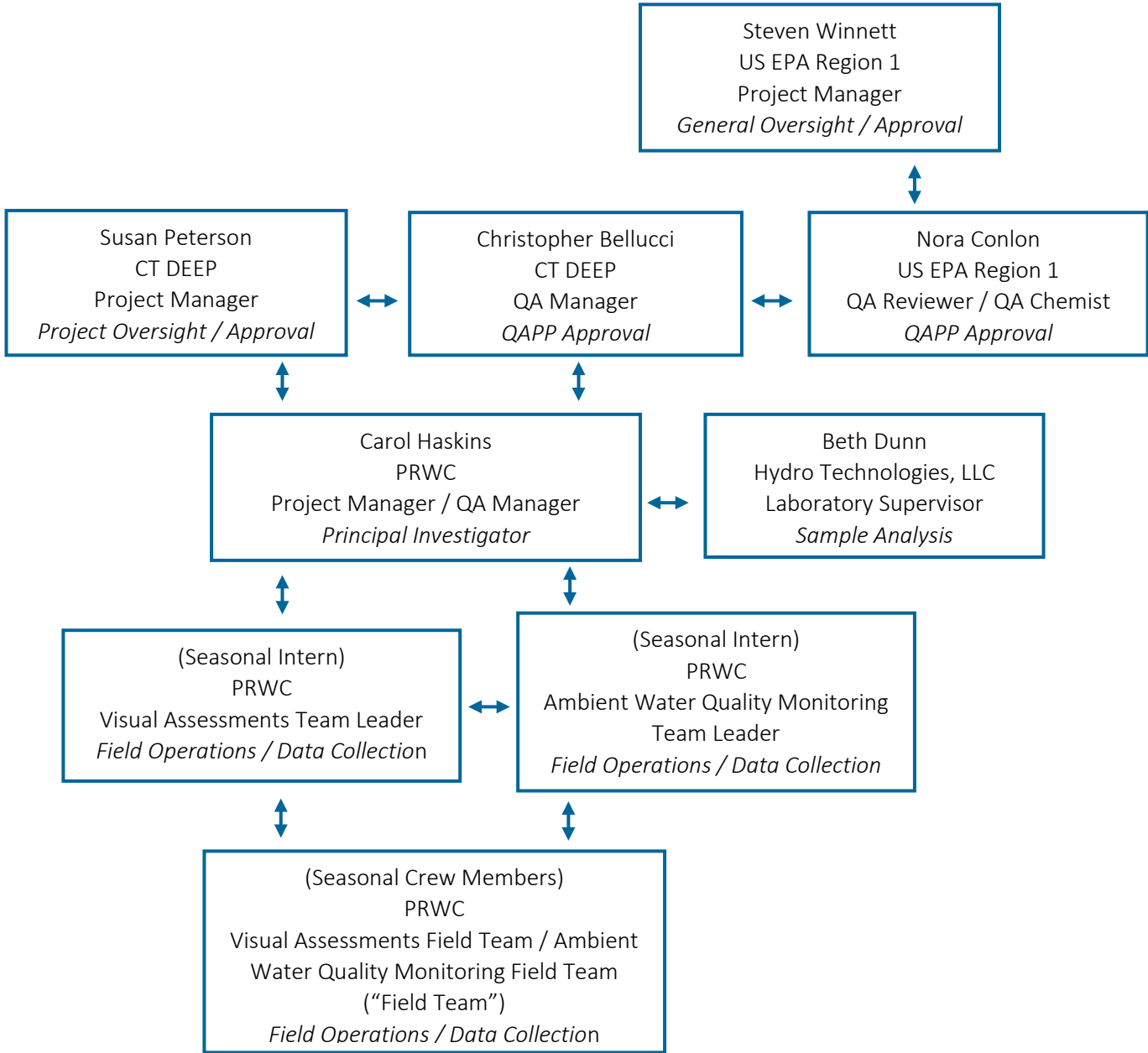


Figure 1. Project Organizational Chart

1.2 Problem Definition/Background

(Element A5)

This QAPP provides a framework for assessing the quality of data obtained from visual assessment surveys, ambient water monitoring, and manipulation of existing data (i.e., secondary data/mapping) collected and used in support of the “Pomperaug River Watershed Based Plan (WBP) Implementation Groundwork” project that is funded in part by CT DEEP through an EPA Clean Water Act Section 319 Nonpoint Source Grant. These activities include fixed-station bacteria monitoring (coupled with specific conductance and nitrate as tracers to help identify the type of pollution source -- i.e. septic, animal waste, agriculture) at 15 sites throughout the Pomperaug River Watershed as well as visual assessment surveys (streamwalk surveys) focused on parcels adjacent to the Weekepeemee River with particular attention to agricultural parcels.

The Pomperaug River Watershed is located in Western Connecticut in Litchfield and New Haven Counties. The 90-square mile regional basin includes parts of eight Connecticut towns in the lower central Housatonic Valley (**Figure 2**). Two segments of the Pomperaug River and two segments of other tributaries within the watershed (Weekepeemee River and Transylvania Brook) are included on the 303(d) impaired watershed list and are categorized as “not supporting” for recreation (CT DEEP, 2020 Integrated Water Quality Report to Congress)¹. These impairments are the result of elevated bacteria levels and were the impetus for the Pomperaug River Watershed Coalition (PRWC) to develop a Nine-Element Watershed Based Plan for the Pomperaug River Watershed. The Pomperaug River Watershed Based Plan (adopted in 2018) was prepared by PRWC in collaboration with Fuss & O’Neill and was funded in part by CT DEEP through an EPA Clean Water Act Section 319 Nonpoint Source Grant.

The basis for additional visual assessment surveys and water sampling work is to fill remaining data gaps that were identified in the Pomperaug River Watershed Based Plan (WBP). Given the size of the Pomperaug River Watershed, compressed timeline, and limited resources available for the initial watershed based planning process, it was challenging to conduct comprehensive field investigations of the entire regional basin. The need for ambient water quality monitoring data was also identified through the process of developing the WBP after recognizing how limited the historic stream sampling data were for the Pomperaug and Weekepeemee Rivers. As a result, additional visual assessment surveys and ambient water quality monitoring were recommended in the WBP. It was noted that supplementary visual assessment surveys, coupled with a strategic water quality monitoring plan, would help to narrow and prioritize stream reaches of concern in the watershed, which in turn would lead to targeted implementation of more site-specific projects and action plans that will be effective at improving water quality in the affected stream reaches. Reaches of most concern in the watershed are those in the Pomperaug River, Weekepeemee River, and Transylvania Brook that are impaired by bacteria (**Figure 3**).

Data from the fixed-station bacteria, nitrate, and conductivity monitoring and additional visual assessment surveys will help establish an improved baseline of water quality conditions as the known impairments are based on limited datasets from 2006 and 2010. These data will be incorporated into an updated Existing Conditions Report that further characterizes pollutant sources and problem areas, which will be used in facilitating the development of an Implementation Strategy that contains more detailed action plans and site-specific restoration projects. The data collected will also serve as a basis for evaluating the efficacy of best management practices (BMPs) proposed for

¹ Impaired Waters [303(d) list] listing history for the streams in the Pomperaug Watershed that categorized as “not supporting” for recreation is as follows: Pomperaug River-03 listed in 2008; Pomperaug River-01 listed in 2012; Weekepeemee River-01 listed in 2012; and Transylvania Brook listed in 2014.

implementation and for measuring progress towards meeting state and federal water quality standards within the previously identified impaired stream segments.

The updated Existing Conditions Report (ECR) will include maps of the study area, ambient water monitoring station locations and sampling results, causes and sources of NPS-related water quality impairments and a record of sites suitable for implementation of BMPs. The ECR will also include references to and a review of relevant water quality monitoring and assessments and pollutant load modeling that have become available since the WBP approval. Accordingly, the ECR will reference the WBP on file at CT DEEP and will include a review the most recent Integrated Water Quality Report to Congress, Total Maximum Daily Load (TMDL) analyses, relevant water quality monitoring data from CT DEEP, municipal stormwater plans and outfall sampling data included in corresponding annual reports, and the most current land use/land cover and other GIS data for preparing maps pertaining to stream assessments and site specific BMPs.

Development of the Implementation Strategy will entail conducting targeted outreach to the agricultural community in the watershed to share details of the ECR as well as provide an overview of recommended agricultural BMPs based on the ambient water quality monitoring data and visual assessment survey information. The goal of the Implementation Strategy is to identify a prioritized list of at least 3 potential projects for which landowner agreements for implementation will be sought. The prioritization will be based on BMPs previously included in the WBP, new sites identified through the visual assessment surveys, monitoring data that characterizes the sources of pollution, as well as the agricultural operator's interest to learn more or willingness to take action. For the prioritized project sites, concept level BMPs will be detailed and will include pollutant load reduction and project cost estimates. Where agricultural operator/landowner agreements are obtained, additional details like project leaders/partners, projected scope of work, implementation schedule, and potential funding sources will be included.

Overall, the goal of the Implementation Groundwork project is to review and obtain the additional scientific data that is necessary to identify specific sources of bacteria to better prioritize best management practices for the Pomperaug River Watershed. The ultimate goal of implementing the WBP is to delist impaired segments of the Pomperaug River and its tributaries from the Impaired Water List.

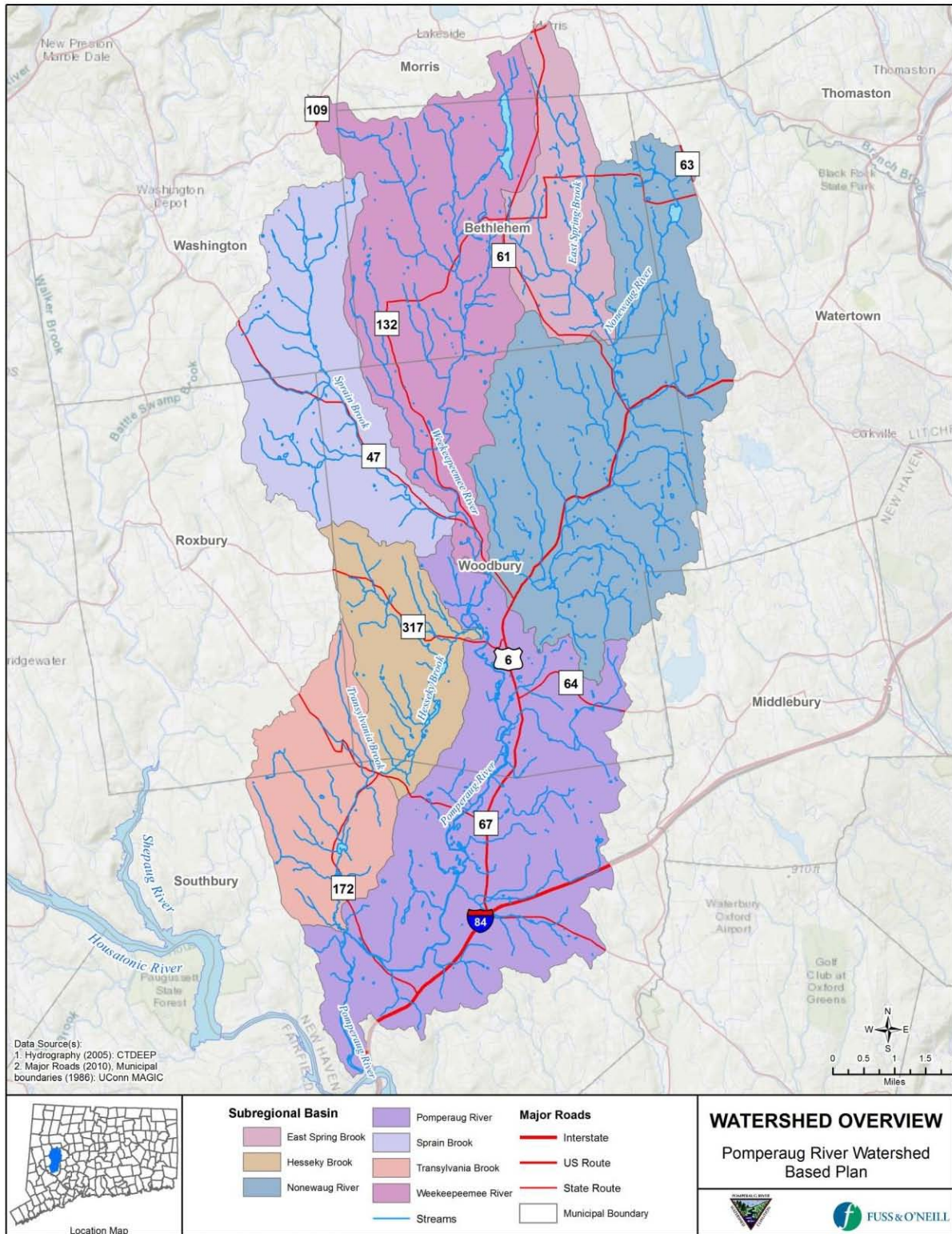


Figure 2. Pomperaug River Watershed

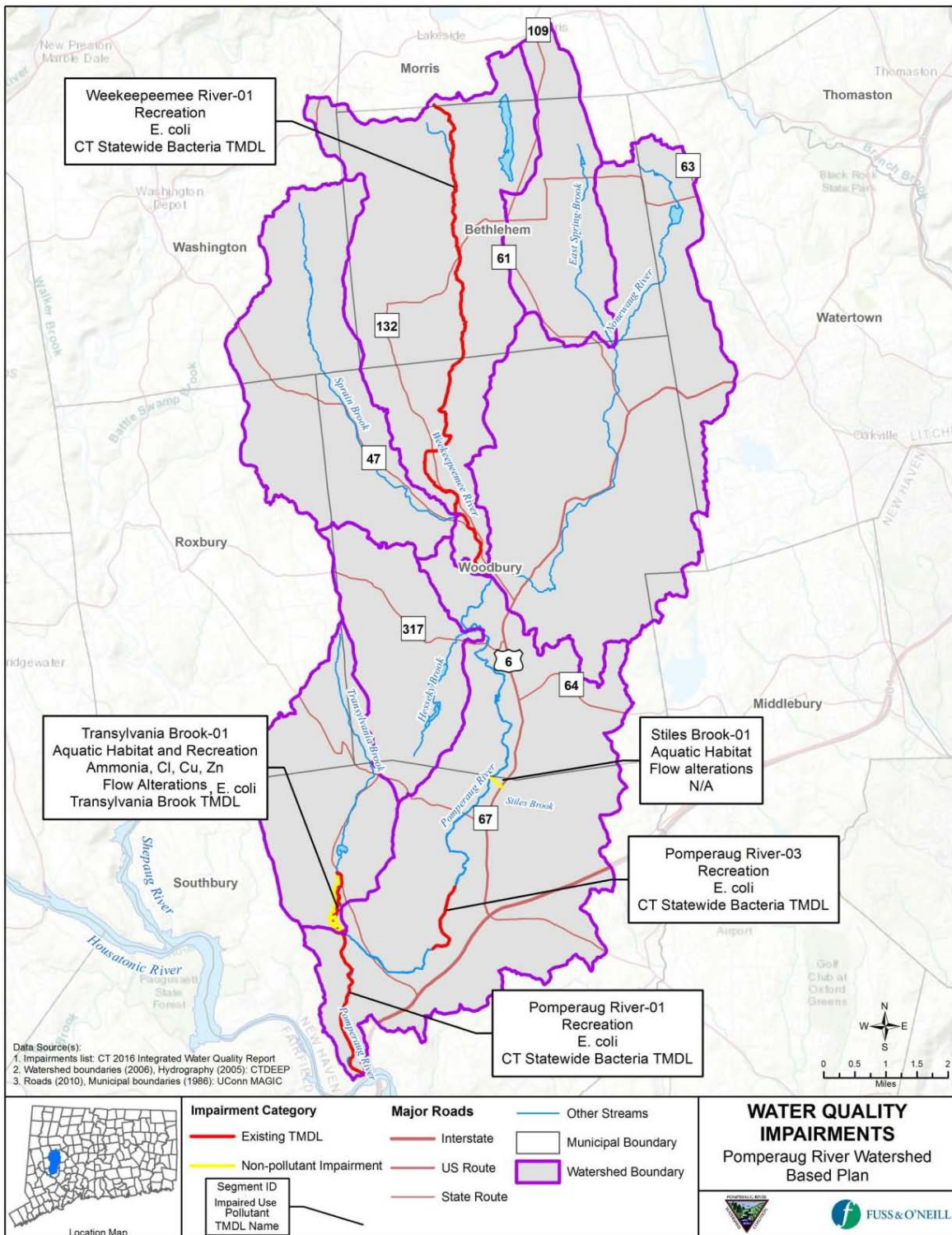


Figure 3. Water Quality Impairments in the Pomperaug Watershed

1.3 Project/Task Description

(Element A6)

This QAPP addresses visual assessment surveys (collection of direct measurements), manipulation of existing data (secondary data), and collection of ambient water quality data (collection of direct measurements) to identify causes of water quality impairments through bracketing and to assist in prioritizing the implementation best management practices in the Pomperaug River Watershed. A schedule for these tasks is provided in **Table 2**. Data collection efforts would begin following approval of the QAPP. Note that this schedule may be adjusted as the project progresses.

Table 2. Project Implementation Schedule

Task	Responsible Party	Estimated Start Date	Deliverables	Est. Completion Date
Visual Assessment Surveys (See Section 1.3.1)	PRWC	July 2021	Field assessment forms and supporting maps/graphics – included in Existing Conditions Report	October 2021
Ambient Water Quality Monitoring (See Section 1.3.2)	PRWC	April 2021	Laboratory reports as well as tabulated, graphed, and/or mapped data – included in Existing Conditions Report	October 2021
Collection and Manipulation of Secondary Data (See Section 1.3.3)	PRWC	April 2021	Prioritized locations for field assessments and bacteria sampling stations annotated list of agricultural operators - included in Existing Conditions Report and Implementation Strategy	November 2021

1.3.1 Visual Assessment Surveys

Screening-level visual assessment surveys of the Pomperaug River Watershed will be conducted by a two-person team using the Center for Watershed Protection (CWP) Unified Stream Assessment (USA) and Unified Subwatershed and Site Reconnaissance (USSR) methods (Kitchell & Schueler, 2005; Wright et al., 2005). Areas to be assessed include stream corridors and upland areas that are known or suspected of contributing bacteria pollution to the 9.7 mile segment of the Weekepeemee River that is listed as impaired and not supporting for recreational use. Areas to be assessed will be selected by the project team based on review of existing data and information on watershed land use, pollutant load estimates included in the Watershed Based Plan, stormwater outfall sampling data, ambient water quality monitoring data, and the findings of previous streamwalk assessments in the watershed. Priority

areas will include stream reaches adjacent to agricultural operations. The following CWP field assessment forms/procedures will be used (see the field data forms provided in **Appendix A** of this QAPP):

- Reach Level Assessment (stream corridor).
- Neighborhood Source Assessment (residential areas).
- Hotspot Site Investigation (commercial, industrial, agricultural, institutional land use).
- Pervious Area Assessment (schools, parks, vacant land).
- Streets and Storm Drains (drainage systems).

Locations of potential pollutant sources will be determined using a Garmin eTrex® 22x GPS Unit (“GPS”).

The visual assessment surveys will help identify pollutant sources, riparian impairments, and potential corrective actions, such as restoration, pollution prevention, and retrofit opportunities in the stream corridor and upland portions of the watershed to reduce watershed bacteria and pollutant loads to the impaired segment of the Weekepeemee River.

1.3.2 Ambient Water Quality Monitoring

Ambient water quality samples will be collected at 15 fixed stations located throughout the watershed twice monthly between the period of April to October to better refine the extent of the impaired stream segments and bracket potential sources of pollution. PRWC’s fixed stations will be selected with consideration to existing monitoring stations used by CT DEEP and PRWC for other sampling activities including macroinvertebrates sampling², stream temperature monitoring³, fish community assessments, and ambient water quality monitoring. Sites will be chosen to reflect the stream segments on the Weekepeemee River, Pomperaug River, and Transylvania Brook that are listed as impaired as well as sites within segments on the Pomperaug River and Nonnewaug River which have not previously been assessed. Inclusion of areas not previously assessed is deemed important as there are unassessed areas between segments categorized as impaired (ex. Pomperaug-02 and Pomperaug-04 have not been assessed but flow between areas listed as impaired). Monitoring stations for the Nonnewaug River are deemed important to assess because the Nonnewaug contributes equally as much water as the Weekepeemee does to the Pomperaug and, as described in the WBP, the Nonnewaug has similar land uses and modeled pollutant loading as the Weekepeemee. Thus, it is expected to have elevated levels of bacteria. Stations will also be selected based on public access and include road crossings as well as parks and other designated open space.

² PRWC participates annually in CT DEEP’s Riffle Bioassessment by Volunteers program and adheres to their associated SOP’s and QAPP (<https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Riffle-Bioassessment-by-Volunteers-RBV>).

³ PRWC participates annually in CT DEEP’s Volunteer Stream Temperature Monitoring program and adheres to their associated SOP’s and QAPP (<https://portal.ct.gov/DEEP/Water/Inland-Water-Monitoring/Volunteer-Stream-Temperature-Monitoring-Network>).

Ambient water samples and associated field measurements and observations will be collected by two-person teams twice monthly following PRWC's Ambient Water Monitoring Protocol (**Appendix B**). Specifically, ambient water quality monitoring will include collecting samples and recording data for the following parameters:

- Bacteria (grab-sample)
- Nitrate (grab-sample)
- Conductivity (field meter)
- Air and Water Temperature (field meter)
- Wet vs. Dry weather sampling (based on previous 24-, 48-, and 72-hour rainfall observed at local precipitation gauge at USGS gaging station)
- Field observations (water color, water odor, water level, and weather conditions)
- Streamflow (from corresponding USGS gauging station)

Grab-samples collected by the field team will be delivered to a state-certified testing laboratory⁴ for analysis. Hand-held meters will be used by the field team to measure conductivity, water temperature, and air temperature. All observations will be recorded on a printed field data sheet or using a digitized version as described in PRWC's Ambient Water Monitoring Protocol (**Appendix B**).

The ambient water quality monitoring data will help bracket pollutant sources and prioritize areas where corrective actions, such as runoff reduction and pollution prevention would be most appropriate to reduce bacteria and other pollutant loads to the impaired stream segments.

A combination of wet and dry weather sampling conditions will help characterize pollutant loading as well as to better understand if the stream reaches are unsafe for recreation only after rain events or if there are areas where bacteria levels are chronically unsafe without stormwater input. Local precipitation data as measured at the USGS Gaging Station on the Weekepeemee River at Hotchkissville, CT will be reviewed to designate the "dry" or "wet" sampling conditions. For the purposes of this project, wet weather conditions are defined as greater than 0.1" precipitation in 24 hours or greater than 0.25" precipitation in 48 hours or greater than 2.0" precipitation in 96 hours. All other conditions are dry weather. To validate the wet weather and dry weather designations and for data comparability to other studies that may use alternate definitions, precipitation values for the previous 24-hours, 48-hours, and 72-hours, and 96-hours will also be recorded on the field data sheet for a quantitative measure that may be helpful in future studies and comparing data to datasets that may have used different wet/dry criteria. The QA Manager / Project Manager will refer to the precipitation data recorded at the USGS Gaging Station to confirm wet or dry sampling condition designations.

⁴ In Connecticut, the Environmental Laboratory Certification Program (ELCP) registers and approves all environmental laboratories (private, municipal, and industrial non-commercial) granting certification for testing of drinking water, wastewater, sewage, solid waste, soils, and other environmental samples for microbiologicals, inorganics, organics, and radiochemicals. The authority for this function is found in the Connecticut General Statutes Sections 19a-29a and 25-40 and Public Health Code Regulations 19-4-1; 19a-36-a25 through A33; and 19a-36-A57 through A63. The ELCP office also enforces U.S. Environmental Protection Agency regulations involving environmental laboratory testing (the Safe Drinking Water Act, the Clean Water Act and the Resource Conservation and Recovery Act). The Environmental Laboratory Certification Program mission is to promote the benchmark by which accurate, precise, and legally defensible analytical data is reported by the environmental laboratory industry for use in compliance and in accordance with federal and state law. This is accomplished by ensuring that environmental laboratories located in or doing business in CT meet all applicable EPA and CT standards.

(<https://portal.ct.gov/DPH/Environmental-Health/Environmental-Laboratory-Certification/Environmental-Laboratory-Certification>)

1.3.3 Secondary Data Manipulation

Secondary data (existing data and previous studies) are needed to prepare the updated Existing Conditions Report (ECR) component of this project. Since the ECR is intended to address data gaps that were identified in the development of the Pomperaug Watershed Based Plan (2018), new data will be categorized as those that have become available after 2016 (the year the WBP project commenced). New data will be summarized and compared to data found in the older references included within the WBP including those upon which the water quality impairments designations were made. There are no specific criteria for the number of years of data needed nor is there uniformity in the datasets available and the intervals at which they are collected.

Existing data and previous studies (i.e., secondary data) will be used as follows in support of this project:

- Baseline watershed conditions as described in the 1999 State of the (Pomperaug) Watershed Report and the 2006 Pomperaug River Watershed Management Plan, and 2018 Pomperaug Watershed Based Plan will be updated to reflect current water quality and land use conditions.
- Areas to be investigated through the use of visual assessment surveys (see Section 1.3.1) will be selected by the project team based upon review of existing data and previous studies on watershed land use, water quality impairments, and pollutant sources, including identified data gaps.
- The extent of impacted buffers along the impaired stream segments in the watershed will be conducted using existing GIS data from the University of Connecticut's Center for Land Use and Education (UConn CLEAR) program and land owner information available from the Naugatuck Valley Council of Governments (NVCOG).

The secondary data and existing studies that will be used for this project include, but are not necessarily limited to:

- Existing data on water quality in the waterbodies, their tributary streams, and watersheds collected by other agencies including, but not limited to, PRWC, CT DEEP, University sponsored research studies and reports, non-profit organization reports (Soil & Water Conservation District (SWCD) and Environmental Review Team (ERT)), 2010 Streamwalk Assessment Report- Pomperaug River Watershed Volunteer Streamwalk Program, monitoring data collected by the USGS, information from municipal stormwater plans and outfall sampling data included in corresponding annual reports, and other studies supported or commissioned by the PRWC, including in-stream habitat assessment completed by the University of Massachusetts.
- Land use and land cover data (either parcel-based land use available from Naugatuck Valley Council of Governments (NVCOG) or University of Connecticut Center for Land Use Education and Research (CLEAR) satellite-derived land cover data).
- Water Quality Monitoring 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 (See Section 1.4.2).

- Pollutant Loading and BMP Effectiveness – Data taken from peer-reviewed literature values will be used to support estimating load reductions from BMPs and BMP cost-effectiveness that will be included in the Implementation Strategy.
- 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. The GIS data will be augmented by GIS mapping available from the watershed municipalities and the Naugatuck Valley Council of Governments (NVCOG), as necessary.
- Data on the physical characteristics of impaired stream segments from CT DEEP, U.S. Geological Survey, and PRWC.

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

1.4 Quality Objectives and Acceptance Criteria

(Element A7)

1.4.1 Direct Data Measurements

Visual Assessment Surveys

Data Quality Objectives (DQOs) for visual 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 the Center for Watershed Protection Urban Subwatershed Restoration Manual Series (2005-2008). The Unified Stream Assessment (USA) and Unified Subwatershed and Site Reconnaissance (USSR) user's manuals and field data sheets are available for download at <http://owl.cwp.org/>. Field data sheets for the visual assessments that are proposed as part of this project are provided in **Appendix A** of this QAPP.

Ambient Water Quality Monitoring

Data Quality Objectives (DQOs) for ambient water quality monitoring rely on a combination of qualitative assessments by field personnel as quantitative measurements using field instruments and laboratory analysis of water samples collected in the field. Accuracy, precision, completeness, representativeness, and comparability of qualitative assessments of site conditions will be assessed through the collaborative consensus of the staff performing those assessments consistent with the Ambient Water Quality Monitoring Protocol provided in **Appendix B** of this QAPP. The qualitative assessments include recording observation codes pertaining to water color, water odor, water level, weather conditions, and precedent precipitation at the time of the sample on the field data sheet provided within the Ambient Water Quality Monitoring Protocol (**Appendix B**).

Quantitative measurements to be collected in the field include air temperature, water temperature, and conductivity. Water samples collected in the field will be submitted to a state-certified testing laboratory for analysis of Nitrate as N and bacteria as *Escherichia coli* (*E. coli*). Accuracy, precision, completeness, representativeness, comparability, bias, and sensitivity of ambient water quality monitoring are detailed below. Broadly, DOQs will be assessed through the regular calibration of field meters, collection and analysis of duplicate samples, and collection and analysis of field blanks before and during each round of sampling.

- **Precision** will be assessed by replicating sample collection procedures in the field to obtain a duplicate set of measurements and duplicate samples from a sample site to provide to the testing laboratory. Two sets of duplicate samples will be collected for each sample round. Each round, the QA Manager will assign the sites the duplicate samples should be collected. Over the course of the sampling season, at least one set of duplicates will be collected for each site. The sequence will be determined by assigning a random number each site. The random number will indicate which sampling round the duplicate should be collected for the corresponding site.
- **Accuracy** will be assessed through the calibration of meters which includes measuring against a standard with a known concentration. Accuracy will also be measured through the analysis of blanks (distilled water).

- **Representativeness** is addressed in the sample collection procedures which call for the samples and readings to be collected from the center of the stream channel at mid-depth where the water is continually moving and mixing and not influenced by still water in the shallows or discharge from stormwater outfalls. Representativeness is also addressed through the use of multiple fixed stations on each stream (to the extent funding allows) to reflect the variations in contributing land use activities. Further, the study calls for a mix of wet and dry weather sampling conditions. Sampling during at least three wet weather events and three dry weather events will achieve representativeness criteria and allow for calculation of a geometric mean under each set of conditions.
- **Comparability** is also addressed in the sample collection procedures and field observations recorded when samples are collected. Tracking sample time, holding time, weather conditions, latitude and longitude, and taking digital photographs at a site ensure samples are collected in the same manner for any given site and that methods are transferable between sampling sites so that results may be compared when considering conditions under which data were collected.
- **Completeness** will be assessed through review of field data sheets to ensure all fields have been completed and that the number of samples collected reflects the number of sites while accounting for duplicate samples and blanks. Completeness also factors in the number of times in the season that sites are sampled, which recognizes that water depth, velocity and other safety hazards may impede sampling. With 12 sampling events planned between April and October, sites sampled at least 10 times will meet the completeness criteria. Completeness will also be considered achieved on the basis of duplicates and blanks prepared for a site. Each site will systematically be assigned for collection of a duplicate and/or field blank at some point in the sampling season. Further, the study calls for a mix of wet and dry weather sampling conditions. Sampling during at least three wet weather events and three dry weather events will achieve completeness criteria and allow for calculation of a geometric mean under each set of conditions. See **Table 3** for a summary of completeness criteria.
- **Sensitivity** of the conductivity meter and thermometer are accounted for in the technical specifications for devices which are included in Appendix C of this QAPP. For analyses performed by Hydro Technologies, LLC laboratory, the detection limits and methods used will be reflected in the results report provided back to PRWC. Laboratory standard operating procedures (SOPs) followed by Hydro Technologies, LLC are included in Appendix D of this QAPP. See **Table 4** for a summary of sensitivity criteria.
- **Bias** is addressed in a couple of ways. One way bias is addressed is through the analysis of blanks (distilled water) that will be submitted blindly to the testing laboratory. Sampler bias is addressed through standard operating procedures that prescribe the sample location and where within the stream channel to collect the sample. Rotating sites where the field team should collect their duplicate sample and blank helps eliminate bias of opting between a site that uses the bucket toss method or wading in the stream method to collect the duplicate sample. Sampler bias is further addressed by using a fixed schedule for collecting samples to help ensure a mix in the weather conditions and not skewing data in deciding between sampling in fair weather or wet weather.

Table 3. Completeness DOQ Criteria

Monitoring Parameter >	Bacteria as <i>Escherichia coli (E. coli)</i>	Nitrate as N
Sampling Period	June to October 2021, April to May 2022	June to October 2021, April to May 2022
Number of Sample Events	12 (twice per month; 10 events is acceptable; at least 3 wet and at least 3 dry weather events)	12 (twice per month; 10 events is acceptable; at least 3 wet and at least 3 dry weather events)
Number of Field Samples / Sample Event	13	13
Number of Field Duplicate Samples / Event	2	2
Number of Field Blanks / Event	1	1
Total Number of Field Samples	156 (10/site or a total of 130 is acceptable)	156 (10/site or a total of 130 is acceptable)
Total Number of Field QC Samples (Includes Duplicates & Blanks)	36 (10 sampling events or 30 field QC samples is acceptable)	36 (10 sampling events or 30 field QC samples is acceptable)
TOTAL Number of Samples	192 (160 is acceptable)	192 (160 is acceptable)

Table 4. Completeness DOQ Criteria

Monitoring Parameter >	Bacteria as <i>Escherichia coli (E. coli)</i>	Nitrate as N
Analytical Method Reference	SM9223B	EPA Method 353.2
Laboratory SOP ⁵	“Bio-P/A & QT by 18h Colilert”	“Nitrate & Nitrite by FIA”
Sample Volume for Method	100 mL	100 mL
Volume of Sample Bottle	250 mL	250 mL
Preservatives	Sodium Thiosulfate (tablet in sample bottle)	Sulfuric Acid (added upon arrival to lab)
Holding Times	6 hours	48 hours
Reporting Units	MPN/100mL	mg/L
Minimum Detection Level	1 MPN/100mL	0.05 mg/L
Maximum Detection Level	2420 MPN/100mL	20.0 mg/L (
Laboratory Reporting Limits	1 MPN/100mL	0.05 mg/L

⁵ Laboratory SOP's from Hydro Technologies, LLC are provided in Appendix B

1.4.2 Non-Direct Data (Secondary Data Manipulation)

(Element A7; Element B9)

Assessing whether the DQOs have been achieved for secondary data collection and manipulation is somewhat different than direct data collection. For indirect/secondary data, important features include 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 data was collected under a QAPP or Standard Operating Procedure (SOP).

Secondary Data Acceptance Criteria

The following criteria will be considered for acceptance of secondary data used in the project:

- Data generated by a reliable source, from a data generator that is generally trusted and respected, including federal, state, and local agencies, or research institutions, and data published in peer-reviewed articles or publications.
- Data for mapping will be collected from as many sources as available, and provide the maximum temporal and spatial coverage of the watershed, if necessary and applicable.
- The data will be comparable with respect to previous studies.
- Data have been collected for purposes similar to this project (i.e., to estimate BMP performance, etc.).
- Data was collected using a QAPP or similar plan.
- Data has been widely used and/or trusted by scientists and professionals in the subject area.

The following decision tree (**Figure 3**) will be used to assess the quality of secondary data. In general, the completeness of the data set will be assessed first, either by inspecting the metadata or the dataset itself.

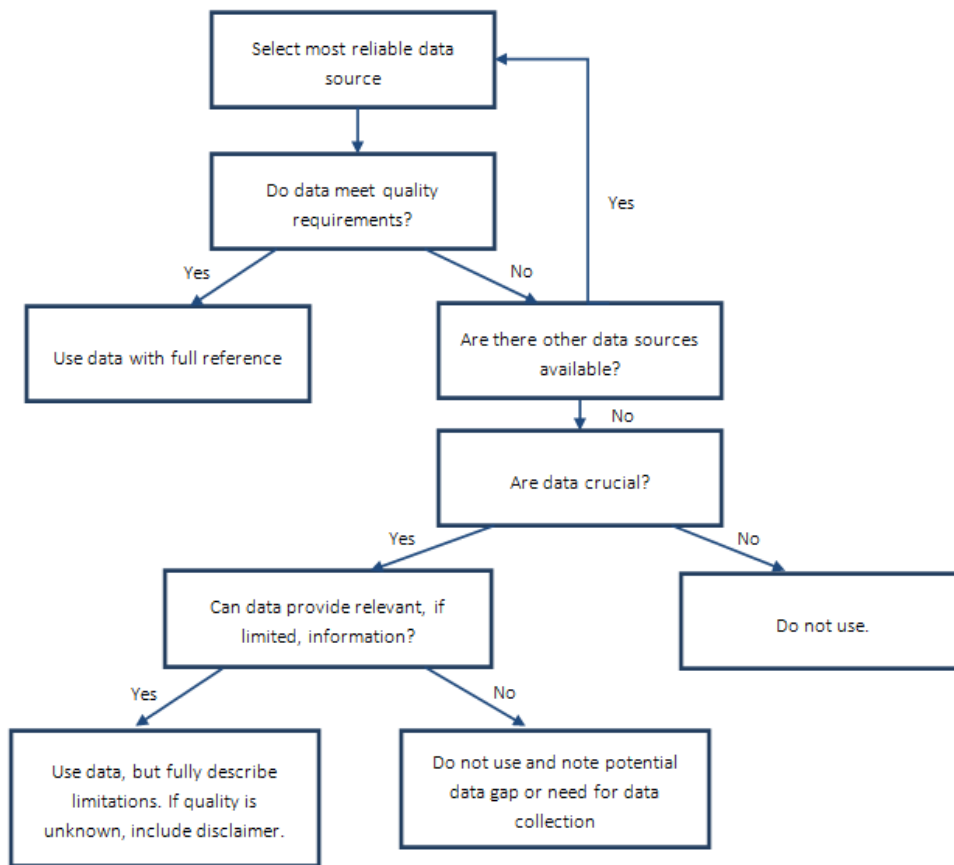


Figure 4. Data Decision Tree

If completeness is adequate, then other requirements will be assessed based on information available from the data providers or accompanying the dataset.

All project deliverables will reference the existence of this QAPP and limitations on known data quality will be fully disclosed as a disclaimer in the project deliverable.

Secondary Data Reduction and Manipulation

Data alteration and reduction will be avoided to the maximum extent practicable. The types of data reduction/alteration anticipated for this project include the following:

- Data units may need to be changed for report consistency, to allow comparisons, or for use in model input.
- Certain datasets may be reduced and represented as percentages (i.e., percent of a land use type).
- Some data reduction may be used to display data in map form (i.e., average values at a site).
- Some data may be reduced for comparison with a water quality benchmark.

Secondary Data Validation

The following measures will be taken to ensure the quality of secondary:

- A copy of every secondary data set will be saved as a read-only, protected file to be used in the event that the integrity of the working dataset is compromised.
- Working data will be stored in a spreadsheet or ArcGIS format and will include relevant raw data, which will be locked for editing.
- Data manipulation will be minimized, but when necessary, data manipulation will start with raw data, and all formulas including units, conversion factors, and formulas will be shown in the spreadsheet.
- Prior to including in project deliverables, raw and reduced data will be displayed in graphic format and inspected to look for anomalous values. Any decision to eliminate anomalous values will be documented in the spreadsheets and will be noted in the project deliverables.

1.5 Special Training/Certification

(Element A8)

Project Staff

All staff referenced in this section is assumed to be project staff at PRWC. Staff from PRWC is responsible for all data collection and handling and reporting tasks. Staff responsible for data collection from PRWC will be assigned duties based on their qualifications and ability to accomplish the task. All project staff will be required to be familiar with this QAPP and relevant Standard Operating Procedures (SOPs) or methods associated with any assigned tasks. The PRWC Project Manager will be responsible for assigning staff to individual tasks and for either training staff or ensuring that staff has adequate prior training for the completion of all assigned tasks. The Project Manager will maintain a training and qualifications log listing the staff person, assigned duties, and dates and type of training or prior qualifications.

SOPs for field efforts will be distributed to PRWC project staff and will be available at all times throughout the project.

The QA Manager, Project Manager, Visual Assessments Team Leader, and the Visual Assessments Team will be trained in the use of methodologies described in the Center for Watershed Protection Urban Subwatershed Restoration Manual Series (2005-2008), and will be familiar with the field data forms in **Appendix A** and the assessment methodologies used to complete those forms in the field.

The QA Manager, Project Manager, Ambient Water Quality Monitoring (AWQM) Team Leader, and AWQM Team will be trained and familiar with PRWC's Ambient Water Monitoring Protocol in **Appendix B** and the associated field data forms, field meters, equipment, and methods described therein.

The PRWC Project Manager will be responsible for assigning staff to individual tasks and for ensuring that staff has adequate prior training, as described above, for the completion of all assigned tasks. The Project Manager will maintain a training and qualifications log listing the staff person, assigned duties, and dates and type of training for the activities specific to this project.

1.6 Documents and Records

(Element A9)

The approved QAPP, and any subsequent revisions, will be distributed to all individuals identified on the distribution list. Project-related documents and records will be accessible to the project members who need to obtain information or record and disseminate data. During data collection, deviations from the approved QAPP will be recorded and all recorded deviations will be compiled for final QA summary report. **Table 3** summarizes project documentation and records management procedures.

Table 5. Documentation and Records

Document/Record	Format	Responsible Party	Person(s) Creating / Authorized to Update	Distribution List
Quality Assurance Project Plan (QAPP)	Hard-copy and digital copy	PRWC Project Manager / QA Manager	PRWC Project Manager / QA Manager (subject to CTDEEP and EPA review / approval)	All persons listed on master distribution list, All QA Managers
Standard Operating Procedures (SOPs)	Electronic and hard-copy	PRWC Project Manager / QA Manager	PRWC Project Manager / QA Manager	All field and data collection staff
Training Log	Electronic or hard-copy	PRWC Project Manager / QA Manager	PRWC Project Manager / QA Manager	PRWC Project Manager / QA Manager
Field Notebooks and Digital Photography	Electronic or Hard-copy	PRWC Project Manager / QA Manager	Visual Assessments Team Leader / Field Team	PRWC Project Manager / QA Manager
Field Data Sheets, Field Notebooks, Chain of Custody Forms, Lab Results, and Digital Photography	Electronic or Hard-copy	PRWC Project Manager / QA Manager	Ambient Water Quality Monitoring Team Leader / Field Team	PRWC Project Manager / QA Manager
Secondary Data	Electronic or Hard-copy	PRWC Project Manager / QA Manager	Project Manager; Field Assessments Team Leader; Ambient Water Quality Monitoring Team Leader	PRWC Project Manager / QA Manager
QA Summary Report	Electronic or Hard-copy	PRWC Project Manager / QA Manager	PRWC Project Manager / QA Manager	All persons listed on master distribution list

Electronic data and copies of hard-copy documents will be maintained as follows:

- Hard Copy Documents will be retained for a minimum of 5 years.
- Electronic copies of all project data files will be centrally stored in separate project subdirectories by PRWC.
- PRWC will conduct weekly cloud storage backup of all centrally stored electronic files.
- At the conclusion of the project, electronic copies of all files will be written to CD or USB storage drive for archival storage.

Visual Assessments Documentation

PRWC field staff will complete visual assessment survey forms (**Appendix A**) and will maintain field notebooks recording other information obtained and field conditions. Crews may take digital photographs to document field conditions. Locations of potential pollutant sources will be recorded with a Garmin eTrex® 22x GPS Unit (“GPS”). The field record will be held by the person recording the information, providing copies to the QA Manager / Project Manager (See Sections 2.1, 2.5, and 4.1).

Ambient Monitoring Documentation

PRWC field staff will complete field data sheets (printed or digitized) (**Appendix B**) and will maintain field notebooks recording other information obtained and field conditions. Digital photographs will be taken with a camera, tablet, or smartphone to document field conditions. The field record will be held by the person recording the information, providing copies to the QA Manager / Project Manager.

Secondary Data Documentation

All sources of secondary data will be identified and fully referenced and all metadata, if applicable, will be included in the final report for the project. Limitations of secondary data will be annotated as appropriate while alteration and reduction of the secondary data will be avoided to the maximum extent practicable. A journal may be kept by the PRWC Project Manager or Team Leaders to track data reductions or other manipulation deemed necessary with the master copy provided to the QA Manager / Project Manager.

QAPP Modification

This section addresses procedures to be followed when modifications are needed to this QAPP. Examples of such modifications include changes in procedures, assessment and reporting.

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 text being modified or added to, the reason why the revision is necessary and the actual replacement/additional language. It will be the responsibility of the PRWC 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 by electronic mail.

QAPP Distribution

This QAPP will be implemented by Pomperaug River Watershed Coalition once the CTDEEP and US EPA have given approval. This QAPP is to be considered a “working document.” The QAPP will be periodically revised as technology, policy and protocol change. All QAPP revisions will be distributed by the PRWC Project Manager to the parties indicated on the Distribution List.

Upon approval and implementation, the original QAPP shall be kept at PRWC’s office in Woodbury, Connecticut and the signed original QAPP should 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 7 days of approval. As new field staff or managers are hired by PRWC, they will be required to review this QAPP within 14 days of their hiring date.

SECTION B – DATA GENERATION AND ACQUISITION

2.1 Visual Assessment Surveys

(Element B1)

Visual assessment surveys will be conducted by PRWC field staff following the Center for Watershed Protection watershed assessment methods, as described in Section 1.3.1 of this QAPP. PRWC staff performing visual assessments of the watershed will be trained in the use of methodologies described in the Center for Watershed Protection Urban Subwatershed Restoration Manual Series (2005-2008), and will be familiar with the field data forms in **Appendix A** and the assessment methodologies used to complete those forms in the field.

Locations of potential pollutant sources will be determined with a Garmin eTrex® 22x GPS Unit (“GPS”) and documented on appropriate field forms (**Appendix A**). Digital photographs may also be taken in the field to support the documentation process. PRWC field staff performing the assessments will be familiar with the Field Notebooks (Activity Documentation) and Site Etiquette provided in the Standard Operating Procedures (SOPs) in **Appendix A**.

Any problems encountered during the visual assessments will be reported to the Project Manager and noted in the field log book. Corrective actions will be discussed between the Project Manager / QA Manager and field staff and documented in the QA Summary Report.

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

2.2 Sampling Methods (Ambient Water Quality Monitoring)

(Element B2)

Ambient stream water samples will be collected by PRWC field staff following the PRWC's Ambient Water Monitoring Protocol as described in Section 1.4.1 of this QAPP. PRWC staff performing ambient water monitoring in the watershed will be trained in the standard operating procedures for collecting stream samples that will be analyzed by a state-certified testing laboratory, taking field measurements, and recording associated observations on a field data sheet as described in the Ambient Water Monitoring Protocol in **Appendix B**. An overview of the sample collection procedures is provided below. Parameters to be analyzed by a contracted laboratory are bacteria as *Escherichia coli* (*E. coli*) and Nitrate as N. Parameters to be measured in the field are conductivity and temperature. Other field observations to be recorded are water color, water odor, water level, weather conditions, and wet or dry weather sampling conditions (See Section 1.3.2 and Appendix B). Streamflow reported by the nearest USGS gauging station will also be recorded.

Any problems encountered while collecting ambient water samples will be reported to the Project Manager and noted in the field log book. Corrective actions will be discussed between the Project Manager / QA Manager and field staff and documented in the QA Summary Report.

Procedures

Either wade into the stream, use an extension pole, or use the bucket method to measure stream temperature and conductivity and to fill sample bottles as described below.

1. **Fill Sample Bottles.** Make sure they have been labeled with permanent marker before filling. Make sure the seal on the sterile bottle for the bacteria sample has not been broken and that it contains a tablet (*sodium thiosulfate, which neutralizes any chlorine that may be present in the sample*). If collecting a duplicate or filling a blank make sure the bottles are distinguished with an A or B after the Site ID. You can either wade into the stream (preferred) or use an extension pole to fill the sample bottles as described below.
 - a. **Wading.** This method is appropriate for sites where the streambank is gently sloped or flat, the water is shallow (less than mid-calf or knee deep) and not too fast moving, you can see the stream bottom, and the stream bottom is firm (not muddy/mucky).
 - i. Carefully enter the stream and walk to the center of the channel. Use a stick or pole to test stream bottom and find good footing. Try not to disturb the sediment from the bottom.
 - ii. Face upstream and plan to collect samples away from your body in areas upstream of any area you disturbed while wading.
 - iii. Submerge capped bottle (with the mouth oriented slightly down) horizontally into the water. Do not fully invert the bottle or the tablet inside it will fall out.
 - iv. At about 8 to 12 inches below the surface (or, if the water is shallow, at the midpoint of river depth), remove bottle cap. Do not touch inside of bottle or cap.
 - v. Slowly turn the bottle upstream away from you and allow bottle to fill. Try not to let any sediment into the bottle.
 - vi. Recap bottle while still submerged. Raise capped bottle back out of water.
 - vii. Uncap and pour out some sample until there is approximately 2.5 to 5cm of headspace at the top of the bottle. Recap bottle and invert to check for leaks.

b. Extension Pole. This method is appropriate for sites with deep (above mid-thigh) or fast moving water, where the stream bottom is muddy or mucky, where the streambank is extremely steep, and/or when at a bridge crossing over the stream. If standing on a bridge, place a second traffic cone 10 paces behind you (towards oncoming traffic) for added visibility. Whether reaching or lowering the pole from the streambank or down from a bridge, aim for collecting your sample from the center of the stream channel. If sampling from a bridge, always sample on the upstream side of the bridge. **ALWAYS be sure to check for and avoid over hanging power lines! ALWAYS be sure to check for oncoming traffic and avoid extending pole into the roadway if there are oncoming vehicles!**

- i. Secure your capped sample bottle to the extension pole using the built-in clamp. Once secure, remove the cap making sure not to touch the inside of the bottle or the bottle cap. For the bacteria sample bottle, pour the sodium thiosulfate tablet into the cap without touching it and keep to the side while collecting the sample.
- ii. Keeping the mouth of the bottle face down, lower or reach the sample bottle into the stream. Submerge the bottle below the surface and turn into the current to fill the bottle (avoid collecting surface film water). Turn the mouth of the bottle skyward before lifting the sample out of the water.
- iii. Raise or retract the pole to retrieve the filled sample bottle. Cap the bottle before removing it from the clamp (if bacteria sample, pour the sodium thiosulfate tablet back into the bottle while capping it). Remove the bottle from the clamp.
- iv. If necessary, uncap and dump out enough water to provide approximately 2.5 to 5cm of headspace at the top of the bottle. Recap the bottle and invert the bottle to check for leaks.

2. **To take water temperature and conductivity measurements, either wade into the stream** to measure (preferred) **or use bucket method** to collect water from the stream to take these measurements.

- b. **Wading.** Refer to Steps 7.a and 7.a.ii and then face upstream and plan to take readings away from your body in areas upstream of any area you disturbed while wading.
- c. **Bucket Method.** This method is appropriate for sites with deep (above mid-thigh) or fast moving water, the stream bottom is muddy or mucky, the streambank is extremely steep, and/or when at a bridge crossing over the stream. If standing on a bridge, place a second traffic cone 10 paces behind you (towards oncoming traffic) for added visibility. Use a 1 gallon to 3 gallon sized bucket with metal handle and at least 25 feet of rope securely attached. (Note: a plastic handle may break under the weight of a full bucket.)
 - i. Inspect the bucket for cracks or holes and wipe down with a towel or paper towel wipe before you begin.
 - ii. Aim for collecting your sample in the center of the stream channel. If sampling from a bridge, **always sample on the upstream side of the bridge.**
 - iii. While hanging onto the rope, **toss/lower the bucket into the water 3 times to rinse** out the bucket and avoid cross contamination from the previous site or vehicle.

- iv. Toss/lower the bucket a fourth time, fill it with water which will be used for measuring temperature and conductivity.
 - v. Avoid placing the filled bucket on a hot paved surface.
3. **Measure water temperature.** Use the thermometer in your field kit to measure water temperature. **Make sure your reading is in Celsius and recorded with one digit after the decimal point.** Dip the metal probe of the thermometer into the main current or water collected in the bucket. **Allow reading to stabilize.** For the best reading, hold the thermometer away from your body and not in contact with other surfaces (sides of bucket or stream bottom).
 4. **Measure conductivity** using Oakton CTS Testr50P field meter (Appendix 3). Hold down the power button to turn on the meter. Make sure your device is on the proper screen which can be confirmed by the title at the top of the screen reading “COND” and the units below it shown as (uS/cm). Rinse cap of the meter and the sensor in the stream or with water collected in the bucket a few three times (dip cap into the river or bucket to fill/rinse; discard rinse water to the side). Then fill the cap of the meter to the “max fill line” with water from the river. The meter will automatically begin measuring conductivity. Allow the meter a few moments to show a stabilized reading. You will see a check mark (✓) at the top, once a stable reading is reached. **Record the conductivity result with one digit after the decimal point.**
 5. **Collect duplicate samples and fill field blanks at sites assigned by the QA Manager / Project Manager.**

2.3 Sample Handling & Custody

(Element B3)

Ambient stream water samples will be collected in disposable, clean/sterile bottles provided by the contracted state-certified testing laboratory. Two types of bottles will be provided – one type for nitrate samples, the other for bacteria samples. Bottles for bacteria analysis will be received with a seal; the seal will not be broken until the sample is collected. As described in PRWC’s Ambient Water Monitoring Protocol in Appendix B, the names of individual(s) filling the sample bottle will be recorded on the field data sheet as well as on a Chain of Custody (COC) Form that will remain with the samples as they are delivered to the testing laboratory. Sample date and time will also be recorded on the field data sheet and COC (Figure 4). Samples will be stored on ice in a cooler from the time they are collected until they are delivered to the laboratory. If the samples are delivered to the laboratory by someone other than the person(s) who collected them, the date/time of the transfer will be documented on the COC. The relinquishment and receipt of samples will also be documented when samples are transferred to the laboratory. A copy or digital photograph of the completed Chain of Custody will be retained for PRWC’s records while the original will remain with the samples at the laboratory.

Samples must be received by the laboratory within 6 hours of their collection time but not later than 2:00 PM as the lab must begin analysis upon receipt of the samples to meet criteria of the analytical methods. As such, samples should be collected between 8:00 AM and 12:00 PM to meet the holding times and also allow enough time for review of field data sheets, chain of custody forms, and consolidation of samples into one vehicle for delivery to the laboratory.

Any problems encountered while handling and transferring custody of ambient water samples will be reported to the Project Manager and noted in the field log book. Corrective actions will be discussed between the Project Manager / QA Manager and field staff and documented in the QA Summary Report.

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CHAIN OF CUSTODY RECORD

COMPANY NAME: Pomperaug River Watershed Coalition		ANALYSES REQUESTED														TOTAL						
ADDRESS: 39 Sherman Hill Rd Suite 103C																# OF						
Woodbury, CT 06798																B						
PROJECT NAME: Pomperaug E.Coli & Nitrate	Email: chaskins@pomperaug.org															O						
PROJECT MANAGER: Carol Haskins	PH:															T						
SAMPLER(S) NAME:	FAX:															L						
																E						
																S						
LAB #: [LA-10-050-01-07]	CLIENT SAMPLE ID Woodbury / Bethlehem	TYPE:	COLLECTION DATE / TIME	E. Coli	Nitrate																	
	N-W-16335 Mill Rd - USGS Guage	SW		X																		1 bio bottle
					X																	250 ml plastic
	N-W-14355 Rt 47 Bridge	SW		X																		1 bio bottle
					X																	250 ml plastic
	N-W-16274 Rt 61 Bridge	SW		X																		1 bio bottle
					X																	250 ml plastic
	W-W-16022 Brushy Hill Rd	SW		X																		1 bio bottle
					X																	250 ml plastic
	W-W-CHOH Chohees Trail	SW		X																		1 bio bottle
					X																	250 ml plastic
	W-W-15530 Jacks Bridge Rd	SW		X																		1 bio bottle
					X																	250 ml plastic
	W-B-15009 Wood Creek Rd	SW		X																		1 bio bottle
					X																	250 ml plastic
TYPE: DW - Discharge Water SW - Surface Water		SPECIAL INSTRUCTIONS/ NOTES:																				
		RELINQUISHED BY:		RECEIVED BY:		DATE		TIME		COMMENTS												

Figure 5. Example Chain of Custody Form.

2.4 Analytical Methods

(Element B4)

Samples delivered to the state-certified testing laboratory will be tested utilizing the following analytical methods to measure bacteria and nitrate:

- Bacteria will be measured as *Escherichia coli* (*E. coli*) using method SM9223B
- Nitrate as N, EPA Method 353.2

Reporting from the laboratory will include the following detail: the parameter tested, the results, units, MDL, analysis date, Method used for the analysis, the Analyst initials, and the Lab ID.

Table 6. Analytical Methods Summary

Monitoring Parameter >	Bacteria as <i>Escherichia coli</i> (<i>E. coli</i>)	Nitrate as N
Sampling Period	April to October 2021	April to October 2021
Number of Sample Events	12 (twice per month; 10 events is acceptable)	12 (twice per month; 10 events is acceptable)
Number of Field Samples / Sample Event	13	13
Number of Field Duplicate Samples / Event	2	2
Number of Field Blanks / Event	1	1
Total Number of Field Samples	156 (10/site or a total of 130 is acceptable)	156 (10/site or a total of 130 is acceptable)
Total Number of Field QC Samples (Includes Duplicates & Blanks)	36 (10 sampling events or 30 field QC samples is acceptable)	36 (10 sampling events or 30 field QC samples is acceptable)
TOTAL Number of Samples	192 (160 is acceptable)	192 (160 is acceptable)
Analytical Method Reference	SM9223B	EPA Method 353.2
Laboratory SOP	“Bio-P/A & QT by 18h Colilert”	“Nitrate & Nitrite by FIA”
Sample Volume for Method	100 mL	100 mL
Sample bottle volume	250 mL	250 mL
Preservatives	Sodium Thiosulfate (tablet in sample bottle)	Sulfuric Acid (added upon arrival to lab)
Holding Times	6 hours	48 hours
Reporting Units	MPN/100mL	mg/L
Minimum Detection Level	1 MPN/100mL	0.05 mg/L
Maximum Detection Level	2420 MPN/100mL	20.0 mg/L (
Laboratory Reporting Limits	1 MPN/100mL	0.05 mg/L

2.5 Quality Control

(Element B5)

2.5.1 Quality Control Requirements and Acceptability Criteria

Visual Assessments

Visual assessment surveys will consist of quasi-subjective evaluations by PRWC field personnel. Quality control of these assessments will be performed in accordance with the method discussed in Section 1.4.1 (DQOs) of this QAPP.

The PRWC Project Manager / 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 personnel have followed the methodologies described in the Center for Watershed Protection Urban Subwatershed Restoration Manual Series (2005-2008). Digital photographs taken during the assessments may be referenced to corroborate the observations recorded on the field data forms. The Visual Assessments Team Leader will check these forms on a daily basis to make sure that they have been filled out properly.

Ambient Water Quality Monitoring

Ambient water quality monitoring consists of both quasi-subjective evaluations by PRWC field personnel and quantitative measures collected in the field and through analysis of samples collected in the field that are later tested by a state-certified laboratory. Quality control of these data will be performed in accordance with the method discussed in Section 1.4.1 (DQOs) of this QAPP.

The PRWC Project Manager / QA Manager will conduct an internal review of the field forms, equipment logs, chain of custody forms, and results reported by the testing laboratory for compliance with quality control requirements. This will consist of verifying that field data forms and chain of custody records have been filled out consistently and completely following the procedures detailed in the Ambient Water Monitoring Protocol in **Appendix B**. Digital photographs taken during the assessments may be referenced to corroborate the observations recorded on the field data forms. Equipment logs will be reviewed to ensure equipment has been inspected and calibrated before each sampling event and that any maintenance has been documented. Times recorded on the chain of custody forms will be reviewed to ensure samples have met the requisite holding times. The Ambient Water Quality Monitoring Team Leader will also check data sheets and custody forms to make sure that they have been filled out properly and that samples have met holding times. Laboratory results will be reviewed by the Project Manager / QA Manager to ensure duplicates yield comparable results and that blanks yield zero or “not detected” results. Should lab results show evidence of contamination, the Project Manager may request copies of bench records from the testing laboratory. After laboratory results are reviewed by the Project Manager / QA Manager, they will be distributed to the Ambient Water Quality Monitoring Team Leader for entry into the mastersheet (see section 4.1.1 and 4.2.1).

Secondary Data

Secondary data will be internally quality controlled by PRWC through in-house review conducted by the Project Manager/ QA Manager as described in Section 1.4.2. The PRWC Project Manager will maintain overall responsibility for examining the work to ensure that methodologies and processes are consistent with the procedures outlined in the QAPP and the overall project goals. This will include monitoring secondary data formatting to ensure that the data are consistent and appropriate for inclusion in the Existing Conditions Report either as tabulated or mapped data.

2.5.2 Failures in Quality Control and Corrective Action

The professional judgment of the Project Manager and Visual Assessments Team Leader will be relied upon to evaluate data collected through the visual assessment surveys of watershed conditions. These assessments may be rejected based on whether the information contained in the field forms have been recorded accurately, completely, and in accordance with the methodology cited previously.

Similarly, the professional judgment of the Project Manager and Ambient Water Quality Monitoring Team Leader will be relied upon to evaluate field observations and measurements recorded as ambient water quality samples are collected. These observations may be rejected based on whether the information contained in the field forms have been recorded accurately, completely, and in accordance with the methodology cited previously. For example, field measurements may be rejected if they are not recorded with the requisite digits after a decimal point or equipment logs indicate that meters were not calibrated before the sampling event. Sample testing data is also subject to rejection based on the results associated with blank. If a blank comes back as anything greater than non-detectable, then cross-contamination occurred and none of the data collected that day will be used. Results from the lab may also be rejected if hold times are not met. Should data be rejected, there are not plans to re-sample or re-run the analyses of the samples submitted. Rather, sampling will resume according to the predetermined schedule.

Professional judgment of the QA Manger / Project Manager and Team Leaders will also be relied upon in evaluating secondary data. Rejecting secondary data is a possibility. Evaluation criteria noted previously in this section and in Section 1.4.2 will be used for data review. Notations of secondary data failing to meet DQOs will be noted in the final deliverables.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

(Element B6)

The Visual Assessments Team Leader and Ambient Water Quality Monitoring Team Leader will be responsible for respectively noting and reporting issues or problems to the Project Manager or QA Manager. Any routine maintenance will be performed by the field personnel in accordance with their respective equipment manuals (**Appendix C**).

Maintenance logs for field equipment will be submitted to and kept by the QA Manager. The log entry will include:

- Name of person maintaining the instrument/equipment.
- Date and description of maintenance procedure.
- Date and description of any instrument/equipment problems.
- Date and description of actions to correct problems.
- List of follow-up activities after maintenance.
- Date next maintenance will be needed.

List of Instruments and Equipment

- **GPS unit** testing, inspection and maintenance will be performed according to manufacturer recommendations, as described in the User Manual (**Appendix C**) and includes checking things such as battery life and coordinate system settings.
- **Digital cameras** will be inspected before each use for battery life and sufficient storage.
- **Tablets** will be inspected and maintained before each use for battery life, sufficient storage, operating system updates, and updates to relevant Apps.
- **Digital thermometers** will be inspected before each use for battery life and setting to report in Celsius.
- **Conductivity meters** will be inspected before each use for battery life and condition of probe/electrode and will be tested and calibrated against standard solutions.

2.7 Instrument/Equipment Calibration and Frequency

(Element B7)

A handheld GPS unit will be used to record locations during the visual assessment surveys. The Garmin eTrex 22x can only be calibrated by the manufacturer. Thus, verification that the GPS unit is operating properly will be done by turning the unit on at the PRWC office, going outside and recording three waypoints scattered throughout the office complex. These waypoints will be downloaded in a KML format to be uploaded into Google Earth ensure they generally align to proximity of the office complex as shown in the satellite imagery. Should batteries be changed during the field day, this process will be repeated upon return to the office. The User Manual for the GPS unit is included in **Appendix C** of this QAPP.

Digital thermometers will be inspected before each use for battery life and settings to report in Celsius. Digital thermometers used for this project are NSIT-certified with +/- 1°C accuracy rating. At the beginning of the season and end of the sampling season the thermometer will be tested for accuracy against an ice bath at freezing temperature.

Conductivity meters will be inspected and calibrated within 24 hours of each round of ambient monitoring. They will be inspected for battery life and condition of probe/electrode and will be tested and calibrated against standard solutions. Chemicals used for conductivity meter calibration will be replaced according to expiration dates provided by the manufacturer.

2.8 Inspection of Supplies and Consumables

(Element B8)

All supplies for field activities will be organized and inspected respectively by the Field Assessment Team Leader or the Ambient Water Quality Monitoring Team Leader for compliance with the acceptance criteria and to make sure supplies and equipment are stocked and in proper working order prior to field work activities. Instruments and equipment requiring additional inspection, maintenance, and calibration are described in Sections 2.6 and 2.7.

Supplies needed for visual assessment surveys include:

- Field Data Forms
- Maps
- Tape measure / Stadia rod
- GPS unit
- Log Books
- Digital cameras
- Life preservers (PFDs)
- Waders
- Pens/Pencils
- Safety vests

Supplies needed for ambient water quality monitoring include:

- Sterilized sample bottles provided by testing lab
- Cooler
- Ice / Frozen Ice Packs
- Distilled water
- Conductivity meter
- Thermometer
- Bucket with rope (x2)
- Waders/boots
- Nitrile gloves
- Clip board
- Field data sheets (as back-up in case tablet malfunctions)
- Chain of custody forms
- Pens/Sharpie/pencils
- Charged Tablet and car charger
- Safety Vests
- Traffic Cone(s)
- Digital Camera
- GPS Unit
- Disinfecting wipes
- Towel

The Visual Assessments Team Leader is responsible for maintaining the supplies needed for visual assessment surveys. The Ambient Water Quality Monitoring Team Leader is responsible for maintaining the supplies needed for ambient monitoring. Supplies or consumables not meeting the acceptance criteria upon inspection will not be used. Any equipment determined to be in unacceptable condition will be repaired or replaced. The field supplies and replacement parts associated with the permanent field equipment may require replacement of worn, broken, or expendable components such as batteries, electrodes, or charging cords. Any replacement parts for field equipment will be ordered and replaced by the Project Manager where possible; otherwise by the manufacturer. Supplies and consumables will be stored in accordance with identified requirements for each item. Specifically, chemicals used for conductivity meter calibration will be stored and replaced according to instructions and expiration dates provided by the manufacturer. Discarded chemicals will also be disposed of according to instructions provided by the manufacturer. Hazardous waste disposal is not anticipated, but any hazardous chemicals will be disposed of through local hazardous waste collection events (there are three such hosted annually by the NVCOG which covers the region where the PRWC office is located). A fresh, factory-sealed bottle of distilled water will be provided for each sampling round to fill field blanks.

2.9 Data Acquisition Requirements (Non-Direct Measurements)

(Element B9)

Secondary Data

Available information on water quality and land use within the Pomperaug River Watershed will be compiled, reviewed and summarized by PRWC. Acceptability of non-direct (secondary) data is described in Section 1.4.2. Both tabulated and graphical summaries of non-direct data will be produced with supporting narrative for inclusion in the Existing Conditions Report.

Since the ECR is intended to address data gaps that were identified in the development of the Pomperaug Watershed Based Plan (2018), new data will be categorized as those that have become available after 2016 (the year the WBP project commenced). New data will be summarized and compared to data found in the older references included within the WBP including those upon which the water quality impairments designations were made. There are no specific criteria for the number of years of data needed nor is there uniformity in the datasets available and the intervals at which they are collected.

Secondary data will be obtained from federal and state agencies, regional authorities and municipalities and others to characterize historic and existing conditions in the watershed. Data sources include, but are not limited to the following:

- Available water quality monitoring data for the watershed collected by PRWC, CT DEEP, United States Geological Survey (USGS), other non-profits including academia, and municipalities. As bacteria indicator data can change from day to day, these datasets will only be used in reference to understand past conditions and to consider if there may be locations where bacteria may chronically be loading to a stream.
- Statewide TMDL Bacteria for the Pomperaug and Weekeepeemee (CT DEEP).
- Pomperaug Watershed Based Plan (Fuss & O'Neill / PRWC 2018).
- Land use and land cover data (either parcel-based land use available from the Naugatuck Valley Council of Governments (NVCOG) or UConn Center for Land Use Education and Research (CLEAR) satellite-derived land cover data).
- Riparian Land Cover Change Analysis, Agricultural Lands Analysis, Forest Fragmentation Analysis, and Land Cover Change Analysis (UConn CLEAR - 1985 to 2010).
- Land Use, Open Space, Zoning, and Parcel Maps (NVCOG).
- Information compiled by PRWC, NVCOG, and other non-governmental organizations.
- Municipal planning documents.
- Published, peer-reviewed studies of pollutant loads from different land uses.

CTDEEP'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 secondary watershed data. The GIS data will be supplemented with GIS mapping available from the watershed municipalities and NVCOG, as necessary.

Generally, 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 any other deliverables. Acceptability criteria for secondary data are detailed in Sections 1.4.2 and 2.5 of this QAPP.

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

2.10 Data Management

(Element B10)

This section defines the specific policies, organization, and procedures related to data management. The following data handling equipment, hardware and software are anticipated to be used in organizing, storing, analyzing, and mapping data associated with this project:

- Desktop computers using the Windows 10 or later operating system.
- Microsoft Office Excel 2007 or later version or Google Sheets equivalent.
- ArcGIS software v10 or later version.
- EpiCollect5 App or later version.
- Cloud-based file storage on Google Drive.

Ultimately, the data management system that will be used for electronic data management is Microsoft Excel.

2.10.1 Data and Information Management

Visual Assessments Data

Items that require data management which are collected or generated in the field by the Visual Assessments Team are field notebooks and field data forms.

Following visual assessment activities, field data (including visual assessment data forms and field notebook copies) will be forwarded to the Project Manager / QA Manager, who is responsible for reviewing the field data for accuracy and completeness. Accuracy and completeness, as defined herein, means that the requested information was collected appropriately and that the site IDs, date collected, etc. are correctly identified on the field forms. If any field data forms are incorrect, incomplete, or missing, the package of data forms will be returned to field personnel for completion and/or correction. Once finalized and approved, originals will be scanned and stored in PDF format in PRWC's electronic files. Original hard copies of field data forms and field notebooks will be retained by the Visual Assessments Team Leader in a location accessible to the Project Manager / QA Manager. The Project Manager will supervise the scanning of all field forms and field notebooks associated with visual assessments surveys. The scanned copies will be stored in PDF format in a dedicated project subdirectory within PRWC's central electronic file storage system.

Ambient Water Quality Monitoring Data

Items that require data management which are collected or generated in the field by the ambient water quality monitoring team are field data sheets (and/or entries made and uploaded within the EpiCollect5 App installed on the field tablet), field notebooks, and chain of custody forms. Other items that require data management are testing results provided by the laboratory.

Following ambient monitoring activities, completed field data sheets (or uploaded entries in the EpiCollect5 App) and chain of custody forms will be forwarded to the Project Manager / QA Manager, who is responsible for reviewing the field data for accuracy and completeness. Accuracy and completeness, as defined herein, means that the requested information was collected appropriately and that the site IDs, date collected, etc. are correctly

identified on the field forms. If any field data forms are incorrect, incomplete, or missing, the package of data forms will be returned to field personnel for completion and/or correction. Field notebook copies will also be forwarded to the Project Manager on request. Once finalized and approved, originals will be scanned and stored in PDF format in PRWC's electronic files. Original hard copies of field data sheets and chain of custody forms will be stored in a central binder organized by sample date. The binder will be retained by the ambient monitoring team leader in a location accessible to the Project Manager / QA Manager. The Project Manager will supervise the scanning of all field forms and field notebooks associated with visual assessments. Data recorded on printed field data sheets will be entered into the EpiCollect5 App, which stores entries in a "mastersheet" within their platform which is Google-based (essentially Google Sheets which is equivalent to and compatible with Microsoft Excel). Access to edit the mastersheet requires a user login controlled by the Project Manager. The mastersheet is, however, publicly viewable and provisional data may be downloaded or exported to Excel for use by project staff. For final reporting project staff will only use data that has passed QC criteria.

Sample testing results will be provided to the Project Manager / QA Manager by email in PDF format. The results will be printed and hard copies will be stored in the central binder organized by date. The PDF files will also be saved in PRWC's electronic files. Results reported by the laboratory will be entered into the mastersheet in EpiCollect5.

Non-Direct Data / Secondary Data

The format of secondary data is expected to vary. As such, the following data handling equipment, hardware and software are anticipated to be used in the acquisition and management of secondary data:

- Desktop computers using the Windows 10 or later operating system.
- Microsoft Office Excel 2007 or later version.
- ArcGIS software v10 or later version.

2.10.2 Electronic Data Management

The general approach to data storage and retrieval of electronic media is as follows:

- Secondary data will be downloaded from the federal and state agencies websites directly or via FTP by PRWC. In some cases, data may have to be ordered for electronic delivery via email or FTP.
- Electronic copies of all project data files will be centrally stored in separate project subdirectories by PRWC.
- PRWC will conduct weekly cloud storage backup of all centrally stored electronic files.
- At the conclusion of the project, electronic copies of all files will be written to CD or USB storage drive for archival storage.

SECTION C – ASSESSMENT AND OVERSIGHT

3.1 Assessment/Oversight and Response Action

(Element C1)

The PRWC Project Manager / QA Manager is responsible for determining the need for and implementation of any corrective action measures to the visual assessments or ambient monitoring procedures. Corrective actions will be implemented upon the identification of problems discovered through system audits by field data sheet review or monitoring oversight. If a problem is identified, the QA Manager will:

- Document the findings of any problems.
- Evaluate the problem in accordance with data quality objectives.
- Determine whether implementation of corrective action is required.
- Assign and implement a corrective action.
- Evaluate the effectiveness of the corrective action.
- Document the corrective actions.

The following is a list of possible occurrences that may require corrective action and the corresponding action that would likely take place.

- If visual assessments of watershed conditions are not logged properly in the field data forms or do not follow the methodology outlined in the QAPP these forms will be flagged by the Visual Assessments Team Leader and Project Manager.
- If field observations of sampling conditions are not recorded properly on the field data sheets or do not follow methodology outlined in the QAPP, these forms will be flagged by the Ambient Water Quality Monitoring Team Leader and Project Manager. Similarly data will be flagged if field blanks yield results indicative of cross contamination.

CTDEEP may implement, at their discretion, various audits or reviews of this project to assess conformance and compliance to the quality assurance project plan in accordance with the CTDEEP Quality Management Plan.

3.2 Reports to Management

(Element C2)

Field data forms and monitoring results that have passed preliminary quality control analysis may be submitted to the CTDEEP and EPA. A caveat will accompany these or any data released on a preliminary basis, explaining that they are for review purposes only and subject to correction after completion of a full data review occurring at the end of the program.

All reports, preliminary or final, will include discussion of steps taken to assure data quality, findings on data quality, and decisions made on questionable data.

SECTION D – DATA VALIDATION AND USABILITY

4.1 Data Review, Verification and Validation

(Element D1)

4.1.1 Direct Data Measurements

Visual Assessment Surveys

Review, verification, and validation is a multi-step process to protect the integrity of the data collected during the visual assessments of watershed conditions and will reduce the number of field data forms that do not meet the DQOs. Verification of the visual assessments will occur at the field level.

The field data forms will be reviewed after the visual assessment date by the QA Manager / Project Manager using all available QC data. Deviations will be flagged. Incomplete data will be noted, as necessary. 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 should be made by the Project Manager / QA Manager.

Ambient Water Quality Monitoring

Review, verification, and validation is a multi-step process to protect the integrity of the data collected as part of the ambient water quality monitoring and will reduce the number of field data forms and testing results that do not meet the DQOs.

Verification of the field data sheets and chain of custody forms will occur at the field level. The field data sheets and chain of custody forms will be reviewed after the visual assessment date by the QA Manager / Project Manager using all available QC data. Deviations will be flagged. Incomplete data will be noted, as necessary. 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.

Verification of laboratory data will occur at the QA Manager / Project Manager level who will review sample testing results using all available QC data. Deviations will be flagged. Incomplete data will be noted, as necessary. QC results that deviate from the data quality objectives will call into question the validity of all lab data reported in that round of sampling.

The final decision on whether to include or reject results reported by the testing laboratory should be made by the Project Manager / QA Manager.

4.1.2 Non-Direct Measurement Data (Secondary Data)

The Project Manager / QA Manager will be responsible for review, verification and validation of secondary data. The review will be conducted to both protect the integrity of the data and make sure that data was used appropriately to support the goals of the project. The review of secondary data will be conducted at the end of the existing conditions background data collection process. The Project Manager / QA Manager will confirm that secondary data was collected consistent with the data decision process described in this QAPP. Any data not meeting the criteria will be reviewed by the Project Manager / QA Manager and either removed from use or flagged in the dataset, with the appropriate qualifying description, for use in the report deliverables.

4.2 Verification and Validation Methods

(Element D2)

4.2.1 Direct Data Measurements

Visual Assessment Surveys

Data quality measures for visual 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 visually comparing a hard copy of field data forms with the information scanned electronically into PDF format. This process will ensure that data has been accurately scanned into the PRWC computer system.

Ambient Water Quality Monitoring

Data quality measures for ambient monitoring will be compared to applicable data quality objectives. The verification process for the completed field data sheets and chain of custody forms will involve the Project Manager visually comparing a hard copy of field data forms with the information scanned electronically into PDF format. This process will ensure that data has been accurately scanned into the PRWC computer system.

To the maximum extent practicable, field measurements and field observations associated with ambient water quality monitoring will be entered/recorded directly in the EpiCollect5 App installed on the field tablet. This will help minimize data entry errors and omissions that could occur when entering data recorded on printed field data sheets into the mastersheet.

Results from sample analyses performed by the testing lab will need to be entered manually into the mastersheet based on the reporting format anticipated from the laboratory. To ensure accuracy of these entries, 10% of entries will be audited to ensure data has been entered correctly. This audit will occur at the end of the field season and will be conducted by the QA Manager. If an inaccurate entry is found, all mastersheet entries will be verified with the original corresponding reports received from the laboratory.

4.2.2 Non-Direct Data Measurements (Secondary and Mapping)

The Project Manager / QA Manager will perform visual inspection of data before including it in deliverables. The following will be observed for secondary data validation:

- A copy of every secondary data set will be saved as a read-only, protected file to be used in the event that the integrity of the working dataset is compromised.
- Working data will be stored in a spreadsheet or ArcGIS format and will include relevant raw data, which will be locked for editing.
- Data manipulation will be minimized, but when necessary, data manipulation will start with raw data, and all calculations, including units, conversion factors, and formulas will be shown in the spreadsheet.

- Prior to including in project deliverables, raw and reduced data will be displayed in graphic format and inspected to look for anomalous values. Any decision to eliminate anomalous values will be documented in the spreadsheets and will be noted in the project deliverables.

Any concerns regarding secondary data will be communicated to the project team. If necessary, data qualifiers for secondary data will be documented in accordance with this QAPP and limitations will be identified, as appropriate, in project deliverables.

4.3 Reconciliation with User Requirements

(Element D3)

Direct Measurements Data

After reviewing the DQOs outlined in Section 1.4 related to visual assessments and ambient water quality monitoring, the Project Manager and QA Manager will evaluate overall program attainment for the direct data acquisition. Ultimately data generated and acquired under this QAPP will be summarized in an Existing Conditions Report that will be shared with stakeholders of the Pomperaug Watershed communities and developed into an Implementation Strategy. For these purposes, data will be tabulated and/or graphically displayed or mapped and supported by narrative. “Raw” data generated through the direct measurements that meet QC criteria will also be provided to CT DEEP and/or EPA in agreed upon formats.

Non-Direct Measurements (Secondary and Mapping)

Once secondary data collection and modeling are complete, the resulting data sets will be compared with the DQOs for secondary and modeling data outlined in Section 1.4. This will include an assessment of the secondary data characteristics relative to the data decision tree in Section 1.4 and will include a narrative summary of the following:

- Number of data sets used that had full references.
- Number of data sets used with disclaimers.

After the review of secondary data DQO and modeling performance, the Project Manager and QA Manager will evaluate overall program attainment for the secondary data.

SECTION E - REFERENCES

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APPENDIX A

Visual Assessment Surveys SOPs

*Center for Watershed Protection User Manuals
(with supporting overview)*

Unified Stream Assessment (USA)
Unified Subwatershed and Siteeonnaissance (USSR)

Field Data Forms

Unified Stream Assessment (USA)
Unified Subwatershed and Siteeonnaissance (USSR)

Equipment Checklist

Field Notebooks

Field Safety Considerations

APPENDIX B

PRWC's Ambient Water Quality Monitoring Protocol

NOTE: This protocol contains its own supporting appendices

*Field Data Sheet and Chain of Custody
PRWC's EpiCollect5 App User Guide
Equipment Technical Specifications & User Manuals*

APPENDIX C

Equipment Manuals & Specifications

Oakton CTS Testr® 50P (“conductivity meter”)

Long-stream Traceable® Thermometer

Lenovo tab (2nd Generation) M10 FHD PLUS (“tablet”)

Garmin eTrex® 22x Handheld GPS (“GPS unit”)

APPENDIX D

Hydro Technologies, LLC Laboratory Standard Operating Procedures

SPO Bio-P/A & QT by 18h Colilert (SM 9223)

SOP Nitrate & Nitrite by EPA 353.2

APPENDIX A

Visual Assessments Surveys SOPs

*Center for Watershed Protection User Manuals
(with supporting overview)*

Unified Stream Assessment (USA)
Unified Subwatershed and Site Reconnaissance (USSR)

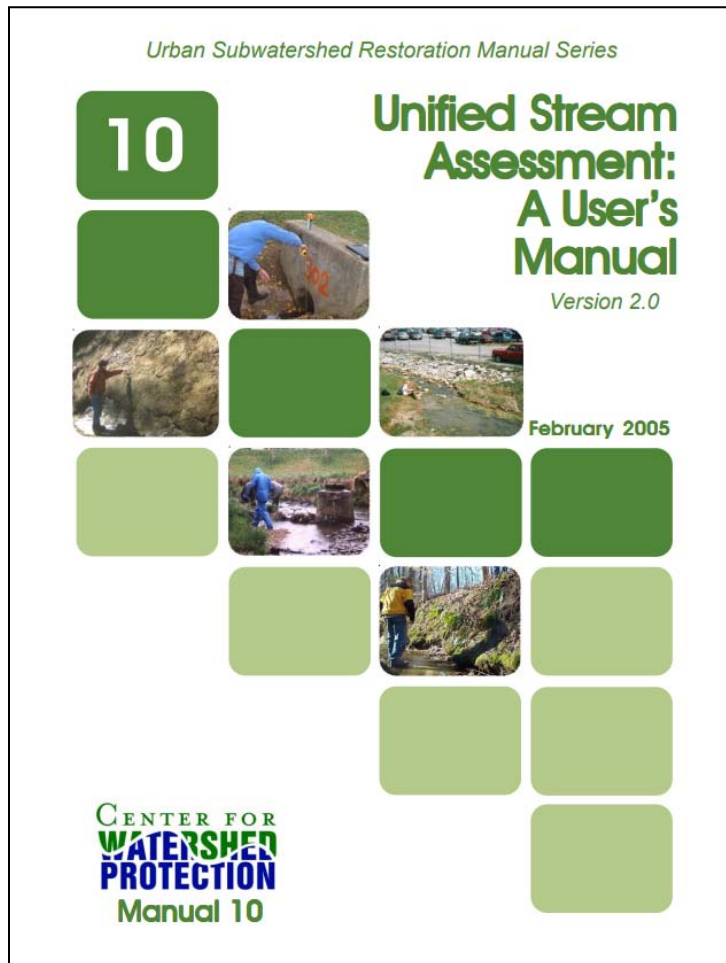
Field Data Forms

Unified Stream Assessment (USA)
Unified Subwatershed and Site Reconnaissance (USSR)

Equipment Checklist

Field Notebooks

Field Safety Considerations



Download of the complete Unified Stream Assessment (USA) User Manual is available from the Center for Watershed Protection's Online Watershed Library at: <https://owl.cwp.org/mdocs-posts/urban-subwatershed-restoration-manual-series-manual-10/>

Unified Stream Assessment Overview

Visual assessments surveys will be completed along the impaired reach of the Weekepeemee River as part of an effort to locate sources of impairments and identify potential pollution (i.e. pathogens and nutrients) reduction projects. These surveys will be conducted according to the Unified Stream Assessment (USA) method developed for small urban watersheds by the Center for Watershed Protection.

Table 1

Why Use the USA?	
<ul style="list-style-type: none">• Cheap, fast• Applies to all kinds of streams—rural and highly urban• One of two basic tools used to initially assess restoration potential in the field• Can and should be adapted to local needs• Identifies problems in the stream corridor• Collects basic feasibility factors on “restorability”• Helps assemble initial inventory of stream corridor restoration sites, such as:	
<i>Discharge investigations</i>	<i>Stream cleanup sites</i>
<i>Stream daylighting projects</i>	<i>Fish barrier removal projects</i>
<i>Storm water retrofits</i>	<i>Culvert repair/replacement sites</i>
<i>Local stream repair/outfall stabilization</i>	<i>Natural channel design</i>
<i>Bank stabilization or grade control</i>	<i>De-channelization</i>
<i>Buffer reforestation</i>	<i>Riparian wetland restoration</i>
<i>Structural repairs to sewer lines</i>	<i>Enforcement actions</i>

Source: *Unified Stream Assessment: A User’s Manual*,
February 2005, Center for Watershed Protection.

The USA is a continuous stream walk that systematically evaluates conditions of the stream channel needed to identify restoration opportunities, including storm water retrofits, stream restoration, riparian management, and discharge prevention. Field assessment forms are used to document conditions, problems, and possible restoration/improvement actions. Eight Impact Assessment Forms collect specific information about the condition and restorability of individual problem sites identified along the stream corridor. They include Stormwater Outfalls, Severe Erosion, Impacted Buffers, Utility Impacts, Trash and Debris, Stream Crossings, Channel Modification, and Miscellaneous Issues. A Reach Assessment Form is used to summarize overall physical conditions of the entire survey reach. Photographs are taken in support of the assessments and are documented on a Photo Inventory form. Standardized collection forms will promote consistency and help establish quality control for data collection.

The USA method was chosen due to its direct applicability to the goals of developing an updated existing conditions report and Implementation Strategy. It thoroughly covers potential stream impacts and concerns that we expect to encounter. The USA is a proven method that has been used successfully by others; and its focus on identifying not only impacts but also restoration opportunities makes it ideal for the end goal of developing pollution reduction projects.

1. Pre-field Preparation

Prior to conducting the surveys, the Visual Assessments Team and Team Leader (“Field Team”) will be established and trained, supplies gathered and organized, survey reaches defined, field maps generated, assessment routes and schedules planned, and the public/ streamside landowners notified about the surveys. Aerial photos, topographic maps, and existing data about known problem areas will be reviewed to assist in defining survey reaches of uniform character and to familiarize field staff with the area to be surveyed. Each reach will be assigned an identification number. Reaches will be about 1 linear mile of stream, depending on access points.

PRWC staff will work with local town governments to publicize the survey project in advance through some form of public notification (e.g. letters to streamside landowners) and notify the local police department when surveys are to be conducted. The Visual Assessments Team will carry several copies of an official municipal notice / authorization letter explaining the survey project and field activities, and providing a contact number for more information while conducting their field work. Copies of the letter can be provided to any private landowners. Should a private landowner request that field teams leave and not survey their property, the field team will comply with the request and leave the private landowner’s property.

2. Stream Corridor Assessment

Field surveys will be conducted by the trained Visual Assessments Team and Team Leader. Surveys will be conducted on foot or by boat, as necessary. Field Teams of two or three people will conduct the surveys during July, August and September when water flows are lower, making it both possible and safe to walk in the stream along most reaches. At this time, potential concerns (e.g. excessive algal growth, increased deposition, bank scouring, open canopy) are also more visible. Initial surveys will be conducted during dry weather conditions to eliminate the possible effects that a rain event may have on normal conditions, such as washing away algae, or obscuring the presence of aquatic vegetation, or making it difficult to determine normal turbidity, water levels or water color. However, if further investigation is required to determine possible nonpoint sources, these may be conducted during or following rainstorms.

Field Team responsibilities are divided as follows: one team member will focus on the reach assessment and impact assessments, and the other will focus on taking photos and recording GPS locations. Field Teams will walk up the stream corridor, but face downstream when determining right/left bank problems. Individual impact sites are mapped and photographed as they are encountered, and impact assessment forms completed and ID numbers assigned. The location and ID are drawn on the reach diagram located on the reach assessment form.

Reach Assessment Forms are completed after walking the entire survey reach. If conditions vary too much to assign an average, the survey reach will be divided into more uniform segments for the purposes of completing the Reach Assessment Form.

Any observed sewage discharge / septic failure or other significant pollution event will be reported immediately to municipal public health officials, the PRWC Project Manager, CTDEEP Project Managers, and the appropriate CT DEEP inspection and enforcement staff. Field Teams will be provided with all necessary contact information.

Table 2

Components of the USA
<p>Impact assessments are site-specific and record data on condition and “restorability” at each problem site. Impact forms comprise an initial inventory of restoration opportunities. The eight impact assessment forms are as follows:</p> <ul style="list-style-type: none"> • Outfalls (OT)—<i>all storm water and other discharge pipes</i> • Severe erosion (ER)—<i>bank sloughing, active widening or incision</i> • Impacted buffer (IB)—<i>lack of natural vegetation, width</i> • Utilities in the Stream Corridor (UT)—<i>leaking sewer, exposed pipes susceptible to damage</i> • Trash and Debris in the Stream Corridor (TR)—<i>trash and illegal dumping</i> • Stream Crossing (SC)—<i>culverts, dams, natural features, etc.</i> • Channel Modification (CM)—<i>straightening, channelization, dredging, etc.</i> • Miscellaneous (MI)—<i>unusual features or conditions</i> <p>The reach level assessment (RCH) form characterizes the average physical conditions over the entire survey reach. The RCH tracks individual problem sites and provides information used to compare reach quality throughout the entire stream corridor.</p> <ul style="list-style-type: none"> • Reach Level Assessment (RCH)—<i>average bank stability, in-stream habitat, riparian vegetation, flood plain connectivity, access, flow, and substrate over the entire reach.</i>

Source: *Unified Stream Assessment: A User’s Manual*, February 2005, Center for Watershed Protection.

The USA method consists of nine stream corridor assessments: eight impact assessments and an overall reach assessment. They are summarized in Table 2. One impact assessment form is completed for each impacted site, and a reach assessment form is completed for each reach. Photographs are documented on a photo inventory form as they are taken in the field and cross referenced to impact assessment or reach assessment forms using the date, stream/reach, a location ID and photo number.

The information collected for each of the nine impact assessments and the reach assessment, as well as associated restoration practices, is summarized in Table 3.

3. Data compilation & Reporting

Survey data will be compiled in a GIS database and mapped with input from DEEP staff. Data will be entered immediately after fieldwork is completed, and spot checked by the PRWC QA Manager / Project Manager. Field Team members will review draft stream corridor maps with site impact assessment locations and survey reach scores to identify inaccuracies in data entry and any gaps in stream corridor coverage.

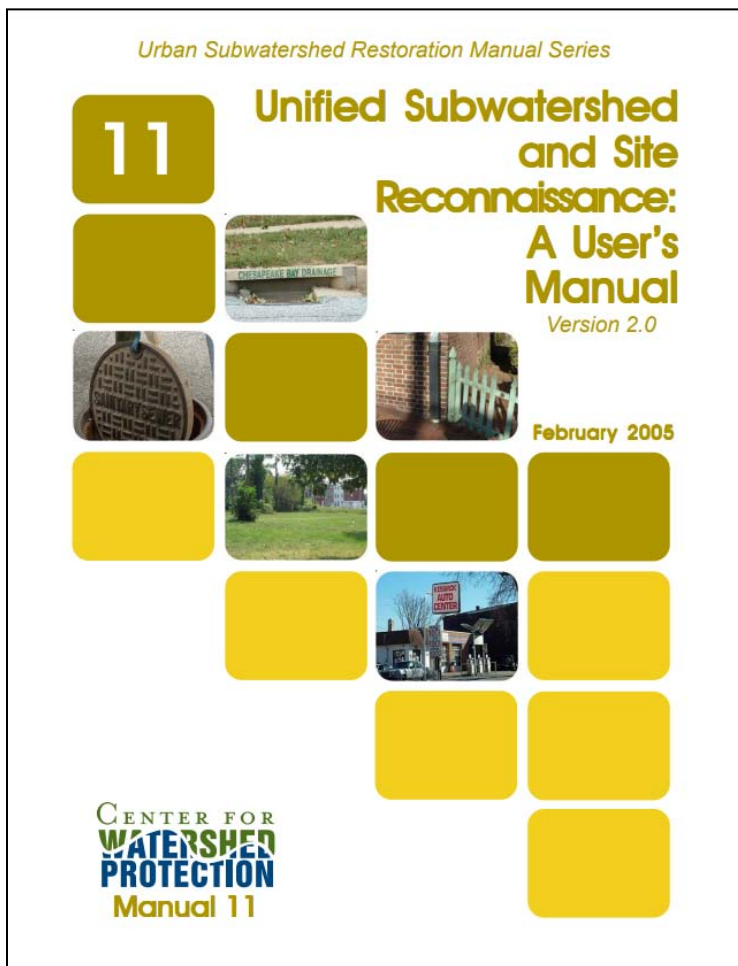
USA data will be used to create detailed maps of the stream corridor showing degraded and non-impacted reaches, and location of problem areas and restoration candidates.

For the purposes of this project, Stream Crossings will not be documented.

Table 3

USA Impact and Reach Assessment Forms and Restoration Practices		
Assessment Form	What It Assesses	Information Collected <i>(In addition to photo & GPS)</i>
Outfalls (OT)	All discharge pipes or channels that discharge storm water or wastewater.	Basic type, source, and condition. If flowing, then flow conditions should be recorded and potentially reported to authorities.
Severe Bank Erosion (ER)	Slope failures, bank sloughing, head cuts, and incision or widening in areas noticeably worse than the average erosive condition of the survey reach. Also infrastructure or property threatened by erosion.	Location (meander or straight section), threat to property or infrastructure, accessibility; and basic bank measurements (height, angle, and bottom and top widths).
Impacted Buffer (IB)	Corridor lengths >100 feet long that lack at least a 25 feet wide, naturally-vegetated riparian buffer on one or both sides of stream.	Diversity and density of vegetation, flood plain conditions, adjacent land use, available area for reforestation
Utilities in Stream Corridor (UT)	Leaking or exposed sewer, water, or other utility lines causing water quality, habitat, or channel stability problems. Includes manhole stacks, pipes along bottom, in the bank, or above the stream susceptible to damage due to lack of maintenance or exposure.	Type, condition, and discharge characteristics associated with leaks (odors, color, etc). If leaking, report immediately to authorities. Record relevant information if potential fish barrier (see SC)
Stream Crossing (SC)	All man-made or natural structures that cross the stream, such as roadways, bridges, railroad crossings, or dams. Pipe crossings and other overhead utilities are assessed under UT.	Type of crossing, culvert dimensions, relative information if suspected fish barrier (6" water drop, or less than ½" water depth during normal flow conditions)
Channel Modification (CM)	Channelized, concrete-lined, or reinforced sections of stream >50 feet in length, regardless of construction material used. Locations of existing stream restoration or bank stabilization projects included. Enclosed sections are assessed under SC or OT.	Type of modification, length of stream impacted
Trash and Debris (TR)	Areas of significant trash and debris accumulation greater than average levels observed across the survey reach. Any areas where potentially hazardous or unknown chemicals have been dumped.	Mobility, dispersal, amount and type of trash; level of effort and type of equipment required for removal; location on public or private property
Misc. Impacts (MI)	High quality areas or unusual feature or activity impacting the stream corridor that doesn't fit into other seven impact assessments. This may include fish kills, cattle access, near stream construction, flood plain excavation, adjacent wetlands, grade controls, or other notable features.	
Reach Level (RCH)	Average characteristics for each survey reach. Tracks locations of impact assessments; used for screening restoration opportunities and for comparing reaches across the subwatershed.	

Source: *Unified Stream Assessment: A User's Manual*, February 2005, Center for Watershed Protection.



Download of the complete Unified Subwatershed and Site Reconnaissance User (USSR) User Manual is available from the Center For Watershed Protection's Online Watershed Library at:

<https://owl.cwp.org/mdocs-posts/urban-subwatershed-restoration-manual-series-manual-11/>

Unified Subwatershed and Site Reconnaissance Overview

If stream corridor surveys or Ambient Water Quality Monitoring results indicate the need for further investigations, possible upland sources will be assessed using CWP's Unified Subwatershed and Site Reconnaissance (USSR) method. The USSR is a rapid field survey to evaluate potential pollution sources and restoration opportunities within urban subwatersheds. As with the USA, the USSR method was chosen due to its direct applicability to the goals of the track down survey effort. The USA and USSR are complimentary survey systems that address both stream corridors and their associated uplands.

The USSR is comprised of four major assessment components which are represented by four field forms. The Neighborhood Source Assessment (NSA) looks within individual neighborhoods for pollution source areas, stewardship behaviors, and residential restoration opportunities. The Hotspot Site Investigation (HSI) ranks the potential severity of hotspots within a subwatershed. Pervious Area Assessments (PAA) evaluate the potential to reforest turf areas or restore remnants of natural areas at all open parcels within the subwatershed. The Streets and Storm Drains (SSD) assessment measures the average pollutant accumulation in the streets, curbs, and catch basins of a subwatershed, and looks at potential for on-site retrofits for parking lots.

The USSR consists of three phases: Desktop Analysis; Field Survey; and Post-field Analysis. These three phases are broken into seven steps as detailed in Table 4.

Table 4

Seven Steps of the USSR		
Pre-Field	Step 1: Gather required information	NPDES permittees Existing neighborhood maps Municipal maintenance schedule for roads Census data List of HOA and contact information Current development projects Mapping data and aerial photographs
	Step 2: Generate field maps	Delineate subwatersheds Delineate residential neighborhoods Review environmental databases for regulated hotspots Perform business permit review for additional hotspots Put together emergency contact list
Field	Step 3: Conduct the USSR	Drive all roads Evaluate residential neighborhoods (NSA form) Survey all hotspot locations (HSI form) Complete PAA form for all pervious area sites Complete SSD form at select storm drains Take photos and GPS readings
	Step 4: Verify data/maps	Rectify differences between pre-fieldwork maps and field notes Identify additional data to be collected
Post-Field	Step 5: Data entry	Enter data from field forms into a spreadsheet or GIS. This involves downloading GPS unit and digital cameras (or getting film developed), and recording details on field maps
	Step 6: Produce list and map of candidate sites for each subwatershed	Screen retrofit, restoration, and pollution prevention projects to identify sites where further investigation is needed
	Step 7: Compile data for all subwatersheds into a single table	Develop subwatershed metrics to develop initial restoration strategy

Source: *Unified Subwatershed and Site Reconnaissance: A User's Manual*, February 2005, Center for Watershed Protection.

The USSR method consists of four major assessments: Neighborhood Source Assessment, Hotspot Site Investigation, Pervious Area Assessment, and Streets and Storm Drains assessment. One field form is completed for each impacted site. Sites for USSR surveys will be identified based on a number of criteria as seen in Table 5.

Table 5

Selection Criteria for USSR Site Assessment		
USSR Field Form	Land Use	Selection Criteria
NSA	Residential	Visit all neighborhoods and sample a subset of individual homes
HSI	Commercial	Visit all regulated hotspots and priority non-regulated hotspots
	Industrial	
	Institutional	
	Municipal	
	Transport - Related	
PAA	Pervious Areas	Visit all publicly-owned pervious areas > 2 acres and all privately-owned pervious areas > 5 acres
SSD	Streets and Storm Water Conveyance	Evaluate road and storm drain conditions at random, pre-selected points Evaluate all parking lots > 2 acres

Source: *Unified Subwatershed and Site Reconnaissance: A User's Manual*, February 2005, Center for Watershed Protection.

A summary of how information from the four USSR assessments is applied to subwatershed restoration is detailed in Table 6.

Table 6

How the USSR Helps in Subwatershed Restoration	
<u>Neighborhoods</u>	<ul style="list-style-type: none">• Evaluates pollutant-producing behaviors in individual neighborhoods and assigns a pollution severity index for screening purposes• Rates each neighborhood for overall restoration potential and identifies specific restoration projects• Examines the feasibility of on-site storm water retrofits• Indicates restoration projects that may require more direct municipal assistance for implementation (tree planting, storm drain stenciling, etc.)
<u>Hotspots</u>	<ul style="list-style-type: none">• Creates an inventory of storm water hotspots, including regulated and non-regulated sites• Rates the severity of each hotspot with regard to its potential to generate storm water runoff or illicit discharges• Suggests appropriate follow-up actions for each hotspot, including referral for immediate enforcement• Examines the feasibility of on-site storm water retrofits
<u>Pervious Areas</u>	<ul style="list-style-type: none">• Evaluates the current condition of natural area remnants and their potential management needs• Determines the reforestation potential of large pervious areas
<u>Streets and Storm Drains</u>	<ul style="list-style-type: none">• Estimates the severity of pollutant accumulation on roads and within storm drain systems• Assesses large parking areas for storm water retrofit potential• Rates the feasibility of four municipal maintenance strategies

FIELD DATA SHEETS

CWP Unified Stream Assessments
CWP Unified Subwatershed and Site Reconnaissance



SURVEY REACH ID: _____	WTRSHD/SUBSHD: _____	DATE: ___/___/___	ASSESSED BY: _____
START TIME: ___:___ AM/PM LMK: _____	END TIME: ___:___ AM/PM LMK: _____	GPS ID: _____	
LAT ___° ___' ___" LONG ___° ___' ___"		LAT ___° ___' ___" LONG ___° ___' ___"	
DESCRIPTION: _____		DESCRIPTION: _____	

RAIN IN LAST 24 HOURS <input type="checkbox"/> Heavy rain <input type="checkbox"/> Steady rain <input type="checkbox"/> Intermittent	PRESENT CONDITIONS <input type="checkbox"/> Heavy rain <input type="checkbox"/> Steady rain <input type="checkbox"/> Intermittent
<input type="checkbox"/> None <input type="checkbox"/> Intermittent <input type="checkbox"/> Trace	<input type="checkbox"/> Clear <input type="checkbox"/> Trace <input type="checkbox"/> Overcast <input type="checkbox"/> Partly cloudy

SURROUNDING LAND USE: <input type="checkbox"/> Industrial <input type="checkbox"/> Commercial <input type="checkbox"/> Urban/Residential <input type="checkbox"/> Suburban/Res <input type="checkbox"/> Forested <input type="checkbox"/> Institutional
<input type="checkbox"/> Golf course <input type="checkbox"/> Park <input type="checkbox"/> Crop <input type="checkbox"/> Pasture <input type="checkbox"/> Other:

AVERAGE CONDITIONS (check applicable)	REACH SKETCH AND SITE IMPACT TRACKING
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BASE FLOW AS % <input type="checkbox"/> 0-25% <input type="checkbox"/> 50%-75%
CHANNEL WIDTH <input type="checkbox"/> 25-50 % <input type="checkbox"/> 75-100%

Simple planar sketch of survey reach. Track locations and IDs for all site impacts within the survey reach (OT, ER, IB, SC, UT, TR, MI) as well as any additional features deemed appropriate. Indicate direction of flow

DOMINANT SUBSTRATE	
<input type="checkbox"/> Silt/clay (fine or slick)	<input type="checkbox"/> Cobble (2.5 -10")
<input type="checkbox"/> Sand (gritty)	<input type="checkbox"/> Boulder (>10")
<input type="checkbox"/> Gravel (0.1-2.5")	<input type="checkbox"/> Bed rock

WATER CLARITY <input type="checkbox"/> Clear <input type="checkbox"/> Turbid (suspended matter)	
<input type="checkbox"/> Stained (clear, naturally colored)	<input type="checkbox"/> Opaque (milky)
<input type="checkbox"/> Other (chemicals, dyes)	

AQUATIC PLANTS Attached: <input type="checkbox"/> none <input type="checkbox"/> some <input type="checkbox"/> lots
IN STREAM Floating: <input type="checkbox"/> none <input type="checkbox"/> some <input type="checkbox"/> lots

WILDLIFE IN OR AROUND STREAM (Evidence of)
<input type="checkbox"/> Fish <input type="checkbox"/> Beaver <input type="checkbox"/> Deer
<input type="checkbox"/> Snails <input type="checkbox"/> Other:

STREAM SHADING (water surface)
<input type="checkbox"/> Mostly shaded (≥75% coverage)
<input type="checkbox"/> Halfway (≥50%)
<input type="checkbox"/> Partially shaded (≥25%)
<input type="checkbox"/> Unshaded (< 25%)

CHANNEL DYNAMICS	<input type="checkbox"/> Downcutting	<input type="checkbox"/> Bed scour
	<input type="checkbox"/> Widening	<input type="checkbox"/> Bank failure
	<input type="checkbox"/> Headcutting	<input type="checkbox"/> Bank scour
	<input type="checkbox"/> Aggrading	<input type="checkbox"/> Slope failure
	<input type="checkbox"/> Sed. deposition	<input type="checkbox"/> Channelized
<input type="checkbox"/> Unknown		

CHANNEL DIMENSIONS (FACING DOWNSTREAM)	Height: LT bank _____ (ft)
	RT bank _____ (ft)
	Width: Bottom _____ (ft)
	Top _____ (ft)

REACH ACCESSIBILITY		
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<p>Good: Open area in public ownership, sufficient room to stockpile materials, easy stream channel access for heavy equipment using existing roads or trails.</p>	<p>Fair: Forested or developed area adjacent to stream. Access requires tree removal or impact to landscaped areas. Stockpile areas small or distant from stream.</p>	<p>Difficult. Must cross wetland, steep slope, or sensitive areas to get to stream. Few areas to stockpile available and/or located a great distance from stream. Specialized heavy equipment required.</p>
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5 4 3 2 1

NOTES: (biggest problem you see in survey reach)

REPORTED TO AUTHORITIES Yes No

OVERALL STREAM CONDITION				
	Optimal	Suboptimal	Marginal	Poor
IN-STREAM HABITAT <i>(May modify criteria based on appropriate habitat regime)</i>	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
VEGETATIVE PROTECTION <i>(score each bank, determine sides by facing downstream)</i>	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
BANK EROSION <i>(facing downstream)</i>	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Grade and width stable; isolated areas of bank failure/erosion; likely caused by a pipe outfall, local scour, impaired riparian vegetation or adjacent use.	Past downcutting evident, active stream widening, banks actively eroding at a moderate rate; no threat to property or infrastructure	Active downcutting; tall banks on both sides of the stream eroding at a fast rate; erosion contributing significant amount of sediment to stream; obvious threat to property or infrastructure.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN CONNECTION	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) able to enter floodplain. Stream not deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.	High flows (greater than bankfull) not able to enter floodplain. Stream deeply entrenched.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
OVERALL BUFFER AND FLOODPLAIN CONDITION				
	Optimal	Suboptimal	Marginal	Poor
VEGETATED BUFFER WIDTH	Width of buffer zone >50 feet; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, crops) have not impacted zone.	Width of buffer zone 25-50 feet; human activities have impacted zone only minimally.	Width of buffer zone 10-25 feet; human activities have impacted zone a great deal.	Width of buffer zone <10 feet; little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
FLOODPLAIN VEGETATION	Predominant floodplain vegetation type is mature forest	Predominant floodplain vegetation type is young forest	Predominant floodplain vegetation type is shrub or old field	Predominant floodplain vegetation type is turf or crop land
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN HABITAT	Even mix of wetland and non-wetland habitats, evidence of standing/ponded water	Even mix of wetland and non-wetland habitats, no evidence of standing/ponded water	Either all wetland or all non-wetland habitat, evidence of standing/ponded water	Either all wetland or all non-wetland habitat, no evidence of standing/ponded water
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
FLOODPLAIN ENCROACHMENT	No evidence of floodplain encroachment in the form of fill material, land development, or manmade structures	Minor floodplain encroachment in the form of fill material, land development, or manmade structures, but not effecting floodplain function	Moderate floodplain encroachment in the form of filling, land development, or manmade structures, some effect on floodplain function	Significant floodplain encroachment (i.e. fill material, land development, or man-made structures). Significant effect on floodplain function
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
Sub Total In-stream: ____ /80 + Buffer/Floodplain: ____ /80 = Total Survey Reach ____ /160				

WATERSHED:		SUBWATERSHED:		UNIQUE SITE ID:	
DATE: ___/___/___		ASSESSED BY:		CAMERA ID:	
				PIC#:	
A. NEIGHBORHOOD CHARACTERIZATION					
Neighborhood/Subdivision Name: _____				Neighborhood Area (acres) _____	
If unknown, address (or streets) surveyed: _____					
Homeowners Association? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Unknown If yes, name and contact information: _____					
Residential (circle average single family lot size): _____					
<input type="checkbox"/> Single Family Attached (Duplexes, Row Homes) <1/8 1/8 1/4 1/3 1/2 acre		<input type="checkbox"/> Multifamily (Apts, Townhomes, Condos)			
<input type="checkbox"/> Single Family Detached <1/4 1/4 1/2 1 >1 acre		<input type="checkbox"/> Mobile Home Park			
Estimated Age of Neighborhood: _____ years		Percent of Homes with Garages: _____ %		With Basements _____ %	
Sewer Service? <input type="checkbox"/> Y <input type="checkbox"/> N					○
Index of Infill, Redevelopment, and Remodeling <input type="checkbox"/> No Evidence <input type="checkbox"/> <5% of units <input type="checkbox"/> 5-10% <input type="checkbox"/> >10%					○
<i>Record percent observed for each of the following indicators, depending on applicability and/or site complexity</i>			Percentage	Comments/Notes	
B. YARD AND LAWN CONDITIONS					
B1. % of lot with impervious cover					
B2. % of lot with grass cover					
B3. % of lot with landscaping (e.g., mulched bed areas)					
B4. % of lot with bare soil					
<i>*Note: B1 through B4 must total 100%</i>					
B5. % of lot with forest canopy					
B6. Evidence of permanent irrigation or "non-target" irrigation					
B7. Proportion of total neighborhood turf lawns with following management status:			High: _____		○
			Med: _____		
			Low: _____		
B8. Outdoor swimming pools? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell Estimated # _____					
B9. Junk or trash in yards? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C. DRIVEWAYS, SIDEWALKS, AND CURBS					
C1. % of driveways that are impervious <input type="checkbox"/> N/A					
C2. Driveway Condition <input type="checkbox"/> Clean <input type="checkbox"/> Stained <input type="checkbox"/> Dirty <input type="checkbox"/> Breaking up					
C3. Are sidewalks present? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, are they on one side of street <input type="checkbox"/> or along both sides <input type="checkbox"/>					
<input type="checkbox"/> Spotless <input type="checkbox"/> Covered with lawn clippings/leaves <input type="checkbox"/> Receiving 'non-target' irrigation					
What is the distance between the sidewalk and street? _____ ft.					
Is pet waste present in this area? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> N/A					
C4. Is curb and gutter present? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, check all that apply:					
<input type="checkbox"/> Clean and Dry <input type="checkbox"/> Flowing or standing water <input type="checkbox"/> Long-term car parking <input type="checkbox"/> Sediment					○
<input type="checkbox"/> Organic matter, leaves, lawn clippings <input type="checkbox"/> Trash, litter, or debris <input type="checkbox"/> Overhead tree canopy					◇

* INDEX: ○ denotes potential pollution source; ◇ denotes a neighborhood restoration opportunity

WATERSHED:		SUBWATERSHED:		UNIQUE SITE ID:	
DATE: ___/___/___		ASSESSED BY:		CAMERA ID:	
MAP GRID:		LAT ___° ___' ___" LONG ___° ___' ___"		LMK #	
A. SITE DATA AND BASIC CLASSIFICATION					
Name and Address: _____		Category: <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Miscellaneous <input type="checkbox"/> Institutional <input type="checkbox"/> Municipal <input type="checkbox"/> Golf Course <input type="checkbox"/> Transport-Related <input type="checkbox"/> Marina <input type="checkbox"/> Animal Facility			
SIC code (if available): _____		Basic Description of Operation: _____			
NPDES Status: <input type="checkbox"/> Regulated <input type="checkbox"/> Unregulated <input type="checkbox"/> Unknown		INDEX*			
B. VEHICLE OPERATIONS <input type="checkbox"/> N/A (Skip to part C)				Observed Pollution Source? <input type="checkbox"/>	
B1. Types of vehicles: <input type="checkbox"/> Fleet vehicles <input type="checkbox"/> School buses <input type="checkbox"/> Other: _____					
B2. Approximate number of vehicles: _____					
B3. Vehicle activities (circle all that apply): Maintained <input type="checkbox"/> Repaired <input type="checkbox"/> Recycled <input type="checkbox"/> Fueled <input type="checkbox"/> Washed <input type="checkbox"/> Stored <input type="checkbox"/>					
B4. Are vehicles stored and/or repaired outside? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
Are these vehicles lacking runoff diversion methods? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
B5. Is there evidence of spills/leakage from vehicles? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
B6. Are uncovered outdoor fueling areas present? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
B7. Are fueling areas directly connected to storm drains? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
B8. Are vehicles washed outdoors? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
Does the area where vehicles are washed discharge to the storm drain? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C. OUTDOOR MATERIALS <input type="checkbox"/> N/A (Skip to part D)				Observed Pollution Source? <input type="checkbox"/>	
C1. Are loading/unloading operations present? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
If yes, are they uncovered and draining towards a storm drain inlet? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C2. Are materials stored outside? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell If yes, are they <input type="checkbox"/> Liquid <input type="checkbox"/> Solid Description: _____					
Where are they stored? <input type="checkbox"/> grass/dirt area <input type="checkbox"/> concrete/asphalt <input type="checkbox"/> bermed area					
C3. Is the storage area directly or indirectly connected to storm drain (circle one)? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C4. Is staining or discoloration around the area visible? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C5. Does outdoor storage area lack a cover? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C6. Are liquid materials stored without secondary containment? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
C7. Are storage containers missing labels or in poor condition (rusting)? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
D. WASTE MANAGEMENT <input type="checkbox"/> N/A (Skip to part E)				Observed Pollution Source? <input type="checkbox"/>	
D1. Type of waste (check all that apply): <input type="checkbox"/> Garbage <input type="checkbox"/> Construction materials <input type="checkbox"/> Hazardous materials					
D2. Dumpster condition (check all that apply): <input type="checkbox"/> No cover/Lid is open <input type="checkbox"/> Damaged/poor condition <input type="checkbox"/> Leaking or evidence of leakage (stains on ground) <input type="checkbox"/> Overflowing					
D3. Is the dumpster located near a storm drain inlet? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
If yes, are runoff diversion methods (berms, curbs) lacking? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Can't Tell					
E. PHYSICAL PLANT <input type="checkbox"/> N/A (Skip to part F)				Observed Pollution Source? <input type="checkbox"/>	
E1. Building: Approximate age: _____ yrs. Condition of surfaces: <input type="checkbox"/> Clean <input type="checkbox"/> Stained <input type="checkbox"/> Dirty <input type="checkbox"/> Damaged					
Evidence that maintenance results in discharge to storm drains (staining/discoloration)? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Don't know					

*Index: ○ denotes potential pollution source; denotes confirmed polluter (evidence was seen)

WATERSHED:		SUBWATERSHED:		UNIQUE SITE ID:	
DATE: ___/___/___		ASSESSED BY:		CAMERA ID:	
MAP GRID:		LAT ___° ___' ___" LONG ___° ___' ___"		LMK#	
A. PARCEL DESCRIPTION					
Size: ___ acre(s) Access to site (<i>check all that apply</i>): <input type="checkbox"/> Foot access <input type="checkbox"/> Vehicle access <input type="checkbox"/> Heavy equipment access					
Ownership: <input type="checkbox"/> Private <input type="checkbox"/> Public Current Management: <input type="checkbox"/> School <input type="checkbox"/> Park <input type="checkbox"/> Right-of-way <input type="checkbox"/> Vacant land					
<input type="checkbox"/> Other (please describe) _____					
Contact Information: _____					
Connected to other pervious area? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, what type? <input type="checkbox"/> Forest <input type="checkbox"/> Wetland <input type="checkbox"/> Other _____					
Estimated size of connected pervious area: ___ acre(s) Record Unique Site ID of connected fragment: _____					
PART I. NATURAL AREA REMNANT					
FOREST			WETLAND		
B. CURRENT VEGETATIVE COVER			B. CURRENT VEGETATIVE COVER		
B1. Percent of forest with the following canopy coverage: Open ___% Partly shaded ___% Shaded ___% <i>*Note – these should total 100%</i>			B1. % of wetland with following vegetative zones: Aquatic: _____ Emergent: _____ Forested: _____ <i>*Note – these should total 100%</i>		
B2. Dominant tree species: _____ _____			B2. Dominant species: _____ _____		
B3. Understory species: _____ _____			B3. Are invasive species present? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Unknown If yes, % of wetland with invasives: _____ Species: _____		
B4. Are invasive species present? <input type="checkbox"/> Y <input type="checkbox"/> N <input type="checkbox"/> Unknown If yes, % of forest with invasives: _____ Species: _____					
C. FOREST IMPACTS			C. WETLAND IMPACTS		
C1. Observed Impacts (<i>check all that apply</i>): <input type="checkbox"/> Animals <input type="checkbox"/> Clearing/encroachment <input type="checkbox"/> Trash and dumping <input type="checkbox"/> Storm water runoff <input type="checkbox"/> Other			C1. Observed Impacts (<i>check all that apply</i>): <input type="checkbox"/> Animals <input type="checkbox"/> Clearing/encroachment <input type="checkbox"/> Trash and dumping <input type="checkbox"/> Storm water runoff <input type="checkbox"/> Hydrologic impacts <input type="checkbox"/> Other		
D. NOTES			D. NOTES		
E. INITIAL RECOMMENDATION					
<input type="checkbox"/> Good candidate for conservation/protection <input type="checkbox"/> Potential restoration candidate <input type="checkbox"/> Poor restoration or conservation candidate					

PART II. OPEN PERVIOUS AREAS

A. CURRENT VEGETATIVE COVER

A1. Percent of assessed surface with:

Turf ____% Other Herbaceous ____% None (bare soil) ____% Trees ____% Shrubs ____% Other ____%
(please describe): _____ *Note - these should total 100%

A2. Turf: Height: _____ inches Apparent Mowing Frequency: Frequent Infrequent No-Mow Unknown
Condition (check all that apply): Thick/Dense Thin/Sparse Clumpy/Bunchy Continuous Cover

A3. Thickness of organic matter at surface: _____ inches

A4. Are invasive species present? Y N Unknown If yes, % of site with invasives: ____
Species: _____

B. IMPACTS

B1. Observed Impacts (check all that apply): Soil Compaction Erosion Trash and Dumping
 Poor Vegetative Health Other (describe): _____

C. REFORESTATION CONSTRAINTS

C1. Sun exposure: Full sun Partial sun Shade Unknown

C2. Nearby water source? Y N Unknown

C3. Other constraints: Overhead wires Underground Utilities Pavement Buildings
 Other (please describe): _____

D. NOTES

[Empty space for notes]

E. INITIAL RECOMMENDATION

- Good candidate for natural regeneration
- May be reforested with minimal site preparation
- May be reforested with extensive site preparation
- Poor reforestation or regeneration site

PART III. SKETCH

[Empty space for sketch]

WATERSHED:	SUBWATERSHED:	UNIQUE SITE ID:
DATE: ___/___/___	ASSESSED BY:	CAMERA ID:
MAP GRID	RAIN IN LAST 24 HOURS <input type="checkbox"/> Y <input type="checkbox"/> N	PIC #
A. LOCATION		
A1. Street names or neighborhood surveyed: _____		
A2. Adjacent land use: <input type="checkbox"/> Residential <input type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Institutional <input type="checkbox"/> Municipal <input type="checkbox"/> Transport-Related		
A3. Corresponding HSI or NSA field sheet? If so, circle HSI or NSA and record its Unique Site ID here _____		
B. STREET CONDITIONS		
B1. Road Type: <input type="checkbox"/> Arterial <input type="checkbox"/> Collector <input type="checkbox"/> Local <input type="checkbox"/> Alley <input type="checkbox"/> Other: _____		
B2. Condition of Pavement: <input type="checkbox"/> New <input type="checkbox"/> Good <input type="checkbox"/> Cracked <input type="checkbox"/> Broken		
B3. Is on-street parking permitted <input type="checkbox"/> Y <input type="checkbox"/> N If yes, approximate number of cars per block: _____		
B4. Are large cul-de-sacs present? <input type="checkbox"/> Y <input type="checkbox"/> N		
B5. Is trash present in curb and gutter? If so, use the index to the right to record amount.		
	Index Rating for Accumulation in Gutters	
	Clean	Filthy
Sediment	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Organic Material	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
Litter	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5	<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5
C. STORM DRAIN INLETS AND CATCH BASINS		
C1. Type of storm drain conveyance: <input type="checkbox"/> open <input type="checkbox"/> enclosed <input type="checkbox"/> mixed		
C2. Percentage of inlets with catch basin storage: <input type="checkbox"/> N/A		
Sample 1-2 catch basins per NSA/HSI	C3. Catch basin #1	C4. Catch basin #2
Latitude	° ' "	° ' "
Longitude	° ' "	° ' "
LMK #		
Picture #		
Current Condition	<input type="checkbox"/> Wet <input type="checkbox"/> Dry	<input type="checkbox"/> Wet <input type="checkbox"/> Dry
Condition of Inlet	<input type="checkbox"/> Clear <input type="checkbox"/> Obstructed	<input type="checkbox"/> Clear <input type="checkbox"/> Obstructed
Litter Accumulation	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
Organics Accumulation	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
Sediment Accumulation	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
Sediment Depth (in feet)	_____ ft.	_____ ft.
Water Depth	_____ ft.	_____ ft.
Evidence of oil and grease	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
Sulfur smell	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
Accessible to vacuum truck	<input type="checkbox"/> Y <input type="checkbox"/> N	<input type="checkbox"/> Y <input type="checkbox"/> N
D. NON-RESIDENTIAL PARKING LOT (>2 acres)		
D1. Approximate size: _____ acres		
D2. Lot Utilization: <input type="checkbox"/> Full <input type="checkbox"/> About half full <input type="checkbox"/> Empty		
D3. Overall condition of Pavement: <input type="checkbox"/> Smooth (no cracks) <input type="checkbox"/> Medium (few cracks) <input type="checkbox"/> Rough (many cracks) <input type="checkbox"/> Very Rough (numerous cracks and depressions)		
D4. Is lot served by a storm water treatment practice? <input type="checkbox"/> Y <input type="checkbox"/> N If yes, describe: _____		
D5. On-site retrofit potential: <input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Poor		



E. MUNICIPAL POLLUTANT REDUCTION STRATEGIES	
E1. Degree of pollutant accumulation in the system: <input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low <input type="checkbox"/> None	
E2. Rate the feasibility of the following pollution prevention strategies:	
Street Sweeping:	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Storm Drain Stenciling:	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Catch Basin Clean-outs:	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
Parking Lot Retrofit Potential:	<input type="checkbox"/> High <input type="checkbox"/> Moderate <input type="checkbox"/> Low
CATCH BASIN SKETCHES	
#1	#2
Notes:	

EQUIPMENT CHECKLIST

- Field Data Forms
- Street / Neighborhood Maps
- Parcel Maps (with and without aerial imagery)
- Tape measure / Stadia rod
- GPS unit
- Field Notebooks
- Digital camera
- Life preservers (PFDs)
- Waders
- Pens/Pencils
- Orange safety vests
- Whistle
- PRWC Stream Assessment In-Progress (ID CARD)
- Project Description / Property Owner Notification Letter
- Clip Board
- Drybag
- Trash bag / Bucket
- Sunscreen, Insect Repellent, Baseball, Hat, Polarized Sunglasses
- First Aid Kit
- Drinking Water, Snacks

FIELD NOTEBOOKS

All Pomperaug River Watershed Coalition (PRWC) field personnel will carry a bound field notebook. All field activities will be documented in the field notebook, regardless of whether or not those activities involve sample collection. Each employee's book will be numbered sequentially with the format of the employee's initials followed by the book number (i.e. **CAH-01**) and will be labeled on the cover as such with the range of dates covered by the book (i.e. 10/23/03 to 8/17/04). Each page of the field notebook book will be numbered with the employee's last name, the book number, and the page number (i.e. **CAH-01-01, CAH-01-02, CAH-01-03**, etc.). The field notebook will document site-specific information such as:

- Project name and location
- Names of other PRWC personnel involved in field activities
- Time and date of arrival at the site
- Weather conditions
- Sampling locations and corresponding sample numbers
- Documentation of field calibration of instruments
- Conversations with individuals on site
- Any unusual events or observations
- All information not recorded on field data sheets
- Time of departure from the site

For field investigations that involve the collection of samples, additional forms of documentation are required.

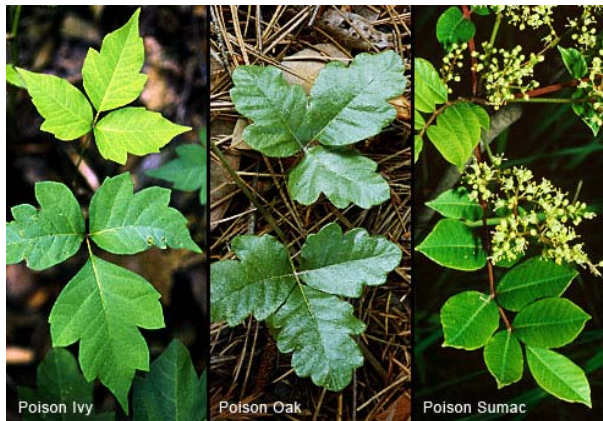
FIELD SAFETY CONSIDERATIONS








One of the most critical considerations for a conducting Visual Assessment Surveys is the safety of the Field Team. All team members should be trained in safety procedures and should carry with them a set of safety instructions and the phone number of the Project Manager and the Team Leader. Safety precautions can never be overemphasized. The following are some basic common sense safety guidelines:

- **Always monitor with at least one partner.** Teams of two to three people are best. Always let the Project Manager know where you are, when you intend to return, and what to do if you don't come back at the appointed time.
- **Dress for walking in the stream.** Surveyors may wish to dress in layers (weather conditions may change through the day), wear sunscreen and insect repellent, a baseball hat, polarized sunglasses, and bring a raincoat along with an extra set of dry clothes, shoes, drinking water and snacks to stay comfortable through the sampling day.
- **Wear brightly colored clothing and/or an orange safety vest** while conducting visual assessment surveys.
- **Wear boots / waders (preferred) when walking the stream channel for extended periods.** Preferred alternative - wear closed-toe shoes (old sneakers), otherwise wear sandals with secure straps (Chacos, Teva, etc) are acceptable. NO FLIP-FLOPS!
- **Have a first aid kit handy.** Know any important medical conditions of team members (e.g., heart conditions or allergic reactions to bee stings).
- **Listen to weather reports.** Never go sampling if severe weather is predicted or if a storm occurs while at the site.
- **Park vehicles in a safe location.** Use established lots or park as far off the traveled roadway as possible, but not on private property unless landowner access has been granted. Be sure your car doesn't pose a hazard to other drivers and that you don't block traffic. Place a traffic cone approximately 10 paces behind the parked vehicle for extra visibility. A PRWC Stream Monitoring In-Progress Identification Card may also be placed on the dashboard when away from vehicle for an extended period of time. Plan for parking one car near your entry point to the stream and one near the end of the reach you are surveying.
- **Put your wallet and keys in a safe place,** such as a watertight bag you keep in a pouch strapped to your waist or in a backpack. Without proper precautions, wallet and keys might end up downstream.
- **Be respectful of private property along the stream channel.** Stay in the stream channel as much as possible and do not enter private property without the permission of the landowner. Take along a card identifying you as a volunteer monitor.
- **Confirm that you are at the proper site location by checking maps, site descriptions, or directions.** Watch for irate dogs, farm animals, wildlife (particularly snakes), and insects such as ticks, hornets, and wasps. Know what to do if you get bitten or stung.
- **Never wade in swift or high water.** Do not monitor if the stream is at flood stage.

- **Do not walk on unstable stream banks.** Disturbing these banks can accelerate erosion and might prove dangerous if a bank collapses. Disturb streamside vegetation as little as possible.
- **Be very careful when walking in the stream itself.** Rocky-bottom streams can be very slippery and can contain deep pools; muddy-bottom streams might also prove treacherous in areas where mud, silt, or sand have accumulated in sink holes. If you must cross the stream, use a walking stick to steady yourself and to probe for deep water or muck. Your partner(s) should wait on dry land ready to assist you if you fall. Do not attempt to cross streams that are swift and above the knee in depth. Wear waders and rubber gloves in streams suspected of having significant pollution problems.
- **Watch for poison ivy, poison oak, poison sumac, and other types of vegetation in your area that can cause rashes and irritation. Also be aware of ticks and biting/stinging insects.***
- **Never drink the water in a stream.** Assume it is unsafe to drink, and bring your own water from home. Always wash hands before / after eating or drinking. Avoid contact with eyes, nose, mouth and skin until hands have been washed with soap.
- **Shower or rinse clean with soap and water after wading in a stream.** Also check for scrapes and scratches, poison ivy, and ticks after conducting field work. Report any injuries incurred during field work to Project Manager.
- If at any time you feel uncomfortable about the condition of the stream or your surroundings, stop monitoring and leave the site at once. **Your safety is more important than the data!**

***Plants and Ticks to be aware of:**



Different Ticks and Infections		
American Dog Tick <i>Dermacentor variabilis</i>		Rocky Mountain spotted fever, Tularemia
Deer Tick Blacklegged Tick Bear Tick <i>Ixodes scapularis</i> <i>Ixodes pacificus</i>		Anaplasmosis, Babesiosis, <i>Borrelia mayonii</i> , <i>Borrelia miyamotoi</i> , Lyme disease, Powassan disease, Tick-borne meningoencephalitis
Groundhog Tick <i>Ixodes cookei</i>		Powassan disease
Gulf Coast Tick <i>Amblyomma maculatum</i>		<i>Rickettsia parkeri</i> rickettsiosis
Lone Star Tick <i>Amblyomma americanum</i>		Hantavirus, Ehrlichiosis, Tularemia STARI (Southern tick-associated rash illness) Lyme disease
Pacific Coast Tick <i>Dermacentor occidentalis</i>		Rocky Mountain spotted fever, Tularemia Colorado tick fever, 30x4D rickettsiosis
Rocky Mountain Wood Tick <i>Dermacentor andersoni</i>		Colorado tick fever, tularemia and Rocky Mountain spotted fever

Safety guidelines adapted from:

United States Environmental Protection Agency, Office of Water (4503F). November 1997. "Volunteer Stream Monitoring: A Methods Manual." Publication Number: EPA 841-B-97-003.

APPENDIX B

PRWC's Ambient Water Quality Monitoring Protocol

NOTE: This protocol contains its own supporting appendices

*Field Data Sheet and Chain of Custody
PRWC's EpiCollect5 App User Guide
Equipment Technical Specifications & User Manuals*



AMBIENT WATER QUALITY MONITORING PROTOCOL

Standard Procedures for

Collecting Stream Samples for Laboratory Analysis

Bacteria as *Escherichia coli* (*E.coli*) and Nitrate as N

Taking and Recoding Field Measurements and Observations

Temperature and Conductivity

Last Revised: 3/2/2022

AMBIENT WATER MONITORING PROTOCOL

Monitoring Overview

Pomperaug River Watershed Coalition maintains a network of 15 fixed ambient stream monitoring stations throughout the watershed where water samples and field measurements are collected to evaluate stream health (Figure 1). For the purposes of this protocol, monitoring will include collecting ambient stream water samples to be analyzed by a state certified testing laboratory for *E. coli* bacteria and nitrate. Field measurements for conductivity and temperature and observations pertaining to water color, odor, flow, designated uses, and sampling conditions (wet/dry and weather) will also be recorded when a stream sample is collected. Field observations are recorded on Field Data Sheet and custody of samples is tracked using a Chain of Custody Form (Appendix 1). Alternatively, field observations may be recorded using the EpiCollect5 App installed on a tablet or smartphone (Appendix 2).

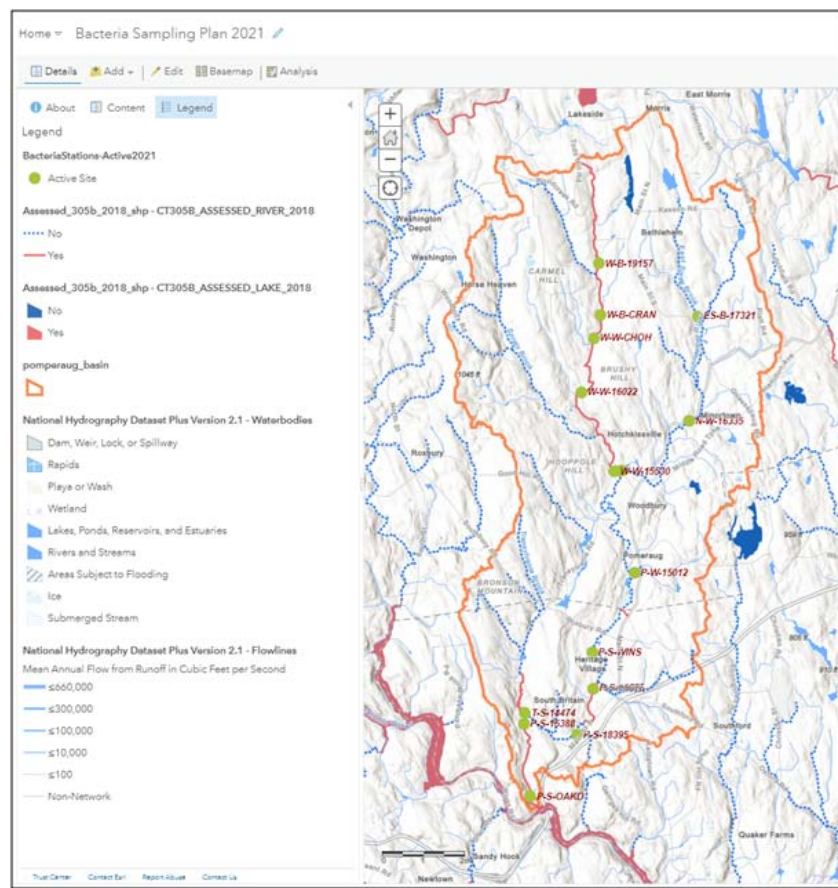


Figure 1. PRWC's Ambient Water Monitoring Stations for the 2021 Field Season.

General Schedule

Sampling will occur twice a month between April and October at 15 fixed stations throughout the watershed. The sampling sites are divided into two sampling routes – northern and southern (Table 1). The northern route consists of sites located on the Weekepeemee and Nonnewaug Rivers and associated tributaries in Woodbury and Bethlehem. The southern route consists of sites on the Pomperaug River, Transylvania Brook, and associated tributaries in Southbury and southern portions of Woodbury.

To the extent practicable, samples will be collected by the Ambient Water Quality Monitoring Team (“Field Team”) on the first and third Tuesday and/or Wednesday of each month. In order to meet the Representativeness and Completeness data quality objectives of this projects (i.e. at least 3 wet weather and at least 3 dry weather sampling events), samples may be collected outside of this schedule based on guidance from the QA Manager / Project Manager.

When the Field Team can be divided into two groups of at least 2 people are available, samples will be collected over the course of a single day (Tuesday). When only one team of two people is available, samples may be collected over two days -- the northern route one day and the southern route the other day.

For the southern route (Pomperaug/Transylvania), sampling will start at Oakdale Manor and continue upriver to Middle Quarter (Table 1). For the northern route (Nonnewaug/Weekepeemee/East Spring Brook), sampling will begin at the Route 47 Bridge and continue in a clockwise manner along Route 47/Route132/Route 61/Route 6-ending near/on Mill Road near the USGS Gaging Station (Table 1).

Samples must be analyzed within **6 hours** of collection and should be dropped off, along with the completed chain of custody form, at the testing lab (Hydro Technologies, 62 Bank St, 2nd Floor, New Milford, CT 06776) as soon as possible. Travel time from the final monitoring sites to the testing lab is approximately 30 minutes.

Station Naming Convention

Sample Stations ID's are assigned by the Project Manager in a manner that reflects the stream name, town of sampling site, and corresponding Site ID number assigned by CT DEEP (if available) or an alpha/alphanumeric code reflective of the sampling location (see formula below). Station ID's are recorded in a master spreadsheet that captures the above information along with descriptive station name, a detailed description of where the sample should be collected, and latitude and longitude.

Option 1: First Initial of River Name – First Initial of Town – CT DEEP AWQ #

Example: P-S-15388 (Pomperaug – Southbury – Audubon Bent of the River)

Option 2: First Initial of River Name – First Initial of Town – 4 or 5 Digit Alpha/AlphaNumeric Abbreviation of Landmark or Road Name

Example: N-W-RTE47 (Nonnewaug-Woodbury-Route 47 Bridge)

Table 1. PRWC Sample Site List (2021/2022) with Street Address for Driving to Sample Location

SOUTHERN ROUTE				
SITE ID <i>(last 5 digits = DEEP AWQ ID)</i>	RIVER	SITE DESCRIPTION	DRIVING ADDRESS	TOWN
P-S-OAKD	Pomperaug	Oakdale Manor	190 Oakdale Manor Dr	Southbury
P-S-15388	Pomperaug	Bent of the River - East Flat Hill Rd	185 East Flat Hill Rd	Southbury
T-S-14474	Transylvania Bk	Seman Park	200 East Flat Hill Road	Southbury
P-S-18395	Pomperaug	The Gym - Flood Bridge Rd	254 Flood Bridge Rd	Southbury
P-S-15025	Pomperaug	Poverty Rd - Ewald Park - USGS Gauge	234 Poverty Rd	Southbury
P-S-WINS	Pomperaug	Heritage Village - River Gardens	447 Winship Dr	Southbury
P-W-15012 <i>(P-W-SPAVE)</i>	Pomperaug	Middle Quarter / South Pomperaug Ave	CAST Preschool 124 S Pomperaug Ave	Woodbury

NORTHERN ROUTE				
SITE ID <i>(last 5 digits = DEEP AWQ ID)</i>	RIVER	SITE DESCRIPTION	DRIVING ADDRESS	TOWN
N-W-14355	Nonnewaug	Rt 47 Bridge - Three Rivers / Young's	130 Washington Rd	Woodbury
W-W-15530	Weekeepeemee	Jacks Bridge Rd - USGS Gauge	Three Rivers Field on Jack's Bridge Rd	Woodbury
W-W-16022	Weekeepeemee	Brushy Hill Rd @ Route 132	316 Weekeepeemee Road	Woodbury
W-W-CHOH	Weekeepeemee	Chohees Trail @ Weekeepeemee Road	170 Chohees Trail	Woodbury
W-B-CRAN	Weekeepeemee	Crane Hollow Road @ Weekeepeemee Road	138 Crane Hollow Road	Bethlehem
W-B-19157	Weekeepeemee	Mill Pond Road @ Route 132 (Guilds Hollow Road)	19 Mill Pond Road	Bethlehem
ES-B-17321	East Spring Bk	Nonnewaug Road @ Porter Hill Road	98 Porter Hill Road	Bethlehem
N-W-16335	Nonnewaug	Mill Rd - USGS Gage	294 Minortown Rd	Woodbury

Field Safety Guidelines

1. ALWAYS work in groups of at least two. The individual on land recording observations should maintain a line of sight of the individual collecting the water sample.
2. When parking, use established lots or as far off the traveled roadway as possible, but not on private property unless landowner access has been granted. Place a traffic cone approximately 10 paces behind the parked vehicle for extra visibility. A PRWC Stream Monitoring In-Progress Identification Card may also be placed on the dashboard when away from vehicle for an extended period of time.
3. Wear brightly colored clothing and/or a safety vest while collecting samples.
4. Wear nitrile gloves when collecting water samples.
5. Wear boots / waders (preferred) if entering the water. Preferred alternative - wear closed-toe shoes (old sneakers), otherwise wear sandals with secure straps (Chacos, Teva, etc) when entering the water. NO FLIP-FLOPS!
6. Wash hands after sampling. Avoid contact with eyes, nose, mouth and skin until hands have been washed. Always wash hands before / after eating or drinking and handling samples.
7. Avoid wading in deep or fast moving water – especially if the stream bottom is not visible. If sampling in/near deep or fast moving water is necessary, wear a personal flotation device.
8. Take heed when wading. Rocky river bottoms can be slippery. Soft river bottoms can have sinkholes. Use a walking stick to test the river bottom.
9. Samplers may wish to dress in layers (weather conditions may change through the day), wear sunscreen and insect repellent, a baseball hat, polarized sunglasses, and bring a raincoat along with an extra set of dry clothes, shoes, drinking water and snacks to stay comfortable through the sampling day.
10. Shower or rinse clean with soap and water after wading in a stream. Also check for scrapes and scratches, poison ivy, and ticks after conducting field work. Report any injuries incurred during field work to Project Manager.

Preparing for Field Work

Day BEFORE Sampling:

1. Familiarize yourself with all sampling equipment and sampling procedures.
2. Gather, inspect, and organize sampling equipment and supplies according to the equipment checklist the day before sampling.
 - a. Ensure you have enough sample bottles for each parameter for each sample site plus a few extras for your blank, duplicate, and just in case one is swept away by the river or accidentally contaminated. Sample bottles are provided by the testing lab.
 - b. Freeze ice packs the night before sampling.
 - c. Charge the tablet and camera.
 - d. Check tablet and EpiCollect5 App for updates before going into the field.
 - e. Print field data sheets and chain of custody forms.

Sampling Day:

1. Pack coolers with ice from the freezer.
2. Calibrate equipment (i.e. conductivity meter) specific instructions included in the appendices.
3. Look up and record streamflow rates from the USGS gauging station websites.

Pomperaug Gage: https://waterdata.usgs.gov/ct/nwis/uv?site_no=01204000

Nonnewaug Gage: https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203600

Weekepeemee Gage: https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203805

4. Check with the Project Manager to determine where your duplicate sample and blank should be collected.
5. Transfer sampling equipment to vehicle(s) and keep organized / easily accessible while conducting field work.

Equipment Checklist

	ITEM
	Sterilized sample bottles provided by testing lab
	Cooler
	Ice / Frozen Ice Packs
	Distilled water
	Conductivity meter
	Thermometer
	Extension pole with clamp
	Bucket with rope (x2)
	Waders/boots
	Nitrile gloves
	Clip board
	Field data sheets
	Chain of custody forms
	Pens/Sharpie/pencils
	Charged Tablet and car charger
	Orange Safety Vests
	Traffic Cone(s)
	Camera
	GPS unit
	Hand sanitizer
	First aid kit (with insect repellent, Tecnu and sunscreen)
	Disinfecting wipes
	Flashlight
	Extra batteries for camera, Garmin, and flashlight
	Towels
	Drinking water and snacks
	Rain coat
	Baseball hat / Polarized sunglasses
	Spare dry clothes
	Sampling pole/ walking stick
	Whistle to call for help in emergencies
	PRWC Brochures / Business Cards
	Trash bag
	PRWC Stream Monitoring In-Progress ID card

Field Observations and Sample Collection

1. **Arrive at the sampling site.** Find a safe place to park. Place traffic cone about 10 paces behind the vehicle and PRWC Stream Monitoring identification card on dashboard.
2. **Put on an orange safety vest and retrieve sampling equipment** from the vehicle. Put on waders or appropriate footwear and nitrile gloves.
3. **Look around the sampling site** for any safety hazards, unusual conditions, and to determine you are in the right location for sample collection. Decide who will be the data recorder and who will collect the sample.
4. **Label bottle with site ID, date, time, and “PRWC” with permanent marker (see photo).** If you are collecting a duplicate sample or filling a blank distinguish them by writing A or B following the Site ID on each bottle and record in the data sheet. When collecting a duplicate, you will need to repeat the sample collection procedures for Steps 5 - 12 below and record data as separate entries. Ensure that the time written on the bottle is the same time recorded on the Chain of Custody form for the lab. Refer to the section on “Quality Control Samples” for more details.



5. **Begin recording field observations** on the field data sheet (Appendix 1) or in the EpiCollect5 App (see Appendix 2). Field observations include water color, water odor, water level, current weather conditions, wet vs. dry sampling event, air temperature, water temperature and conductivity. **Be sure to complete all required fields including sampler names, date, time, etc.** When using EpiCollect5, enter Regular Sample when a single sample is collected from the site (i.e. no duplicate or blank). If you are collecting a duplicate sample at the site, enter Duplicate for sample type and proceed with observations (then repeat for the second sample -- giving you two entries for this site). If using a printed data sheet, record the Site ID of the duplicate in the box for “Dup:”.

Wet vs. Dry Weather Sampling Conditions

The QA Manager / Project Manager will refer to the precipitation recorded from the USGS Gaging Station #01203805 on the Weekeepeemee River at Hotchkissville, CT (https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203805) to confirm wet or dry sampling conditions. The amount of precipitation observed at in the 24-hours, 48-hours, 72-hours, and 96-hours prior to sampling will be recorded on the field data sheet for reference.

Wet Weather Conditions are defined as sampling events where precipitation prior to sampling is greater than 0.1" precipitation in 24 hours *or* greater than 0.25" precipitation in 48 hours *or* greater than 2.0" precipitation in 96 hours.

Dry Weather Conditions are defined as all other conditions not satisfying the wet weather criteria.

6. **Use the thermometer in your field kit to measure air temperature.** Make sure your reading is in Celsius and recorded with one digit after the decimal point. Make sure it has stabilized in the ambient air. Temperature will fluctuate from a car that has the air conditioning running or a thermometer stored in a hot/cold trunk. For the best reading, hold the thermometer away from your body, and ensure that it is dry, off the ground, and not in contact with other surfaces.

TIP: You will save time by sequencing your field measurements and observations in the following order:

- Fill sample bottles.
- Take stream water temperature.
- Start conductivity measurement.
- Record field observations (color, odor, weather conditions, etc).
- Take site photos.

7. **Fill Sample Bottles.** Make sure they have been labeled with permanent marker before filling. Make sure the seal on the sterile bottle for the bacteria sample has not been broken and that it contains a tablet (*sodium thiosulfate, which neutralizes any chlorine that may be present in the sample*). If collecting a duplicate or filling a blank make sure the bottles are distinguished with an A or B after the Site ID. You can either wade into the stream (preferred) or use an extension pole to fill the sample bottles as described below.

a. **Wading.** This method is appropriate for sites where the streambank is gently sloped or flat, the water is shallow (less than mid-calf or knee deep) and not too fast moving, you can see the stream bottom, and the stream bottom is firm (not muddy/mucky).

- i. Carefully enter the stream and walk to the center of the channel. Use a stick or pole to test stream bottom and find good footing. Try not to disturb the sediment from the bottom.
- ii. Face upstream and plan to collect samples away from your body in areas upstream of any area you disturbed while wading.
- iii. Submerge capped bottle (with the mouth oriented slightly down) horizontally into the water. Do not fully invert the bottle or the tablet inside it will fall out.
- iv. At about 8 to 12 inches below the surface (or, if the water is shallow, at the midpoint of river depth), remove bottle cap. Do not touch inside of bottle or cap.
- v. Slowly turn the bottle upstream away from you and allow bottle to fill. Try not to let any sediment into the bottle.
- vi. Recap bottle while still submerged. Raise capped bottle back out of water.
- vii. Uncap and pour out some sample until there is approximately 2.5 to 5cm of headspace at the top of the bottle. Recap bottle and invert to check for leaks.



- b. Extension Pole.** This method is appropriate for sites with deep (above mid-thigh) or fast moving water, where the stream bottom is muddy or mucky, where the streambank is extremely steep, and/or when at a bridge crossing over the stream. If standing on a bridge, place a second traffic cone 10 paces behind you (towards oncoming traffic) for added visibility. Whether reaching or lowering the pole from the streambank or down from a bridge, aim for collecting your sample from the center of the stream channel. If sampling from a bridge, always sample on the upstream side of the bridge. **ALWAYS be sure to check for and avoid over hanging power lines! ALWAYS be sure to check for oncoming traffic and avoid extending pole into the roadway if there are oncoming vehicles!**
- i. Secure your capped sample bottle to the extension pole using the built-in clamp. Once secure, remove the cap making sure not to touch the inside of the bottle or the bottle cap. For the bacteria sample bottle, pour the sodium thiosulfate tablet into the cap without touching it and keep to the side while collecting the sample.
 - ii. Keeping the mouth of the bottle face down, lower or reach the sample bottle into the stream. Submerge the bottle below the surface and turn into the current to fill the bottle (avoid collecting surface film water). Turn the mouth of the bottle skyward before lifting the sample out of the water.
 - iii. Raise or retract the pole to retrieve the filled sample bottle. Cap the bottle before removing it from the clamp (if bacteria sample, pour the sodium thiosulfate tablet back into the bottle while capping it). Remove the bottle from the clamp.
 - iv. If necessary, uncap and dump out enough water to provide approximately 2.5 to 5cm of headspace at the top of the bottle. Recap the bottle and invert the bottle to check for leaks.

8. **To take water temperature and conductivity measurements, either wade into the stream to measure (preferred) or use bucket method to collect water from the stream to take these measurements.**

- a. **Wading.** Refer to Steps 7.a and 7.a.ii and then face upstream and plan to take readings away from your body in areas upstream of any area you disturbed while wading.
- b. **Bucket Method.** This method is appropriate for sites with deep (above mid-thigh) or fast moving water, the stream bottom is muddy or mucky, the streambank is extremely steep, and/or when at a bridge crossing over the stream. If standing on a bridge, place a second traffic cone 10 paces behind you (towards oncoming traffic) for added visibility. Use a 1 gallon to 3 gallon sized bucket with metal handle and at least 25 feet of rope securely attached. (Note: a plastic handle may break under the weight of a full bucket.)



- i. Inspect the bucket for cracks or holes and wipe down with a towel or paper towel wipe before you begin.
 - ii. Aim for collecting your sample in the center of the stream channel. If sampling from a bridge, **always sample on the upstream side of the bridge.**
 - iii. While hanging onto the rope, **toss/lower the bucket into the water 3 times to rinse** out the bucket and avoid cross contamination from the previous site or vehicle.
 - iv. Toss/lower the bucket a fourth time, fill it with water which will be used for measuring temperature and conductivity.
 - v. Avoid placing the filled bucket on a hot paved surface.
9. **Measure water temperature.** Use the thermometer in your field kit to measure water temperature. **Make sure your reading is in Celsius and recorded with one digit after the decimal point.** Dip the metal probe of the thermometer into the main current or water collected in the bucket. **Allow reading to stabilize.** For the best reading, hold the thermometer away from your body and not in contact with other surfaces (sides of bucket or stream bottom).

10. **Measure conductivity** using Oakton CTS Testr50P field meter (Appendix 3). Hold down the power button to turn on the meter. Make sure your device is on the proper screen which can be confirmed by the title at the top of the screen reading “COND” and the units below it shown as (uS/cm). Rinse cap of the meter and the sensor in the stream or with water collected in the bucket a few three times (dip cap into the river or bucket to fill/rinse; discard rinse water to the side). Then fill the cap of the meter to the “max fill line” with water from the river. The meter will automatically begin measuring conductivity. Allow the meter a few moments to show a stabilized reading. You will see a check mark (✓) at the top, once a stable reading is reached. **Record the conductivity result with one digit after the decimal point.**



11. **Record site conditions.** Note site conditions in comments (e.g., presence of water fowl, other wildlife, water appearance, weather, and/or anything that may affect the sample results).
12. **Take Site Photos.** Sequence your photography to capture upstream first and then downstream so they can be distinguished when photos are downloaded. As long as the date/time settings are set and up-to-date, it will record the date and time photo was taken and assign it to the file “properties.” This will help the Project Manager catalog photos for each site and verify the field observations made by the field team members. Tips for photos: Take photos in landscape view (turn device horizontally). It is okay to include a person in a photo for scale (also makes for good outreach photos). Include the river / stream with surrounding land features (don’t take a photo of just the water) for context. Having close-ups are okay, but the bigger picture is just as important. Avoid using a wide-angle (or “fish-eye”) lens as they distort the image.

*NOTE: If using EpiCollect5 App to record field data, exit out of the EpiCollect5 App to take photos on the tablet itself using the camera app. Sequence photos to take upstream photo first, then downstream photo. Then return to EpiCollect5 and use the “upload photo” option from there. If uncertain how to do this, simply “take photo” in the EpiCollect5 App.

13. **Complete the Chain of Custody Form.** Make sure sample time on bottle matches sample time on data sheet and sample time on chain of custody and the number of bottles for each parameter are filled in (Enter 1 if regular sample, enter 2 if blank or duplicate also collected at the site).

14. Wrap up.

- a. Review Data Sheet / Data Entry to make sure everything is complete.
- b. Make sure the chain of custody is complete.
- c. Gather your equipment, samples and any trash you might have created (or found) and return to the vehicle.
- d. Turn off the thermometer and conductivity meter to extend battery life.
- e. Place sample bottles upright in a cooler filled with ice. Samples should be stored in the dark between 1 to 4 °C.
- f. Travel to the next site.



15. Transport samples to the lab.

- a. Once all samples have been collected, return to the PRWC office or designated location to consolidate samples from the Northern Route and the Southern Route into one cooler to prepare for transport to the laboratory.
- b. Review the Chain of Custody forms once again to make sure times on the bottles and the number of bottles match.
- c. Scan or take a photo of the completed Chain of Custody forms and email them to the lab and notify them you are on your way to drop off. This helps the lab begin the log-in process for the samples.
- d. Deliver samples to the lab. Unload samples from the cooler as directed by staff at the lab; the cooler will return with the courier to PRWC. The person relinquishing the samples to the lab and the person at the lab receiving the samples should sign the Chain of Custody form. Ask for a photocopy of the signed form which is to be retained by PRWC and kept in the "Bacteria Monitoring Binder."
- e. Obtain new sample bottles for the next round of sampling. The Ambient Water Quality Monitoring Team Leader or Project Manager will have notified the lab in advance to prepare bottles for pick up.
- f. Results received from the lab will also be printed and kept in the binder while the digital file will be retained in PRWC electronic files.

Quality Control Samples

A **field blank** (distilled water) and a **field duplicate** (a second sample taken at one of the sites) should be submitted for each sampling event. When two field teams are available and samples are collected over the course of a single day, each field team will be tasked with collecting a duplicate sample and one team will be assigned a blank. When three field teams are available for the sample round, two teams will collect duplicated samples while the third team will prepare the blank. When one field team is available and samples are collected over the course of two days, one duplicate will be prepared and one blank will be prepared.

Find out from the QA Manager / Project Manager where to collect a duplicate sample and which site to assign the field

blank. Over the course of the season, each site will, at some point, have a duplicate and/or blank assigned it. The goal is to change up where they are assigned so the laboratory is unaware of which sample is the blank and which is the duplicate. This also helps ensure the collection procedures are consistent and transferable across the varying conditions of the sample sites.

Duplicate Sample Procedures

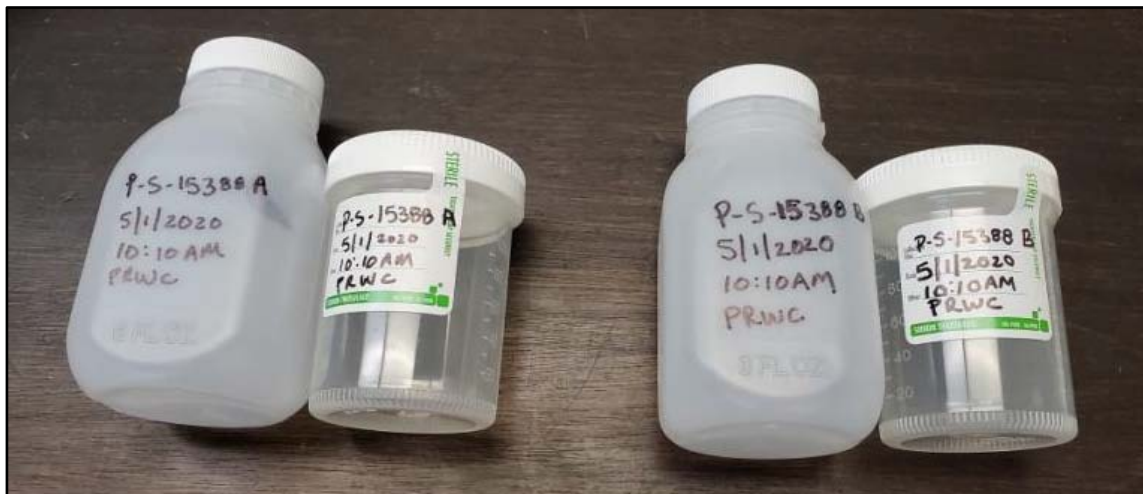
1. The intent is to **repeat the sample collection process a second time** through to ensure collection procedures and results are consistent. Thus, you **follow the protocol for the first sample and then repeat from the beginning** to take a new air temperature reading, a new water temperature reading, a new conductivity reading, and fill a second set of sample bottles. If you are using the bucket toss method - that means dumping the bucket from which the first set of sample bottles were filled and doing another bucket toss for the second set of sample bottles and readings.

What is the purpose of submitting duplicate and blank samples?

Duplicate samples are used to assess variance of the total method including sampling and analysis. These samples are carried through all steps of the sampling and analytical procedures in an identical manner; thus they should yield identical or near identical results. Duplicate samples help assess accuracy and precision throughout the sampling process.

Blank samples are submitted to determine whether a laboratory is clean or not. They also help ensure that samplers are not contaminating samples during the collection process. A blank consists of filling a sample bottle with distilled water and submitting to the laboratory with a stream sample ID assigned to it. Blanks should yield results of 0 (zero) or not-detected for each analyses being conducted.

2. **Sample bottles should be distinguished by adding an A and B after the Site ID (see photo).** It is okay for the sample times to match. Label bottle with site ID, date, time, and “PRWC” with permanent marker.



3. **Record Field Observations as “Duplicates”.** Both the first and second set of samples and corresponding field observations are both entered as “Duplicates” in Epicollect5 (or recorded individually on the printed field data sheet) resulting in two entries for the site. If using a printed data sheet, record the Site ID of the duplicate in the box for “Dup:”. On the printed sheet, it is also helpful to make a note next to the Site ID that this is where the duplicate was collected. This can be done by writing “A & B” next to the Site ID or by writing “duplicate” in the observations/comments box.
4. **Complete Chain of Custody Form.** On the Chain of Custody, record “A & B” next to the site ID where the duplicate was prepared and enter “2” for the number of bottles for each analysis. Make sure sample time on bottles matches the sample time listed on the Chain of Custody.
5. **Wrap up.**
 - a. Review Data Sheet / Data Entry to make sure everything is complete.
 - b. Make sure the chain of custody is complete.
 - c. Gather your equipment, samples and any trash you might have created (or found) and return to the vehicle.
 - d. Turn off the thermometer and conductivity meter to extend battery life.
 - e. Place sample bottles upright in a cooler filled with ice. Samples should be stored in the dark between 1 to 4 °C.
 - f. Travel to the next site.

Blank Sample Procedures

- 1. Label each bottle with site ID, date, time, and "PRWC" with permanent marker.** Distinguish between the regular sample and the blank by adding **an A and B after the Site ID (see photo)**. It is okay for the sample times to match.

- 2. Collect your stream sample at the assigned site and enter/record field observations as a "regular sample."** Make note in the observations/comments in EpiCollect5 which letter (A or B) was assigned on the sample bottle. If using a printed data sheet, record the Site ID of the Blank in the box for "Blank:". On the printed sheet, it is also helpful to make a note next to the Site ID that this is where the Blank was filled. This can be done by writing "A & B" next to the Site ID or by writing "blank" in the observations / comments box.

- 3. Prepare your field blank. Start a new entry in EpiCollect5 and select "Blank" for sample type. Pour some distilled water from the sample jug into a clean, spare sample bottle (one without the tablet in it) to take the water temperature and to use for a conductivity reading.** Enter these readings along with water color and water odor observations (skip water level, uses, weather, and flow entries or enter "99999" for these fields). Then fill **the labeled sample bottles with distilled water from the jug provided.**

- 4. Complete Chain of Custody Form.** On the Chain of Custody, record "A & B" next to the site ID where the blank was prepared and enter "2" for the number of bottles for each analysis. Make sure sample time on bottles matches the sample time listed on the Chain of Custody.

- 5. Wrap up.**
 - a. Review Data Sheet / Data Entry to make sure everything is complete.
 - b. Make sure the chain of custody is complete.
 - c. Gather your equipment, samples and any trash you might have created (or found) and return to the vehicle.
 - d. Turn off the thermometer and conductivity meter to extend battery life.
 - e. Place sample bottles upright in a cooler filled with ice. Samples should be stored in the dark between 1 to 4 °C.
 - f. Travel to the next site.

References

Central Massachusetts Regional Stormwater Coalition. July 2013. Standard Operating Procedures 1: Dry Weather Outfall Inspection. https://www.centralmastormwater.org/sites/g/files/vyhlf386/f/uploads/dry_outfall_inspection_sop_and_form_final.pdf

Central Massachusetts Regional Stormwater Coalition. October 2012. Standard Operating Procedures 2: Wet Weather Outfall Inspection. https://www.centralmastormwater.org/sites/g/files/vyhlf386/f/uploads/wet_weather_outfall_inspection_sop_final.pdf

Connecticut Department of Health and Connecticut Department of Energy & Environmental Protection. August 2011. Quality Assurance Project Plan for the Beach Monitoring and Notification Program for Connecticut Coastal Beaches. https://portal.ct.gov/-/media/DEEP/water/beach_monitoring/beachqapp11pdf.pdf

Myers, D.N., Stoeckel, D.M., Bushon, R.N., Francy, D.S., and Brady, A.M.G., 2014, Fecal indicator bacteria (ver. 2.1): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A7, sec. 7.1, May 2014, accessed March 14, 2018, from <http://pubs.water.usgs.gov/twri9A7/>.

USEPA. 1997. Volunteer Stream Monitoring: A Methods Manual. EPA 841-B-97-003.U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

APPENDIX 1

Field Data Sheet Instructions

Chain of Custody Form Instructions

Field Data Sheet Instructions

Pomperaug River Watershed Coalition - Stream Sampling Program
Field Data Sheet: Northern Route 2022

Note: Please submit this sheet with water samples.

Samplers: _____ Streamflow at USGS Gauge (Nonnewaug): _____ flow (CFS) Time _____ Rainfall (inches) at USGS Gauge (Weekeepemec) _____

 Date: _____ Streamflow at USGS Gauge (Weekeepemec): _____ flow (CFS) Time _____ Past 24 hours: _____
 _____ Past 48 hours: _____
 _____ Past 72 hours: _____
 _____ Past 96 hours: _____

Site Number	River	Nearest Road	Town	Sample time	Sample Method	Wet or Dry?	Air Temp C	Water Temp C	Observation Codes	Conductivity (us/ml)	Observations/ Comments
N-W-14355	Nonnewaug	Rt 47 Bridge	Woodbury								
W-W-15530	Weekeepemec	Jacks Bridge Rd	Woodbury								
W-W-16022	Weekeepemec	Brushy Hill Rd	Woodbury								
W-W-CHOH	Weekeepemec	Chohees Trail	Woodbury								
W-B-CRAN	Weekeepemec	Crane Hollow Road	Bethlehem								
W-B-19157	Weekeepemec	Mill Pond Road	Bethlehem								
ES-B-17321	East Spring Brook	Nonnewaug Road / Porter Hill Road	Woodbury								
N-W-16335	Nonnewaug	Mill Rd - USGS Gauge	Woodbury								
Dup:											
Blank:											

SAMPLING METHOD
 (enter number code for each method used)

1. Wading
 2. Extension Pole
 3. Bucket

OBSERVATION CODES
 (enter letter code for each observation that applies):

Water Level	Water Odor	Water Color	Observed Use	Current Weather
A. Very Low	F. Rotten Egg	L. Murky (Brown)	R. Swimming	V. Sunny
B. Low	G. Chlorine	M. Silty	S. Fishing	W. Sun w/ some clouds
C. Average	H. Milky	N. Green	T. Boating	X. Cloudy w/ some sun
D. High	I. Gas or Oil	O. Teal	U. Other	Y. Cloudy/Overcast
E. Very High	J. None	P. Cloudy		Z. Raining
	K. Other: _____	Q. Clear		

Wet vs. Dry Weather Sampling Conditions

The QA Manager / Project Manager will refer to the precipitation recorded from the USGS Gauging Station #01203B05 on the Weekeepemec River at Hotchkissville, CT (https://waterdata.usgs.gov/ct/rwrf/v?site_no=01203B05) to confirm wet or dry sampling conditions.*

Wet Weather Conditions are defined as sampling events where precipitation prior to sampling is greater than 0.1" precipitation in 24 hours or greater than 0.25" precipitation in 48 hours or greater than 2.0" precipitation in 96 hours.

Dry Weather Conditions are defined as all other conditions not satisfying the wet weather criteria.

*The amount of precipitation observed at in the 24-hour, 48-hour, 72-hour, and 96-

Other field notes: _____

A partially pre-filled Field Data Sheet will be used by the sampling team.

Pre-filled fields on the data sheet include Site Number, River, Nearest Road, Town, which are listed in order of the sampling route.

The field sampler should complete the top of the form at the beginning of sample day by entering:

- Sampler Name(s) – Use first and last for each person
- Date
- Streamflow (cfs) for each relevant USGS gaging station

The field sampling team needs to complete the following fields at each site:

- Sample Time
- Sample Method (Wading, Pole, Bucket)
- Wet or Dry (type of sampling condition - see definition in gray box)
- Air Temperature

- Water Temperature
- Conductivity
- Observation Codes (list code for each applicable observation)
- Observations and comments (site specific)

The field sampling team needs to record sample ID codes for duplicates and blanks on the field data form.

- Where “Dup:” is listed, simply enter the Site ID Number in the same box and complete the River, Nearest Road, Town.
- Where “Blank” is listed enter the Site ID you have assigned to the blank based one where it was filled.
- It is also helpful to add a note in the comments field indicating a duplicate or blank for that site.

Other Field Notes

This is a place to write down any other observations or questions that might come up throughout the sampling day. (*Example: You might get a question from a passerby that you don’t know how to answer and want to pass it along to the Project Manager.*)

Wet vs. Dry Weather Sampling Conditions

The QA Manager / Project Manager will refer to the precipitation recorded from the USGS Gaging Station #01203805 on the Weekepeemee River at Hotchkissville, CT (https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203805) to confirm wet or dry sampling conditions. The amount of precipitation observed at in the 24-hours, 48-hours, and 72-hours, and 96 hours prior to sampling will be recorded on the field data sheet for reference.

- **Wet Weather Conditions** are defined as sampling events where precipitation prior to sampling is greater than 0.1" precipitation in 24 hours *or* greater than 0.25" precipitation in 48 hours *or* greater than 2.0" precipitation in 96 hours.
- **Dry Weather Conditions** are defined as all other conditions not satisfying the wet weather criteria.

Chain of Custody Form Instructions

HYDRO TECHNOLOGIES, INC.
P.O. BOX 1987, 62 BANK ST.
NEW MILFORD, CT 06776

PHONE: (860) 358-6773
FAX: (860) 350-2288

CHAIN OF CUSTODY RECORD

COMPANY NAME: Pomperaug River Watershed Coalition				TOTAL # OF B O T T L E S		
ADDRESS: 39 Sherman Hill Rd Suite 103C Woodbury, CT 06798						
PROJECT NAME: Pomperaug E.Coli & Nitrate		Email: cshaw@pomperaug.org				
PROJECT MANAGER: Carol Robbins		PHONE:				
SAMPLER(S) NAME:		FAX:				
LAB ID: -CLAS 958(24-7)	CLIENT SAMPLE ID	TYPE	COLLECTION DATE/TIME	ANALYSES REQUESTED COMMENTS OR NOTES (PRESERVATION)		
	Woodbury / Bethlehem					
	N-W-16335 Mill Rd - USGS Gauge	SW			X	1 bio bottle
					X	250 ml plastic
	N-W-14355 Rt 47 Bridge	SW			X	1 bio bottle
					X	250 ml plastic
	N-W-16274 Rt 61 Bridge	SW			X	1 bio bottle
					X	250 ml plastic
	W-W-16022 Brushy Hill Rd	SW			X	1 bio bottle
					X	250 ml plastic
	W-W-CHOH Chochees Trail	SW			X	1 bio bottle
					X	250 ml plastic
	W-W-15530 Jacka Bridge Rd	SW			X	1 bio bottle
					X	250 ml plastic
	W-B-15009 Wood Creek Rd	SW			X	1 bio bottle
				X	250 ml plastic	
TYPE: SW - Discharge Water SU - Surface Water				SPECIAL INSTRUCTIONS/NOTES:		
RELINQUISHED BY:		RECEIVED BY:		DATE	TIME	

A partially pre-filled sample form will be provided. Pre-filled fields include:

- Company name, address, phone, email, and Project Manager’s name.
- Client Sample ID’s with sites listed in order of the sampling route.
- Type of Sample (“SW” indicates surface water)
- Analyses requested (which appear in line with type of sample bottle/preservation)

The field sampling team needs to complete the following fields:

- Sampler Name(s) – Use first and last
- Date and Time sample collected at each site.
- The number of each bottle type filled for each site. If more than one sample, add a note to indicate A & B under the Client Sample ID.
- Signatures of the person relinquishing the samples to the lab and person receiving the samples and date/time samples are relinquished.

The lab will retain the original Chain of Custody Form and provide PRWC with a hard copy of the signed Chain of Custody Form at the time samples are released.

APPENDIX 2

**EpiCollect5 App User Guide for
PRWC's Ambient Water Quality Monitoring Program**



EpiCollect5¹ App User Guide for PRWC's Ambient Water Quality Monitoring Program

Last Revised: 3/2/2022



Epicollect5 Data Collection
Oxford University, CGPS

¹ Epicollect5 is a free and easy-to-use mobile data-gathering platform. It provides both the web and mobile applications for the generation of forms (questionnaires) and freely hosted project websites for data collection.

Projects are created by using the web application at five.epicollect.net then downloaded to the device to perform the data collection. Data are collected (including GPS and media) using multiple devices and all data can be viewed on a central server (via map, tables, and charts). Data can be exported in csv and json format.

The mobile app is available for both Android (5+) and iOS (8+).

Epicollect5 is part of the **Big Data Institute at Oxford University** (<https://www.bdi.ox.ac.uk>) and hosted on the world-class cloud hosting provider, **Digital Ocean**: <https://www.digitalocean.com>, in their **UK** data center.

PRWC USER GUIDE for EpiCollect5

Downloading the App & Finding the PRWC Bacteria Sampling Field Data Form in EpiCollect5

Connect device to wi-fi or enable 3G/4G/5G data connection.

Download EpiCollect5 App from Google Play or Apple Store and install accordingly. App will need permission to access the device camera and location features.

Once installed, open the app and use the Add Project option in the upper right corner to access PRWC Bacteria Sampling Field Data Form (note - name will be updated prior to 2021 field season; disregard the PRWC Bacteria Sampling 2020 project). Search **PRWC Ambient Water Quality Monitoring** to locate and select. The project will be added to the projects list. This is the form where all field data is to be entered starting in 2021.

Preparing Device for Field Work

As you gather, inspect, and calibrate your sampling equipment and supplies as described in PRWC's Ambient Water Monitoring Manual **make sure to fully charge the tablet or smart phone** you plan to use in the field **the night before** sampling day.

On sampling day, check for app updates while connected to wi-fi before going into the field. Turn on the device to confirm that it is fully charged. Then open the EpiCollect5 app and select the PRWC Bacteria Sampling Project to open the field data form while connected to the internet. A dialogue box will appear to alert you of any changes/updates to the form. Install any updates.

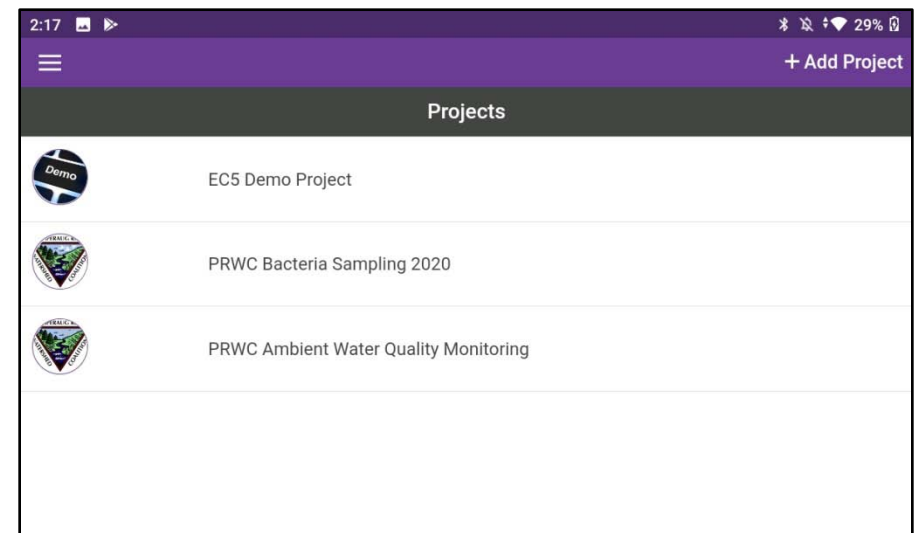


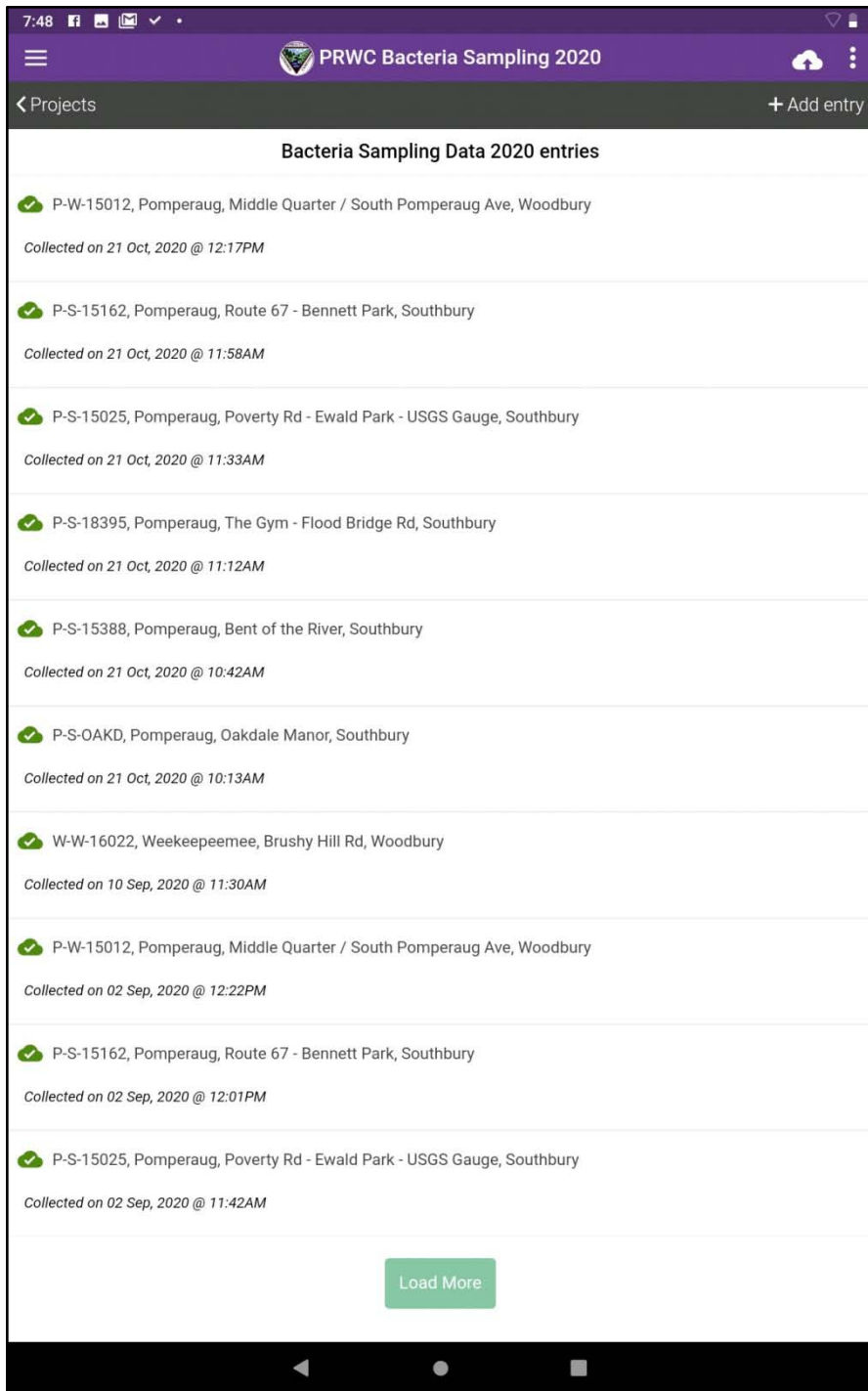
Epicollect5 Data Co.
Oxford University, CGPS

You may find a list of previously entered data available to view in the app. Note each entry listed displays the date and time of data collection and a cloud shaped icon. A green cloud icon containing a white check-mark indicates that the entry has been uploaded/synced to the master data-sheet. A white cloud with a black outline indicates a data entry made while offline and that has not yet been uploaded/synced to the master datasheet.

Once each entry has been uploaded/synced to the master data-sheet, it can be cleared from the list by clicking on the three dot icon in the upper right hand corner (next to the cloud) and selecting clear synced entries.

The device may then be used offline. Note - the location feature on your device does not need wi-fi or 3G+ to find your location in the field, but the Location setting on your device needs to be turned on. Check "Location" status in Settings under Privacy before heading into the field.



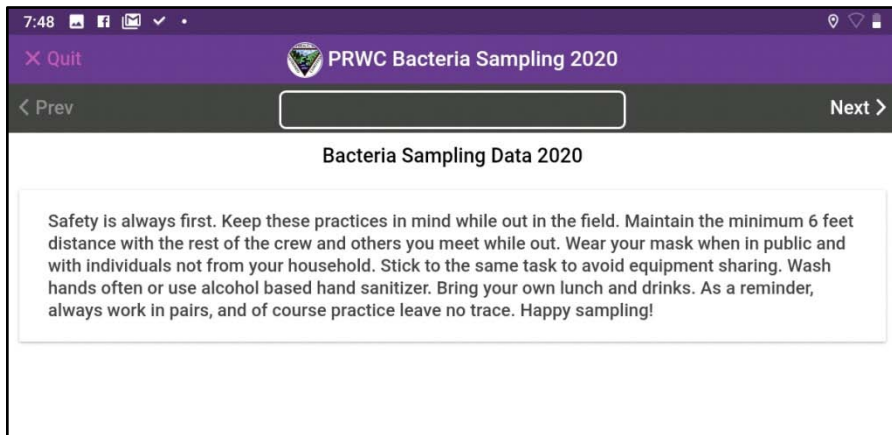


Adding New Sampling Entries

After Preparing Device for Field Work, you are ready to start entering data.

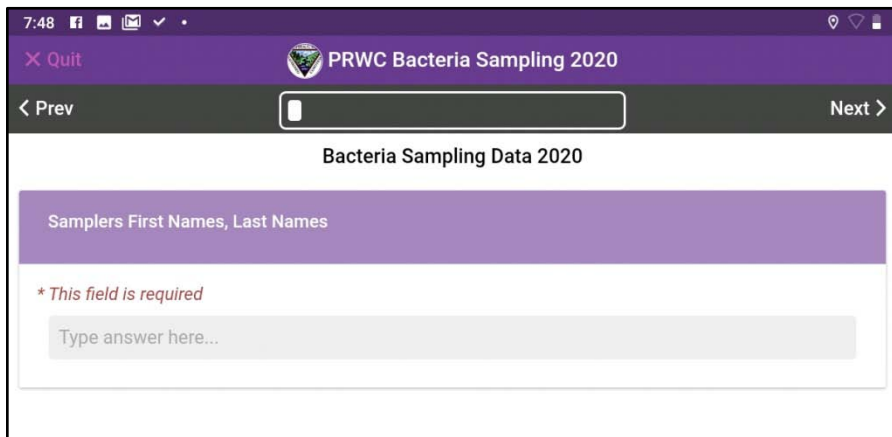
Open the PRWC Bacteria Sampling Project, click the +Add Entry icon in the upper right corner, and follow the prompts. Note each screen will contain a single question and response field. Most fields are required and you will not be able to click Next without entering data.

In the event the information is not available, enter 99999 to move forward but make sure to add a comment at the end of the form in the Observations/Comments section to document the situation that necessitated this entry. Example situations might be that you misplace your thermometer, forget to look-up streamflow, or your conductivity meter fails while in the field.



Welcome screen with friendly reminders.

Click next to proceed.



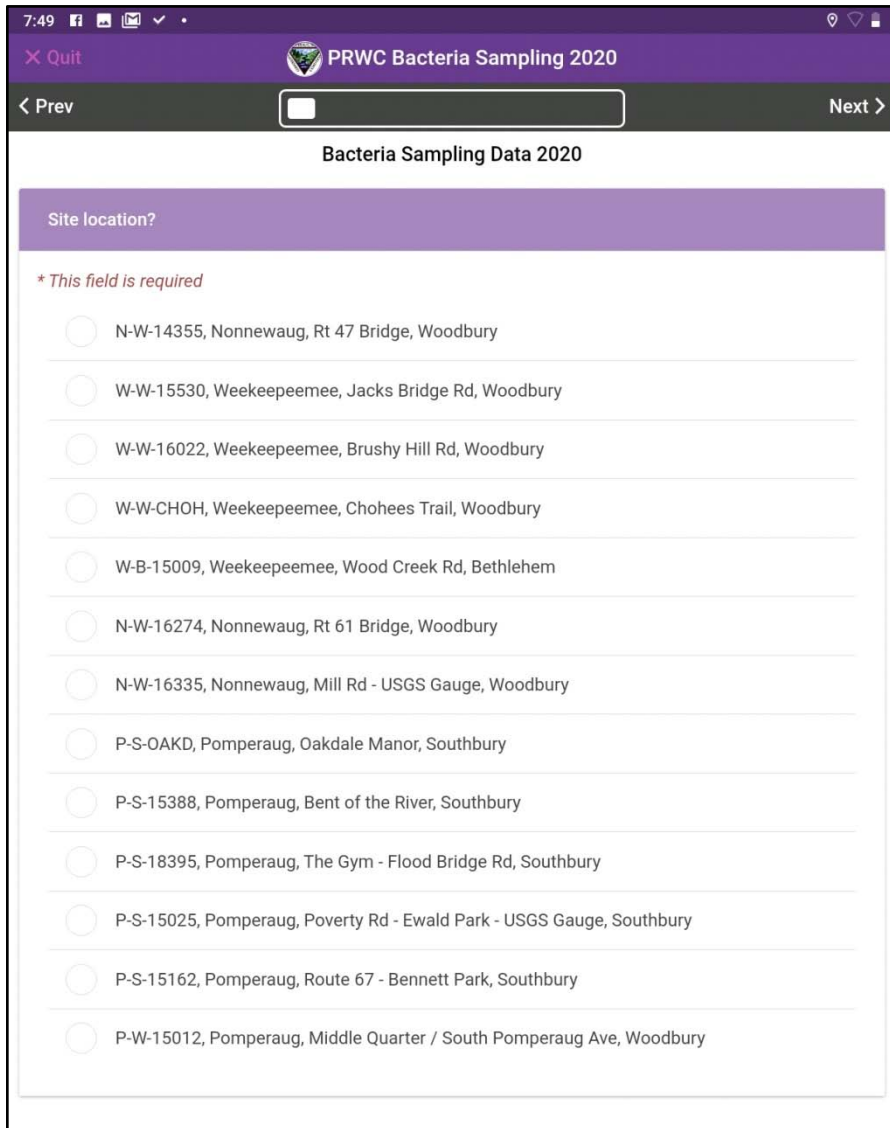
Enter First AND Last Names of each person on the sample team.

Tip -- Copy this text to your clipboard after you type it in your first entry so you can paste it in your next entry. This will help eliminate typos and save time.

Click next to proceed.

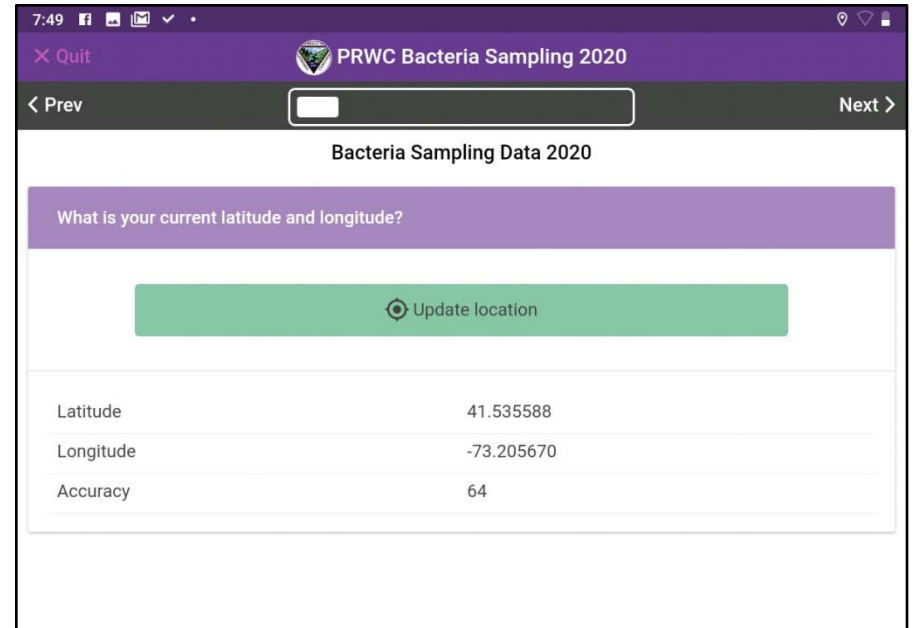
Site Location

Toggle the radio button to identify your sampling site. Sites are listed in the order of the sampling route to make them easier to find in the list. Click Next to proceed.



The screenshot shows the 'Bacteria Sampling Data 2020' app interface. At the top, there is a purple header with 'PRWC Bacteria Sampling 2020' and a 'Quit' button. Below the header is a navigation bar with 'Prev' and 'Next' buttons. The main content area is titled 'Bacteria Sampling Data 2020' and features a purple bar with the text 'Site location?'. Below this, a red asterisk indicates that the field is required. A list of 14 sampling sites is displayed, each with a radio button and a text description of the location. The sites are listed in the following order:

- N-W-14355, Nonnewaug, Rt 47 Bridge, Woodbury
- W-W-15530, Weekepeemee, Jacks Bridge Rd, Woodbury
- W-W-16022, Weekepeemee, Brushy Hill Rd, Woodbury
- W-W-CHOH, Weekepeemee, Chohees Trail, Woodbury
- W-B-15009, Weekepeemee, Wood Creek Rd, Bethlehem
- N-W-16274, Nonnewaug, Rt 61 Bridge, Woodbury
- N-W-16335, Nonnewaug, Mill Rd - USGS Gauge, Woodbury
- P-S-OAKD, Pomperaug, Oakdale Manor, Southbury
- P-S-15388, Pomperaug, Bent of the River, Southbury
- P-S-18395, Pomperaug, The Gym - Flood Bridge Rd, Southbury
- P-S-15025, Pomperaug, Poverty Rd - Ewald Park - USGS Gauge, Southbury
- P-S-15162, Pomperaug, Route 67 - Bennett Park, Southbury
- P-W-15012, Pomperaug, Middle Quarter / South Pomperaug Ave, Woodbury



The screenshot shows the 'Bacteria Sampling Data 2020' app interface for updating location. At the top, there is a purple header with 'PRWC Bacteria Sampling 2020' and a 'Quit' button. Below the header is a navigation bar with 'Prev' and 'Next' buttons. The main content area is titled 'Bacteria Sampling Data 2020' and features a purple bar with the text 'What is your current latitude and longitude?'. Below this, there is a green button labeled 'Update location'. Below the button, there is a table showing the current location data:

Latitude	41.535588
Longitude	-73.205670
Accuracy	64

Latitude / Longitude

Click the green button to update your location.

Note - the location feature on your device does not need a wi-fi or 3G/4G/5G connection to find your location in the field. However, to do this, the Location setting on your device needs to be turned ON. If the device does not automatically populate the latitude, longitude, and accuracy fields, the location setting may be turned off. To turn on, return to your device home screen and turn on the location feature. This is typically found in Settings under Privacy.

Click next to proceed.

The screenshot shows a mobile application interface for 'PRWC Bacteria Sampling 2020'. At the top, there is a purple header with the title and a 'Quit' button. Below the header is a navigation bar with 'Prev' and 'Next' buttons. The main content area is titled 'Bacteria Sampling Data 2020' and contains a question: 'Is this a duplicate, blank, or regular sample?'. There are three radio button options: 'Duplicate' (selected), 'Blank', and 'Regular sample'. A notification bell icon is visible in the bottom right corner.

Type of Sample

Distinguishing the type of sample is important for data management.

“Regular Sample”

For most sites, you will be collecting only ONE sample (or filling one sample bottle for each type of analysis) and each bottle will be labeled using the Site ID code, date, time, and organization name. In this case select “Regular sample”.

“Duplicate”

At one of your sites, you will be asked to collect a duplicate sample. That means filling TWO sample bottles for each type of analysis. An “A” or “B” will be added after the SITE ID code on the sample bottle to indicate a duplicate sample. By selecting “Duplicate” on sample type, you will only need to enter the field data once for that site. The project manager will then know to average the results for the two samples.

“Blank”

At one of your sites, you will be asked to create a field blank. That means filling the sample bottle with distilled water. This is a quality assurance measure for both the lab and the sample team to make sure sample bottles are not being contaminated in the sampling process and that meters are functioning correctly.

For the site where you fill the blank, you will label your sample bottles using the SITE ID and adding an “A” or “B” after each. Each of these samples needs its own entry in the field data form. For the stream sample, enter as you would for a regular sample and complete the form based on your field observations. For the blank, enter it as a “Blank”. For both the regular and the blank, use the observation/notes section of the form to add a comment indicating how the bottles were labeled (i.e. A = regular sample and B = Blank).

See “Entering Field Observations for Blanks” at the end of this document for further instructions on how to capture field data for the blank.

7:49

Quit

PRWC Bacteria Sampling 2020

Prev

Next

Bacteria Sampling Data 2020

Date? (MM/dd/YYYY)

* This field is required

02/03/2021 X

The date selected is: 02/03/2021

Sample Date

The date field will auto-populate. Confirm that it is recorded in MM/DD/YYYY format. Click Next to proceed.

7:50

Quit

PRWC Bacteria Sampling 2020

Prev

Next

Bacteria Sampling Data 2020

Time? (HH:mm:ss)

* This field is required

7:50:01 PM X

The time selected is: 19:50:01

Sample Time

The time field will auto-populate. Confirm that it is recorded in HH:MM:SS format followed by AM or PM.

NOTE - The HH:MM captured here is the sample time that should be written on the sample bottle and recorded on the Chain of Custody Form.

Click Next to proceed.

7:50 [social icons] PRWC Bacteria Sampling 2020

< Prev [input field] Next >

Bacteria Sampling Data 2020

Nearest USGS streamflow gauge?

* This field is required

Pick possible answer

Streamflow

Recording streamflow helps the QA Manager / Project Manager understand stream conditions at the time of the sample (high, low, average flow rate, recent rain events, etc).

For sites on Pomperaug River, Transylvania Brook, or Bullet Hill Brook select Pomperaug from the dropdown list.

For sites on the Nonnewaug, East Spring Brook, or Lewis Atwood Brook select Nonnewaug from the dropdown list.

For sites on the Weekepeemee, Sprain Brook or Wood Creek, select Weekepeemee.

7:50 [social icons] PRWC Bacteria Sampling 2020

< Prev [input field] Next >

Bacteria Sampling Data 2020

Streamflow (cfs)?

* This field is required

[Type answer here...]

To look up the current streamflow rate (measured in “cfs” or cubic feet per second), visit the website for the respective gauging station and to find “Most recent instantaneous value” and enter value in form. The value should contain one digit after the decimal point.

Pomperaug Gage:

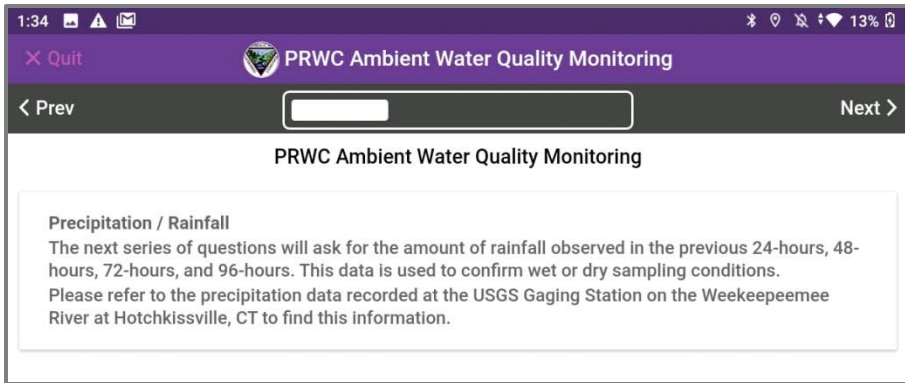
https://waterdata.usgs.gov/ct/nwis/uv?site_no=01204000

Nonnewaug Gage:

https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203600

Weekepeemee Gage:

https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203805



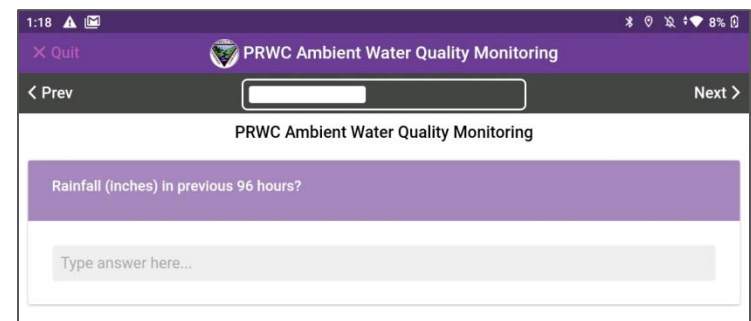
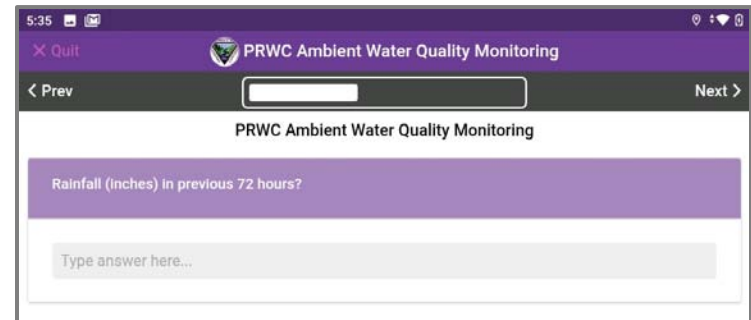
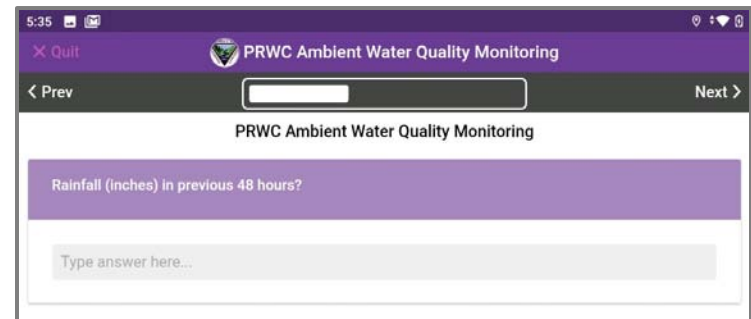
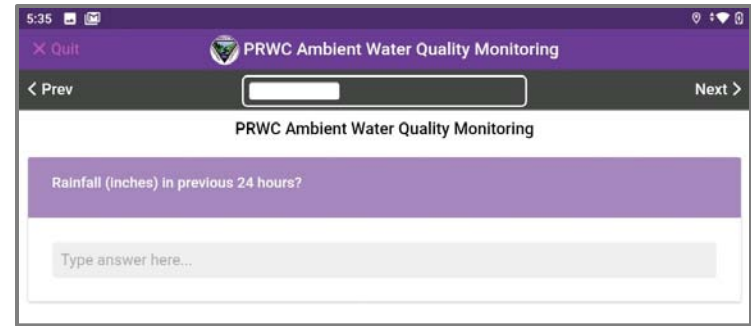
Precipitation

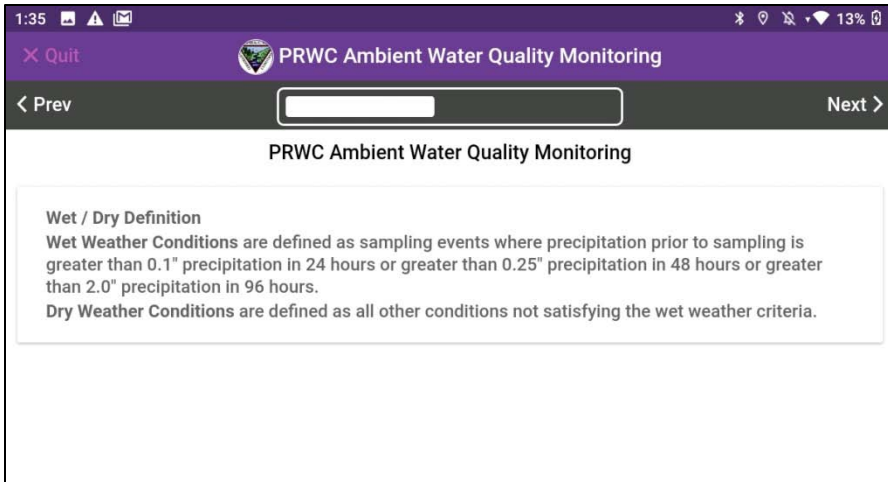
Recording precipitation in the previous 24, 48, and 72, and 96 hours helps the QA Manager / Project Manager determine if the sampling conditions are defined as Wet Weather or Dry Weather.

Please refer to the precipitation data recorded at the USGS Gaging Station on the Weekepeemee River at Hotchkissville, CT (link below) to find this information. Precipitation is measured in inches To look up the precipitation data, visit the website and at the top of the page make sure the check box for the “precipitation” parameter is checked. Select “Graph” for the output format and adjust the “Days” to 1 or 2 or 3 or 4 days respectively. Refer to the graph to find the total precipitation during the defined timeframe. Enter value in the form. The value should contain two digits after the decimal point. If less than 1, please record the 0 before the decimal point.

Weekepeemee Gage:

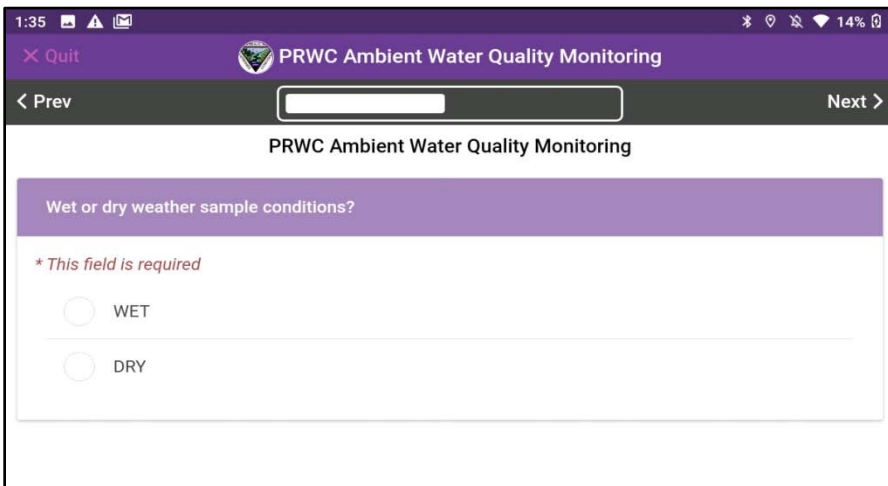
https://waterdata.usgs.gov/ct/nwis/uv?site_no=01203805





Wet vs. Dry Weather Sampling

Dialogue screen provides definitions for “WET” and “DRY” weather sampling conditions. Review the definition and determine which type of sample you are collecting. Click next to proceed.



Select Wet or Dry based on the definition provided.

Click next to proceed.

Note: The Principal Investigator will review the weather conditions to make an official determination on the WET / DRY sample designation and correct entry if necessary.

7:51 [Icons] PRWC Bacteria Sampling 2020

< Prev [Search Bar] Next >

Bacteria Sampling Data 2020

Current weather conditions?

* This field is required

Sunny

Sun with some clouds

Clouds with some sun

Cloudy

Foggy/misty

Light rain

Moderate or steady rain

Heavy rain

Current Weather Conditions

Select the weather description that best matches the conditions at the time of your sample. Note - weather conditions may change throughout the sample day and that's okay!

7:51 [Icons] PRWC Bacteria Sampling 2020

< Prev [Search Bar] Next >

Bacteria Sampling Data 2020

Air temperature? (Celsius)

* This field is required

Type answer here...

Air Temperature

Use the thermometer in your field kit to measure air temperature.

Make sure your reading is in Celsius and recorded with one digit after the decimal point.

Tips: Make sure it has stabilized in the ambient air. Temperature will fluctuate from a car that has the air conditioning running or a thermometer stored in a hot/cold trunk. For the best reading, hold the thermometer away from your body, ensure that it is dry, off the ground, and not in contact with other surfaces.

7:51 [Icons] PRWC Bacteria Sampling 2020

< Prev [Input Field] Next >

Bacteria Sampling Data 2020

Water level?

** This field is required*

Very low

Low

Average

High

Very high

Water Level

This observation can be somewhat subjective until the sampler sees the site in various conditions. Do your best to compare water level to the height of the streambank and extent of wetted area within the width of the channel as described in PRWC's Ambient Water Quality Monitoring Protocol.

This observation is supported by sites photographs and compared to the streamflow rate recorded at the nearest gauge to confirm the selection made.

7:52 [Icons] PRWC Bacteria Sampling 2020

< Prev [Input Field] Next >

Bacteria Sampling Data 2020

Water odor?

** This field is required*

Rotten egg

Chlorine

Musky

Gas or oil

None

Other

Water odor

Sniff water in the sample bucket or near stream level if you have waded into the stream.

If you selected Other - use the Observations / Comments section at the end of the form to describe.

7:52 [Icons] PRWC Bacteria Sampling 2020

Quit [Search Bar] Prev Next

Bacteria Sampling Data 2020

Water color?

* This field is required

Muddy (brown)

Silty

Green

Tea

Cloudy

Clear

Water color

Check all that apply.

Base your selection on the appearance of water in your sample bucket or sample bottle to eliminate glare or reflections or influence of the stream substrate in your observation.

If you selected Other - use the Observations / Comments section at the end of the form to describe.

7:52 [Icons] PRWC Bacteria Sampling 2020

Quit [Search Bar] Prev Next

Bacteria Sampling Data 2020

Observed use?

* This field is required

Swimming

Fishing

Boating

Other

Observed Uses -

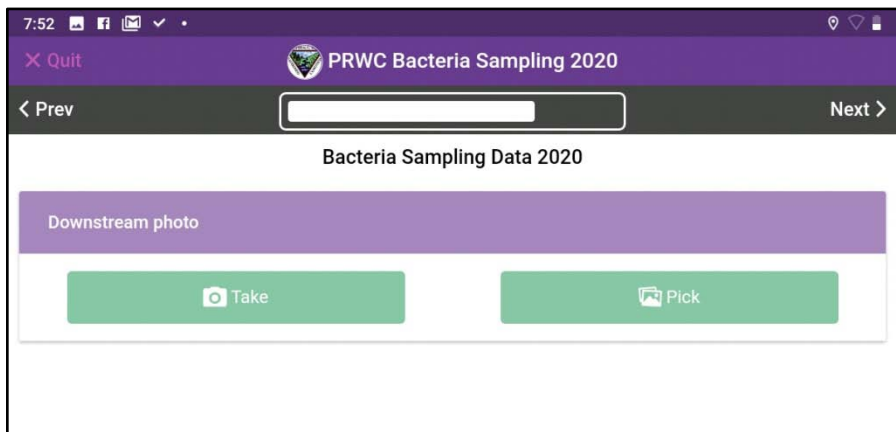
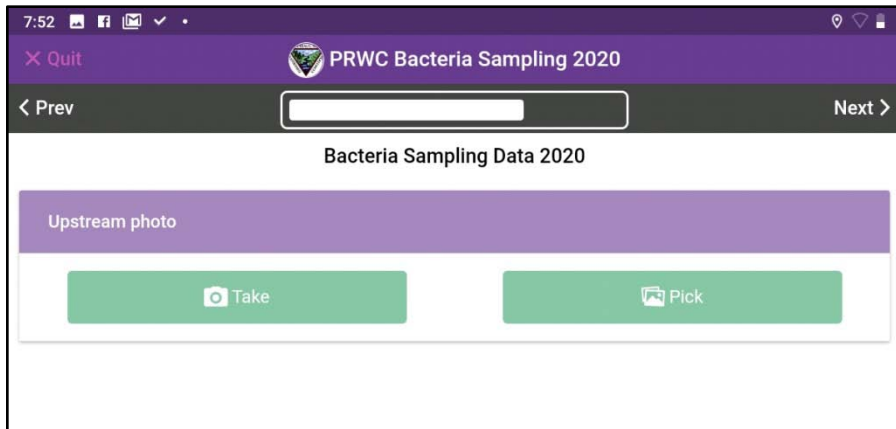
Check all that apply.

Swimming should only be selected if the site is a public swimming area. None of PRWC's sites correspond to public swimming areas.

Unless posted, fishing is permitted at most sites.

Pomperaug is considered a navigable waterway, but boating is not realistic except for the most downstream portion where it joins Lake Zoar / Housatonic River.

Other can be used to distinguish areas that have restrictions for fishing, swimming, and boating. (Example - Audubon at Bent of the River restricts these activities and is a wildlife sanctuary).



Site Photos

Users are encouraged to select the “PICK” option for uploading a photo rather than “TAKE”. If you use “take” the camera will open and allow you to take a photo within the EpiCollect App. You will be shown a preview of the photo and given an option to save or retake. The photo you save will be saved to the EpiCollect cloud and not be saved on the device.

When using “PICK”, you are selecting a photo from the photo gallery on the device -- photos taken using the device camera outside of the Epicollect app. You will need to open the Camera outside of the Epicollect and switch between the two apps to take the photos and then select one from your photo gallery.

If you are unsure of how to navigate between the two programs, just stick to the TAKE option.

NOTE: Please take photos in landscape view (turn device to the horizontal) to capture stream surroundings. Please DO NOT use the wide angle lens option if the device has this feature. It warps the proportions of the photograph.

Which way is Upstream? Downstream?

If you are not sure which way the river is flowing, toss a stick or leaf or other item that floats to see which direction it moves.

4:49

PRWC Bacteria Sampling 2020

Quit

Prev

Next

Bacteria Sampling Data 2020

Which method did you use to take temperature and conductivity readings?

* This field is required

Wading method

Bucket method

Sampling Method Used for Temperature and Conductivity Measurements

Check the box to indicate which sampling method was used when taking the water temperature and conductivity measurements.

7:52

PRWC Bacteria Sampling 2020

Quit

Prev

Next

Bacteria Sampling Data 2020

Water temperature? (Celsius)

* This field is required

Type answer here...

Water Temperature

Use the thermometer in your field kit to measure water temperature.

Make sure your reading is in Celsius and recorded with one digit after the decimal point.

Tips: Make sure the temperature reading has stabilized. For the best reading, hold the thermometer away from your body when measuring it in the stream and make sure the thermometer is not in contact with other surfaces when taking the reading from water in a sample bucket (edges or bottom of the sample bucket).

7:53 [status icons] PRWC Bacteria Sampling 2020

Quit [back] [input field] [next]

Bacteria Sampling Data 2020

Conductivity? (µS/cm)

* This field is required

Type answer here...

Conductivity

Use the meter in your test kit to measure conductivity.***

Make sure your device is on the proper screen which can be confirmed by the title at the top of the screen reading COND and the units below it shown as (uS/cm).

Record the conductivity result with one digit after the decimal point.

*** See "Operation Manual for Oakton CTSTestr 50" for specific instructions on how to use this field meter.

4:50 [status icons] PRWC Bacteria Sampling 2020

Quit [back] [input field] [next]

Bacteria Sampling Data 2020

Which method did you use to fill sample bottles?

* This field is required

Wading Method

Extension Pole Method

Sampling Method Used to Fill Sample Bottles

Check the box to indicate which sampling method was used to fill the sample bottles for bacteria and nitrate analysis.

Observations / Comments

Use this field to enter descriptions for “other” water color, odor, notes on blanks and duplicates and other observations you made while in the field. Example -- perhaps some wildlife encounters, question from a passerby, pollution event in progress like an oil or sewage plume entering the stream. Anything you think might influence sample results or be helpful or of interest to the Principal Investigator.

Bacteria Result and Nitrate Result

Leave Blank. These will be entered by the Project Manager after results are received from the testing laboratory.



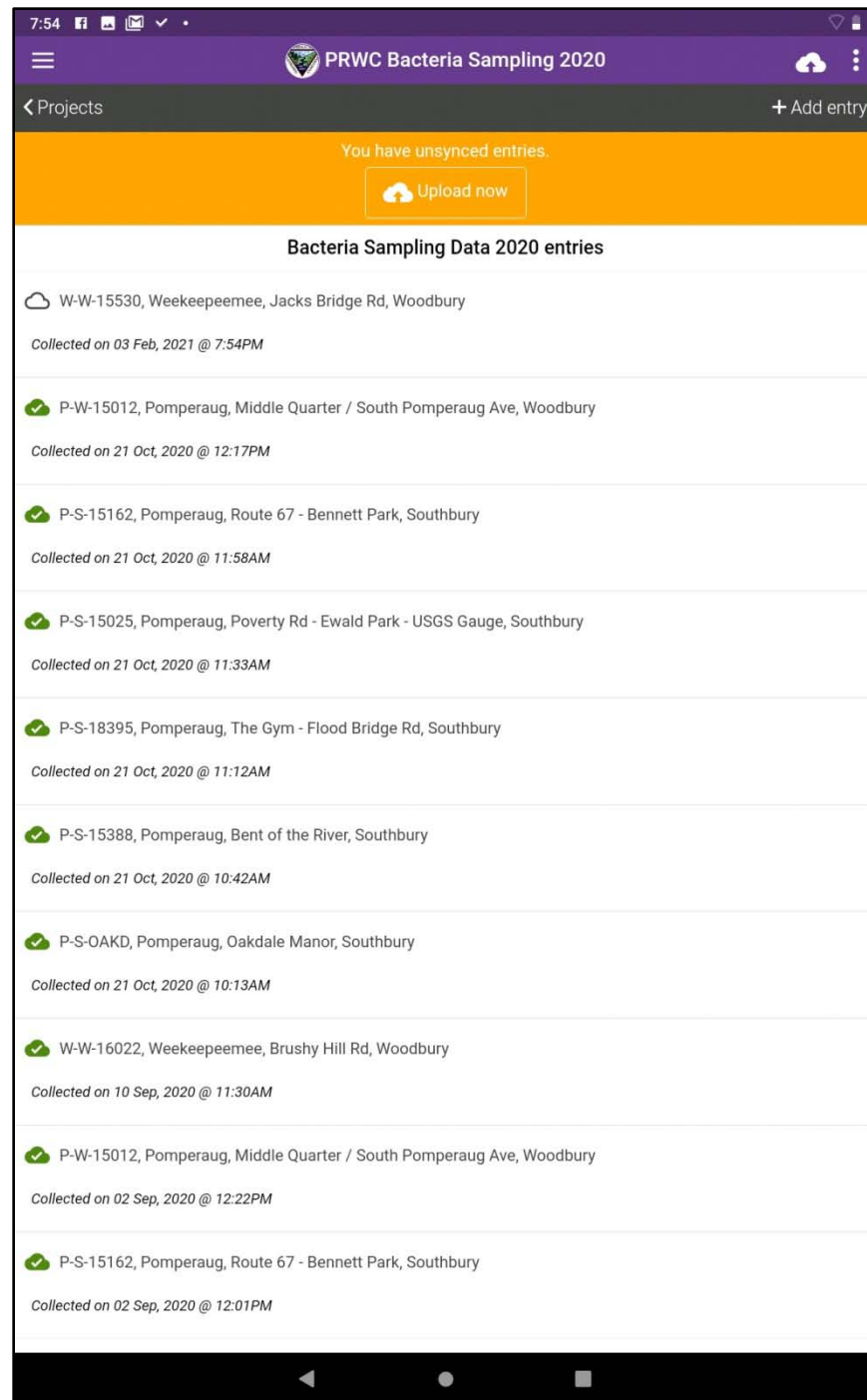
Save Entry

Congratulations! You have completed your field observations for this site. Click Save Entry and you will be taken back to the entries list. Confirm your entry has been added to the list. If you are offline, you will see a message at the top of the screen that there are unsynced entries. Entries will be synced at the end of the sample day when connected to Wi-Fi.

Travel to your next site and start a new entry following instructions from the “Adding New Sampling Entries” step.

Complete your sampling route and when connected to Wi-Fi, sync your entries for the day by clicking “Upload Now”. Your entries will be populated to the master sheet hosted through the EpiCollect5 website. Please do not delete any entries from your device until the Project Manager confirms that entries have been uploaded successfully to the master sheet.

The master data-sheet that can be viewed on the EpiCollect5 website. Only when logged in as the Project Manager can data records be edited after they have been uploaded. It is at this step in the sequence that bacteria and nitrate results from the testing lab are entered.



APPENDIX 3

OAKTON CTS Testr® 50P Technical Specs and User Manual

Traceable Digital Thermometer Technical Specs

Lenovo tab M10 FHD PLUS (Tablet) Technical Specs

...setting the standard again and again[®]



Oakton[®] 50 Series Conductivity Pocket Testers

New design stands up to the challenges of measuring water quality—even stands upright

The Oakton conductivity pocket testers stand up to everyday use, harsh environments, and the test of time. The testers can even stand upright when the cap is used as the stabilizing base. When you choose one of these conductivity testers, you get a pocketful of useful features and benefits.

- Easy-to-replace sensor module lets you use the tester body over and over again
- Intuitive interface has self-diagnostic error messages, and battery-life and stable reading indicators
- Simple operation at your fingertips with MENU button, 1-button calibration, and HOLD button to freeze readings for recording
- Valox[®] body resists most chemicals and is rugged, dustproof, waterproof, and IP67 rated
- Leakproof cap functions as a sample cup, hydrating cup, and stabilizing base to stand the tester upright
- Uses common AAA batteries

Cap Design: versatile and functional



Tester stands upright with wide, stable base



Leakproof: use to store and keep electrode hydrated



Use as a sample cup to calibrate or measure

Applications

Agriculture | Aquaculture & Aquariums | Cooling Towers | Education |
 Electroplating | Environmental Monitoring | Food & Beverage |
 Hydroponics | Manufacturing | Photo Development | Pools & Spas |
 Printing | Water & Wastewater Treatment



Easily replace sensor module with a twist—no tools required

CTSTestr™ 50P and 50C Pocket Testers

- 3-in-1 testers measure conductivity, TDS, and salinity
- Up to 3-point conductivity calibration with automatic standard recognition
- Selectable TDS factor adds versatility
- Factory calibrated against NaCl standards—ideal for testing salinity in pools
- Available with pin-style or cup-style sensor



Immerse and read with pin-style sensor



Draw or grab samples with cup-style sensor

PCTSTestr™ 50 Multiparameter Pocket Tester

- Measures pH, conductivity, TDS, and salinity
- Long-life pH electrode and stainless steel pin-style conductivity sensor provide compatibility with a wide range of samples
- Up to 3-point pH calibration with NIST or USA autobuffer recognition, user-adjustable temperature coefficient, and self-adjusting TDS and salinity factors



Includes: protective plastic storage case, lanyard, and batteries.



Model	CTSTestr 50P (pin-style sensor)	CTSTestr 50C (cup-style sensor)	PCTSTestr 50
Catalog number	WD-35634-55	WD-35634-65	WD-35634-35
Range	pH	—	-1.00 to 15.0
	Conductivity	0.0 to 200.0 µS, 200 to 2000 µS, 2.00 to 20.00 mS	
	TDS	0.0 to 100.0 ppm, 100 to 1000 ppm; 0.10 to 10.00 ppt (TDS factor 0.5)	
	Salinity	0.00 to 10.00 ppt	
Resolution	Temperature	32 to 140°F (0 to 60°C)	
	pH	—	0.01
	Conductivity	0.1 µS, 1 µS; 0.01 mS	
	TDS	0.1 ppm, 1 ppm; 0.01 ppt	
Accuracy	Salinity	0.10 ppt	
	Temperature	0.1°C / 0.1°F	
	pH	—	±0.01
	Conductivity	±1% full-scale	
pH buffer recognition	TDS	±1% full-scale	
	Salinity	±1% full-scale	
Calibration	Up to 3 points (pH, conductivity and TDS); 1 point (salinity)		
TDS factor	0.40 to 1.00 (selectable)		
Temperature compensation	Automatic		
Power	Four AAA 1.5 V batteries (included)		

Operating Instructions

OAKION®

CTS Testr™ 50 Pocket Testers

Applications

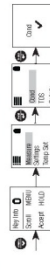
- Aquaculture
- Electroplating rinse tanks
- Aquariums and fish farms
- Printing industry
- Boiler blow-down
- Swimming pools
- Drinking water
- Verification of reverse osmosis system operation
- Hydroponics
- Water & wastewater treatment

Getting Started

The CTS Testr 50 Pocket Tester has been factory calibrated and usually works well out of the box. However, it is best practice to take a few minutes to perform the sensor cap and soak the sensor in warm tap water for 10 minutes or so. Prior to taking the measurements, periodic recalibration with certified standards is recommended for best accuracy.

Measurement Parameter Setting

1. Press ON/OFF (o) to power on the tester.
2. Press MENU/V to enter setup window. Press HOLD/← to select Measure. The display shows Cond, TDS and Salinity.
3. Scroll down by pressing MENU/V to toggle between Cond, TDS and Salinity. Press HOLD/← to select Cond.
4. The display shows the selected measure with a ✓.



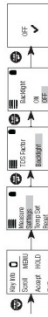
TDS Factor Setting

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Settings.
2. Press HOLD/← to select Settings. The display shows TDS factor and Backlight.
3. Press HOLD/← to select the default TDS factor setting or MENU/V to adjust the setting.
4. Press HOLD/← to confirm the selection of the setting. The display shows the set TDS factor with a ✓.



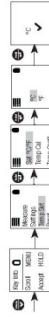
Backlight Settings

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Settings.
2. Press HOLD/← to select Settings. The display shows TDS Factor and Backlight.
3. Scroll down by pressing MENU/V to toggle between TDS Factor and Backlight. Press HOLD/← to select Backlight.
4. The display shows ON and OFF. Scroll down by pressing MENU/V to toggle between ON and OFF. Backlight ON increases readability in low-light conditions.
5. Press HOLD/← to select the desired backlight option. The display shows the selected backlight option with a ✓.



Temperature Settings

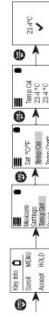
1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
2. Press HOLD/← to select Set °C/°F. Scroll down by pressing MENU/V to toggle between °C and °F.
3. Press HOLD/← to select temperature unit. The display shows the selected temperature setting with a ✓.



Temperature Calibration

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set.
2. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
3. Scroll down by pressing MENU/V to toggle between Set °C/°F, Temp Cal and Temp Coeff. Press HOLD/← to select Temp Cal.
4. The lower display shows the current measured temperature reading based on the test cell and the upper display shows the current measured temperature reading based on factory default calibration.
5. Dip the tester into a solution of known temperature and allow time for the built-in temperature sensor to stabilize.
6. Press MENU/V to adjust the temperature value or press the HOLD/← to confirm the calibrated value as the new temperature value of the solution.

Note: To exit this program without confirming the calibration, press CAL/ESC.



Temp Coefficient

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set.
2. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
3. Scroll down by pressing MENU/V to toggle between Set °C/°F, Temp Cal and Temp Coeff.
4. Press HOLD/← to select Temp Coeff or MENU/V to adjust the Temp Coeff.
5. Press HOLD/← to confirm the Temp Coeff value. The new value is automatically confirmed with a ✓.



Calibration for Conductivity, TDS, or Salinity

For best results, periodic calibration with an accurate standard is recommended prior to measurement. Use the calibration standard value that is close to your intended sample value. The tester will retain one calibration value in each mode (conductivity, TDS, salinity) when the instrument is powered off. The conductivity value can be automatically updated when the instrument is powered on. Salinity values require manual calibration. The instrument will retain the last calibration value in the mode that was powered off. See "Measurement Parameter Setting" to change the desired parameter.

Automatic Calibration for Conductivity

1. Remove the cap and press ON/OFF (o) to power on.
2. Dip the sensor in at least 30 mm of calibration standard.
3. Stir gently and press CAL/ESC key to begin the calibration.
4. The display will show CAL followed by the default value. CAL is indicated on the display during calibration mode.
5. If the reading is within the calibration range of the automatically recognized standards: 80 (84 µS/cm), 1410 (1413 µS/cm), or 12,90 (12,88 mS/cm), the ✓ icon is displayed when the automatic calibration standard value has been detected.
6. Press HOLD/← to accept the auto conductivity standard and finish the calibration.
7. Display returns to Measurement window.



Manual Calibration

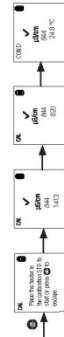
When the conductivity reading is outside calibration range of the automatic conductivity standards or when TDS or salinity is used, the tester will require manual adjustment.

1. Repeat steps 1 to 4 from "Automatic Calibration for Conductivity".
 2. Press MENU/V to manually adjust the value to the desired reading.
- Note:** The adjustment will decrease only, however the adjustment will eventually cycle to the highest available value after decreasing by 40% of the initial value.
3. Press HOLD/← to accept and finish the calibration when the desired value is selected.

Note: To abort calibration, press CAL/ESC to escape.

4. Once the calibration is finished and user has accepted the changes, measurement window will now show the calibrated reading.

Note: The auto conductivity standards are 84 µS/cm, 1413 µS/cm & 12.88 mS/cm.



CTS Measurement

1. Press ON/OFF (o) to power the tester on if needed.
2. Dip the electrode about 2 cm to 3 cm into the test solution. Stir and let the reading stabilize. The timer icon will blink during this time. Once the reading is stabilized, the timer stops blinking and ✓ will appear to indicate the stability of the reading.

CAUTION: Testing dry samples is not accurate and can lead to sensor damage or leakage. Solids must be wet and free of particulates that may break the glass sensor. Excessive force into dry samples can cause glass breakage.

3. Note the CTS value or press HOLD/← to freeze the reading. To release the reading, press HOLD/← again.
4. Press ON/OFF (o) for 3 seconds to turn off tester. If key is not pressed for 6.5 minutes, the tester will automatically shut off to conserve batteries.



User Reset

- Reset the CTS calibration to the user's default settings by using the user reset function. Temperature user calibration is not affected by the user reset function.
1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Reset. Press HOLD/← to select User Reset. The display shows User Reset and Factory Reset.
 2. Press HOLD/← to select User Reset.
 3. The display automatically shows No and Yes. Scroll down by pressing MENU/V to toggle between No and Yes.
 4. Press HOLD/← to confirm either No or Yes. Display shows User Reset option with a ✓.



Factory Reset

- Reset the CTS to the factory default settings by using the factory reset function.
1. Press MENU/V to enter setup window. Scroll down by pressing the MENU/V to select Reset. Press HOLD/← to select Reset. The display shows User Reset and Factory Reset.
 2. Scroll down by pressing MENU/V to toggle between the resets. Press HOLD/← to select Factory Reset.
 3. The display automatically shows No and Yes. Scroll down by pressing MENU/V to toggle between No and Yes.
 4. Press HOLD/← to confirm either No or Yes. The display shows the Factory Reset option with a ✓.



HOLD Function

This feature helps to freeze the display for a delayed observation.

1. Press HOLD/← button to freeze measurement.
2. Press HOLD/← again to release measurement.



Sensor Maintenance

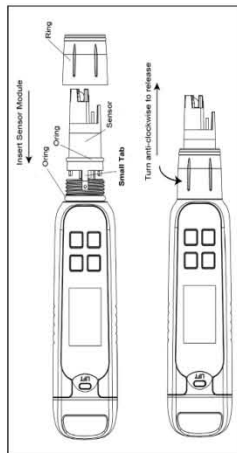
1. Always keep the sensors electrodes clean. Rinse the electrodes with deionized water and wipe them dry with clean cloth before storing with its protective cap. For cup type electrodes, remove the white plastic cap and thoroughly clean viscous solutions. Never scratch electrodes with a hard substance.
2. For better performance, soak the electrode in alcohol for 10 to 15 minutes and rinse with de-ionized water before starting any measurement process. This is to remove dirt and oil stains on the electrode which may affect the accuracy of the measurements.

Sensor Replacement

Replace the sensor module at the fraction of the cost of a new tester. When the tester fails to calibrate or gives fluctuating readings in calibration standards, you need to change the electrode.

1. With dry hands, grip the ring with sensor facing you. Twist the ring counter-clockwise. Save the ring for later use.
2. Pull the old sensor module away from the tester.
3. Align the four tabs on the new module so that they match the four slots on the tester.
4. Gently push the module onto the slots to sit it in position. Push the smaller O-ring fully onto the new sensor module. Push the other O-ring over the module and thread it into place by firmly twisting clockwise.

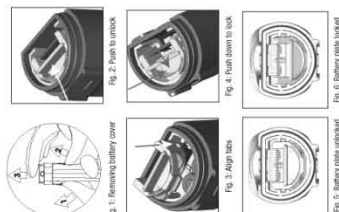
Note: It is necessary that you recalibrate your tester prior to measurement after a sensor replacement.



Replacing the Batteries

The CTS Testr 50 Pocket Tester uses four AAAA 1.5 V batteries.

1. To remove the battery cover, see Figure 1. Clear the front catch and then the back catch, before sliding the cover off.
2. To remove the battery plate, push the center tab towards the front of the tester as shown in Figure 2. Once unlocked, invert the tester upside down to remove batteries. Each side uses two AAAA batteries. Open the cover with positive terminal facing downward.
3. To lock the battery plate, align the small tabs (Figure 3) into the guide ribs on the housing and then press down. See Figure 4.



Warranty

This instrument is supplied with a warranty against manufacturing defects for a period of one year from the date of purchase.

Return of Items

Authorization must be obtained from your distributor before returning items for any reason. When applying for authorization, please include information regarding the reason the item(s) are to be returned. We reserve the right to make improvements in design, construction and appearance of products without notice. Prices are subject to change without notice.

Self-Diagnostic Messages

0	Batteries are weak and need replacement soon.
stable error	Appears when calibration is attempted but the reading is not yet stable. Wait for the reading to stabilize or manually confirm the calibration by pressing enter.
over range	The reading is above the measuring range of tester.

CTSTestR 50	
Conductivity	
Conductivity range	0.0 to 200.0 µS, 200 to 2000 µS, 2.00 to 20.00 mS
Resolution	0.1 µS, 1 µS, 0.01 mS
Relative accuracy	±1% full scale
Normalization temperature	25.0°C (77°F)
Temperature co-efficient	0.0% to 10.0%
Calibration points	Up to 3 points
TDS	
TDS range	0.0 to 100.0 ppm, 100 to 1000 ppm, 0.10 to 10.00 ppt (TDS Factor 0.5)
Resolution	0.1 ppm, 1 ppm, 0.01 ppt
Relative accuracy	±1% full scale
Calibration points	Up to 3 points
TDS factor	0.40 to 1.00 (selectable)
Salinity	
Salinity range	0.00 to 10.00 ppt
Resolution	0.10 ppt
Relative accuracy	±1% full scale
Calibration points	1
Temperature	
Temperature range	0 to 80°C (32.0 to 140.0°F)
Temperature resolution	0.1°C / 0.1°F
Temperature accuracy	From 0 to 50°C (±0.5°C / ±0.9°F + 1 LSD); from 50 to 80°C (±1.0°C / ±1.8°F + 1 LSD)
Temperature compensation	Yes (Automatic Temperature Compensation)
General	
Display	Graphics, dot matrix 80 x 100 pixel
Auto off	8.5 minutes (from last key press)
Reset	User / Factory
Power requirement	Four AAAA 1.5 V batteries
Battery life	20-50 hours
Water proofing	IP54 (IP)
Environmental operating conditions	
Ambient operating temperature	5 to 45°C / 41 to 113°F
Relative humidity	5% to 85% noncondensing
Storage temperature	-20 to 60°C / -4 to 140°F
Storage humidity	5% to 85% noncondensing

Accessories

Ordering Code	Product Description
35634-55	CTS Testr 50P pin-style pocket tester with case, lanyard, and batteries
35634-65	CTS Testr 50C cup-style pocket tester with case, lanyard, and batteries
35634-57	Replacement sensor module for CTS Testr 50P pin-style tester
35634-07	Replacement sensor module for CTS Testr 50C cup-style tester
35634-09	Replacement sensor cap
09376-00	Replacement alkaline batteries, AAA, 1.5 V. Pack of 12
17101-45	NIST traceable calibration with data for pocket testers

OAKTON
INSTRUMENTS

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August, 2017

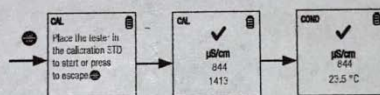
10650100_MAN_35634-55-65

OAKTON CTS Testr® 50P

At-a-Glance User Instructions for Calibration and Making Conductivity Measurements

Automatic Calibration for Conductivity

1. Remove the cap and press ON/OFF (⏻) to power on.
2. Dip the sensor in at least 30 mm of calibration standard.
3. Stir gently and press CAL/ESC key to begin the calibration.
4. The display will show CAL followed by the default value. CAL is indicated on the display during calibration mode.
5. If the reading is within the calibration range of the automatically recognized standards; 80 (84 $\mu\text{S}/\text{cm}$), 1410 (1413 $\mu\text{S}/\text{cm}$), or 12.90 (12.88 mS/cm), the ✓ icon is displayed when the automatic calibration standard value has been detected.
6. Press HOLD/↵ to accept the auto conductivity standard and finish the calibration.
7. Display returns to Measurement window.



Manual Calibration

When the conductivity reading is outside calibration range of the automatic conductivity standards or when TDS or salinity is used, the tester will require manual adjustment.

1. Repeat steps 1 to 4 from "Automatic Calibration for Conductivity".
2. Press MENU/√ to manually adjust the value to the desired reading.

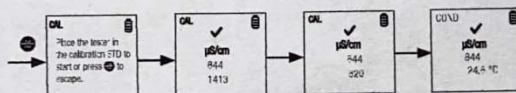
Note: The adjustment will decrease only, however the adjustment will eventually cycle to the highest available value after decreasing by 40% of the initial value.

3. Press HOLD/↵ to accept and finish the calibration when the desired value is selected.

Note: To abort calibration, press CAL/ESC to escape.

4. Once the calibration is finished and user has accepted the changes, measurement window will now show the calibrated reading.

Note: The auto conductivity standards are 84 $\mu\text{S}/\text{cm}$, 1413 $\mu\text{S}/\text{cm}$ & 12.88 mS/cm .



Measure conductivity using field meter. Hold down the power button to turn on the meter. Make sure your device is on the proper screen which can be confirmed by the title at the top of the screen reading COND and the units below it shown as ($\mu\text{S}/\text{cm}$). Rinse cap of the meter and the sensor in the stream or with water collected in the bucket a few times (dip cap into the river or bucket to fill/rinse and then discard to the side). Then fill the cap of the meter to the "max fill line" with water from the river. The meter will automatically begin measuring conductivity. Allow the meter a few moments to show a stabilized reading. You will see a check mark at the top, once a stable reading is reached. **Record the conductivity result with one digit after the decimal point.**



Long-Stem Traceable® Thermometer Specs and Use Manual

Long-Stem Traceable Thermometer

Be the first to review this product

IN STOCK

NORMALLY SHIPS WITHIN 1-3 DAYS

\$52.00

Select Temp Accuracy: *

±0.2°C at tested points, otherwise ±1.0 ±0.5°C at tested points, otherwise ±1.0

±1°C between (-30 to 150°C)

Select Probe Length: *

8 inches 11.375 inches

Qty: 1 Add To Cart

DESCRIPTION SPECS INSTRUCTIONS & LITERATURE REVIEWS (0)

Traceable® Long-Stem Thermometer

Ideal for replacing all glass and mercury thermometers in the lab

- On/off switch provides longer battery life, °F/°C switchable range
- Long stem allows for taking readings while stirring and is ideal for use in incubators and ovens

Replaces mercury and glass thermometers.

Perfect-sized unit fits into flasks, cuvettes, test tubes, beakers, ovens, and incubators. Read temperatures in foods, gases, samples, reagents, water baths, and semisolids. Stainless-steel probe (304) is resistant to most laboratory chemicals. ABS plastic and stainless-steel construction (no glass or mercury) makes it safe. Readings are updated every second.

Features

- Temperature range: -58 to 302°F and -50 to 150°C
- Resolution is 0.1° from -20 to 200° (1° outside this range)
- Accuracy is (Choose above)
- Brilliant LCD is 1/4-inch-high
- Stem Dimensions: 0.14" diameter.Length: Choose above

Traceable® Certificate

Multi-point calibration on an individually-numbered Traceable® Certificate which assures accuracy from our ISO/IEC 17025:2017 (1750.01) calibration laboratory accredited by A2LA. It indicates traceability of measurements to the SI units through NIST or other recognized national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Agreement. Probe materials is 304 Stainless-steel. Supplied: Traceable® Certificate, protective sleeve, and battery.

DESCRIPTION **SPECS** INSTRUCTIONS & LITERATURE REVIEWS (0)

Temperature Range	4052/4352 : - 50°C to 150°C ; 4353/4354 : -50 to 300°C
Temperature Resolution	0.1° from -20 to 200°(1° otherwise)
Probe Dimensions	4052/4352: 1/8" stem diameter, 8" stem length, 1.2" Top, 11" overall; 4353/4354: 1/8" stem diameter, 11 3/8" stem length, 14 3/8" overall
LCD Digit Size	1/4 in
Supplied With	Traceable® Certificate, protective sleeve, and battery

SPECIFICATIONS

Mode: 8" stem length

Range: -58 to 302 °F / -50 to 150 °C

Model: 11.4" stem length

Range: -58 to 482 °F / -50 to 250 °C

Resolution: 0.1° from -20° to 200°
(both models) 1° otherwise

OPERATION

Remove the stem from the protective sheath. Slide the ON/OFF switch to ON to turn the unit on. Slide the °F/°C switch to °F to display the temperature in Fahrenheit or to °C to display the temperature in Celsius. Insert the stem of the thermometer into the material to be measured.

Slide the ON/OFF switch to OFF to turn the unit off. Replace the protective sheath. To conserve battery life, always turn the unit off when not in use.

ALL OPERATIONAL DIFFICULTIES

If this thermometer does not function properly for any reason, replace the battery with a new high-quality battery (see the "Battery Replacement" section). Low battery power can occasionally cause any number of "apparent" operational difficulties. Replacing the battery with a new fresh battery will solve most difficulties.

BATTERY REPLACEMENT

Erratic readings, a faint display, or no display, are all indicators that the battery must be replaced. Remove the battery cap, located at the top of the unit by turning it in the direction of the arrow (counterclockwise). Remove the exhausted battery and replace with a new 1.5 volt silver oxide size 357 battery. Make certain the positive (+) side is visible. Replace the battery cover. Do not overtighten the cap.

WARRANTY, SERVICE, OR RECALIBRATION
For warranty, service, or recalibration, contact:

TRACEABLE® PRODUCTS

12554 Old Galveston Rd., Suite B230
Webster, Texas 77598 USA
Ph. 281 482-1714 • Fax 281 482-9448
E-mail support@traceable.com • www.traceable.com

Traceable® Products are ISO 9001:2018 Quality-Certified by DNV and ISO/IEC 17025:2017 accredited as a Calibration Laboratory by A2LA.

Cat. No. 4052 / 4352 / 4353 / 4354

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**TRACEABLE®
LONG-STEM
THERMOMETER
INSTRUCTIONS**

PERFORMANCE

Processor

Processor Family

MediaTek Processor

Processor

Processor Name	Cores	Threads	Base Frequency	Max Frequency	Cache	Memory Support	Processor Graphics
MediaTek Helio P22T	8x A53	8	-	A53@2.3GHz	-	LPDDR3	IMG PowerVR GE8320 GPU

Operating System

Android Pie

Graphics

Graphics	Type	Memory	Key Features
IMG PowerVR GE8320 GPU	Integrated	Shared	-

Chipset

MediaTek SoC (System on Chip) platform

Memory

Memory Type

LPDDR4x-3200

Storage

Storage Support

- 128GB eMMC on systemboard
- 64GB eMMC on systemboard
- 32GB eMMC on systemboard
- MicroSD card, supports FAT32 up to 256GB, exFAT up to 1TB

Storage Type

Disk Type	Interface	RPM	Security
Flash Memory	eMMC	-	-

Removable Storage

Card Reader

- MicroSD card slot (WiFi model, supports up to 256GB FAT32)
- Nano-SIM + microSD card slot (WWAN model, supports up to 256GB FAT32)

Multi-Media

Speakers

Dual side speaker, tuned with Dolby® Atmos®

Microphone

Dual array microphone (with dedicated DSP)

Camera

Front 5.0-megapixel, fixed focus; and rear 8.0-megapixel, auto focus

VoiceCall

- VoiceCall
- Not support

Notes:

- Lenovo® TB-X606V only

Sensor

Vibrator

Vibrator

Sensors

- Ambient light sensor (ALS)
- Hall sensor
- Accelerometer (G) sensor
- Proximity sensor

Battery

Battery

Integrated Li-Polymer 5000mAh (minimum) / 5100mAh (typical)

Max Battery Life

Standby Time: Over 6 weeks

Online Video Playback Time: 8.5 hr

Browsing Time: 9 hr

Notes:

- All battery life claims are approximate maximum and based on results using the MobileMark® 2014 and/or MobileMark 2018 battery-life benchmark tests. Actual battery life will vary and depends on many factors such as product configuration and usage, software use, wireless functionality, power management settings, and screen brightness. The maximum capacity of the battery will decrease with time and use.

Charging Time

Over 3.5 hours

Power Adapter

5V/2A USB-C AC adapter

DESIGN

Display

Display

Size	Resolution	Touch	Type	Brightness	Surface	Aspect Ratio	Contrast Ratio	Color Gamut	Viewing Angle	Key Features
10.3"	FHD (1920x1080)	Multi-touch	IPS	330 nits	Glossy	-	-	70.3% NTSC	160°	-

Notes:

- California Electronic Waste Recycling Fee
In California, per state law, Lenovo charges an electronic waste recycling fee on this covered device at the time of sale of the product. For more information, go to <https://www.calrecycle.ca.gov/Electronics/Consumer>

Touchscreen

Capacitive-type multi-touch, supports 10-point touch, TDDI technology

Input Device

Pen

- Lenovo Active Pen 3 with replaceable battery
- Not support

Mechanical

Dimensions (WxDxH)

244.2 x 153.3 x 8.15 mm (9.61 x 6.03 x 0.32 inches)

Weight

460 g (1.01 lbs)



Case Color

- Iron grey
- Platinum grey

Case Material

Metal

Buttons

- Volume button
- Power button

CONNECTIVITY

Network

WLAN + Bluetooth™

802.11ac Dual Band 1x1 Wi-Fi + Bluetooth 5.0

WWAN

- 4G LTE
- Not configured

SIM Card

Not Support

Cellular Bands

GSM: B2/B3/B5/B8

UMTS: B1/B2/B5(B6/B19)/B8

FDD LTE: B1/B2/B3(Expanded Band3)/B4/B5(B19)/B7/B8/B20

TDD LTE: B38/B40

WIFI Direct

WIFI Direct

WIFI Display

WIFI Display

FM Radio

FM Radio

Location

Models	Location
WWAN model	GPS + GLONASS + A-GPS
Wi-Fi model	GPS + GLONASS

Ports

Standard Ports

- 1x USB-C 2.0 (support data transfer, OTG and Power Delivery)
- 1x headphone / microphone combo jack (3.5mm)
- 1x Pogo pin connector (2-point)

Notes:

- Depending on many factors, actual data transfer speed may be lower than theoretical speed

Optional Ports

- 1x microSD card slot (WiFi model)
- 1x Nano-SIM + microSD card slot (LTE model)

SERVICE

Warranty

Base Warranty

- 1-year carry-in service

- 1-year mail-in service
- 1-year depot service
- 2-year carry-in service
- 2-year mail-in service
- 2-year (1-yr battery) depot service
- 2-year (1-yr battery) depot or carry-in service

SOFTWARE

Preinstalled Software

- Tips
- Lenovo Vantage
- Netflix
- Google Photos
- Google Play
- Kids Mode
- Google
- Google Chrome
- Dolby Atmos

CERTIFICATIONS

Green Certifications

- ENERGY STAR® 8.0
- RoHS

Notes:

- ENERGY STAR 8.0 (TB-X606F, TB-X606X)

Other Certifications

TÜV Rheinland Low Blue Light certified



APPENDIX C

Equipment Manuals & Specifications

Oakton CTS Testr® 50P (“conductivity meter”)

Long-stream Traceable® Thermometer

Lenovo tab (2nd Generation) M10 FHD PLUS (“tablet”)

Garmin eTrex® 22x Handheld GPS (“GPS unit”)

...setting the standard again and again[®]



Oakton[®] 50 Series Conductivity Pocket Testers

New design stands up to the challenges of measuring water quality—even stands upright

The Oakton conductivity pocket testers stand up to everyday use, harsh environments, and the test of time. The testers can even stand upright when the cap is used as the stabilizing base. When you choose one of these conductivity testers, you get a pocketful of useful features and benefits.

- Easy-to-replace sensor module lets you use the tester body over and over again
- Intuitive interface has self-diagnostic error messages, and battery-life and stable reading indicators
- Simple operation at your fingertips with MENU button, 1-button calibration, and HOLD button to freeze readings for recording
- Valox[®] body resists most chemicals and is rugged, dustproof, waterproof, and IP67 rated
- Leakproof cap functions as a sample cup, hydrating cup, and stabilizing base to stand the tester upright
- Uses common AAA batteries

Cap Design: versatile and functional



Tester stands upright with wide, stable base



Leakproof: use to store and keep electrode hydrated



Use as a sample cup to calibrate or measure

Applications

Agriculture | Aquaculture & Aquariums | Cooling Towers | Education |
 Electroplating | Environmental Monitoring | Food & Beverage |
 Hydroponics | Manufacturing | Photo Development | Pools & Spas |
 Printing | Water & Wastewater Treatment



Easily replace sensor module with a twist—no tools required

CTSTestr™ 50P and 50C Pocket Testers

- 3-in-1 testers measure conductivity, TDS, and salinity
- Up to 3-point conductivity calibration with automatic standard recognition
- Selectable TDS factor adds versatility
- Factory calibrated against NaCl standards—ideal for testing salinity in pools
- Available with pin-style or cup-style sensor



Immerse and read with pin-style sensor



Draw or grab samples with cup-style sensor

PCTSTestr™ 50 Multiparameter Pocket Tester

- Measures pH, conductivity, TDS, and salinity
- Long-life pH electrode and stainless steel pin-style conductivity sensor provide compatibility with a wide range of samples
- Up to 3-point pH calibration with NIST or USA autobuffer recognition, user-adjustable temperature coefficient, and self-adjusting TDS and salinity factors



Includes: protective plastic storage case, lanyard, and batteries.



Model	CTSTestr 50P (pin-style sensor)	CTSTestr 50C (cup-style sensor)	PCTSTestr 50
Catalog number	WD-35634-55	WD-35634-65	WD-35634-35
Range	pH	—	-1.00 to 15.0
	Conductivity	0.0 to 200.0 µS, 200 to 2000 µS, 2.00 to 20.00 mS	
	TDS	0.0 to 100.0 ppm, 100 to 1000 ppm; 0.10 to 10.00 ppt (TDS factor 0.5)	
	Salinity	0.00 to 10.00 ppt	
Resolution	Temperature	32 to 140°F (0 to 60°C)	
	pH	—	0.01
	Conductivity	0.1 µS, 1 µS; 0.01 mS	
	TDS	0.1 ppm, 1 ppm; 0.01 ppt	
Accuracy	Salinity	0.10 ppt	
	Temperature	0.1°C / 0.1°F	
	pH	—	±0.01
	Conductivity	±1% full-scale	
pH buffer recognition	TDS	±1% full-scale	
	Salinity	±1% full-scale	
Calibration	Up to 3 points (pH, conductivity and TDS); 1 point (salinity)		
TDS factor	0.40 to 1.00 (selectable)		
Temperature compensation	Automatic		
Power	Four AAA 1.5 V batteries (included)		

Operating Instructions

OAKION

CTS Testr™ 50 Pocket Testers

Applications

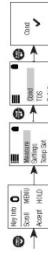
- Aquaculture
- Electroplating rinse tanks
- Aquariums and fish farms
- Printing industry
- Boiler blow-down
- Swimming pools
- Drinking water
- Verification of reverse osmosis system operation
- Hydroponics
- Water & wastewater treatment

Getting Started

The CTS Testr 50 Pocket Tester has been factory calibrated and usually works well out of the box. However, it is best practice to take a few minutes to perform the sensor cap and soak the sensor in warm tap water for 10 minutes or so. Prior to taking the measurements, periodic calibration with certified standards is recommended for best accuracy.

Measurement Parameter Setting

1. Press ON/OFF (o) to power on the tester.
2. Press MENU/V to enter setup window. Press HOLD/← to select Measure. The display shows Cond, TDS and Salinity.
3. Scroll down by pressing MENU/V to toggle between Cond, TDS and Salinity. Press HOLD/← to select Cond.
4. The display shows the selected measure with a ✓.



TDS Factor Setting

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Settings.
2. Press HOLD/← to select Settings. The display shows TDS factor and Backlight.
3. Press HOLD/← to select the default TDS factory setting or MENU/V to adjust the setting.
4. Press HOLD/← to confirm the selection of the setting. The display shows the set TDS factor with a ✓.



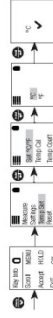
Backlight Settings

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Settings.
2. Press HOLD/← to select Settings. The display shows TDS Factor and Backlight.
3. Scroll down by pressing MENU/V to toggle between TDS Factor and Backlight. Press HOLD/← to select Backlight.
4. The display shows ON and OFF. Scroll down by pressing MENU/V to toggle between ON and OFF. Backlight ON increases readability in low-light conditions.
5. Press HOLD/← to select the desired backlight option. The display shows the selected backlight option with a ✓.



Temperature Settings

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
2. Press HOLD/← to select Set °C/°F. Scroll down by pressing MENU/V to toggle between °C and °F.
3. Press HOLD/← to select temperature unit. The display shows the selected temperature setting with a ✓.



Temperature Calibration

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set.
2. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
3. Scroll down by pressing MENU/V to toggle between Set °C/°F, Temp Cal and Temp Coeff. Press HOLD/← to select Temp Cal.
4. The lower display shows the current measured temperature reading based on the test cell and the upper display shows the current measured temperature reading based on factory default calibration.
5. Dip the tester into a solution of known temperature and allow time for the built-in temperature sensor to stabilize.
6. Press MENU/V to adjust the temperature value or press the HOLD/← to confirm the calibrated value as the new temperature value of the solution.

Note: To exit this program without confirming the calibration, press CAL/ESC.



Temp Coefficient

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Temp Set.
2. Press HOLD/← to select Temp Set. The display shows Set °C/°F, Temp Cal and Temp Coeff.
3. Scroll down by pressing MENU/V to toggle between Set °C/°F, Temp Cal and Temp Coeff.
4. Press HOLD/← to select Temp Coeff or MENU/V to adjust the Temp Coeff.
5. Press HOLD/← to confirm the Temp Coeff value. The new value is automatically confirmed with a ✓.



Calibration for Conductivity, TDS, or Salinity

For best results, periodic calibration with an accurate standard is recommended prior to measurement. Use the calibration standard value that is close to your intended sample value. The tester will retain one calibration value in each mode (conductivity, TDS, salinity) when the instrument is powered off. The conductivity value can be automatically updated when the instrument is powered on. Salinity values require manual calibration. The instrument will prompt the user to calibrate the conductivity value if it was powered off. See "Measurement Parameter Setting" to change the desired parameter.

Automatic Calibration for Conductivity

1. Remove the cap and press ON/OFF (o) to power on.
2. Dip the sensor in at least 30 mm of calibration standard.
3. Stir gently and press CAL/ESC key to begin the calibration.
4. The display will show CAL followed by the default value. CAL is indicated on the display during calibration mode.
5. If the reading is within the calibration range of the automatically recognized standards: 80 (84 µS/cm), 1410 (1413 µS/cm), or 12,90 (12,88 mS/cm), the ✓ icon is displayed when the automatic calibration standard value has been detected.
6. Press HOLD/← to accept the auto conductivity standard and finish the calibration.
7. Display returns to Measurement window.



Manual Calibration

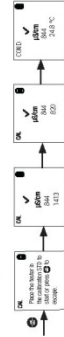
When the conductivity reading is outside calibration range of the automatic conductivity standards or when TDS or salinity is used, the tester will require manual adjustment.

1. Repeat steps 1 to 4 from "Automatic Calibration for Conductivity".
 2. Press MENU/V to manually adjust the value to the desired reading.
- Note:** The adjustment will decrease only, however the adjustment will eventually cycle to the highest available value after decreasing by 40% of the initial value.
3. Press HOLD/← to accept and finish the calibration when the desired value is selected.

Note: To abort calibration, press CAL/ESC to escape.

4. Once the calibration is finished and user has accepted the changes, measurement window will now show the calibrated reading.

Note: The auto conductivity standards are 84 µS/cm, 1413 µS/cm & 12.88 mS/cm.



CTS Measurement

1. Press ON/OFF (o) to power the tester on if needed.
2. Dip the electrode about 2 cm to 3 cm into the test solution. Stir and let the reading stabilize. The timer icon will blink during this time. Once the reading is stabilized, the timer stops blinking and ✓ will appear to indicate the stability of the reading.



CAUTION: Testing dry samples is not accurate and can lead to sensor damage or leakage. Solids must be wet and free of particulates that may break the glass sensor. Excessive force into dry samples can cause glass breakage.

3. Note the CTS value or press HOLD/← to freeze the reading. To release the reading, press HOLD/← again.
4. Press ON/OFF (o) for 3 seconds to turn off tester. If key is not pressed for 6.5 minutes, the tester will automatically shut off to conserve batteries.

User Reset

Reset the CTS calibration to the user's default settings by using the user reset function. Temperature user calibration is not affected by the user reset function.

1. Press MENU/V to enter setup window. Scroll down by pressing MENU/V to select Reset. Press HOLD/← to select User Reset. The display shows User Reset and Factory Reset.
2. Press HOLD/← to select User Reset.
3. The display automatically shows No and Yes. Scroll down by pressing MENU/V to toggle between No and Yes.
4. Press HOLD/← to confirm either No or Yes. Display shows User Reset option with a ✓.



Factory Reset

Reset the CTS50 to the factory default settings by using the factory reset function.

1. Press MENU/V to enter setup window. Scroll down by pressing the MENU/V to select Reset. Press HOLD/← to select Reset. The display shows User Reset and Factory Reset.
2. Scroll down by pressing MENU/V to toggle between the resets. Press HOLD/← to select Factory Reset.
3. The display automatically shows No and Yes. Scroll down by pressing MENU/V to toggle between No and Yes.
4. Press HOLD/← to confirm either No or Yes. The display shows the Factory Reset option with a ✓.



HOLD Function

This feature helps to freeze the display for a delayed observation.

1. Press HOLD/← button to freeze measurement.
2. Press HOLD/← again to release measurement.



Sensor Maintenance

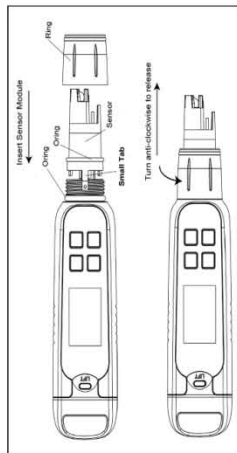
1. Always keep the sensors electrodes clean. Rinse the electrodes with deionized water and wipe them dry with clean cloth before storing with its protective cap. For cup type electrodes, remove the white plastic cap and thoroughly clean viscous solutions. Never scratch electrodes with a hard substance.
2. For better performance, soak the electrode in alcohol for 10 to 15 minutes and rinse with de-ionized water before starting any measurement process. This is to remove dirt and oil stains on the electrode which may affect the accuracy of the measurements.

Sensor Replacement

Replace the sensor module at the fraction of the cost of a new tester. When the tester fails to calibrate or gives fluctuating readings in calibration standards, you need to change the electrode.

1. With dry hands, grip the ring with sensor facing you. Twist the ring counter-clockwise. Save the ring for later use.
2. Pull the old sensor module away from the tester.
3. Align the four tabs on the new module so that they match the four slots on the tester.
4. Gently push the module onto the slots to sit it in position. Push the smaller O-ring fully onto the new sensor module. Push the other O-ring over the module and thread it into place by firmly twisting clockwise.

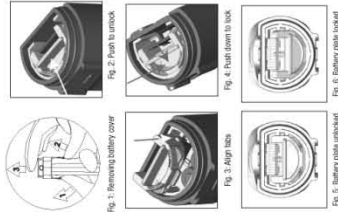
Note: It is necessary that you recalibrate your tester prior to measurement after a sensor replacement.



Replacing the Batteries

The CTS Testr 50 Pocket Tester uses four AAAA 1.5 V batteries.

1. To remove the battery cover, see Figure 1. Clear the front catch and then the back catch, before sliding the cover off.
2. To remove the battery plate, push the cover tab towards the front of the tester as shown in Figure 2. Once unlocked, invert the plate upside down to remove batteries. Each side uses two AAAA batteries. Open the cover with positive terminal facing downward.
3. To lock the battery plate, align the small tabs (Figure 3) into the guide ribs on the housing and then press down. See Figure 4.



Warranty

This instrument is supplied with a warranty against manufacturing defects for a period of one year from the date of purchase.

Return of Items

Authorization must be obtained from your distributor before returning items for any reason. When applying for authorization, please include information regarding the reason the item(s) are to be returned.

We reserve the right to make improvements in design, construction and appearance of products without notice. Prices are subject to change without notice.

Self-Diagnostic Messages

0	Batteries are weak and need replacement soon.
stable error	Appears when calibration is attempted but the reading is not yet stable. Wait for the reading to stabilize or manually confirm the calibration by pressing enter.
over range	The reading is above the measuring range of tester.

CTSTestR 50	
Conductivity	
Conductivity range	0.0 to 200.0 µS, 200 to 2000 µS, 2.00 to 20.00 mS
Resolution	0.1 µS, 1 µS, 0.01 mS
Relative accuracy	±1% full scale
Normalization temperature	25.0°C (77°F)
Temperature co-efficient	0.0% to 10.0%
Calibration points	Up to 3 points
TDS	
TDS range	0.0 to 100.0 ppm, 100 to 1000 ppm, 0.10 to 10.00 ppt (TDS Factor 0.5)
Resolution	0.1 ppm, 1 ppm, 0.01 ppt
Relative accuracy	±1% full scale
Calibration points	Up to 3 points
TDS factor	0.40 to 1.00 (selectable)
Salinity	
Salinity range	0.00 to 10.00 ppt
Resolution	0.10 ppt
Relative accuracy	±1% full scale
Calibration points	1
Temperature	
Temperature range	0 to 80°C (32.0 to 140.0°F)
Temperature resolution	0.1°C / 0.1°F
Temperature accuracy	From 0 to 50°C (±0.5°C / ±0.9°F + 1.1SD); from 50 to 80°C (±1.0°C / ±1.8°F + 1.1SD)
Temperature compensation	Yes (Automatic Temperature Compensation)
General	
Display	Graphics, dot matrix 80 x 100 pixel
Auto off	8.5 minutes (from last key press)
Reset	User / Factory
Power requirement	Four AAA 1.5 V batteries
Battery life	20-50 hours
Water proofing	IP57
Environmental operating conditions	
Ambient operating temperature	5 to 45°C / 41 to 113°F
Relative humidity	5% to 85% noncondensing
Storage temperature	-20 to 60°C / -4 to 140°F
Storage humidity	5% to 85% noncondensing

Accessories

Ordering Code	Product Description
35634-55	CTS Testr 50P pin-style pocket tester with case, lanyard, and batteries
35634-65	CTS Testr 50C cup-style pocket tester with case, lanyard, and batteries
35634-57	Replacement sensor module for CTS Testr 50P pin-style tester
35634-07	Replacement sensor module for CTS Testr 50C cup-style tester
35634-09	Replacement sensor cap
09376-00	Replacement alkaline batteries, AAA, 1.5 V. Pack of 12
17101-45	NIST-traceable calibration with data for pocket testers

OAKION
INSTRUMENTS

www.4oakton.com

August, 2017

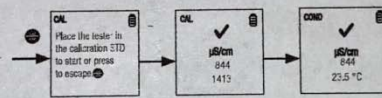
10650100_MAN_35634-55-65

OAKTON CTS Testr® 50P

At-a-Glance User Instructions for Calibration and Making Conductivity Measurements

Automatic Calibration for Conductivity

1. Remove the cap and press ON/OFF (⏻) to power on.
2. Dip the sensor in at least 30 mm of calibration standard.
3. Stir gently and press CAL/ESC key to begin the calibration.
4. The display will show CAL followed by the default value. CAL is indicated on the display during calibration mode.
5. If the reading is within the calibration range of the automatically recognized standards; 80 (84 $\mu\text{S}/\text{cm}$), 1410 (1413 $\mu\text{S}/\text{cm}$), or 12.90 (12.88 mS/cm), the ✓ icon is displayed when the automatic calibration standard value has been detected.
6. Press HOLD/↵ to accept the auto conductivity standard and finish the calibration.
7. Display returns to Measurement window.



Manual Calibration

When the conductivity reading is outside calibration range of the automatic conductivity standards or when TDS or salinity is used, the tester will require manual adjustment.

1. Repeat steps 1 to 4 from "Automatic Calibration for Conductivity".
2. Press MENU/√ to manually adjust the value to the desired reading.

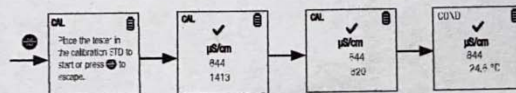
Note: The adjustment will decrease only, however the adjustment will eventually cycle to the highest available value after decreasing by 40% of the initial value.

3. Press HOLD/↵ to accept and finish the calibration when the desired value is selected.

Note: To abort calibration, press CAL/ESC to escape.

4. Once the calibration is finished and user has accepted the changes, measurement window will now show the calibrated reading.

Note: The auto conductivity standards are 84 $\mu\text{S}/\text{cm}$, 1413 $\mu\text{S}/\text{cm}$ & 12.88 mS/cm .



Measure conductivity using field meter. Hold down the power button to turn on the meter. Make sure your device is on the proper screen which can be confirmed by the title at the top of the screen reading COND and the units below it shown as ($\mu\text{S}/\text{cm}$). Rinse cap of the meter and the sensor in the stream or with water collected in the bucket a few times (dip cap into the river or bucket to fill/rinse and then discard to the side). Then fill the cap of the meter to the "max fill line" with water from the river. The meter will automatically begin measuring conductivity. Allow the meter a few moments to show a stabilized reading. You will see a check mark at the top, once a stable reading is reached. **Record the conductivity result with one digit after the decimal point.**



Long-Stem Traceable® Thermometer Specs and Use Manual

DESCRIPTION SPECS INSTRUCTIONS & LITERATURE REVIEWS (0)

Traceable® Long-Stem Thermometer

Ideal for replacing all glass and mercury thermometers in the lab

- On/off switch provides longer battery life, °F/°C switchable range
- Long stem allows for taking readings while stirring and is ideal for use in incubators and ovens

Replaces mercury and glass thermometers.

Perfect-sized unit fits into flasks, cuvettes, test tubes, beakers, ovens, and incubators. Read temperatures in foods, gases, samples, reagents, water baths, and semisolids. Stainless-steel probe (304) is resistant to most laboratory chemicals. ABS plastic and stainless-steel construction (no glass or mercury) makes it safe. Readings are updated every second.

Features

- Temperature range: -58 to 302°F and -50 to 150°C
- Resolution is 0.1° from -20 to 200° (1° outside this range)
- Accuracy is (Choose above)
- Brilliant LCD is 1/4-inch-high
- Stem Dimensions: 0.14" diameter.Length: Choose above

Traceable® Certificate

Multi-point calibration on an individually-numbered Traceable® Certificate which assures accuracy from our ISO/IEC 17025:2017 (1750.01) calibration laboratory accredited by A2LA. It indicates traceability of measurements to the SI units through NIST or other recognized national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Agreement. Probe materials is 304 Stainless-steel. Supplied: Traceable® Certificate, protective sleeve, and battery.

DESCRIPTION **SPECS** INSTRUCTIONS & LITERATURE REVIEWS (0)

Temperature Range	4052/4352 : - 50°C to 150°C ; 4353/4354 : -50 to 300°C
Temperature Resolution	0.1° from -20 to 200°(1° otherwise)
Probe Dimensions	4052/4352: 1/8" stem diameter, 8" stem length, 1.2" Top, 11" overall; 4353/4354: 1/8" stem diameter, 11 3/8" stem length, 14 3/8" overall
LCD Digit Size	1/4 in
Supplied With	Traceable® Certificate, protective sleeve, and battery

SPECIFICATIONS

Mode: 8" stem length

Range: -58 to 302 °F / -50 to 150 °C

Model: 11.4" stem length

Range: -58 to 482 °F / -50 to 250 °C

Resolution: 0.1° from -20° to 200°
(both models) 1° otherwise

OPERATION

Remove the stem from the protective sheath. Slide the ON/OFF switch to ON to turn the unit on. Slide the °F/°C switch to °F to display the temperature in Fahrenheit or to °C to display the temperature in Celsius. Insert the stem of the thermometer into the material to be measured.

Slide the ON/OFF switch to OFF to turn the unit off. Replace the protective sheath. To conserve battery life, always turn the unit off when not in use.

ALL OPERATIONAL DIFFICULTIES

If this thermometer does not function properly for any reason, replace the battery with a new high-quality battery (see the "Battery Replacement" section). Low battery power can occasionally cause any number of "apparent" operational difficulties. Replacing the battery with a new fresh battery will solve most difficulties.

BATTERY REPLACEMENT

Erratic readings, a faint display, or no display, are all indicators that the battery must be replaced. Remove the battery cap, located at the top of the unit by turning it in the direction of the arrow (counterclockwise). Remove the exhausted battery and replace with a new 1.5 volt silver oxide size 357 battery. Make certain the positive (+) side is visible. Replace the battery cover. Do not overtighten the cap.

WARRANTY, SERVICE, OR RECALIBRATION

For warranty, service, or recalibration, contact:

TRACEABLE® PRODUCTS

12554 Old Galveston Rd, Suite B230
Webster, Texas 77598 USA
Ph. 281 482-1714 • Fax 281 482-9448
E-mail support@traceable.com • www.traceable.com

Traceable® Products are ISO 9001:2018 Quality-Certified by DNV and ISO/IEC 17025:2017 accredited as a Calibration Laboratory by A2LA.

Cat. No. 4052 / 4352 / 4353 / 4354

Traceable® and Ultra™ are registered trademarks/trademarks of Cole-Parmer.

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**TRACEABLE®
LONG-STEM
THERMOMETER
INSTRUCTIONS**

Lenovo tab M10 FHD PLUS (2nd Generation) Technical Specs

Tab M10 FHD Plus (2nd Gen)

Lenovo

PSREF
Product Specifications
Reference

PERFORMANCE

Processor

Processor Family

MediaTek Processor

Processor

Processor Name	Cores	Threads	Base Frequency	Max Frequency	Cache	Memory Support	Processor Graphics
MediaTek Helio P22T	8x A53	8	-	A53@2.3GHz	-	LPDDR3	IMG PowerVR GE8320 GPU

Operating System

Android Pie

Graphics

Graphics	Type	Memory	Key Features
IMG PowerVR GE8320 GPU	Integrated	Shared	-

Chipset

MediaTek SoC (System on Chip) platform

Memory

Memory Type

LPDDR4x-3200

Storage

Storage Support

- 128GB eMMC on systemboard
- 64GB eMMC on systemboard
- 32GB eMMC on systemboard
- MicroSD card, supports FAT32 up to 256GB, exFAT up to 1TB

Storage Type

Disk Type	Interface	RPM	Security
Flash Memory	eMMC	-	-

Removable Storage

Card Reader

- MicroSD card slot (WiFi model, supports up to 256GB FAT32)
- Nano-SIM + microSD card slot (WWAN model, supports up to 256GB FAT32)

Multi-Media

Speakers

Dual side speaker, tuned with Dolby® Atmos®

Microphone

Dual array microphone (with dedicated DSP)

Camera

Front 5.0-megapixel, fixed focus; and rear 8.0-megapixel, auto focus

VoiceCall

- VoiceCall
- Not support

Notes:

- Lenovo® TB-X606V only

Sensor

Vibrator

Vibrator

Sensors

- Ambient light sensor (ALS)
- Hall sensor
- Accelerometer (G) sensor
- Proximity sensor

Battery

Battery

Integrated Li-Polymer 5000mAh (minimum) / 5100mAh (typical)

Max Battery Life

Standby Time: Over 6 weeks
Online Video Playback Time: 8.5 hr
Browsing Time: 9 hr

Notes:

- All battery life claims are approximate maximum and based on results using the MobileMark® 2014 and/or MobileMark 2018 battery-life benchmark tests. Actual battery life will vary and depends on many factors such as product configuration and usage, software use, wireless functionality, power management settings, and screen brightness. The maximum capacity of the battery will decrease with time and use.

Charging Time

Over 3.5 hours

Power Adapter

5V/2A USB-C AC adapter

DESIGN

Display

Display

Size	Resolution	Touch	Type	Brightness	Surface	Aspect Ratio	Contrast Ratio	Color Gamut	Viewing Angle	Key Features
10.3"	FHD (1920x1080)	Multi-touch	IPS	330 nits	Glossy	-	-	70.3% NTSC	160°	-

Notes:

- California Electronic Waste Recycling Fee
In California, per state law, Lenovo charges an electronic waste recycling fee on this covered device at the time of sale of the product. For more information, go to <https://www.calrecycle.ca.gov/Electronics/Consumer>

Touchscreen

Capacitive-type multi-touch, supports 10-point touch, TDDI technology

Input Device

Pen

- Lenovo Active Pen 3 with replaceable battery
- Not support

Mechanical

Dimensions (WxDxH)

244.2 x 153.3 x 8.15 mm (9.61 x 6.03 x 0.32 inches)

Weight

460 g (1.01 lbs)



Case Color

- Iron grey
- Platinum grey

Case Material

Metal

Buttons

- Volume button
- Power button

CONNECTIVITY

Network

WLAN + Bluetooth™

802.11ac Dual Band 1x1 Wi-Fi + Bluetooth 5.0

WWAN

- 4G LTE
- Not configured

SIM Card

Not Support

Cellular Bands

GSM: B2/B3/B5/B8

UMTS: B1/B2/B5(B6/B19)/B8

FDD LTE: B1/B2/B3(Expanded Band3)/B4/B5(B19)/B7/B8/B20

TDD LTE: B38/B40

WIFI Direct

WIFI Direct

WIFI Display

WIFI Display

FM Radio

FM Radio

Location

Models	Location
WWAN model	GPS + GLONASS + A-GPS
Wi-Fi model	GPS + GLONASS

Ports

Standard Ports

- 1x USB-C 2.0 (support data transfer, OTG and Power Delivery)
- 1x headphone / microphone combo jack (3.5mm)
- 1x Pogo pin connector (2-point)

Notes:

- Depending on many factors, actual data transfer speed may be lower than theoretical speed

Optional Ports

- 1x microSD card slot (WiFi model)
- 1x Nano-SIM + microSD card slot (LTE model)

SERVICE

Warranty

Base Warranty

- 1-year carry-in service

- 1-year mail-in service
- 1-year depot service
- 2-year carry-in service
- 2-year mail-in service
- 2-year (1-yr battery) depot service
- 2-year (1-yr battery) depot or carry-in service

SOFTWARE

Preinstalled Software

- Tips
- Lenovo Vantage
- Netflix
- Google Photos
- Google Play
- Kids Mode
- Google
- Google Chrome
- Dolby Atmos

CERTIFICATIONS

Green Certifications

- ENERGY STAR® 8.0
- RoHS

Notes:

- ENERGY STAR 8.0 (TB-X606F, TB-X606X)

Other Certifications

TÜV Rheinland Low Blue Light certified



GARMIN eTrex® 22x Technical Specs and User Manual

OVERVIEW | **SPECS** | IN THE BOX | MAPS | ACCESSORIES

General

PHYSICAL DIMENSIONS	2.1" x 4.0" x 1.3" (5.4 x 10.3 x 3.3 cm)
DISPLAY SIZE	1.4" x 1.7" (3.5 x 4.4 cm); 2.2" diag (5.6 cm)
DISPLAY RESOLUTION	240 x 320 pixels
DISPLAY TYPE	2.2" transfective, 65K color TFT
WEIGHT	5 oz (141.7 g) with batteries
BATTERY TYPE	2 AA batteries (not included); NIMH or Lithium recommended
BATTERY LIFE	25 hours
WATER RATING	IPX7
HIGH-SENSITIVITY RECEIVER	✓
INTERFACE	mini USB
MEMORY/HISTORY	8 GB



MANUALS >



SOFTWARE >



SUPPORT CENTER >

Maps & Memory

PRELOADED MAPS	yes (TopoActive; routable)
ABILITY TO ADD MAPS	✓
BASEMAP	✓
AUTOMATIC ROUTING (TURN BY TURN ROUTING ON ROADS)	✓
MAP SEGMENTS	3000
BIRDSEYE	250 BirdsEye Imagery files
INCLUDES DETAILED HYDROGRAPHIC FEATURES (COASTLINES, LAKE/RIVER SHORELINES, WETLANDS AND PERENNIAL AND SEASONAL STREAMS)	✓
INCLUDES SEARCHABLE POINTS OF INTERESTS (PARKS, CAMPGROUNDS, SCENIC LOOKOUTS AND PICNIC SITES)	✓
DISPLAYS NATIONAL, STATE AND LOCAL PARKS, FORESTS, AND WILDERNESS AREAS	✓
EXTERNAL MEMORY STORAGE	yes (32 GB max microSD™ card)
WAYPOINTS/FAVORITES/LOCATIONS	2000
TRACKS	200
TRACK LOG	10000 points, 200 saved tracks
ROUTES	200 routes, 250 points per route; 50 points auto routing

Sensors

GPS	✓
GLONASS	✓
GPS COMPASS (WHILE MOVING)	✓

Outdoor Recreation

POINT-TO-POINT NAVIGATION	✓
COMPATIBLE WITH BASECAMP™	✓
AREA CALCULATION	✓
HUNT/FISH CALENDAR	✓
SUN AND MOON INFORMATION	✓
GEOCACHING-FRIENDLY	Yes (Paperless)
CUSTOM MAPS COMPATIBLE	yes (100 custom map tiles)
PICTURE VIEWER	✓

Garmin eTrex® 22x User Manual:

<https://support.garmin.com/en-US/?partNumber=010-02256-00&tab=manuals>

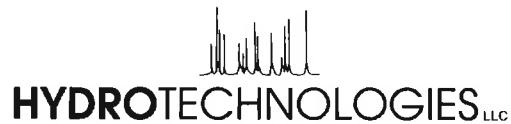
APPENDIX D

Hydro Technologies, LLC Laboratory Standard Operating Procedures

SPO Bio-P/A & QT by 18h Colilert (SM 9223)

SOP Nitrate & Nitrite by EPA 353.2

62 Bank Street, 2nd Floor
New Milford, CT 06776
PH (860) 355-8773
FAX (860) 350-2258
www.gohydro.com



CT DPH Lab# PH-0627
NELAP Lab #11978
EPA Lab #CT00051
Drinking Water, Waste Water, Soil,
Air Testing, Sampling & Consulting

May 26, 2021

Carol Haskins, Executive Director
Pomperaug River Watershed Coalition
39 Sherman Hill Road, Suite 103C
Woodbury, CT 06798

Dear Carol,

Thank you for the opportunity to work with you again this season on the Pomperaug River Watershed Coalition project!

We have provided you with our SOP for the analyses that we will be performing and the other data that you have requested. As you know the holding time for E. coli for the method that we will be using is normally 30 hours, but since your project is considered "compliance monitoring", the holding time will be reduced to 6 hours. We are fully capable of complying with the 6-hour holding time provided that the samples are received by the lab as close to the time the samples are collected, but no later than 2:00pm on the day that the samples are collected.

We are still receiving samples in our vestibule and ask that the chain of custody forms for the samples are emailed or sent via text message to our admin@gohydro.com email address as soon as possible so that we can "pre-log" the samples. This will help speed the log in process and get the samples into the lab quicker.

Please let me know if you have any questions or concerns.

A handwritten signature in blue ink, appearing to read "Beth Dunn".

Beth Dunn
Business Manager
Hydro Technologies, LLC

www.gohydro.com
BDunn@gohydro.com

cc. file

Hydro Technologies, LLC 62 Bank Street, New Milford, CT 06776 Telephone: 860 355 8773	Title: SOP Bio-P/A & QT by 18h Colilert	
	Doc. No. SOP – SM9223 – 18h Colilert	Rev. No. 5
	Effective Date: 8/28/2019	Page 1 of 13

Standard Operating Procedure:

Bio-P/A & QT by 18hr Colilert

Approved by:

Technical Director of Microbiology

_____ (Name)
 (Signature)

_____ (Initials) _____ (Date)

Quality Assurance Officer

_____ (Name)
 (Signature)

_____ (Initials) _____ (Date)

1.0 SCOPE AND APPLICATION

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- 1.1 The enzyme substrate test used by the Colilert-18 media utilizes hydrolysable substrates for the detection of total coliform bacteria and *Escherichia coli* in drinking water and source water samples. Formulations are also available for the analysis of marine waters. Colilert-18 media can produce presence/absence results or quantitative results that have a range of <1 to >2420 MPN/100mL.

2.0 SUMMARY OF THE METHOD

- 2.1 Colilert-18 media is used to determine the presence of total coliforms and *Escherichia coli*. Colilert-18 is a defined substrate technology (DST), meaning that it targets specific microbes from a mixture of bacterial species. The media contains two nutrient indicators:
 - 2.1.1 ONPG (ortho-Nitrophenyl-B-Galactosidase)
Colorimetric substrate for the detection of B-galactosidase activity. If B-galactosidase is present, it hydrolyzes the ONPG molecule into galactose and ortho-nitrophenol.
 - 2.1.2 MUG (4-methylumbelliferyl-beta-D-glucuronide)
- 2.2 Coliforms contain B-galactosidase enzyme which metabolizes the ONPG nutrient indicator and changed it from colorless to yellow.
- 2.3 *E. Coli* produces the enzyme beta-D-glucuronidase, which hydrolyzes the beta-D-glucopyranosiduronic derivatives to aglycons and D-glucuronic acid. *E. Coli* used B-glucuronidase to metabolize MUG and create fluorescence.
- 2.4 After an incubation period of 18-22 hours at a temperature of 35 +/- 0.5C, Coliform bacteria will be detected by a yellow color, and samples containing *E. Coli* will fluoresce.

3.0 DEVIATIONS FROM THE METHOD

- 3.1 Samples of known residual chlorine content are tested again for chlorine presence prior to adding media. This is to ensure that the sodium thiosulfate contained in the sample container neutralized any residual chlorine that may have been present. This added step in the procedure prevents false negative results.

4.0 DEFINITIONS

- 4.1 Most Probable Number: the number of organisms that are most likely to have produced laboratory results in a particular test.
- 4.2 Quality Control: A system of maintaining standards in manufactured products by testing a sample of the output against the specification. Activities that are undertaken to demonstrate the accuracy and precision of your monitoring.
- 4.3 Aseptic technique: a practice or procedure to prevent contamination from pathogens that involves the strictest rules to minimize the risk of infection or cross contamination.
- 4.4 Cross contamination: The process by which bacteria or other microorganisms are unintentionally transferred from one substance or object to another.

5.0 INTERFERENCES

- 5.1 Background color of sample
 - 5.1.1 Colilert-18 allows for a positive sample to be detected by the presence of a yellow color after incubation. A sample that is yellow in color prior to the

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addition of the Colilert-18 media can cause difficulty in reading the results.

- 5.1.1.1 Retain a portion of the sample that does not contain the media as a comparison to the result.
- 5.1.1.2 Consider using a different method for determining the presence of Total Coliform and *E. coli*. Refer to SOP for Total Coliform and *E. Coli* by Colisure. Presence of bacteria is determined by a change in color to magenta.
- 5.2 Some waters with a high Calcium salt content can form a precipitate, however this will not affect the reaction.
- 5.3 Loss of or inadequate amount of Sodium Thiosulfate in a sample that contains residual chlorine, may cause a false negative to be read.
 - 5.3.1 Any sample that has a known residual chlorine content must be checked to see if there is any level of chlorine in the sample prior to adding media.

6.0 SAFETY

- 6.1 All samples should be handled with caution as their bacteriological composition will be unknown at the time of processing.
- 6.2 Gloves must be worn to limit exposure to bacteria and to aid in conducting aseptic techniques.
- 6.3 Analysis and the disposal of positives must be conducted under a hood.

7.0 EQUIPMENT AND SUPPLIES

- 7.1 Quantitative trays
 - 7.1.1 QT Trays (51 well): Allows for a quantitative reading up to >201MPN/100mL. (Product number: WQT100)
 - 7.1.2 2K Trays (49 Large well & 48 small well): Allows for a quantitative reading up to >2420MPN/100mL. (Product number: WQT-2K)
- 7.2 Incubator at 35C +/- 0.5C
- 7.3 UV Light at 365nm
- 7.4 Water bath with thermometer that reads up to 35C
- 7.5 IDEXX Quanti-tray Sealer
- 7.6 IDEXX QT and 2k Tray Rubber Inserts

8.0 REAGENTS AND STANDARDS

- 8.1 P/A Comparator: Part number: WP104
- 8.2 2k Comparator: Part number: WQT2KC
- 8.3 Substrate media
 - 8.3.1 Colilert-18 by IDEXX companies. Product number: WP200-18
- 8.4 Dilution water that does not contain any buffer components.

9.0 SAMPLE COLLECTION, PRESERVATION, SHIPMENT, AND STORAGE

- 9.1 Samples must be collected in pre-sterilized disposable plastic bottles that contain sufficient amounts of Sodium Thiosulfate to neutralize 5ppm residual chlorine.
- 9.2 Samples must be cooled to 4C until ready to analyze.
- 9.3 Samples must be cooled to 4C during transit
- 9.4 Analyze within 30 hours from the time of collection (Note: There are no preservation or hold time requirements for sealed containers of bottled drinking water.)

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10.0 QUALITY CONTROL

10.1 MEDIA QC

10.1.1 For each new lot of media check performance with three controls a Pos-Pos control, a Pos-Neg control and a Neg-Neg control. For example

SPECIES	EXPECTED RESULT (E.Coli/Coliform)
<i>Escherichia coli</i>	+/+
<i>Enterobacter aerogenes</i>	+/-
<i>Klebsiella variicola</i>	+/-
<i>Pseudomonas</i>	-/-

All three controls can be purchased by IDEXX, product number: 98-29000-00

10.1.2 Recheck performance of media after 90 days from the previous check up to the expiration date of the media and then dispose of any unused media.

10.2 STERILE BOTTLES FOR BACTERIAL COLLECTION

10.2.1 With each new lot number of sterile bottles containing Sodium sulfate, conduct the following:

10.2.1.1 Ensure that the sodium thiosulfate can neutralize 5ppm of residual chlorine.

10.2.1.2 Ensure sterility by filling each container with double strength tryptic soy broth and incubating at 35 +/-0.5C. Check at 24 and 48 hours.

10.3 TEMPERATURE LOGS

10.3.1 The temperature of the incubators used must be recorded twice daily, each reading must be at least four hours apart.

10.3.2 Thermometers used for incubators and water baths must be calibrated annually against a certified NIST thermometer. Correction factors must be recorded.

10.4 AUTOCLAVE MAINTENANCE

10.4.1 The autoclave used to sterilize all positive quantitative results must be maintained monthly. (See SOP Autoclave maintenance)

10.4.2 The functionality of the autoclave must be checked monthly with a spore strip or spore ampule to ensure that the bacteria is being sterilized.

11.0 INITIAL DEMONSTRATION OF PERFORMANCE

11.1 Each analyst must complete an initial demonstration of capability prior to reporting any data using this method.

11.2 Initial demonstration of capability is performed by purchasing quality control organisms from IDEXX and preparing 4 QCS samples. Passing criteria for all QCS samples is necessary to obtain the initial DOC. On-going DOCS may be completed by performing a proficiency evaluation.

12.0 LIMIT OF DETECTION

12.1 MDL procedure does not apply to presence/absence tests, refer to SOP- Determination of MDL

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12.2 According to the IDEXX MPN table, the lowest detectable value is <1 MPN/100mL

13.0 CALIBRATION AND STANDARDIZATION

- 13.1 Ensure that the comparators used are not beyond their expiration date.
- 13.2 Be sure to put sample aside if there is background color, for comparison.
- 13.3 All thermometers used in incubators and water bath's must be calibrated against a NIST certified thermometer annually. Calibration factors must be recorded.

14.0 PROCEDURE

14.1 SAMPLE SET-UP

- 14.1.1 Using the computer-generated to-do list, set out the samples in numerical order and check that all samples are accounted for.
- 14.1.2 Check for the presence of chlorine on all samples submitted without chlorine levels provided or those of known chlorine levels.
 - 14.1.2.1 For all chlorine positives, use a sterile pipette tip and pipette a small amount on to a chlorine test strip to confirm if Sodium Thiosulfate was able to neutralize any chlorine that may have been present.
- 14.1.3 Check that each bottle contains at least 98mL of water and that there is no evidence of leaks.
 - 14.1.3.1 If there is more than 100mL of sample, aseptically pour off any excess.
 - 14.1.3.2 If there is less than 100mL, note the amount provided on the bench sheet and fill up to 100mL with sterile, un-buffered water. Qualify the data and use a multiplier if using the quantitative method.
 - 14.1.3.3 If necessary, transfer to a new sterile container if there are leaks or cracks and be sure to document this transfer on the bench sheet in case contamination occurred during transfer.
- 14.1.4 Under the laminar flow hood, open the bacteria sample bottles one at a time and add contents of one Colilert-18 snap pack for 100mL.
- 14.1.5 Cap the sample and shake until the reagent is dissolved.
- 14.1.6 Proceed to 14.2: Presence/Absence Procedure OR 14.3: Quanti-tray Enumeration Procedure.

14.2 PRESENCE/ABSENCE PROCEDURE

- 14.2.1 Place the samples in a water bath with a thermometer that is submerged in a test bottle filled with 100mL of water.
- 14.2.2 Turn on the water bath and monitor the thermometer which will indicate when the samples are up to temperature. When a temperature of 35C is obtained, turn off the water bath and move all samples to the incubator. If possible, space the samples out within the incubator.
- 14.2.3 Incubate at 35 +/- 0.5C for 18 to 22 hours.

14.3 QUANTI-TRAY ENUMERATION PROCEDURE

- 14.3.1 From step 14.1.4 above, turn on the IDEXX Quanti-tray sealer and wait for the green light – this indicates that the sealer is up to temperature.
- 14.3.2 Number the Quanti-trays with the sample I.D. number
 - 14.3.2.1 Use a 51 well QT tray when "QT" or "E. coli" is written on the

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- sample bottle.
- 14.3.2.2 Use the larger 2k tray when '2k" is written on the sample bottle.
- 14.3.3 Use one hand to hold the Quanti-tray upright with the well side facing your palm. Squeeze the upper part of the tray so that it bends towards the palm of your hand.
- 14.3.4 Pull the foil tab away from the tray and pour the sample in slowly, avoiding contact with foil to diminish contamination. Once the sample is poured, dispose of the sample container, and lightly tap the side of the tray to release any air bubbles.
- 14.3.5 Place the filled sample tray onto the IDEXX rubber insert with the well side facing down and the open tray side to the upward-most part of the sealer slope – to avoid sample pouring out.
- 14.3.6 Gently insert the rubber insert through the sealer. The sealer roller will grab and move the tray through – do not push or pull.
- 14.3.7 This process of going through the sealer eliminates the step of pre-warming samples to 35C in a water bath.
- 14.3.8 Incubate at 35 +/- 0.5C for 18-22 hours.

15.0 DATA ANALYSIS AND CALCULATIONS

15.1 FOR PRESENCE/ABSENCE:

- 15.1.1 Positives before 18 hours and negatives after 22 hours are valid.
- 15.1.2 After incubation, if the sample is less yellow than comparator, then the result is negative for both total coliform and E. coli.
- 15.1.3 After incubation, if the sample is equally yellow or more yellow than the comparator, then the result is positive for total coliform.
- 15.1.4 After incubation, if the sample is yellow and the fluorescence is equal to or greater than the comparator, then the result is positive for total coliform and E. coli.

15.2 FOR ENUMERATION (QT/2K QUANTITATIVE RESULTS):

- 15.2.1 Count the number of positive large wells and positive small wells. Use the IDEXX administered MPN tables to determine the most probable number count. **IMAGE 2, IMAGE 3, IMAGE 4**
- 15.2.2 Positives before 18 hours and negatives after 22 hours are valid.
- 15.2.3 After incubation, if the sample in each well is less yellow than comparator, then the result is negative for both total coliform and E. coli.
- 15.2.4 After incubation, if the sample in each well is equally yellow or more yellow than the comparator, then the result is positive for total coliform.
- 15.2.5 If the sample in each well is yellow and the fluorescence is equal to or greater than the comparator, then the result is positive for total coliform and E. coli.
- 15.2.6 Report quantitative results in most probable number (MPN)
- 15.2.7 Report a negative as <1, not zero, according to the IDEXX MPN table.

15.3 CLIENT NOTIFICATION

- 15.3.1 Administration must be informed of any positive bacterial results as soon as they are able to be read. A client must be notified within 48 hours of a positive bacterial result.

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16.0 METHOD PERFORMANCE, DATA REVIEW, AND ACCEPTANCE CRITERIA

- 16.1 Positives before 18 hours and negatives after 22 hours are considered acceptable.
- 16.2 If any dilutions were prepared, dilution factors must be applied when reporting quantitative results. MDLs must be changed accordingly.
- 16.3 Reject any data if the quality control associated with the lot of media used is unacceptable.
- 16.4 Corrective actions must be composed for any data that does not fall within acceptable QC limits. This includes, but is not limited to:
 - 16.4.1 Failed incubation time: Commonly due to unsuspected inclement weather
 - 16.4.2 Incubation temperature exceeded or too low: Commonly due to a power outage or problems occurring with the set temperature.
 - 16.4.3 Incorrect sample-handling: Sample was set as something that was not requested (P/A or quantitative).
 - 16.4.4 Issues with media: Media was used for analysis prior to conducting the QC requirements for each lot number. Media was found to be faulty.
- 16.5 Hydro Technologies data qualifiers must be applied to all data that does not meet method criteria.
 - Q01: Sample was received after the recommended holding time.
 - Q16: Sample was analyzed after the recommended holding time.

If no data qualifier suits the application, a new data qualifier must be entered into the LIMS and applied to the samples in question.

17.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

- 17.1 Each sample requires one media packet and therefore pollution is already as little as possible for this method.
- 17.2 Use caution when handling sample containers to avoid cracking/leaking. Careful handling can limit the amount of sample containers used for this method.
- 17.3 Positive presence/absence samples can be poured down a sink under a well-functioning hood to eliminate vapors or spores. Be sure to have the water running to aid in eliminating the media and sample volume.
- 17.4 Positive QT/2k Trays must be autoclaved on a sterilization cycle.
 - 17.4.1 DO NOT attempt to poke holes in the tray backing and submerging in chlorinated water. Opportunistic bacteria or viruses could be present in the sample, particularly after incubation. This exposure is considered a great health hazard.

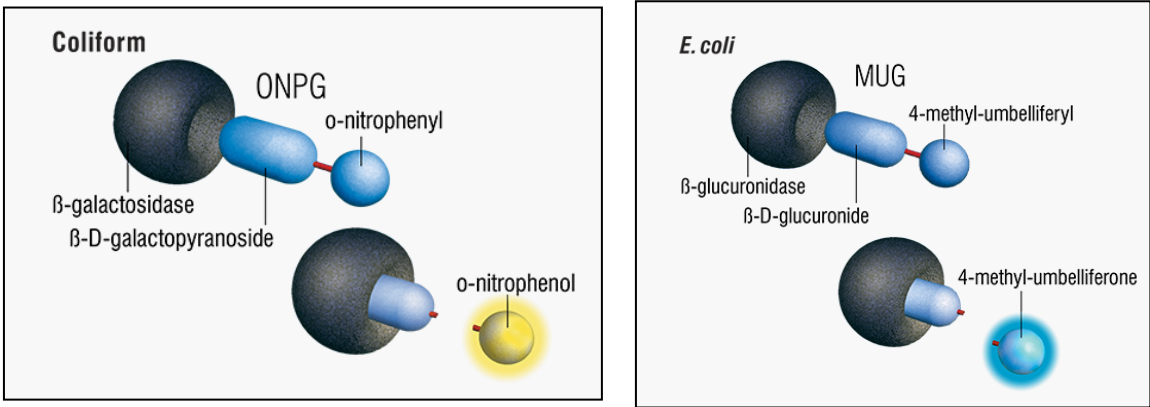
18.0 REFERENCES

- 18.1 Baird, Rodger, et al. *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association, 2012.
- 18.2 "IDEXX." *Colilert 18 - IDEXX US*, www.idexx.com/en/water/water-products-services/colilert-18/.

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IMAGE 1: IDEXX Colilert-18 Science. Source: "IDEXX." *Colilert 18 - IDEXX US*, www.idexx.com/en/water/water-products-services/colilert-18/.



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IMAGE 2: IDEXX MPN table for QT Quanti-trays (51 well). <1 to >201 MPN

51-Well Quanti-Tray[®] MPN Table

Number of wells giving positive reaction per 100 mL sample	Most Probable Number (MPN)	95% Confidence Limits	
		Lower	Upper
0	<1	0.0	3.7
1	1.0	0.3	5.6
2	2.0	0.6	7.3
3	3.1	1.1	9.0
4	4.2	1.7	10.7
5	5.3	2.3	12.3
6	6.4	3.0	13.9
7	7.5	3.7	15.5
8	8.7	4.5	17.1
9	9.9	5.3	18.8
10	11.1	6.1	20.5
11	12.4	7.0	22.1
12	13.7	7.9	23.9
13	15.0	8.8	25.7
14	16.4	9.8	27.5
15	17.8	10.8	29.4
16	19.2	11.9	31.3
17	20.7	13.0	33.3
18	22.2	14.1	35.2
19	23.8	15.3	37.3
20	25.4	16.5	39.4
21	27.1	17.7	41.6
22	28.8	19.0	43.9
23	30.6	20.4	46.3
24	32.4	21.8	48.7
25	34.4	23.3	51.2
26	36.4	24.7	53.9
27	38.4	26.4	56.6
28	40.6	28.0	59.5
29	42.9	29.7	62.5
30	45.3	31.5	65.6
31	47.8	33.4	69.0
32	50.4	35.4	72.5
33	53.1	37.5	76.2
34	56.0	39.7	80.1
35	59.1	42.0	84.4
36	62.4	44.6	88.8
37	65.9	47.2	93.7
38	69.7	50.0	99.0
39	73.8	53.1	104.8
40	78.2	56.4	111.2
41	83.1	59.9	118.3
42	88.5	63.9	126.2
43	94.5	68.2	135.4
44	101.3	73.1	146.0
45	109.1	78.6	158.7
46	118.4	85.0	174.5
47	129.8	92.7	195.0
48	144.5	102.3	224.1
49	165.2	115.2	272.2
50	200.5	135.8	387.6
51	> 200.5	146.1	infinite

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IMAGE 3: PART 1 - IDEXX MPN Table for 2k trays (49 Large well, 48 small well). <1 to >2420 MPN

Small Wells Positive

Large Wells Positive

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0	<1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
1	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
2	20	30	40	51	61	71	81	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
3	31	41	51	61	72	82	92	103	113	124	134	145	155	165	176	186	197	208	218	229	239	250	260	271	282
4	41	52	62	72	83	93	104	114	125	135	146	156	167	178	188	199	210	220	231	242	253	263	274	285	296
5	52	63	73	84	94	105	115	126	136	147	158	169	179	190	200	211	222	233	244	255	266	277	288	299	310
6	63	74	84	95	106	116	127	138	149	160	170	181	192	203	214	225	236	247	258	269	280	291	302	313	324
7	75	85	96	107	118	128	139	150	161	172	183	194	205	216	227	238	249	260	271	282	294	305	316	328	339
8	86	97	108	119	130	141	152	163	174	185	196	207	218	229	241	252	263	274	286	297	308	320	331	343	354
9	98	109	120	131	142	153	164	176	187	198	209	220	232	243	254	266	277	289	300	312	323	335	346	358	370
10	110	121	132	144	155	166	177	189	200	211	223	234	246	257	269	280	292	303	315	327	338	350	362	374	386
11	122	134	145	156	168	179	191	202	214	225	237	248	260	272	283	295	307	319	330	342	354	366	378	390	402
12	135	146	158	169	181	193	204	216	228	239	251	263	275	286	298	310	322	334	346	358	370	382	395	407	419
13	148	160	171	183	195	206	218	230	242	254	266	278	290	302	314	326	338	350	362	375	387	399	412	424	436
14	161	173	185	197	209	221	233	245	257	269	281	293	305	317	330	342	354	367	379	391	404	416	429	442	454
15	175	187	199	211	223	235	247	259	272	284	296	309	321	333	346	358	371	384	396	409	422	434	447	460	473
16	189	201	213	225	238	250	262	275	287	300	312	325	337	350	363	375	388	401	414	427	440	453	466	479	492
17	203	216	228	241	253	266	278	291	303	316	329	341	354	367	380	393	406	419	432	445	459	472	485	498	512
18	218	231	243	256	269	281	294	307	320	333	346	359	372	385	398	411	424	438	451	465	478	492	505	519	532
19	233	246	259	272	285	298	311	324	337	350	363	376	390	403	416	430	443	457	471	484	498	512	526	540	554
20	249	262	275	288	301	315	328	341	354	368	381	395	408	422	436	449	463	477	491	505	519	533	547	561	575
21	265	279	292	305	318	332	345	359	373	386	400	414	428	441	455	469	484	498	512	526	541	555	569	584	599
22	282	295	309	323	336	350	364	377	391	405	419	433	448	462	476	490	505	519	534	548	563	578	593	608	623
23	299	313	327	341	355	368	383	397	411	425	439	454	468	483	497	512	527	542	556	571	586	602	617	632	647
24	317	331	345	359	373	388	402	417	431	446	460	475	490	505	520	535	550	565	581	611	626	641	656	673	690
25	336	350	364	379	393	408	422	437	452	467	482	497	512	527	543	558	573	589	605	620	636	652	668	684	700
26	355	369	384	399	414	428	443	459	474	489	504	520	535	551	567	582	598	614	630	647	663	679	696	712	729
27	374	389	404	420	435	450	465	481	496	512	528	544	560	576	592	608	624	641	657	674	691	708	725	742	759
28	395	410	426	441	457	473	488	504	520	536	552	569	585	602	618	635	652	669	686	703	720	737	755	773	790
29	417	432	448	464	480	496	512	528	545	561	578	595	612	629	646	663	680	698	715	733	751	769	787	805	824
30	439	455	471	487	504	520	537	554	571	588	605	622	640	657	675	693	710	729	747	765	783	802	821	840	859
31	462	479	495	512	529	546	563	581	598	616	633	651	669	687	705	724	742	761	779	799	818	837	857	876	896
32	487	504	521	538	556	573	591	609	627	645	663	682	700	719	738	757	776	795	815	835	854	875	895	915	936
33	512	530	548	565	583	602	620	638	657	676	695	714	733	752	772	792	812	832	852	873	893	914	936	957	978
34	539	557	576	594	613	631	650	670	689	708	728	748	768	788	808	829	850	871	892	914	935	957	979	1002	1024
35	568	586	605	624	644	663	683	703	723	743	763	784	805	826	847	869	891	913	935	957	980	1003	1026	1050	1073
36	598	617	637	657	677	697	717	738	759	780	801	823	845	867	889	912	935	958	981	1005	1029	1053	1077	1102	1127
37	629	650	670	691	712	733	754	776	798	820	842	865	888	911	934	958	982	1006	1031	1056	1081	1107	1133	1159	1186
38	663	684	706	727	749	771	794	816	839	862	886	910	934	958	983	1008	1034	1060	1086	1112	1139	1166	1194	1222	1250
39	700	722	744	767	789	813	836	860	884	909	934	959	984	1010	1036	1063	1090	1118	1146	1174	1203	1232	1261	1292	1322
40	738	762	785	809	833	857	882	908	934	959	985	1012	1039	1067	1095	1124	1153	1182	1212	1243	1274	1305	1337	1370	1403
41	780	805	830	855	880	906	933	960	987	1014	1043	1071	1100	1130	1160	1191	1222	1254	1287	1320	1354	1388	1423	1459	1495
42	826	852	878	905	932	960	988	1017	1046	1076	1106	1137	1169	1201	1234	1267	1301	1336	1372	1408	1445	1483	1522	1561	1602
43	876	904	932	960	990	1019	1050	1081	1112	1145	1178	1211	1246	1281	1317	1354	1391	1430	1470	1510	1552	1594	1638	1682	1728
44	931	961	991	1022	1054	1086	1119	1153	1187	1223	1259	1296	1334	1374	1414	1455	1497	1541	1585	1631	1679	1727	1777	1829	1882
45	993	1025	1058	1092	1126	1162	1198	1236	1274	1314	1354	1396	1439	1483	1529	1576	1624	1674	1726	1780	1835	1892	1951	2012	2075
46	1063	1098	1134	1172	1210	1250	1291	1333	1376	1421	1467	1515	1565	1616	1670	1725	1782	1842	1904	1968	2035	2105	2178	2254	2333
47	1143	1183	1224	1266	1309	1354	1401	1450	1500	1553	1607	1664	1723	1785	1849	1916	1986	2060	2142	2224	2310	2400	2495	2595	2700
48	1239	1284	1331	1379	1430	1483	1539	1597	1658	1722	1789	1860	1935	2014	2098	2187	2282	2382	2489	2603	2723	2851	2987	3130	3282
49	1355	1408	1464	1523	1585	1650	1720	1793	1872	1956	2046	2143	2247	2359	2481	2613	2755	2909	3076	3255	3446	3654	3873	4106	4352

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IMAGE 4: PART 2 - IDEXX MPN Table for 2k trays (49 Large well, 48 small well). <1 to >2420 MPN

IDEXX Quanti-Tray⁺/2000 MPN Table

# Large Wells Positive	# Small Wells Positive																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000

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Revision Record

Revision No.	Date	Responsible Person	Description of Change
1	05/17/2010	Lawrence Paetsch	NELAC/ELAP Compliance
2	5/21/2015	Lawrence Paetsch	NELAC/ELAP Compliance
3	11/28/2018	Rebecca Warren	1.4 ,1.5, 1.6, 3.3.1, 4.1, 4.2.1
4	6/19/2019	Rebecca Warren	Annual review. Updated format
5	8/28/2019	Rebecca Warren	Added client notification of 48 hours
6	1/20/2021	Rebecca Warren	Added all TNI components

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HydroTechnologies, Inc 62 Bank Street, New Milford, CT 06776 Telephone: 860 355 8773	Title: SOP for Nitrate & Nitrite by FIA	
	DocNo. SOP353.2	Rev. No. 6
	Effective Date: 01/27/2021	Page 1 of 11

Standard Operating Procedure:

Nitrate-Nitrite by EPA 353.2

Approved by:

Technical Director

_____ (Name)
 (Signature)

_____ (Initials) _____ (Date)

Quality Assurance Officer

_____ (Name)
 (Signature)

_____ (Initials) _____ (Date)

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1.0 METHOD

- 1.1 EPA Method 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry
- 1.2 QuikChem Method 10-107-04-1-A Determination of Nitrate/Nitrite in Surface and Wastewaters by Flow Injection Analysis (Low Flow Method)

2.0 APPLICABLE MATRICES

- 2.1 This method applies to surface water and wastewater.

3.0 LIMITS OF DETECTION/QUANTITATION

- 3.1 Range of quantitation – 0.05 to 20.0 mg/L.
- 3.2 Laboratory determined detection limit – 0.05 mg/L.

4.0 SCOPE AND APPLICATION

- 4.1 This method is used to quantitatively determine the concentration of nitrate and/or nitrite in surface water and wastewater samples.

5.0 SUMMARY

- 5.1 Nitrate is reduced to nitrite by passing through a cadmium-copper reduction column. The total nitrite (reduced nitrate plus original nitrite) is then diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting solution has a magenta color which can be read at 520nm and correlates to the concentration of nitrite. Nitrite can be determined through the same process without the use of the cadmium-copper reduction column. Nitrate alone can be mathematically determined by subtracting the nitrite value from the combined nitrate plus nitrite value.

6.0 DEFINITIONS

- 6.1 METHOD DETECTION LIMIT (MDL) – The minimum measured concentration of a substance that can be identified, measured, and reported with 99% confidence that the measured concentration is distinguishable from method blank results.
- 6.2 LINEAR CALIBRATION RANGE (LCR) - The concentration range over which the instrument response is linear
- 6.3 LABORATORY REAGENT BLANK (LRB) - An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.
- 6.4 LABORATORY FORTIFIED BLANK (LFB) – An aliquot of reagent water or other blank matrices to which known quantities of the method analytes are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory can make accurate and precise measurements.
- 6.5 LABORATORY FORTIFIED SAMPLE MATRIX (LFM) – An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results.

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The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations.

- 6.6 INSTRUMENT PERFORMANCE CHECK SOLUTION (IPC) - A solutions of one or more methods analytes, surrogates, internal standards, or other test substances used to evaluate the performance of the instrument system with respect to a defined set of criteria.
- 6.7 QUALITY CONTROL SAMPLE (QCS) - A solution of method analytes of known concentrations that is used to fortify an aliquot of LRB or other sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check laboratory performance with externally prepared test materials.

7.0 INTERFERENCES

- 7.1 Elevated turbidity or color can accumulate in the cadmium reduction column preventing flow. Samples with floating particulates or color should be pre-filtered to prevent this build up.
- 7.2 Residual chlorine. Samples should be checked for residual chlorine prior to analyzing.
- 7.3 High concentrations of iron, copper, or other metals. EDTA is added to the buffer reagent to prevent this interference.
- 7.4 Large concentrations of oil and grease. Samples found to have high oil and grease results can be pre-extracted with an organic solvent prior to analyzing.

8.0 SAFETY

- 8.1 All reagents should be handled appropriately with proper personal protective equipment (ie. gloves, eye wear, lab coat, etc.) and adequate ventilation. The toxicity or carcinogenicity of each reagent used in this method has not necessarily been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable. Known cautions are included below.
- 8.2 Cadmium Column for nitrate analysis is considered hazardous in the following ways: may cause cancer, suspected of causing genetic defects, suspected of damaging fertility or the unborn child, causes damage to organs through prolonged or repeated exposure, and toxic to aquatic life with long lasting effects. Under normal circumstances, the cadmium granules do not need to be accessed inside the column. Cadmium columns are disposed of as hazardous waste.
- 8.3 Sodium Hydroxide causes eye, skin, digestive, and respiratory tract burns on contact.
- 8.4 Ammonium Chloride is harmful if swallowed and can cause eye irritation.
- 8.5 Disodium EDTA is harmful if inhaled and may cause damage to organs through prolonged and repeated exposure.
- 8.6 Phosphoric Acid causes burns through all exposure routes.
- 8.7 Sulfanilamide causes eye, skin, and respiratory tract irritation. Also, may cause reproductive and fetal effects and may be harmful if swallowed. Repeated or large doses may damage liver, blood, spleen, or cause development of tumors.
- 8.8 N-(1-naphthyl) ethylenediamine dihydrochloride causes skin, eye, and respiratory irritation.

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9.0 EQUIPMENT

- 9.1 Glassware
- 9.2 Scale
- 9.3 Autosampler
- 9.4 Computer with Omnion Software
- 9.5 Quick Chem 8500 Series II
- 9.6 Proportioning pump
- 9.7 Manifold with cadmium reduction column
- 9.8 Colorimetric detector
- 9.9 10nm band pass, 80 µL Flow cell
- 9.10 520nm interference filter

10.0 REAGENTS AND STANDARDS

10.1 PREPARATION OF REAGENTS

- 10.1.1 Reagent 1: 15N Sodium Hydroxide – Add 150g sodium hydroxide to 250mL of DI water very slowly. This reaction is exothermic and will get extremely hot. Stir until dissolved.
- 10.1.2 Reagent 2: Ammonium Chloride Buffer – Add 938g of DI water to a tared container. Add 85g of ammonium chloride and 1g of disodium ethylenediamine tetraacetic acid dihydrate (disodium EDTA). Stir until dissolved. Adjust to pH of 8.5 using reagent 1 (15N NaOH solution).
- 10.1.3 Reagent 3: Sulfanilamide Color Reagent – Add 438g of DI water to a tared, dark container. Add 85g of 85% phosphoric acid, 20g of sulfanilamide, and 0.5g of N-(1-naphthyl) ethylenediamine dihydrochloride. Stir for 30 minutes. This reagent expires in one month.

10.2 PREPARATION OF STANDARDS

- 10.2.1 Using (i) a 50mL volumetric flask, (ii) standard with a concentration of 1000 mg/L purchased from an outside vendor, and (iii) DI water as the diluent, prepare the standards as follows:

Analyte	Type of Standard	Standard Concentration (mg/L)	Volume of Standard (mL)
Nitrate	Calibration (1 ^o)	20	1
		10	0.5
		7.5	0.375
		0.5	0.025
		5	0.25
	Check (IPC) (1 ^o)	5	0.25
	LFB (2 ^o)	10	0.5
Nitrite	Calibration (1 ^o)	5	0.25
		2	0.1
		0.5	0.025
		1	0.05
		2	0.1
	Check (IPC) (1 ^o)	1	0.05
	LFB (2 ^o)	2	0.1

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11.0 SAMPLE COLLECTION & PRESERVATION

- 11.1 Collect at least 250mL in plastic or glass.
- 11.2 Preserve with sulfuric acid to a pH<2.
- 11.3 Cool to 4°C.
- 11.4 Analyze within 2 days

12.0 QUALITY CONTROL (QC)

- 12.1 Initial demonstration of performance: Linear Calibration Range (LCR) and Method Detection Limit (MDL). An outside QC sample is analyzed quarterly.
- 12.2 Calibration Standards. The instrument is calibrated with a calibration blank and at least three standards. The calibration curve is drawn using linear regression (not forced through origin). Acceptance criteria is a correlation coefficient of 0.995 or greater. The calibration curve must be verified on each day of use. If any calibration verification exceeds the initial values by +/- 10%, the curve must be re-established.
- 12.3 On-going assessment: (a) Lab Reagent Blank (LRB) and Lab Fortified Blank (LFB) with each batch, (b) Lab Fortified Matrix (LFM) and duplicate to 10% of routine samples, (c) Instrument Performance Check (IPC) (mid-range std) and a calibration blank immediately following calibration, after every 10 samples, and at the end of the run, (d) LCR every six months, and (e) MDL continuously calculated using blank data and running the lowest point on the calibration curve above zero.
- 12.4 Cadmium reduction column: Run a cadmium column efficiency test when installing a new column on the manifold and monthly thereafter. To run a column efficiency test, prepare [1], [5], and [10] nitrite and nitrate standards. Using the Nitrate method, run the nitrite, then nitrate sample for each of the three concentrations. Calculate the recovery by dividing the nitrate results by the nitrite results. The recovery should be greater than 90%.

13.0 CALIBRATION AND STANDARDIZATION

14.0 PROCEDURE

14.1 SEQUENCE AND SAMPLE SETUP

- 14.1.1 Power on autosampler, pump, and system unit. Open the Omnion software. Select Open and select the previous Nitrate template. This will load the Nitrate method for analysis. Note: The Nitrate method measures nitrate and nitrite collectively.
- 14.1.2 Filter influent and turbid samples. Typically, for the Nitrate Method, dilute effluent samples by 1/3 using DI water. Enter the samples into the Sequence list using the previous run as a template. After all initial calibration protocols [which include blanks, calibration standards, LFB and a mid-range check standard], click on the first line and over-write the sample ID in the Name column and click "Enter" to move to the next line. Make sure to keep to the QC requirements of spikes, duplicates, blanks, and check standards after every ten samples. Once all samples are added, select Export Worksheet Data under the Run tab to print.
- 14.1.3 Refer to the printed sequence list while loading the samples into the auto-sampler tray. Place all standards and spikes in the permanent rack on the Auto-sampler. Load all samples into the removable racks. The #1 sample spot is the furthest out from the sampling arm and most left.

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14.2 INSTRUMENT SET-UP AND RUN METHOD

- 14.2.1 Prepare all reagents according to section 7.1 of the Lachat Method 10-107-04-1-A
- 14.2.2 Install the Nitrate manifold on the Lachat. The manifold schematic is shown in section 17.1 of the method.
- 14.2.3 Install the tubing on the pump. The pump is set to 35 rpm.
- 14.2.4 Run all lines with water for 10 minutes to check for leaks and flow issues.
- 14.2.5 Start buffer line first and run for 2 minutes before adding the sample lines to the other reagents.
- 14.2.6 Start reagent lines and run for 10 minutes to allow for equilibrium.
- 14.2.7 When air is out of lines put Cadmium reduction column on-line.
- 14.2.8 Allow time for the reagents to equilibrate. Select Preview to monitor the baseline. The baseline should be less 0.5.
- 14.2.9 Click run when the baseline is smooth and equilibrated. Monitor the run. When the calibration has completed, the method will allow the run to continue to standards and samples only if the correlation coefficient is 0.995 or higher.
- 14.2.10 At the end of analysis, under the tools tab, click custom report to print the report including Cup Number, Peak Area, Calibration, DQM Tests, Channel Data Display (Show N Peaks per Chart), and Detection Time.
- 14.2.11 To run nitrite, place the Cadmium reduction column off-line
- 14.2.12 Open previous Nitrite run and adjust Sample IDs accordingly. Export worksheet data.
- 14.2.13 Replace nitrate standards, LFB, and LFM(s) with nitrite standards,. Replace the diluted effluent samples with undiluted effluent samples.
- 14.2.14 Start reagent lines and run to allow for equilibrium. Select Preview to monitor the baseline.
- 14.2.15 Click run when the baseline is smooth and equilibrated. Monitor the run. When the calibration has completed, the method will allow the run to continue to standards and samples only if the correlation coefficient is 0.995 or better.
- 14.2.16 At the end of analysis, under the tools tab, click custom report to print the report including Cup Number, Peak Area, Calibration, DQM Tests, Channel Data Display (Show N Peaks per Chart), and Detection Time.
- 14.2.17 Remove the reagent lines to water.
- 14.2.18 After the water rinse, remove the lines and allow them to run dry. Remove the manifold for storage.

15.0 DATA ANALYSIS AND CALCULATIONS

- 15.1 In the Omnion software, sample concentration is calculated based on the regression equation determined from the calibration curve of peak area vs. standard concentration.
- 15.2 To calculate nitrate results, subtract the Nitrite method results from the Nitrate method results.
- 15.3 Analytes with results below the MDL will be reported as ND. Analytes with results above the highest calibration point will be appropriately diluted and re-run.
- 15.4 Report results in mg/L of NO₃ as N and NO₂ as N.

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16.0 CONTINGENCIES FOR OUT-OF-CONTROL DATA

16.1 Out of control data is not reported until the cause is found, and the solution is implemented. Possible solutions include re-making standards or reagents or identifying flow issues with pump/manifold tubing. If necessary, the following sources can be utilized: the troubleshooting guide in the operating manual of QuikChem 8500 or Omnion software.

17.0 WASTE MANAGEMENT

17.1 Cadmium reduction columns are disposed of as hazardous waste per regulations. Our hazardous waste company is Clean Harbors. All other waste is disposed of according to all federal, state, and local regulations.

18.0 REFERENCE DOCUMENTS

- 18.1 Method 353.2 from U.S EPA. Revision 2.0. August 1993
- 18.2 QuikChem Method 10-107-04-01-A. Revised 4 December 1997
- 18.3 Safety Data Sheet on Cadmium Column for Nitrate. Lachat Instruments. Issue Date 3 August 2016. Version 2.3. Product Code 50237A from Hach.
- 18.4 Safety Data Sheet on Sodium Hydroxide. Fisher Scientific. Revision 10. Date 15 February 2008.
- 18.5 Safety Data Sheet for Ammonium Chloride. Fisher Scientific. Revision 11. Date 11. February 2008.
- 18.6 Safety Data Sheet for Ethylenediaminetetraacetic acid, disodium salt dihydrate. Thermo Fisher Scientific. Revision 5. Date 3 September 2009.
- 18.7 Safety Data Sheet for Phosphoric Acid. Fisher Scientific. Revision 10. Date 28 January 2008.
- 18.8 Safety Data Sheet for Sulfanilamide. Fisher Scientific. Revision 6. Date 24 January 2008.
- 18.9 Safety Data Sheet for N-(1-naphthyl) ethylenediamine dihydrochloride. Thermo Fisher Scientific. Revision 5. Date 21 June 2010.

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19.0 TABLES/DIAGRAMS

19.1 QC Summary Sheet

QC test	Frequency	Acceptance criteria	Comments
Calibration	every day of use	99.5% correlation	blk & at least 3 stds
Calibration verification	At the begin of run	+/- 10% of conc	
LRB (blank)	1 per batch	< MDL	
Calibration (blank)	At the beginning of the run, after every 10 samples, and at end of run	< MDL	
IPC (Inst. Per check)	every 10, end of run	+/- 10% of calib.	mid range std
LFB (using 2 nd source standard)	every run	+/- 20% recovery of spike	Spiking levels: 2 for nitrite and 10 for nitrate
LFM (using 2 nd source standard)	every run	+/- 30% recovery of spike	Spiking level: 1
Duplicate	10% of samples	70 - 130% relative percent difference	> 4 x the mdl
2 nd source QCS	1 per quarter	+/- 10% of true value	
LDR (linear dynamic range)	Every six months		

Nitrate/Nitrite (353.2)

Run Date: _____	Batch: _____
Analyst: _____	Control Chart: <input type="checkbox"/> yes
MDL: 0.05	MDL: 0.05

NO3 Run			NO2 Run		
r = _____ (> 0.995)			r = _____ (> 0.995)		
Blanks < MDL Yes <input type="checkbox"/> No <input type="checkbox"/>			Blanks < MDL Yes <input type="checkbox"/> No <input type="checkbox"/>		
LFB (+/- 20%) = _____			LFB (+/- 20%) = _____		
Check Standards			Check Standards		
TV STD	Observed STD	Rec (+/- 10%)	TV STD	Observed STD	Rec (+/- 10%)
Duplicates (70-130%)			Duplicates (70-130%)		
For 10% of samples Yes <input type="checkbox"/> No <input type="checkbox"/>			For 10% of samples Yes <input type="checkbox"/> No <input type="checkbox"/>		
Value	Duplicate	% Difference	Value	Duplicate	% Difference
LFM (70 - 130 %)			LFM (70 - 130%)		
For 10% of samples Yes <input type="checkbox"/> No <input type="checkbox"/>			For 10% of samples Yes <input type="checkbox"/> No <input type="checkbox"/>		
Sample	Spike Value	Recovery	Sample	Spike Value	Recovery

Instrumentation: Lachat QuikChem 8500 series 2
 Color Reagent I.D. _____ Buffer I.D. _____

Reviewed by: _____ Date: _____ Revision 121620BW

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Revision Record

Revision No.	Date	Responsible Person	Description of Change
1	11/15/2016	L. Paetsch	Updated and Revised SOP Format
2	02/06/2017	L. McGuire	Updated Calibration Stds and footer
3	3/07/2019	M. Ottersen	Updated NO2 Standards and SOP Format
4	1/29/2020	J. Chap	Updated header, footer, QC requirements, sample and instrument set-up, and reporting
5	1/27/2021	K. Dempsey	Updated/added TNI 23 SOP Components
6			
7			

APPENDIX D
MODIFICATION / ADDENDUM

Hydro Technologies, LLC
subcontracting of testing services to
EnviroTest Laboratories, Newburg, NY

EnviroTest Laboratories
Laboratory Standard Operating Procedures

Colilert-18-Fecal Coliform

Colilert/Colisure – Coliform, Total / *E. Coli* (Qualitative) –
Closiure and SM 20, 21-23 9223B (-04) (Colilert);
E. Coli (Enumeration) SM 20, 21-23 9223B (-04) and SM 9223B-2004

Inorganic Anions, IC, EPA Method 300.0 Rev 2.1

Carol Haskins

From: rcusack@envirotestlaboratories.com
Sent: Thursday, January 13, 2022 3:42 PM
To: 'Carol Haskins'; ethan@specifiedlabs.com
Subject: RE: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

Categories: Red Category

Hi Carol, It looks good to me.

Renee Cusack
Laboratory Director
EnviroTest Laboratories, LLC
315 Fullerton Ave.
Newburgh, NY 12550
845-562-0890 X 803
rcusack@envirotestlaboratories.com

From: Carol Haskins <chaskins@pomperaug.org>
Sent: Thursday, January 13, 2022 3:35 PM
To: rcusack@envirotestlaboratories.com; ethan@specifiedlabs.com
Subject: RE: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

Hi Renee and Ethan -

I don't think it will be a problem to adjust the time we start collecting samples in order to meet the courier at 2:30 PM. In the best case scenario, it takes PRWC's sample teams approximately 2.5 hours to collect samples, and then 0.5 hours to deliver to New Milford. Accordingly, we would begin our sampling at 11:30 AM (maybe 11:15 AM). So, that's 3 hours to the courier pick-up. I imagine the courier will fill in details on the chain of custody form, so that might add a few minutes if there are a lot of sample batches to track/transfer. Add 1 hour to go from NM to Newburg. Let's say that brings us to around 4.5 hours if there is no traffic or other unusual situations. It's a little tight on the 6 hour hold time, but still some wiggle room as long as the samples get processed when they arrive at the lab.

For the purposes of our QAPP, I want to summarize our discussions and emails to confirm I understand the modifications in the lab operations so that I can clearly communicate the same to our project managers at DEEP and EPA. Please let me know if I have misstated anything below.

The existing partnership between Hydro Technologies (New Milford, CT) and EnviroTest Laboratories (Newburg, NY) is expanding.

The expanded partnership will consolidate most lab testing services to one location. Most analytical testing previously performed at Hydro Technologies (New Milford, CT) will be performed at the Newburgh NY facility of EnviroTest Laboratories.

Billing and reporting will still be through the HydroTechnologies. In effect, the analyses are subcontracted by HydroTechnologies to EnviroTest Laboratories. Detail within the results report will contain a field displaying the Lab ID where the analysis was completed.

EnviroTest Laboratories is a State of Connecticut Department of Public Health certified lab (PH-0554). Hydro Technologies will remain a Connecticut certified laboratory (PH-0787).

Samples collected by PRWC will be delivered to the HydroTechnologies facility in New Milford, CT. From here, a courier will pick-up the samples and deliver them to EnviroTest Lab in Newburg (located one hour from New Milford). The courier picks up samples at 2:30 PM Monday thru Friday. The hand-off of samples from PRWC to HydroTechnologies to the Courier to EnviroTest will be tracked on the chain of custody form.

EnviroTest ensures they will be able to satisfy the compliance monitoring requirement for a 6 hour hold time to begin incubation for *E. coli* analysis if PRWC is able to deliver samples to New Milford within 3.5 hours of collection time.

EnviroTest Lab uses the same 18h Colilert method (SM9223) for analyzing *E. coli* as HydroTechnologies. EnviroTest also uses the same methods for Nitrate as N (EPA Method 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry) as HydroTechnologies.

Price per analysis will remain the same at \$20/*E. coli* sample and \$13/Nitrate sample.

PRWC will continue to test twice a month for April and May 2022. Sample dates will be pre-determined and coordinated with the lab to ensure samples can expeditiously be processed upon receipt to meet the required hold time.

Frequency of sampling for the remainder of the 2022 field season is dependent on funding availability.

Thanks,
Carol

From: rcusack@envirotestlaboratories.com [<mailto:rcusack@envirotestlaboratories.com>]

Sent: Tuesday, January 11, 2022 10:19 AM

To: 'Carol Haskins'; ethan@specifiedlabs.com

Subject: RE: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

Hi Carol, The prices for the analysis will stay the same. We have a daily courier run at 2:30 PM Monday thru Friday from New Milford to Newburgh. Hopefully you will be able to schedule your sampling events keeping that time in mind. If it happens that you can't meet the drop off time or need an earlier time we will pick up the cost of the Lyft driver.

Renee Cusack
Laboratory Director
EnviroTest Laboratories, LLC
315 Fullerton Ave.
Newburgh, NY 12550
845-562-0890 X 803
rcusack@envirotestlaboratories.com

From: Carol Haskins <chaskins@pomperaug.org>

Sent: Monday, January 10, 2022 4:25 PM

To: ethan@specifiedlabs.com; 'Renee Cusack (E-mail)' <rcusack@envirotestlaboratories.com>

Subject: RE: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

Hi Ethan and Renee -

I have a follow-up question for you with the operations/logistics change... namely, pricing. Hydro has been able to give us the rate of \$20/sample for E. coli and \$13/sample for nitrate. Will that continue to be the rate for 2022 and/or is there any additional fee that would be incurred to when you have to do a special courier run on days to pick up from New Milford to meet the 6 hour hold time.

Carol

From: Ethan Einwohner [<mailto:ethan@specifiedlabs.com>]
Sent: Wednesday, January 5, 2022 11:30 AM
To: Carol Haskins; Renee Cusack (E-mail)
Subject: Re: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

Hi Carol I hope that you are doing great. Great speaking with you and Renee Cusack, our Laboratory Director, just now.

Renee's direct phone number is 845 562 0890 x 803

And my cell is 845 562 0890

With many thanks

Ethan Einwohner
Hydro Technologies LLC
Envirotest Laboratories LLC
Specified Testing Labs LLC

On Wed, Jan 5, 2022, 10:51 AM Carol Haskins <chaskins@pomperaug.org> wrote:

Hi Ethan -

Thank you for letting us know about this change. We will evaluate whether or not we will be able to continue using your services for our stream bacteria sampling in light of the hold time requirements for EPA compliance monitoring and the terms of our Quality Assurance Project Plan. If we have to drive bacteria samples an extra hour (1 hour from New Milford, but actually 1.5 hours from our office), it will add a lot of extra pressure to meet the 6-hour hold time and may be unrealistic to continue using your services for this particular monitoring initiative. We will follow-up in the coming month as we evaluate.

Carol

.><(((e>`...><(((e> .><(((e>`...><(((e>

Carol Haskins, Executive Director

Pomperaug River Watershed Coalition

39 Sherman Hill Road, Suite 103C, Woodbury, CT 06798

203-263-0076 | www.pomperaug.org | [Facebook](#)

From: Ethan Einwohner [mailto:ethan@specifiedlabs.com]

Sent: Tuesday, December 28, 2021 7:49 PM

To: Ethan Einwohner

Subject: Happy New Year from Hydro Technologies! Please read attached Important Client Letter

To: Valued Commercial Clients of Hydro Technologies LLC

Happy New Year from Hydro Technologies! Please read the attached important Client Letter

We at Hydro Technologies thank you for your business in 2021 and look forward to serving you in the New Year and coming years!

Please read the attached important Client Letter and please do not hesitate to reach me by email or phone at the number listed below, or any of our other managers listed in the attached Client Letter.

We wish you and yours continued health and success in 2022!


With thanks,

Ethan Einwohner, CEO, Head of Ownership Group

Hydro Technologies LLC
EnviroTest Laboratories LLC

(646) 714 5651

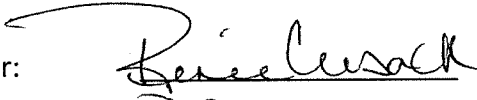
ethan@specifiedlabs.com

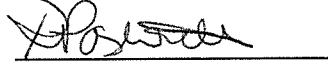
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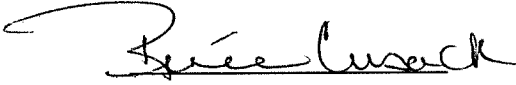
STANDARD OPERATING PROCEDURE

PROCEDURE TITLE: Colilert-18, Fecal Coliform

Approvals and Signatures

Laboratory Director:  Date: 10/7/2020

QA Manager:  Date: 10/6/2020

Section Supervisor  Date: 10/17/2020


Periodic Review:

Signature	Title	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____

Revision No.	Date	Responsible Person	Description of Change
0	9/13/2017	R. Cusack R. Pastorello	New SOP
1	8/17/2020	R. Cusack R. Pastorello	Updates for consistency and conformance to 2016 TNI standard. Added new header and Periodic review

1. SCOPE AND APPLICATION

1.1 This method is intended for use in the detection and confirmation of fecal coliforms in wastewater. The minimum, non-zero number of bacterial counts detectable with this method is a function of the dilution scheme used when processing the sample. The Colilert-18 method can be applied to test for fecal coliforms in wastewaters with the Quanti-Tray® system. Since there can be a

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wide range of fecal coliform levels in wastewaters, dilutions can be used with this method for detecting and enumerating the actual level.

2. SUMMARY OF METHOD

2.1 The method is based on Defined Substrate Technology®. The product utilizes a nutrient indicator (ONPG) that produces a yellow color when metabolized by fecal coliforms at 44.5°C. When the reagent is added to the sample and incubated, it can detect these bacteria at 1 CFU/ml at 18 hours and up to 22 hours. In this method, fecal coliform bacteria are defined as bacteria that produce a yellow color after 18-22 h incubation at 44.5° +/- 0.2° C. Positive results are visualized only by color change, not fluorescence.

3. DEVIATIONS FROM METHOD

3.1 No modifications are made to the method

4. DEFINITIONS

4.1 Refer to SOP Laboratory Definitions "SOP-LABDEF".

5. INTERFERENCES


5.1 Some samples containing humic material may have an innate color and a control blank of the same water sample may be required for comparison to the inoculated sample

6. SAFETY

6.1 See SOP "Frequently Used Chemical Hazards/Inorganic Department"

6.2 Waste Streams Produced by the Method

6.2.1 Safely dispose of samples by autoclaving after the analysis has been completed then discard the samples in the garbage.

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7. EQUIPMENT AND SUPPLIES

- 7.1 Incubator maintained at $44.5 \pm 0.2^{\circ}\text{C}$. (Water jacketed or water bath that can maintain the required temperature tolerance).
- 7.2 Low level Chlorine test strips

8. REAGENTS AND STANDARDS

- 8.1 IDEXX – Colilert -18 Snap Packs containing sufficient Colilert reagent for 100 mL of sample volume.
- 8.2 Quanti-Tray or Quanti-Tray/2000 for Colilert
- 8.3 IDEXX Antifoam Vessels


9. SAMPLE COLLECTION, PRESERVATION AND HOLD TIME

- 9.1 Chlorinated samples must be preserved with 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulfate),
- 9.2 Non-chlorinated samples are to have no $\text{Na}_2\text{S}_2\text{O}_3$ added.
- 9.3 Maximum holding time for surface water, waste & ambient waters is 8 hours from collection to analysis.
- 9.4 Analysis time on reports is time placed in incubator
- 9.5 Samples that require thermal preservation shall be considered acceptable if the arrival temperature of a representative sample container meets the method or mandated temperature requirement. Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of this section or the method or the regulatory requirement. In these cases, the samples *may* be considered acceptable if the samples are received on ice with evidence that the cooling process has begun.

NOTE: The intent is for the samples to be preserved immediately and analyzed as soon as possible.

- 9.6 Microbiological samples from known chlorinated sources (such as wastewater effluent), unknown sources where disinfectant (e.g. chlorine) usage is suspected (such as a new client or a new source), and all potable water supplies (including source water) shall be checked for absence of disinfectant residual in the laboratory unless all of the following conditions are met:

- a. The laboratory can show that the received sample containers are from its laboratory or have been appropriately tested and documented;

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- b. Sufficient sodium thiosulfate was in each container before sample collection to neutralize at minimum 5 mg/L of chlorine for drinking water and 15 mg/L of chlorine for wastewater samples;
- c. One (1) container from each batch of laboratory-prepared containers or lot of purchased ready-to-use containers is checked to ensure efficacy of the sodium thiosulfate to 5 mg/L chlorine or 15 mg/L chlorine as appropriate and the check is documented;
- d. Disinfectant residual is checked in the field and actual concentration is documented with sample submission.

10. QUALITY CONTROL

10.1 Refer to Section 16 'Method Performance, Data Review, and Acceptance Criteria'.

10.2 Monthly Media Check:

10.2.1 Inoculate 1 sterile bottle filled with 100mL sterile water with one Quanti-cult or equivalent E. coli standard. Acceptable result: positive = yellow color

10.2.2 Inoculate 1 sterile bottle filled with 100mL sterile water with one Quanti-cult Pseudomonas aeruginosa or equivalent non-coliform standard. Acceptable result: negative = colorless

10.2.2.1 Record the results in the daily Logbook.

10.2.3 Proceed as in procedure section.

10.3 Sterile Bottle Check:


10.3.1 Prepare a sterile bottle check by pouring 50 mL of sterile double strength (Tryptic Soy Broth) TSB and 50 mL of sterile water in a sterile bottle and incubate for 48 hours at 35°C. Perform a visual check for presence of turbidity, if no turbidity is observed bottles may be used if turbidity is seen notify the Lab Director ASAP and do NOT use the bottles.

10.4 Each lot of sterile bottles must be checked for volume

10.4.1 Place a sterile bottle on balance, tare the balance and then fill with DI water the 100mL fill line and record weight of water. The fill line is accurate to within $\pm 2.5\%$. This bottle can then be used to check for thiosulfate efficiency.

10.5 Each lot of sterile bottles must be checked for thiosulfate efficiency.

10.5.1 This is done by adding 15 mg/l of chlorine solution to a sterile thiosulfate container containing 100 mLs DI water. Shake and test for chlorine residual.

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10.6 Quanti-Tray Sealer Check

10.6.1 Monthly verification that sealer is working properly.


10.6.2 Fill Quanti-Tray with 100mL DI H₂O containing food coloring. If the food coloring is observed outside the wells the sealer should be checked for malfunction. Purchase a new sealer if it is determined that it is not sealing properly.

11. INITIAL DEMONSTRATION OF PERFORMANCE

11.1 Each analyst must complete an initial demonstration of capability prior to reporting any data using this method.

11.2 If the method or regulation does not specify an initial DOC, the following procedure is acceptable. It is the responsibility of the laboratory to document that other approaches to initial DOC are adequate.

- a) The target organism(s) shall be diluted in a volume of sterile, quality system matrix (a sample in which no target organisms or interferences are present at concentrations that will impact the results of a specific method). When required by method, the diluent shall be sterile buffered water and/or sterile peptone water unless specified by the manufacturer. Prepare at least four (4) aliquots at the concentration specified, or if unspecified, to the countable range for plate methods or working range for most probable number (MPN) type methods.
- b) For enumeration methods, at least four (4) aliquots shall be prepared and analyzed concurrently according to the method.
- c) Using all of the results, convert these results to logarithmic values, then calculate the mean recovery and standard deviation of the log converted results in the appropriate reporting units for each organism of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence, the laboratory shall assess performance against established and documented criteria.
- d) For qualitative tests, acceptable performance in a blind study, either internally or externally generated, may be used to meet this Standard, provided that the study consists of a minimum of a blank, a negative culture, and a positive culture for each target organism.
- e) Compare the information from c) above to the corresponding acceptance criteria for precision and accuracy in the method (if applicable) or in laboratory-generated acceptance criteria such as relative standard deviation (if there are not established mandatory criteria). If all parameters meet the

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acceptance criteria, the analysis of actual samples may begin. If any one of the parameters does not meet the acceptance criteria, the performance is unacceptable for that parameter.

- f) When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst shall proceed according to i) or ii) below.
 - i. Locate and correct the source of the problem and repeat the initial DOC for all parameters of interest beginning with b) above.
 - ii. Repeat the initial DOC for all parameters that failed to meet criteria.
- g) Repeated failure, however, confirms a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all organisms of interest beginning with b) above.

12. LIMIT OF DETECTION


12.1 The reporting limit (LOQ) from MPN charts for 100 mL
 =(0) wells = <1CFU/100mL. If dilution is made adjust limit accordingly.

13. CALIBRATION AND STANDARDIZATION

13.1 Not applicable to this method.

14. PROCEDURE

- 14.1 Sample Preparation
 - 14.1.1 Bring the samples to room temperature.
 - 14.1.2 If chlorine residual is not provided by client; check each sample for presence of chlorine by pouring a small amount of sample onto a low level chlorine test strip. If paper indicates that chlorine is present, the test must be invalidated.
 - 14.1.3 Adjust sample volume to 100 mL
 - 14.1.4 If sample requires dilution use sterile dilution water then multiply result by dilution factor
- 14.2 Quanti-Tray Enumeration Procedure (**Colilert**)
 - 14.2.1 Add contents of one pack Colilert-18 media to a 100mL, room temperature sample in a sterile vessel. Vessel does not need to be transparent or non-fluorescing.
 - 14.2.2 Cap vessel and shake until dissolved.
 - 14.2.3 Pour sample/reagent mixture into a Quanti-Tray/2000 and seal in an IDEXX Quanti-Tray Sealer.

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- 14.2.4 Place the sealed tray face down in a 44.5 ± 0.2 °C (for fecal coliforms) incubator for 18 hours. For incubation in a water bath submerge the Quanti-Tray, as is, below the water level using a weighted ring.
- 14.2.5 Read results according to the results interpretation table below. Count the number of positive wells and for a MPN/count use MPN table to arrive at a most probable number.
- 14.2.6 Colilert-18 results are to be read after 18 hours of incubation. However, if the results are ambiguous to the analyst based on the initial reading, incubate up to an additional four hours (but not to exceed 22 hours total) to allow the color to intensify.
- 14.2.7 Colilert-18 results are definitive at 18–22 hours. In addition, positives for fecal coliforms observed before 18 hours and negatives observed after 22 hours are also valid.

Appearance	Result
Less yellow than the comparator when incubated at 44.5 ± 0.2 °C	Negative for fecal coliforms
Yellow equal to or greater than the comparator when incubated at 44.5 ± 0.2 °C	Positive for fecal coliforms

- 14.2.8 Read results according to table below, comparing color to color comparator.
- 14.2.9 Record number of positive wells and for a Most Probable Number (MPN)/count use MPN table to arrive at a most probable number.
- 14.2.10 Sample can be diluted with sterile water to increase detection limit. Results are multiplied by dilution factor.

15. DATA ANALYSIS AND CALCULATIONS

15.1 For Enumeration methods the values are taken from the Most Probable Number (MPN) tables and are based on a sample volume of 100 mL.

15.2 If sample dilutions are made, multiply the MPN value by the dilution factor to obtain the proper quantitative result.

15.2.1 For example: if 1 mL of sample is used the dilution factor is 100.

15.2.2 For example: If 10mL of sample is used the dilution factor is 10

16. METHOD PERFORMANCE, DATA REVIEW, AND ACCEPTANCE CRITERIA


QC ANALYSIS	FREQUENCY	QC CRITERIA	CORRECTIVE ACTION
Colilert -18 lot Verification	Each lot of media received	E. coli = positive = yellow Pseudomonas aeruginosa = negative = colorless	Media must be verified before it is used on samples. Notify Lab Director
Sterile Bottle Control Check for Sterility Check for Thiosulfate efficiency Check for Volume	Each lot of Sterile bottles received.	Negative/Negative No chlorine residual present after addition of 15 mg/l. Volume check: $\pm 2.5\%$ accuracy	Bottles must be verified before they are used. Notify Lab Director if there is a failure.
Sealer Check	Once per month	No leakage	Notify Lab Director if there is a failure.
Quantitrays	Each new lot of trays received, or manufacturers certificate.	Negative/Negative	Notify Lab Director if there is a failure.

17. POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1 See SOP "Waste Management Procedure"

18. REFERENCES

18.1 IDEXX Laboratories, Inc. Colilert*-18 and Quanti-Tray* Test Method for the Detection of Fecal Coliforms in Wastewater, October 2011, Instructions with Colilert*-18 Test Kit

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STANDARD OPERATING PROCEDURE

PROCEDURE TITLE: Colilert/Colisure –
 Coliform, Total / E. coli (Qualitative) – Colisure and SM 20,21-23 9223B (-04) (Colilert);
 E. coli (Enumeration) SM 20,21-23 9223B (-04) and SM 9223B -2004


Approvals and Signatures

Laboratory Director: *Renee Cusack* Date: 10/7/2020
 QA Manager: *Pastorello* Date: 10/6/2020
 Section Supervisor *Renee Cusack* Date: 10/7/2020

Periodic Review:

Signature	Title	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____

Revision No.	Date	Responsible Person	Description of Change
6	3/21/2016	M. Ruthven	- Added Colilert to section 3.0, 4.0, 5.0, & 9.0 - Section 6.4 "Maximum hold time" changed to "analysis time"
7	7/25/16	M. Pistole R. Cusack	- Removed references to Colilert-18- Sections: 9.4.4, 9.4.8, 9.5.5, 9.5.8, 9.6.5, 9.7.7; reference to use of color comparator added - 4.0, 9.5.6, 9.6.4 corrected time-Quanti-Tray Enumeration Procedure (Colisure) removed- 10.0 QC section updated
8	8/6/2020	R. Cusack R. Pastorello	Updates for consistency and conformance to 2016 TNI standard. Added new header and Periodic review, changed SOP name

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1. SCOPE AND APPLICATION

- 1.1 Colilert or Colisure are used for the simultaneous detection and confirmation of total coliforms and E. coli in water.

2. SUMMARY OF METHOD

- 2.1 When total coliforms metabolize Colilert's nutrient-indicator, ONPG, the sample turns yellow. When E. coli metabolize Colilert's nutrient indicator, MUG, the sample also fluoresces. Colilert can simultaneously detect these bacteria at 1 cfu/100mL within 24 - 28 hours even with as many as 2 million heterotrophic bacteria per 100mL present.
- 2.2 When total coliforms metabolize Colisure's nutrient indicator CPRG, the sample turns from yellow to red/magenta. When E. coli metabolize Colisure's nutrient-indicator MUG, the sample also fluoresces. Colisure can simultaneously detect these bacteria at 1 cfu/100mL within 24 - 48 hours even with as many as 2 million heterotrophic bacteria per 100mL present.

3. DEVIATIONS FROM METHOD

- 3.1 No modifications are made to the method

4. DEFINITIONS


- 4.1 Refer to SOP Laboratory Definitions "SOP-LABDEF".

5. INTERFERENCES

- 5.1 There are no interferences with this method.

6. SAFETY

- 6.1 See SOP "Frequently Used Chemical Hazards/Inorganic Department"
- 6.2 Waste Streams Produced by the Method
- 6.2.1 Safely dispose of samples by autoclaving after the analysis has been completed then discard the samples in the garbage.

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7. EQUIPMENT AND SUPPLIES

- 7.1 Incubator- Must maintain a temperature of $35^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$.
- 7.2 Quanti-Tray Sealer
- 7.3 HACH Chlorine test strips

8. REAGENTS AND STANDARDS


- 8.1 IDEXX – Colilert Snap Packs containing sufficient Colilert reagent for 100 mL of sample volume.
- 8.2 Quanti-Tray or Quanti-Tray/2000 for Colilert
- 8.3 Colisure Snap Packs containing sufficient Colisure reagent for 100 mL of sample volume.
- 8.3 IDEXX Antifoam Vessels

9. SAMPLE COLLECTION, PRESERVATION AND HOLD TIME

- 9.1 Chlorinated samples must be preserved with 0.008% $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulfate),
- 9.2 Non-chlorinated sample are to have no $\text{Na}_2\text{S}_2\text{O}_3$ added.
- 9.3 Maximum holding time is 30 hours for drinking waters.
- 9.4 Maximum holding time for surface water, waste & ambient waters is 8 hours from collection to analysis.
- 9.5 Analysis time on reports is time placed in incubator
- 9.6 Samples that require thermal preservation shall be considered acceptable if the arrival temperature of a representative sample container meets the method or mandated temperature requirement. Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of this section or the method or the regulatory requirement. In these cases, the samples *may* be considered acceptable if the samples are received on ice with evidence that the cooling process has begun.

NOTE: The intent is for the samples to be preserved immediately and analyzed as soon as possible.


- 9.7 Microbiological samples from known chlorinated sources (such as wastewater effluent), unknown sources where disinfectant (e.g. chlorine) usage is suspected (such as a new client or a new source), and all potable water supplies (including source water) shall be checked for absence of disinfectant residual in the laboratory unless all of the following conditions are met:

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- a. The laboratory can show that the received sample containers are from its laboratory or have been appropriately tested and documented;
- b. Sufficient sodium thiosulfate was in each container before sample collection to neutralize at minimum 5 mg/L of chlorine for drinking water and 15 mg/L of chlorine for wastewater samples;
- c. One (1) container from each batch of laboratory-prepared containers or lot of purchased ready-to-use containers is checked to ensure efficacy of the sodium thiosulfate to 5 mg/L chlorine or 15 mg/L chlorine as appropriate and the check is documented;
- d. Disinfectant residual is checked in the field and actual concentration is documented with sample submission.

10. QUALITY CONTROL

- 10.1 Refer to Section 16 'Method Performance, Data Review, and Acceptance Criteria'.
- 10.2 Monthly Media Check:
 - 10.2.1 Inoculate 1 sterile bottle filled with 100mL sterile water with one Quanti-cult or equivalent E. coli standard. Acceptable result: positive/positive (P/P).
 - 10.2.2 Inoculate 1 sterile bottle filled with 100mL sterile water with one Quanti-cult Klebsiella pneumoniae or equivalent total coliform standard. Acceptable result: positive/negative (P/N).
 - 10.2.3 Inoculate 1 sterile bottle filled with 100mL sterile water with one Quanti-cult Pseudomonas aeruginosa or equivalent non-coliform standard. Acceptable result: negative/negative (N/N).
 - 10.2.3.1 Record the results in the daily Logbook.
 - 10.2.4 Proceed as in procedure section.
- 10.3 Sterile Bottle Check:
 - 10.3.1 Prepare a sterile bottle check by pouring 50 mL of sterile double strength (Tryptic Soy Broth) TSB and 50 mL of sterile water in a sterile bottle and incubate for 48 hours at 35°C. Perform a visual check for presence of turbidity, if no turbidity is observed bottles may be used if turbidity is seen notify the Lab Director ASAP and do NOT use the bottles.
- 10.4 Each lot of sterile bottles must be checked for volume
 - 10.4.1 Place a sterile bottle on balance, tare the balance and then fill with DI water the 100mL fill line and record weight of water. The fill line is accurate to within $\pm 2.5\%$. This bottle can then be used to check for thiosulfate efficiency.

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- 10.5 Each lot of sterile bottles must be checked for thiosulfate efficiency.
 - 10.5.1 This is done by adding 15 mg/l of chlorine solution to a sterile thiosulfate container containing 100 mLs DI water. Shake and test for chlorine residual.
- 10.6 Quanti-Tray Sealer Check
 - 10.6.1 Monthly verification that sealer is working properly.
 - 10.6.2 Fill Quanti-Tray with 100mL DI H₂O containing food coloring. If the food coloring is observed outside the wells the sealer should be checked for malfunction. Purchase a new sealer if it is determined that it is not sealing properly.

11. INITIAL DEMONSTRATION OF PERFORMANCE

11.1 Each analyst must complete an initial demonstration of capability prior to reporting any data using this method.

11.2 If the method or regulation does not specify an initial DOC, the following procedure is acceptable. It is the responsibility of the laboratory to document that other approaches to initial DOC are adequate.

- a) The target organism(s) shall be diluted in a volume of sterile, quality system matrix (a sample in which no target organisms or interferences are present at concentrations that will impact the results of a specific method). When required by method, the diluent shall be sterile buffered water and/or sterile peptone water unless specified by the manufacturer. Prepare at least four (4) aliquots at the concentration specified, or if unspecified, to the countable range for plate methods or working range for most probable number (MPN) type methods.
- b) For enumeration methods, at least four (4) aliquots shall be prepared and analyzed concurrently according to the method.
- c) Using all of the results, convert these results to logarithmic values, then calculate the mean recovery and standard deviation of the log converted results in the appropriate reporting units for each organism of interest. When it is not possible to determine mean and standard deviations, such as for presence/absence, the laboratory shall assess performance against established and documented criteria.
- d) For qualitative tests, acceptable performance in a blind study, either internally or externally generated, may be used to meet this Standard, provided that the study consists of a minimum of a blank, a negative culture, and a positive culture for each target organism.

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- e) Compare the information from c) above to the corresponding acceptance criteria for precision and accuracy in the method (if applicable) or in laboratory-generated acceptance criteria such as relative standard deviation (if there are not established mandatory criteria). If all parameters meet the acceptance criteria, the analysis of actual samples may begin. If any one of the parameters does not meet the acceptance criteria, the performance is unacceptable for that parameter.
- f) When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst shall proceed according to i) or ii) below.
 - i. Locate and correct the source of the problem and repeat the initial DOC for all parameters of interest beginning with b) above.
 - ii. Repeat the initial DOC for all parameters that failed to meet criteria.
- g) Repeated failure, however, confirms a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all organisms of interest beginning with b) above.

12. LIMIT OF DETECTION

12.1 The reporting limit (LOQ) from MPN charts for 100 mL
 =(0) wells = <1CFU/100mL. If dilution is made adjust limit accordingly.
 For Present/Absent – not applicable

13. CALIBRATION AND STANDARDIZATION

13.1 Not applicable to this method.

14. PROCEDURE

- 14.1 Sample Preparation
 - 14.1.1 Bring the samples to room temperature.
 - 14.1.2 If chlorine residual is not provided by client; check each sample for presence of chlorine by pouring a small amount of sample onto a HACH chlorine test strip. If paper indicates that chlorine is present, the test must be invalidated.
 - 14.1.3 Adjust sample volume to 100 mL

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- 14.2 Procedure Presence/Absence (P/A) (Bottles) (**Colilert**)
- 14.2.1 Add contents of one pack Colilert media to a 100mL sample in a sterile, transparent, non-fluorescing vessel.
- 14.2.2 Cap vessel and shake until dissolved.
- 14.2.3 Incubate at 35 ± 0.5 °C for at least 24 hours no longer than 28.
- 14.2.4 Observe bottles for yellow color, comparing color to color comparator.
- 14.2.5 If yellow color is observed, look for fluorescence with a 6-watt, 365 nm, UV light within 5 inches of the sample. Face light away from your eyes and towards the sample.
- 14.2.6 Samples are negative if at any time after 24 hours there is no yellow and/or fluorescence.
- 14.2.7 Yellow or yellow/fluorescence observed before 24 hours is a valid positive. However, after 28 hours from inoculation, heterotrophs may overwhelm Colilert’s inhibition system. **Therefore, yellow or yellow/fluorescence first observed after 28 hours from inoculation is not a valid positive.**
- 14.2.8 Read results according to table below, comparing color to color comparator.

Appearance	Result
Colorless or slight tinge (less yellow color than comparator).	<i>Negative for total coliforms and E. coli</i>
Yellow equal to or greater than the comparator	<i>Positive for total coliforms</i>
Yellow and fluorescence equal to or greater than the comparator	<i>Positive for E. coli</i>

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- 14.3 Quanti-Tray Enumeration Procedure (**Colilert**)
- 14.3.1 Add contents of one pack Colilert media to a 100mL, room temperature sample in a sterile vessel. Vessel does not need to be transparent or non-fluorescing.
- 14.3.2 Cap vessel and shake until dissolved. If needed samples may be placed in the 35°C incubator for up to 20 minutes to aid in dissolution.
- 14.3.3 Pour sample/reagent mixture into a Quanti-Tray/2000 and seal in an IDEXX Quanti-Tray Sealer.
- 14.3.4 Place the sealed Tray face down in a 35 ± 0.5 °C incubator for 24 hours (this 24 hour includes warming time).
- 14.3.5 If any wells are yellow, comparing color to color comparator, look for fluorescence with a 6-watt, 365 nm, UV light within 5 inches of the sample. Face light away from your eyes and towards the sample.
- 14.3.6 Samples are negative if at any time after 24 hours there is no yellow and/or fluorescence.
- 14.3.7 Yellow or yellow/fluorescence observed before 24 hours is a valid positive. However, after 28 hours from inoculation, heterotrophs may overwhelm Colilert’s inhibition system. **Therefore, yellow or yellow/fluorescence first observed after 28 hours from inoculation is not a valid positive.**
- 14.3.8 Read results according to table below, comparing color to color comparator.
- 14.3.9 Record number of positive wells and for a Most Probable Number (MPN)/count use MPN table to arrive at a most probable number.
- 14.3.10 Sample can be diluted with sterile water to increase detection limit. Results are multiplied by dilution factor.

Appearance	Result
Colorless or slight tinge (less yellow color than comparator).	<i>Negative for total coliforms and E. coli</i>
Yellow equal to or greater than the comparator	<i>Positive for total coliforms</i>
Yellow and fluorescence equal to or greater than the comparator	<i>Positive for E. coli</i>

14.4 Procedure Presence/Absence (P/A) (**Colisure**)

- 14.4.1 Add contents of one pack Colisure media to 100mL of dilution water for the negative control.
- 14.4.2 Add contents of one pack Colisure media to a 100mL sample in a sterile, transparent, non-fluorescing vessel.
- 14.4.3 Cap vessel and shake.
- 14.4.4 Incubate at 35 ± 0.5°C for 24 - 48 hours.
- 14.4.5 Read results according to table below, comparing color to color comparator.


Appearance	Result
Yellow/gold	<i>Negative for total coliforms and E. coli</i>
Red or magenta	<i>Positive for total coliforms</i>
Red/magenta and fluorescence	<i>Positive for E. coli</i>

- 14.4.6 Look for Fluorescence with a 6 watt, 365nm, UV light within 5 inches of the sample, in a dark environment. Face light away from your eyes and towards the sample.
- 14.4.7 If the sample is pink or orange, incubate further (up to 48 hours maximum). A sample that remains pink or orange at 48 hours is negative for coliforms and E. coli.
- 14.4.8 Samples are negative at any time after 24 hours there is no red, magenta and/or fluorescence.
- 14.4.9 Red/magenta with fluorescence observed before 24 hours is a valid positive. However, after 48 hours, heterotrophs may overwhelm Colisure’s inhibition system. Therefore, red/magenta with fluorescence first observed after 48 hours is not a valid positive.

15. DATA ANALYSIS AND CALCULATIONS

15.1 For Enumeration methods the values are taken from the Most Probable Number (MPN) tables and are based on a sample volume of 100 mL.

15.2 If sample dilutions are made, multiply the MPN value by the dilution factor to obtain the proper quantitative result.

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15.2.1 For example: if 1 mL of sample is used the dilution factor is 100.

15.2.2 For example: If 10mL of sample is used the dilution factor is 10

16. METHOD PERFORMANCE, DATA REVIEW, AND ACCEPTANCE CRITERIA

QC ANALYSIS	FREQUENCY	QC CRITERIA	CORRECTIVE ACTION
Colilert/ Colisure lot Verification	Each lot of media received	E. coli = positive/positive Total coliform = positive/negative Non-coliform = negative/negative	Media must be verified before it is used on samples. Notify Lab Director
Sterile Bottle Control Check for Sterility Check for Thiosulfate efficiency Check for Volume	Each lot of Sterile bottles received.	Negative/Negative No chlorine residual present after addition of 15 mg/l. Volume check: $\pm 2.5\%$ accuracy	Bottles must be verified before they are used. Notify Lab Director if there is a failure.
Sealer Check	Once per month	No leakage	Notify Lab Director if there is a failure.
Quantitrays	Each new lot of trays received, or manufacturers certificate.	Negative/Negative	Notify Lab Director if there is a failure.

17. POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1 See SOP "Waste Management Procedure"

18. REFERENCES

- 18.1 "Standard Methods for the Examination of Water and Wastewater", 21st Edition, 2004 Method SM 9223B
- 18.2 Colilert Test Kit Instructions from IDEXX Laboratories
- 18.3 Colisure Test Kit Instructions from IDEXX Laboratories

STANDARD OPERATING PROCEDURE

PROCEDURE TITLE: Inorganic Anions, IC, EPA Method 300.0 Rev. 2.1

Approvals and Signatures

Laboratory Director:

Renee Cusack Date: 8/10/2020

QA Manager:

[Signature] Date: 8/10/2020

Section Supervisor

Renee Cusack Date: 8/10/2020

Periodic Review:

Signature	Title	Date
_____	_____	_____
_____	_____	_____
_____	_____	_____

Revision No.	Date	Responsible Person	Description of Change
7	10/18/14	M Pistole	-Added Revision History Table-Added requirement that OPO4 for waste water to be filtered within 15 minutes of sampling and note that if sample are not they are to be reported with an NCM stating such
8	01/25/17	R Cusack M Pistole	-Added Periodic Review Section-5.0: updated reference section-6.0: Removed reference to Bromate, Chlorate, and Chlorite. Added holding time for Nitrate for chlorinated drinking water samples -9.1.8.1 and 9.2: updated-9.3.1 and 9.3.2: updated calibration-10.0: updated QC chart
9	7/13/2020	ddms J.Rossi R.Pastorello R. Cusack	Updated Sections 9 and 10 updates for consistency and conformance to 2016 TNI standard

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1. SCOPE AND APPLICATION

1.1 This method is applicable to the determination of sulfate, bromide, nitrite, ortho-phosphate, fluoride, chloride, and nitrate in drinking water, surface water, and mixed domestic and industrial wastewater.

2. SUMMARY OF METHOD

2.1 A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor, and conductivity meter.

3. DEVIATIONS FROM METHOD

3.1 No Modifications are made to the method.

4. DEFINITIONS

4.1 Refer to SOP Laboratory Definitions "SOP-LABDEF".

5. INTERFERENCES

5.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. Large amounts of an anion can interfere with the peak resolution of an adjacent anion. Sample dilution and/or fortification can be used to solve most interference problems associated with retention times.


5.2 The water dip or negative peak that elutes near, and can interfere with, the fluoride peak can usually be eliminated by the addition of the equivalent of 1mL of concentrated eluent (7.3 100X) to 100 mL of each standard and sample.

5.3 Method interferences may be caused by contaminants in the reagent water, reagents, glassware, and other sample processing apparatus that lead to discrete artifacts or elevated baseline in ion chromatograms.

5.4 Samples that contain particles larger than 0.45 μ and reagent solutions that contain particles larger than 0.20 μ require filtration to prevent damage to instrument columns and flow systems.

5.5 Any anion that is not retained by the column or only slightly retained will elute in the area of fluoride and interfere. Known coelution is caused by carbonated and other small organic anions. At concentrations of fluoride above 1.5 mg/L, this interference may not be

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significant, however, it is the responsibility of the user to generate precision and accuracy information in each sample matrix.

5.6 The acetate anion elutes early during the chromatographic run. The retention times of the anions also seem to differ when large amounts of acetate are present. Therefore, this method is not recommended for leachates of solid samples when acetic acid is used for pH adjustment.

5.7 The quantitation of unretained peaks should be avoided, such as low molecular weight organic acids (formate, acetate, propionate etc.) which are conductive and coelute with or near fluoride and would bias the fluoride quantitation in some drinking and most waste waters.

5.8 Any residual chlorine dioxide present in the sample will result in the formation of additional chlorite prior to analysis. If any concentration of chlorine dioxide is suspected in the sample purge the sample with an inert gas (argon or nitrogen) for about five minutes or until no chlorine dioxide remains.

5.9 Substances with retention times similar to and overlap those of an anion of interest. Because many anions interfere, use an ion-exchange column to remove interferences.

6. SAFETY

6.1 Refer to SOP "Frequently Used Chemical Hazards/Inorganic Department".

6.2 Specific Safety Concerns or Requirements

6.2.1 Exercise caution when using syringes with attached filter assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

7. EQUIPMENT AND SUPPLIES


7.1 Balance - Analytical, capable of accurately weighing to the nearest 0.0001 g.

7.2 Dionex 1100 Ion chromatograph with Data System

7.3 Anion guard column: Dionex AG14A or equivalent.

7.4 Anion separator column:

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7.4.1 Anion analytical column: Dionex AS14A column (P/N 056904). An optional column may be used if comparable resolution of peaks is obtained.

7.5 Detector -- Conductivity cell: Approximately 1.25 µL internal volume, (Dionex, or equivalent) capable of providing data as required.

7.6 Volumetric pipettes and flasks

8. REAGENTS AND STANDARDS

8.1. Sulfate Stock Solution: Purchased from High Purity or equivalent, concentration=1000mg/L

8.2. Nitrate Stock Solution: Purchased from High Purity or equivalent, concentration=100mg/L

8.3 Bromide Stock Solution: Purchased from High Purity or equivalent, concentration=100mg/L

8.4 Chloride Stock Solution: Purchased from High Purity or equivalent, concentration=1000mg/L

8.5 Fluoride Stock Solution: Purchased from High Purity or equivalent, concentration=100mg/L

8.6 Nitrite Stock Solution: Purchased from High Purity or equivalent, concentration=100mg/L

8.7 Ortho-Phosphate Solution: Phosphorus solution purchased from High Purity or equivalent, concentration=100mg/L

8.8 Anion Eluent: For AS14A Column:

8.8.1 Sodium carbonate (Na_2CO_3) 8 mM and Sodium bicarbonate (NaHCO_3) 1.0 mM.

8.8.1.1 10x concentrate: Dissolve 2.7767g sodium bicarbonate (NaHCO_3) and 31.4258g sodium carbonate (Na_2CO_3) in distilled water and dilute to 3.5 liters.

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8.8.1.2 Working solution: Dilute 350mL concentrated Eluent to 3.5L with DI water.

9. SAMPLE COLLECTION < PRESERVATION AND HOLD TIME

9.1 Samples can be collected in plastic or glass. Sample preservation and holding times for the anions that can be determined by this method are as follows:

<u>Analyte</u>	<u>Preservation</u>	<u>Holding Time</u>
Bromide	None required	28 days
Chloride	None required	28 days
Fluoride	None required	28 days
Nitrate-N	Cool, 4°C	48 hours
Nitrate-N*	Cool, 4°C	14 days

*Chlorinated Samples Only

<u>Analyte</u>	<u>Preservation</u>	<u>Holding Time</u>
Nitrite-N	Cool, 4°C	48 hours
Ortho-Phosphate-P (DW)	Cool, 4°C	48 hours (Drinking Water)
Ortho-Phosphate-P (NPW)	**Filter within 15 minutes	
	Cool, 4°C	48 hours (Waste Water)
Sulfate	Cool, 4°C	28 days

****Note:** Samples for ortho-phosphate not filtered within 15 minutes of collection are to be reported with an NCM stating such.

10. QUALITY CONTROL

10.1 Method Blank - A method blank must be analyzed each day samples are analyzed and for every 20 samples of the same matrix, whichever is more frequent.

10.2 Laboratory Control Sample (LCS) – An LCS must be analyzed each day samples are analyzed and for every 20 samples of the same matrix, whichever is more frequent.

Matrix Spike and sample Duplicate (MS) – One MS and sample duplicate must be analyzed with each batch of samples of the same matrix, not to exceed 20 samples.

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11. INITIAL DEMONSTRATION OF CAPABILITY

11.1 Each analyst must complete an initial demonstration of capability prior to reporting any data using this method.

11.2 Initial demonstrations of capability will be performed using purchased quality control solutions such as with the LCS above. Four replicate samples are analyzed according to the procedure in Section 14.

11.3 The average recovery of the four samples must be within the criteria defined in Section 16.

12. LIMIT OF DETECTION

12.1 An MDL (or Limit of Detection – LOD) verification is calculated annually from points analyzed and collected quarterly for this method and kept on file. Refer to SOP-MDL for procedure.

12.2 The reporting limit is equivalent to the concentration of the lowest standard.

13. CALIBRATION AND STANDARDIZATION

13.1 Prepare calibration standards are indicated below. Nitrite is not added to the combined standards; a separate calibration is performed for Nitrite.

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Cal Standard #1

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	0.250 mL	50 mL	0.5 mg/L	Fluoride
1000 mg/L	0.075 mL	50 mL	1.5 mg/L	Chloride
100 mg/L	0.250 mL	50 mL	0.5 mg/L	Bromide
100 mg/L	0.125 mL	50 mL	0.25 mg/L	Nitrate
100 mg/L	0.125 mL	50 mL	0.25 mg/L	Ortho Phosphate
1000 mg/L	0.250 mL	50 mL	5.0 mg/L	Sulfate

Cal Standard #2

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	0.50 mL	50 mL	1.0 mg/L	Fluoride
1000 mg/L	0.175 mL	50 mL	3.5 mg/L	Chloride
100 mg/L	0.50 mL	50 mL	1.0 mg/L	Bromide
100 mg/L	0.375 mL	50 mL	0.75 mg/L	Nitrate
100 mg/L	0.50 mL	50 mL	1.0 mg/L	Ortho Phosphate
1000 mg/L	0.50 mL	50 mL	10.0 mg/L	Sulfate

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Cal Standard #3

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	1.0 mL	50 mL	2.0 mg/L	Fluoride
1000 mg/L	0.250 mL	50 mL	5.0 mg/L	Chloride
100 mg/L	0.750 mL	50 mL	1.5 mg/L	Bromide
100 mg/L	0.750 mL	50 mL	1.5 mg/L	Nitrate
100 mg/L	0.750 mL	50 mL	1.5 mg/L	Ortho Phosphate
1000 mg/L	0.750 mL	50 mL	15 mg/L	Sulfate

Cal Standard #4

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	1.5 mL	50 mL	3.0 mg/L	Fluoride
1000 mg/L	0.375 mL	50 mL	7.5 mg/L	Chloride
100 mg/L	1.25 mL	50 mL	2.5 mg/L	Bromide
100 mg/L	1.25 mL	50 mL	2.5 mg/L	Nitrate
100 mg/L	1.25 mL	50 mL	2.5 mg/L	Ortho Phosphate
1000 mg/L	1.25 mL	50 mL	25 mg/L	Sulfate

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Cal Standard #5

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	2.0 mL	50 mL	4.0 mg/L	Fluoride
1000 mg/L	0.40 mL	50 mL	8.0 mg/L	Chloride
100 mg/L	1.5 mL	50 mL	3.0 mg/L	Bromide
100 mg/L	1.5 mL	50 mL	3.0 mg/L	Nitrate
100 mg/L	1.5 mL	50 mL	3.0 mg/L	Ortho Phosphate
1000 mg/L	1.75 mL	50 mL	35 mg/L	Sulfate


Cal Standards Nitrite

Working Solution Concentration	Volume of Working Solution	Final Volume in Distilled Water	Final Standard Concentration	Parameter
100 mg/L	0.125 mL	50 mL	0.25 mg/L	Nitrite – Cal Std 1
100 mg/L	0.250 mL	50 mL	0.5 mg/L	Nitrite – Cal Std 2
100 mg/L	0.50 mL	50 mL	1.0 mg/L	Nitrite – Cal Std 3
100 mg/L	1.0 mL	50 mL	2.0 mg/L	Nitrite – Cal Std 4
100 mg/L	1.5 mL	50 mL	3.0 mg/L	Nitrite – Cal Std 5

13.2 Calibrate using a minimum of 5 points. Recalibrate whenever the linear response falls outside $\pm 10\%$.

13.3 A second source initial calibration verification (ICV) standard must be analyzed following an acceptable initial calibration. The recovery of each analyte must be within $\pm 10\%$.

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13.3 The calibration curve must be verified on each working day, or whenever the anion eluent is changed, and after every 20 samples, by analyzing a continuing calibration standard (at or near the midpoint of the calibration curve) and a blank immediately following, after every tenth sample and at the end of the sample run. If the response or retention time for any analyte varies from the expected values by more than $\pm 10\%$, the test must be repeated, using fresh calibration standards. If the results are still more than $\pm 10\%$, a new calibration curve must be prepared for that analyte.

13.4 For calibrations evaluated using correlation coefficient or coefficient of determination, the laboratory shall evaluate relative error by:

measurement of the Relative Error (%RE)

Relative error is calculated using the following equation:

$$\% \text{ Relative Error} = \frac{x'_i - x_i}{x_i} \times 100$$

x_i = True value for the calibration standard

x'_i = Measured concentration of the calibration standard

13.5 This calculation shall be performed for two (2) calibration levels: the standard at or near the mid-point of the initial calibration and the standard at the lowest level.

The Relative Error for the standard at or near the mid-point of the initial calibration must be $\leq 10\%$ and for the standard at the lowest level must be $\leq 30\%$

14. PROCEDURE

14.1 Load and inject a fixed amount of well mixed sample.

14.1.1 Flush injection loop thoroughly, using each new sample. Use the same size loop for standards and samples.

14.1.2 Record the resulting peak size in peak height units.

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14.1.3 The width of the retention time window used to make identifications should be based upon measurements of actual retention time variations of standards over the course of a day. Three times the standard deviation of a retention time can be used to calculate a suggested window size for each analyte. However, the experience of the analyst should weigh heavily in the interpretation of chromatograms.

14.1.4 If the response for the peak exceeds the working range of the system, dilute the 14.1.4 sample with an appropriate amount of reagent water and reanalyze.

Note: Retention time is inversely proportional to concentration. Nitrate and sulfate exhibit the greatest amount of change, although all anions are affected to some degree. In some cases this peak migration may produce poor resolution or identification.

15. DATA ANALYSIS AND CALCULATIONS

15.1 Data Analysis and Calculation

15.1.1 The data station calculates the concentration of the samples by comparing sample peak response to that of the standards.

15.1.2 Multiply answer by appropriate dilution factor.

15.1.3 Report only those values that fall between the lowest and the highest calibration standards.


15.1.4 Samples exceeding the highest standard should be diluted and reanalyzed.

15.1.5 Report results in mg/L.

16. METHOD PERFORMANCE, DATA REVIEW, AND ACCEPTANCE CRITERIA

QC ANALYSIS	FREQUENCY	QC LIMIT	CORRECTIVE ACTION
Initial Demonstration of Capability (IDOC): prepare and analyze 4 blank spikes at 1-4 times the reporting limit	For each new analyst before unsupervised analysis of samples	90-110%	Prepare and reanalyze new samples. If still out, see Lab Director
Continuing Demonstration of Capability	Annually	90-110%	Prepare and reanalyze new samples. If still out, see QA Manager.
Initial Calibration 5 points	As needed	% Difference <10% $R^2 \leq 0.995$	Halt analysis re-calibrate. If still out re-make standards and re-calibrate.
Continuing Calibration Blank (CCB)	One per every 10 samples and at end of sequence	< Detection Limit	Reanalyze, if still out, clean system and begin analysis over at last passing CCB.
Continuing Calibration (CCV)	One per every 10 samples.	90-110%	Reanalyze, if still out recalibrate and reanalyze all samples not bracketed by passing CCV, if CCV is high and samples are ND ok to report. NCM written
Duplicate	One per matrix, or per analytical batch, not to exceed 20 samples	< 20% RPD	Reanalyze, if precision criteria still not met determine if matrix or method is the cause.
Matrix Spike (MS)	One per analytical batch.	80-120%	If out and LCS is within control limits, assume matrix interference.
Laboratory Control Sample (LCS)	One per matrix or per analytical batch not to exceed 20 samples	90-110%	Re-analyze. If still out, halt analysis, re-calibrate and re-analyze associated samples.
MDL Study See 'SOP-MDL'.	See 'SOP-MDL'	See 'SOP-MDL'	See Laboratory Director

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17. POLLUTION PREVENTION AND WASTE MANAGEMENT

17.1 See SOP "Waste Management Procedure"

17.2 Waste Streams Produced by the Method

17.2.2 Alkaline and/or acidic waste generated by the analysis is collected and discarded down the acid-neutralizing sink

17.2.3 Contaminated plastic materials such as IC syringes, filters, caps and vials utilized for sample preparation are rinsed with water and discarded in the garbage.

18.0 REFERENCES

18.1 "Methods for Chemical Analysis of Water and Wastes" EPA-Method 300.0, Rev 2.1, August 1993.

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