

Appendix D

Data Validation and Usability Report

**USACE New England
Lower Merrimack River
Water Quality Monitoring**
Data Usability and Assessment Review
Laboratory Data

May 2017



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Attachment 1. Data Validation and Usability Report

Attachment 2. June 2014 and February 2015 Ammonia Field Blank Analysis

Acronyms

°C	degrees Centigrade
C/N	Carbon to Nitrogen Ratio
CBOD20	20-day Carbonaceous Biological Oxygen Demand
CBOD5	5-day Carbonaceous Biological Oxygen Demand
DIN	Dissolved Inorganic Nitrogen
DO	Dissolved Oxygen
DON	Dissolved Organic Nitrogen
DQI	data quality indicators
DQOs	data quality objectives
EAI	Eastern Analytical, Inc.
EPA	U.S. Environmental Protection Agency
LCS	laboratory control sample
MDL	method detection limit
mg/L	milligrams per liter
MS/MSDs	matrix spike/matrix spike duplicates
NC	not calculable
ND	nondetect
NOX	Nitrate and Nitrite
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PO4	Orthophosphate
POC	Particulate Organic Carbon
PON	Particulate Organic Nitrogen
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SOP	standard operating procedures
SQL	sample quantitation limit
SMAST	The School for Marine Science and Technology at University of Massachusetts Dartmouth
TDN	Total Dissolved Nitrogen
TKN	Total Kjeldhal Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
ug/L	micrograms per liter

Section 1

Introduction

1.1 Data Usability and Assessment Review

A field sampling program was developed as part of the Lower Merrimack River Study (Phase III of the Merrimack River Watershed Assessment Study). The primary objective of the field sampling program is to provide an accurate and representative picture of the current water quality conditions at specific sampling stations along the mainstem and key tributaries, with particular emphasis on nonpoint sources including major tributaries. Data collected under this task will be used to augment Phase I and Phase II data, to better understand nonpoint sources and how to manage them, and to refine existing water quality and hydrologic/hydraulic models. These models will serve as the basis for future planning and regulatory decisions in the basin.

The purpose of this assessment is to evaluate the data collected and determine whether they meet the quality objectives outlined in the Lower Merrimack River Quality Assurance Project Plan (QAPP), revised December 2014. This report details the quality assurance/quality control (QA/QC) activities conducted, describes the data verification, data validation and data usability review, and summarizes the review results for all Phase III sampling events.

Section 2

Usability Summary

Samples were collected and analyzed in accordance with the work plan except for some field changes enacted during the investigations. These changes and deviations did not negatively impact the usability of the data and are discussed in Section 2 of the Lower Merrimack River Study Monitoring Report. The sampling deviations did not affect project goals.

The data reported in this usability report is usable as reported with the data validation qualifiers added. No analytical sample results were rejected.

Section 3

Quality Assurance Objectives

QA objectives for measuring data are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). The QA objectives provide a mechanism for ongoing control and evaluating and measuring data quality throughout the project.

A review of the collected data is necessary in order to identify if data measurement objectives established in the seven-step data quality objective (DQO) process have been met. In general the following data measurement objectives were considered:

- Specification of particular analytical method and reporting detection limit requirements
- Identification of the appropriate laboratory analytical QC requirements
- Verify if appropriate levels of other PARCCS criteria for the data has been met
- Delineation of specific sample-handling issues or other project-specific issues

The data validation review of the QA objectives verifies if the collected data are of sufficient quality to support their intended use.

Section 4

Summary of Field and Laboratory QA Activities

CDM Smith performed sampling for one dry weather mainstem event in June 2014, one wet weather mainstem event in October 2015, one dry weather key tributary event in July 2016, and one hybrid dry/wet weather mainstem event in August 2016. Specific sampling details are presented in Section 2 of the Lower Merrimack River Study Monitoring Report.

CDM Smith completed all sampling activities in accordance with the approved QAPP. Samples were collected and shipped to University of Massachusetts University Laboratory, School for Marine Science and Technology at UMASS-Dartmouth (SMAST) and Eastern Analytical, Inc. (EAI) of Concord, New Hampshire. The QAPP and associated attachments defined the procedures to be followed and the data quality requirements for the field program.

4.1 Deviations from Field Procedures

Due to conditions encountered in the field, some deviations were made from the QAPP during the fieldwork portion of the sampling events. Specific deviations are discussed in Section 2 of the Lower Merrimack River Study Monitoring Report.

None of the deviations compromised the quality of the data.

4.2 Field and Analytical QA/QC

QC samples such as field blanks, equipment rinsate blanks and field duplicates were collected at the frequency described in the QAPP to determine the quality of the field data.

Field QA/QC objectives were accomplished through the use of appropriate sampling techniques and collection of field duplicates and rinsate blanks.

As detailed in Attachment 1, analytical QC data (such as calibrations, method blanks, spike recoveries, etc.) were not provided for independent verification for a majority of sample analyses. Method blanks were provided by EAI for non-bacterial analyses, and laboratory control samples (LCS) and LCS duplicates were provided for CBOD5, CBOD20 (select events only), and Total Suspended Solids (TSS). A laboratory duplicate was provided for the select chlorophyll-a results. Otherwise, the laboratory indicated if there were any quality issues with the data and those have been addressed in this report.

4.3 Laboratory Methods

Samples were analyzed using the following methods:

Parameter	Method Description
Alkalinity	SM 2320B- Titration (f)
Ammonia Nitrogen (NH ₄)	SM 4500 NH ₃ D- Phenate Method (b)
5-day Carbonaceous Biological Oxygen Demand (CBOD ₅)	SM5210B-01- incubation and DO measurement
20-day Carbonaceous Biological Oxygen Demand (CBOD ₂₀)	SM5210B-01- incubation and DO measurement
Chlorophyll-a	SM 10200H
C/N (Carbon to Nitrogen Ratio)	Ratio: Moles of POC/moles of PON
Conductivity	Field measurement with YSI
Dissolved Inorganic Nitrogen (DIN)	Sum of ammonia nitrogen and nitrate + nitrite
Dissolved Organic Nitrogen (DON)	SM 4500 NO ₃ F- Persulfate Digest & Automated Cadmium Reduction Method (a, c)
Dissolved Oxygen (DO)	Winkler DO- Potentiometric autotitrator; Field measurement with YSI
Enterococcus	ASTM D6503
Escherichia coli (E. Coli)	SM 9223B
Fecal Coliform	SM 9223B C18 QT
Field Dissolved Oxygen Percent	Field measurement with YSI
Nitrate + Nitrite (NO _x)	SM 4500 NO ₃ F- Automated Cadmium Reduction Method (a)
Orthophosphate (PO ₄)	SM 4500 PE- Ascorbic Acid Method (d)
Particulate Organic Carbon (POC)	Elemental analysis (e)
Particulate Organic Nitrogen (PON)	Elemental analysis (e)
pH	Field measurement with YSI
Salinity	Field measurement with YSI
Specific Conductivity	Field measurement with YSI
Temperature	Field measurement with YSI
Total Dissolved Nitrogen (TDN)	SM 4500 NO ₃ F- Persulfate Digest & Automated Cadmium Reduction Method (a, c)
Total Kjeldhal Nitrogen (TKN)	Sum of ammonium and total organic nitrogen
Total Nitrogen (TN)	Post-analytical calculation
Total Phosphorus (TP)	SM 4500 PE- Persulfate Method (a, c, d)
Total Suspended Solids (TSS)	SM 2540D-97
Turbidity	Field measurement with HACH kit

- a. QuikChem Method 10-107-04-1-J (0-700uM) and 31-107-04-1-C (0-50 and 0-10uM) Zellweger Analytics, Lachat Instruments Division, Milwaukee, WI USA.
Quik Chem method based upon the following techniques:

Method 4500-NO₃- F. Automated Cadmium Reduction Method, Standard Methods
 Wood, E., F. Armstrong and F. Richards. 1967. Determination of nitrate in sea water by cadmium copper reduction to nitrite. *J. Mar. Biol. Ass. U.K.* 47:23-31.
 Bendschneider, K. and R. Robinson. 1952. A new spectrophotometric method for the determination of nitrite in sea water. *J. Mar. Res.* 11: 87-96.

- b. Ammonia method based upon the following techniques:
 Scheiner, D. 1976. Determination of ammonia and Kjeldahl nitrogen by indophenol method. *Water Resources* 10: 31-36.
 Method 4500-NH₃ D. Phenate Method, Standard Methods.
- c. D'Elia, C.F., P.A. Stuedler and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. *Limnol. Oceanogr.* 22: 760-764.
- d. Murphy, J. and J.Riley. 1962. A modified single solution method for the determination of phosphate in natural waters. *Analytical Chimica Acta* 27:31-36.
 Method 4500-P E. Ascorbic Acid Method, Standard Methods.
- e. Perkin-Elmer Model 2400 CHN Elemental Analyzer Technical Manual.
- f. Method 2320 Alkalinity, Standard Methods
 Hach alkalinity Titration Kit, Digital Titrator Model 16900-01

It should be noted that there were minor variations in the analytical method used versus those listed in the QAPP, as follows:

- DON via SM 4500 NO₃ F, versus SM 4500 N-org as listed in the QAPP;
- Fecal coliform via SM 9223B C18 QT, versus SM9221 as listed in the QAPP;
- NO_x via SM 4500 NO₃ F, versus EPA 353.2 as listed in the QAPP;
- PO₄ via SM 4500 PE, versus EPA 300.1 as listed in the QAPP; and,
- POC and PON via elemental analysis, versus EPA 440.0 as listed in the QAPP.

Regardless, all the methods used for these sampling events met project objectives as specified in the QAPP.

Section 5

Data Review Procedures

Data review was conducted by qualified CDM Smith data validators. Where specific guidance was not available, the data was evaluated in a conservative manner consistent with industry standards using professional experience. To the extent possible the data were reviewed and data qualifiers were added in accordance with the following documents, as applicable for each method.

- U.S Environmental Protection Agency (EPA) National Functional Guidelines for Inorganic Superfund Data Validation, August 2014;
- EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update I, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; and
- Standard Methods for the Examination of Water and Wastewater, 21st Edition, American Public Health Association 2005.

The data review narratives indicate that the sample analyses generally met the QC criteria cited in the methods. Results associated with QC outliers were qualified by the data validators.

5.1 Qualifier Definitions

The following definitions provide explanations of the qualifiers assigned to results in the data review process.

- J Estimated data due to exceeded quality control criteria.
- U Analyte was analyzed for but not detected.
- UJ Nondetect result is estimated due to exceeded quality control criteria.
- R Data is rejected.
- ND Non-detect (used by the laboratories for this project)

Section 6

Data Quality Indicators

Data Quality Indicators (DQI) criteria were established to ensure precision, accuracy, representativeness, comparability, completeness, and sensitivity of analysis for the analytical fractions and for the media sampled. Analytical QC procedures are detailed in the most current revisions of SW-846 methodologies and laboratory specific criteria. Analytical precision, accuracy, and sensitivity DQIs required for this project are provided in the laboratory SOWs.

The DQIs provide a mechanism for ongoing control, to evaluate and measure data quality throughout the project. These criteria are defined in the sections below. Individual sample delivery group (SDGs) validation reports with specific sample detail are provided in Attachment 1.

6.1 Precision

Precision is a quantitative term that estimates the reproducibility of a set of replicate measurements under a given set of conditions. It is defined as a measurement of mutual agreement between measurements of the same property, and is expressed in terms of relative percent difference (RPD) between duplicate determinations.

RPD is calculated as follows:

$$\text{RPD} = \text{absolute value} \left[\frac{(C1-C2)}{\{(C1+C2)/2\}} \right] \times 100 \text{ percent}$$

Where: C1 = Concentration of split sample #1
C2 = Concentration of split sample #2

Laboratory analytical precision for the reported data is determined by review of the laboratory duplicate results. Field duplicate precision is determined by review of field duplicate results. As stated previously, laboratory analytical precision QC was not provided by the laboratories for Event #1-Dry Weather (June 2014); however one laboratory duplicate sample for chlorophyll-a was provided for Event #2- Wet Weather (October 2015) and Tributary Event #1 – Dry Weather (July 2016), and six laboratory duplicate samples, two for each CBOD, CBOD-5 and chlorophyll-a were provided for Event #3 – Dry/Wet Weather (August 2016). Four field duplicate samples were collected for Event #1-Dry Weather (June 2014) data set; five field duplicate samples were collected for the Event #2- Wet Weather (October 2015); five field duplicate samples were collected for the Event #3-Dry/Wet Weather (August 2016) ; and 3 field duplicate samples were collected for Tributary Event #1 – Dry Weather (July 2016)

Analytical precision cannot be determined if one of the reported values is less than the reporting limit (nondetect). Therefore when an analyte is not detected in both the parent and duplicate sample, the RPD result is reported as not calculable (NC). When one concentration is above and one below the reporting limit, the criteria used is that the detected result must be less than two times the reporting limit of the nondetect sample.

The field duplicate RPD criterion is 30 percent and the laboratory duplicate RPD criterion is 20 percent. Duplicate results for concentrations close to the detection limits are reviewed based on their absolute differences as compared to their respective quantitation limit values. When the analyte concentration is less than 5 times the reporting limit in either sample, the criteria used is the absolute difference between the two values which should be less than the reporting limit.

The field duplicate RPD results are as follows:

Mainstem Event #1 (Dry Weather)- June 2014 Data

One field duplicate pair analyzed for chlorophyll-a (M-024D-G-EVENT1/ DUP4-D-EVENT1) had an RPD above the 30 percent criteria at 135 percent. These chlorophyll-a results were qualified as estimated "J" for the duplicate sample and parent sample. Note, this qualification is based on the revised result for the parent sample due to pheophytin interferences.

Two field duplicate pairs analyzed for dissolved organic nitrogen (DON) (M004-G-EVENT1/ DUP1-D-EVENT1 and M010-G-EVENT 1/ DUP2-D-EVENT1) had RPDs above the 30 percent criteria at 34.0 percent AND 30.9 percent, respectively. These DON results were qualified as estimated "J" for the duplicate sample and parent sample.

One field duplicate pair analyzed for E. coli (M-024D-G-EVENT1/ DUP4-D-EVENT1) had an RPD above the 30 percent criteria at 44.6 percent. These E. coli results were qualified as estimated "J" for the duplicate sample and parent sample.

One field duplicate pair analyzed for orthophosphate (PO₄) (M010-G-EVENT 1/ DUP2-D-EVENT1) had an RPD above the 30 percent criteria at 37.7 percent. These PO₄ results were qualified as estimated "J" for the duplicate sample and parent sample.

Two field duplicate pairs analyzed for particulate organic nitrogen (PON) (M010-G-EVENT 1/ DUP2-D-EVENT1 and T010-G-EVENT 1/ DUP3-D-EVENT1) had RPDs above the 30 percent criteria at 49.8 percent AND 73.7 percent, respectively. These PON results were qualified as estimated "J" for the duplicate sample and parent sample.

Carbon to nitrogen (C/N) ratio was calculated by the laboratory for two field duplicate pairs (M010-G-EVENT1/ DUP2-D-EVENT1 and T010-G-EVENT 1/ DUP3-D-EVENT1), which had RPDs above the 30 percent criteria at 53.5 percent AND 72.3 percent, respectively. It should be noted that these data points are a ratio of POC to PON molar results rather than straight analytical results, and that PON results for these duplicate pairs were already qualified above. These C/N ratio results were qualified as estimated "J" for the duplicate sample and parent sample; however the qualification is considered conservative since PON results were already qualified.

One field duplicate pair analyzed for TSS (M-024D-G-EVENT1/ DUP4-D-EVENT1) had an RPD above the 30 percent criteria at 33.3. These TSS results were qualified as estimated "J" for the duplicate sample and parent sample.

All other RPD results were within criteria, and all results are considered usable. The attached data validation reports in Attachment 1 detail these results.

Mainstem Event #2 (Wet Weather)- October 2015 Data

One field duplicate pair analyzed for ammonia (M004D-G-EVENT2/M004-D-EVENT2) had an RPD above the 30 percent criteria at 32.6 percent. These ammonia results were qualified as estimated “J” for the duplicate sample and parent sample.

One field duplicate pair analyzed for TSS (M004D-G-EVENT2/M004-D-EVENT2) had an RPD above the 30 percent criteria at 31.6 percent. These TSS results were qualified as estimated “J” for the duplicate sample and parent sample.

Dissolved oxygen was measured in the field for all stations and analyzed for select samples by the laboratory via the Winkler method. An additional calculation was performed on the Winkler result to determine percent saturation. One field/laboratory duplicate pair analyzed for dissolved oxygen [M001-F-EVENT2 (Field)/M001-G-EVENT2 (Winkler)] had an RPD above the 30 percent criteria at 130.2 percent and 130.3 percent, respectively for concentration and saturation. While it is suspected that the Winkler result may be an outlier based on the low concentration reported as compared to results at nearby sampling stations, dissolved oxygen results were qualified as estimated “J” for both the field and laboratory samples as a conservative measure.

All other RPD results were within criteria, and all results are considered usable. The attached data validation reports in Attachment 1 detail these results.

Mainstem Event #3 (Dry/Wet Weather)- August 2016 Data

One field duplicate pair analyzed for ammonia (O002D-G-EVENT3/DUP2-D-EVENT3) had an RPD above the 30 percent criteria at 46.41 percent. These ammonia results were qualified as estimated “J” for the duplicate sample and parent sample.

One field duplicate pair analyzed for particulate organic carbon (T010-G-EVENT3/DUP3-D-EVENT3) had an RPD above the 30 percent criteria at 58.59 percent. These particulate organic carbon results were qualified as estimated “J” for the duplicate sample and parent sample.

Two field duplicate pairs analyzed for particulate organic nitrogen (T010-G-EVENT3/DUP3-D-EVENT3 and M016D-C-EVENT3/DUP5-D-EVENT3) had RPDs above the 30 percent criteria at 38.91 percent and 36.15 percent, respectively. These particulate organic nitrogen results were qualified as estimated “J” for the duplicate samples and parent samples.

One field duplicate pair analyzed for fecal coliform (M024D-G-EVENT3/DUP4-D-EVENT3) had an RPD above the 30 percent criteria at 60.22 percent. These fecal coliform results were qualified as estimated “J” for the duplicate sample and parent sample.

Two field duplicate pairs analyzed for dissolved organic nitrogen (M024D-C-EVENT3/DUP4-D-EVENT3 and M016D-C-EVENT3/DUP5-D-EVENT3) had RPDs above the 30 percent criteria at 113.32 percent and 75.03 percent, respectively. These dissolved organic nitrogen results were qualified as estimated “J” for the duplicate samples and parent samples.

Two field duplicate pairs analyzed for total organic nitrogen (M024D-C-EVENT3/DUP4-D-EVENT3 and M016D-C-EVENT3/DUP5-D-EVENT3) had RPDs above the 30 percent criteria at 48.29 percent and

51.32 percent, respectively. These total organic nitrogen results were qualified as estimated “J” for the duplicate samples and parent samples.

One field duplicate pair analyzed for TSS (M016D-C-EVENT3/DUP5-D-EVENT3) had an RPD above the 30 percent criteria at 51.85 percent. These TSS results were qualified as estimated “J” for the duplicate sample and parent sample.

One field duplicate pair analyzed for CBOD5 (M016D-C-EVENT3/DUP5-D-EVENT3) had an RPD above the 30 percent criteria at 46.15 percent. These CBOD5 results were qualified as estimated “J” for the duplicate sample and parent sample.

One field duplicate pair analyzed for nitrates (M016D-C-EVENT3/DUP5-D-EVENT3) had an RPD above the 30 percent criteria at 40.98 percent. These nitrates results were qualified as estimated “J” for the duplicate sample and parent sample.

Dissolved oxygen was measured in the field for all stations and analyzed for select samples by the laboratory via the Winkler method. An additional calculation was performed on the Winkler result to determine percent saturation. During the August 2016 event, one team (Boat Team 1) collected Winkler samples at two samples on their stretch of the river, and both of these samples demonstrated variability when compared to the field readings. The field/laboratory duplicate pairs analyzed for dissolved oxygen [M001-F-EVENT3 (Field)/M001-G-EVENT3 (Winkler) and M004-F-EVENT3 (Field)/M001-G-EVENT3 (Winkler)] had an RPD above the 30 percent criteria at 34.6 percent/35.7 percent and 40.1 percent/ 40.7 percent, respectively for concentration and saturation. While all individual results are within acceptable ranges and some variability is expected, dissolved oxygen concentration and percent saturation results were qualified as estimated “J” for all field and laboratory samples collected by Boat 1 as a conservative measure (Stations M001, M002, M003, M004, M006D, O001U, O001D, O003U, and O003D).

All other RPD results were within criteria, and all results are considered usable. The attached data validation reports in Attachment 1 detail these results.

Tributary Event #1 (Dry Weather)- July 2016 Data

One field duplicate pair analyzed for chlorophyll-a (Shawsheen6-G-EVENT1/ DUP3-D-EVENT1) had an RPD above the 30 percent criteria at 108.4 percent. These CHLA results were qualified as estimated “J” for the duplicate sample and parent sample.

Two field duplicate pair analyzed for E. coli (Spicket5-G-EVENT1/ DUP5-D-EVENT1 and Shawsheen6-G-EVENT1/ DUP3-D-EVENT1) had an RPD above the 30 percent criteria at 80.9 percent AND 55.6 percent, respectively. These E. coli results were qualified as estimated “J” for the duplicate sample and parent sample.

Two field duplicate pair analyzed for Fecal Coliform (Spicket5-G-EVENT1/ DUP5-D-EVENT1 and Shawsheen6-G-EVENT1/ DUP3-D-EVENT1) had an RPD above the 30 percent criteria at 58.8 percent AND 117.6 percent, respectively. These Fecal Coliform results were qualified as estimated “J” for the duplicate sample and parent sample.

One field duplicate pair analyzed for CBOD-20 (Concord5D-C-EVENT1/ DUP1-D-EVENT1) had an RPD above the 30 percent criteria at 31.6 percent. These CBOD-20 results were qualified as estimated “J” for the duplicate sample and parent sample.

All other RPD results were within criteria, and all results are considered usable. The attached data validation reports in Attachment 1 detail these results.

Reporting Limits

It is important to note that reporting limits for all parameters during all events were very low (by most analytical laboratory standards) and all results were within the same order of magnitude. Very low reporting limits are needed to generate results that are useful for modeling. If many results are reported as “non-detect,” it is difficult to know if the models are representing the water quality within a reasonable range. As discussed with the laboratory, the differences in parent and duplicate samples are most likely due to an increased margin of error with concentrations that low and so close to the reporting limit. As a result, all results are considered acceptable and no rejection of data is required.

6.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted reference or true value, and is a measure of the bias in a system. Accuracy of the laboratory data was assessed by comparing LCS recovery, MS recovery, and other applicable laboratory QC. Accuracy is expressed as a percent recovery, which was calculated by:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The EAI laboratory reports 133001, 148530, 148531, 159240, 159241, 159348, and 158501 included LCS and LCS duplicate samples for TSS and CBOD5. Additionally, 148530, 148531, 159240, 159241, 159348, and 158501 included LCS and LCS duplicate samples for CBOD20. According to the QAPP, the percent recovery criteria range is between 80 and 100 percent, and the RPD between the LCS and LCSD results must be less than 20 percent. The acceptable percent recovery criteria established by the laboratory was slightly different. The LCS/LCSD percent recoveries and RPDs were within all applicable criteria.

Accuracy based on LCS/LCSD percent recoveries and RPDs could not be evaluated based on the analytical data received from EAI for other analyses including bacteria, CBOD20 (2014), and chlorophyll-a, or based on the analytical data from SMAST.

Accuracy of field measurements was assessed by comparing readings to the expected range for each parameter. With the exception of turbidity during Mainstem Event #1-Dry Weather (June 2014), all results were within acceptable ranges. Initial and final field turbidity readings from the June 2014 event were slightly below the acceptable range for select stations, with readings ranging from -1.90 NTU to -7.40 NTU. The negative results were rejected. The turbidity readings during Mainstem Event #2-Wet Weather (October 2015), Mainstem Event #3 Event- Dry/Wet Weather (August 2016), and Tributary Event #1 – Dry Weather (July 2016) were all within the acceptable range. While some field

readings during these events were slightly outside of the ranges typically observed, all results were within acceptable levels and no qualification was required.

Sample Preservation and Holding Times

Sample preservation, handling, and holding times are evaluated during the validation process. All holding times were met for the June 2014 Dry Weather Event #1 data set. All samples collected on the day of sampling were preserved on ice during sampling and transportation. This was confirmed by the sample conditions page in EAI report 133000, which stated that samples adhered to the lab's sample acceptance policy and were received on ice. There are 11 samples that were reported as being received between 10.2°C and 11°C. All of these samples were collected between 6:15 am and 8:30 am, and were in transit to the lab by 9:45 am. It is estimated that all of these samples were in laboratory custody within 2 to 4.5 hours after sample collection, and any temperature impacts during that brief time period would be minimal. It is suspected that the warmer temperatures measured at receipt may be a result of consolidation of sample bottles into fewer coolers to facilitate transportation and the time required for that cooler's temperature to fully acclimate. It should also be noted that EAI recommends that the acceptable temperature range is 0-6°C; however, 9223B C18 QT (Colilert-18/ Quanti Tray) indicates that temperatures less than 10°C for fecal coliform samples are acceptable. Though some temperatures were above the maximum recommended temperatures, the temperatures were not considered grossly outside of the guidance temperature range and samples were consistently preserved on ice, and therefore no qualifiers were applied.

During the October 2015 mainstem wet weather event, all samples except the Merrimac MA WWTP Effluent 1 CBOD5 and CBOD20 samples and reanalyzed M027-G-EVENT2 enterococcus sample were analyzed within their respective hold times. The Merrimac MA WWTP Effluent 1 sample was analyzed for CBOD and CBOD20 50 hours and 45 minutes after sampling, which is 2 hours and 45 minutes past the hold time of 48 hours. The M027-G-EVENT2 enterococcus sample was diluted and re-analyzed just outside the hold time of 8 hours (8 hours and 54 minutes after sample collection). These hold time exceedances have been evaluated to be insignificant, and since no samples were analyzed grossly outside their hold times, no qualifiers were applied.

All holding times and preservation requirements were met for the July 2016 Dry Weather Tributary Event #1 data set, as well as August 2016 Dry/Wet Weather Event #3 data set

6.3 Blank Contamination

As stated in the field sampling plan, rinsate blanks were to be prepared and submitted for analysis with primary samples. The field blanks and equipment rinsate blanks consisted of distilled water. Similarly, a laboratory blank is a water sample free of any known contaminants that is used to determine if any contamination occurred during the analytical process.

The field blank samples were prepared from distilled water. The individual sample bottles were filled at the sampling location with distilled water. The rinsate blank samples were prepared with distilled water that was passed over the decontaminated sampling equipment and transferred to the appropriate sample bottles.

Field, equipment, and laboratory blank results are summarized below:

Mainstem Event #1 (Dry Weather)- June 2014 Data

A select few field and equipment blanks had concentrations greater than sample results at respective river stations. No qualifiers were applied to sample results based on field blank results but the data user should note that some of the field blank samples had minor contamination. Of note were the ammonia concentrations in field blank samples. Field blank samples were prepared by multiple land and boat sampling crews at various sample stations by pouring distilled water directly into the sample bottle. The purpose of these field blanks is to assess potential contamination from field conditions during sampling or from the laboratory during the analytical process. It was observed that all ammonia field blanks had relatively comparable concentrations above the reporting limit, and in one suspect instance above its respective river station result. It is important to recognize that the laboratory was able to meet very low reporting limits, and thus able to report trace concentrations of ammonia in the blank samples.

In order to determine if the source of ammonia in these blanks was due to contamination from ambient conditions on the day of sampling, sample bottles, the distilled water itself, or the analytical process, additional field blank samples were analyzed by SMAST in February 2015. Three field blanks were prepared at CDM Smith's sample room using bottles from SMAST and one bottle from an additional laboratory. Distilled water was filtered and poured directly into sample bottles. Additionally, SMAST prepared a blank using their own high quality water source, and prepared a standard sample with a known concentration of ammonia. Results from this additional analysis indicated that field blank concentrations were slightly higher or on the same order of magnitude as concentrations observed during the June 2014 blanks. Although lower than results from CDM Smith's supplied blank samples, the laboratory also reported concentrations in their blank water source comparable to those observed during the June 2014 round. As a result, it is believed that the trace concentrations observed in the field blanks during the June 2014 event are not significant. The June 2014 concentrations are likely due to the sources of distilled water rather than ambient conditions, bottle source, deviations in the sampling plan, or laboratory contamination. Field blank audit results from June 2014 and February 2015 are included in Attachment 2.

As the field blank audit samples indicated that the source of ammonia in field blanks is due to the distilled water source, CDM Smith used professional judgment in qualifying associated results. Since distilled water was used for both the field blank and equipment rinsate blank samples, it was determined that the rinsate blank results are biased high and should be adjusted based on the ammonia field blank results for each respective team. As a result, all ammonia rinsate blank concentrations were below analytical results for the respective team, indicating that proper equipment decontamination was performed.

Since the data is being used to establish a general characterization of the water quality and is not intended as a regulatory determination of compliance, all data is considered usable despite the minor contamination in the blank samples. Laboratory blanks were nondetect for those parameters analyzed. Thus, for the purposes of the Lower Merrimack River Study, blank contamination does not violate the data quality objectives. Specific details of blank concentrations are presented in Attachment 1.

Mainstem Event #2 (Wet Weather)- October 2015 Data

A select few field and equipment blanks had concentrations greater than sample results at respective river stations. One field blank and two equipment rinsate blanks had results that exceeded the results of the samples collected by their corresponding land or boat sampling crews. In two of those three samples, ammonia was the analyte in question. As was the case with the June 2014 data, the source of ammonia in the field and equipment blanks is considered to be the distilled water rather than ambient conditions, deviations in the sampling plan, or laboratory contamination. Since the same distilled water was used for both the field blank and equipment rinsate blank samples, it was determined that the rinsate blank results are biased high and should be adjusted based on the ammonia field blank results for each respective team. As a result, all ammonia rinsate blank concentrations were below reporting limits and/or below concentrations for the respective team, indicating that proper equipment decontamination was performed. As such, no qualifiers were applied to sample results based on field or equipment blank results due to the assumed contamination of the source.

Since the data is being used to establish a general characterization of the water quality and is not intended as a regulatory determination of compliance, all data is considered usable despite the minor contamination in the blank samples. Laboratory blanks were nondetect for those parameters analyzed. Thus, for the purposes of the Lower Merrimack River Study, blank contamination does not violate the data quality objectives. Specific details of blank concentrations are presented in Attachment 1.

Mainstem Event #3 (Dry/Wet Weather)- August 2016 Data

A select few field and equipment blanks had concentrations greater than sample results at respective river stations. No qualifiers were applied to sample results based on field blank results but the data user should note that some of the field blank samples had minor contamination. Similar to 2014 and 2015 results, of note were the ammonia concentrations in field blank samples. Field blank samples were prepared by multiple land and boat sampling crews at various sample stations by pouring distilled water directly into the sample bottle. It is important to recognize that the laboratory was able to meet very low reporting limits, and thus able to report trace concentrations of ammonia in the blank samples. As a result, it is believed that the trace concentrations observed in the field blanks during the August 2016 event are not significant. The August 2016 concentrations are likely due to the sources of distilled water rather than ambient conditions, bottle source, deviations in the sampling plan, or laboratory contamination. Field blank audit results from June 2014 and February 2015 are included in Attachment 2.

Since distilled water was used for both the field blank and equipment rinsate blank samples, it was determined that the rinsate blank results are biased high and should be adjusted based on the ammonia field blank results for each respective team. As a result, most ammonia rinsate blank concentrations were at or below analytical results for the respective team with the exception of Land Team 1 samples, indicating that proper equipment decontamination was performed. While the Land Team 1 equipment rinsate blank was relatively higher than the others, this result and associated sample results are still considered low-level and over an order of magnitude below any regulatory thresholds, and no qualifiers were applied. Also, since the data is being used to establish a general

characterization of the water quality and is not intended as a regulatory determination of compliance, all data is considered usable despite the minor contamination in the blank samples. Laboratory blanks were nondetect for those parameters analyzed. Thus, for the purposes of the Lower Merrimack River Study, blank contamination does not violate the data quality objectives. Specific details of blank concentrations are presented in Attachment 1.

Tributary Event #1 (Dry Weather)- July 2016 Data

A select few field and equipment blanks had concentrations greater than sample results at respective river stations. Not including NH₄ results which are addressed below, three field blank results and three equipment rinsate blank results exceeded the results of the samples collected by their corresponding land or boat sampling crews.

As was the case with all other events, the source of ammonia in the field and equipment blanks is considered to be the distilled water rather than ambient conditions, deviations in the sampling plan, or laboratory contamination. Since the same distilled water was used for both the field blank and equipment rinsate blank samples, it was determined that the rinsate blank results are biased high and should be adjusted based on the ammonia field blank results for each respective team. As a result, most ammonia rinsate blank concentrations were at or below concentrations for the respective team, with the exception of Boat Team 1, indicating that proper equipment decontamination was performed. While the Boat Team 1 equipment rinsate blank was relatively higher than the others, this result and associated sample results are still considered low-level and over an order of magnitude below any regulatory thresholds, and no qualifiers were applied.

Since the data is being used to establish a general characterization of the water quality and is not intended as a regulatory determination of compliance, all data is considered usable despite the minor contamination in the blank samples. Laboratory blanks were nondetect for those parameters analyzed. Thus, for the purposes of the Lower Merrimack River Study, blank contamination does not violate the data quality objectives. Specific details of blank concentrations are presented in Attachment 1.

Section 7

Representativeness, Comparability, and Sensitivity

Representativeness and comparability are achieved by using approved, documented sampling procedures and analytical methodologies. By following the approved QAPP, sampling events should yield results representative of environmental conditions at the time of sampling. Similarly, reasonable comparability of analytical results for this, and future sampling events, can be achieved if the same approved analytical methods and sampling procedures are employed.

A review of reported sample result detection limits compared to the QAPP requirements ensures the collected data meets project objectives for sensitivity.

7.1 Representativeness

Representativeness is a qualitative term that expresses the degree to which the sample data accurately and precisely represent the environmental conditions corresponding to the location and depth interval of sample collection. Requirements and procedures for sample collection and analysis are designed to maximize sample representativeness.

Representativeness can be monitored by reviewing field documentation and/or by performing field audits. Chain of custodies and field notes were reviewed by the field team leader for the dry weather sampling event. The field team leader also performed audits of the sampling activities including checking paperwork and sampling methods.

Field sampling accuracy was attained through strict adherence to the approved final work plan and by using approved analytical methods for sample analyses. Based on this, the data should represent as near as possible the actual field conditions at the time of the sampling.

All analytical methods used by the laboratory were acceptable. It should be noted, however, that EAI inadvertently provided the incorrect analytical method for chlorophyll-a in laboratory reports 133001 and 148529. The method used consistently was Standard Method 10200H (2c)(1b), "Determination of chlorophyll-a ,b, and c (trichromatic method)", which is a type of spectrophotometric method. The laboratory reports were reissued with the correct method references.

In the original report for 133001, the laboratory indicated the chlorophyll-a results for six samples collected during the June 2014 event may have been biased high due to the presence of pheophytin, as detailed in Attachment 1. Pheophytin is a degradation product of chlorophyll-a. Therefore, the potentially high biased data may not have been entirely representative of chlorophyll-a conditions at those stations. Based on further discussion later in the Study, EAI determined it was appropriate to adjust the concentrations of these six results in 133001 (June 2014 event), plus 30 samples in 148529 (October 2015 event) and 2 samples in 159241 (August 2016 event) to account for pheophytin interferences. Adjustments were only possible in samples that could be acidified. Acidification to determine pheophytin interference is not a step in the 10200H (2c) method; however, EAI's internal SOP does state that samples that have absorbances between 0.1 and 1.0nm should be acidified and,

based on a calculated ratio, the report should be footnoted if interference is present. This step goes a little beyond what is required in section (2c) of the referenced Standard Method, and follows 10200 (H)(2b) which is the spectrophotometric determination of Chlorophyll-a in the presence of pheophytin. EAI indicated that they did not originally footnote it on several reports when there might have been an interference. They further indicated that while not required by the standard method, acidified data was available for select samples that had absorbances between 0.1 and 1.0nm that would allow calculation of chlorophyll-a minus any interference from pheophytin on these samples. Calculations for pheophytin interference cannot be done on samples that were not acidified. EAI reissued lab reports 133001, 148529, and 159241 with the adjusted chlorophyll-a results, ultimately resulting in an average decrease of approximately 45% (See Attachment 1). No qualifiers were applied by CDM Smith since these adjusted results are considered to be accurate and representative of chlorophyll-a concentrations in the river at those locations.

E.coli are an integral part of the Fecal coliform group, as are Klebsiella and other bacteria. There are many different strains of E.coli, and some are less tolerant to higher temperatures than others. Laboratories are limited by EPA's SOPs as to what temperatures and media may be used for analysis. As such, E.coli must be incubated at 35°C and Fecal Coliform at 44.5 °C. Both tests use the same method and media except for the incubation temperature. For multiple reports, the laboratory indicated that some E. coli species were less tolerant to the higher temperatures required by the Fecal Coliform test resulting in Fecal Coliform results less than E. coli results. When the E.coli is higher than the Fecal Coliform it means that at 35 °C E.coli was able to properly grow, but at 44.5°C it may have died off, leading to lower Fecal numbers. Since the laboratory did not qualify these results in the October 2015 and August 2016 rounds, no qualifiers will be applied to this data; however, it is important to note that some Fecal Coliform results may be biased low.

By using EPA or applicable approved sampling procedures, analytical methodologies, and written SOPs, as presented in the QAPP, these sampling events should yield results representative of environmental conditions at the time of sampling.

Deviations to the planned sampling activities were minimal and did not compromise the quality of the data to represent conditions within the project area. All analytical methods were acceptable. Therefore, the data collected are suitable for a representative characterization of the project area.

7.2 Comparability

Comparability is a qualitative term that expresses the confidence with which a data set can be compared with another. Strict adherence to standard sample collection procedures, analytical detection limits, and analytical methods assures that data are comparable. This comparability is independent of laboratory personnel, data reviewers, or sampling personnel. Comparability criteria are met for the project if, based on data review, the sample collection and analytical procedures are determined to have been followed, or defined to show that variations did not affect the values reported.

To ensure comparability of data generated for the site, standard sample collection procedures and approved analytical methods were utilized by CDM Smith. Sample analyses were performed by the subcontract laboratories using the equivalent methodology. Utilizing such procedures and methods

enables the current data to be comparable with the previous data sets generated with similar methods.

EAI noted that the analytical procedure for the enterococcus bacteria requires relatively low salinity levels to avoid interference. Two select samples exceeded that salinity level for the October 2015 mainstem wet weather event. When a sample's salinity is too high, the laboratory is required to dilute the sample to normalize the salinity. One such sample was analyzed undiluted, and the enterococcus result was qualified as estimated J, as presented in Attachment 1.

For the purposes of this data usability report, comparability has been met.

7.3 Sensitivity

Sensitivity is related to the ability to compare analytical results with project-specific levels of interest, such as delineation levels or action levels. Analytical quantitation limits for the various sample analytes should be below the level of interest to allow an effective comparison.

Detection Limits

Each analytical method used during the monitoring sampling was chosen because it has a reporting limit (RL) at or below the level of concern. For each analyte, the QAPP provided a RL that the laboratory was to achieve to provide analytical results at or below regulatory comparison criteria.

The RL is generally equal to or greater than the method detection limit (MDL). The RLs are set above MDLs to allow for sample matrix interferences and minimize false positives.

Development of the MDL is detailed in 40 CFR part 136 Appendix B as "the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero..." Generated by statistical analysis of multiple analyses of a low level standard, MDLs represent the best fundamental measurement of instrument sensitivity and the basis for establishing reporting limits.

Reporting limits are a compromise between analytical sensitivity and precision. Setting low RLs can lead to poorly defensible data due to false positive (Type I) and/or false negative (Type II) errors, whereas elevated RLs can hamper site characterization. Laboratory determinations of MDLs are performed on non-typical samples (e.g., distilled water) leading to idealized limits. Confidence in detection limits increases with instrument signal level above the MDL, and higher limits mean better precision.

Laboratory results are reported according to rules that provide established certainty of detection and reporting limits. The laboratory reported nondetect results as "false" or with a "<" sign indicating the result is less than the reporting limit. Qualifying the result as an estimated concentration reflects increased uncertainty in the reported value.

Detection limits were low enough to meet project objectives for all events.

7.4 Data Completeness

Completeness of the field program is defined as the percentage of samples planned for collection as listed in the QAPP versus the actual samples collected during the field program (see equation A).

Completeness for acceptable data is defined as the percentage of acceptable data obtained judged to be valid versus the total quantity of data generated (see equation B.) Acceptable data includes both data which passes all the QC criteria (unqualified data) and data that may not pass all of the QC criteria but had appropriate corrective actions taken (qualified but useable data).

$$A. \quad \% \text{ Field Completeness} = C \times \frac{100}{n}$$

Where: C = actual number of samples collected
n = total number of samples planned

$$B. \quad \% \text{ Analytical Completeness} = V \times \frac{100}{n'}$$

Where: V = number of measurements judged valid
n' = total number of measurements made

Completeness goals for both the number of samples collected in the field and for sample results that are usable for project decisions (not rejected and appropriately qualified if required) have been met for both the wet and dry weather sampling events.

Section 8

Assessment of Data Usability and Reconciliation with QAPP Goals

For all wet weather and/or dry weather sampling events on the mainstem and key tributaries, minimal qualifiers were applied due to field QC parameters. No qualifiers were applied to any data set due to laboratory QC parameters. Laboratory QC parameters were not provided by the laboratories for all parameters and hence were only able to be evaluated for select parameters. The field QC results were overall within criteria and based on professional judgment the data sets from all sampling events are usable for project decisions.

Section 9

References

CDM Smith Federal Programs. 2014. Merrimack River Watershed Assessment Study Phase III QAPP, December 2014.

U.S Environmental Protection Agency (EPA) National Functional Guidelines for Inorganic Superfund Data Validation, August 2014

SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996.

Standard Methods for the Examination of Water and Wastewater, 21st Edition, American Public Health Association. 2005.

Attachment 1

Data Validation and Usability Report

**Attachment 1
Lower Merrimack River Study
Data Validation Worksheet**

Sample Event: Event 1 (Dry Weather Event)
 Laboratory: School for Marine Science and Technology at UMASS-Darmouth (SMAS)- Report CDM 2014 Eastern Analytical Laboratory (EAI)- Reports 133000 & 133001R

Matrix:	Water	
Collection date:	6/25/2014	
Analysis/Methods:	C/N - Carbon to Nitrogen Ratio	NOX - Nitrates
	CBOD20 - 20 day Carbonaceous Biological Oxygen Demand	pH (Field reading)
	CBOD5 - 5 day Carbonaceous Biological Oxygen Demand	PO4 - Orthophosphates
	CHLA - Chlorophyll-a	POC - Particulate Organic Carbon
	COND - Conductivity (Field reading)	PON - Particulate Organic Nitrogen
	DIN - Dissolved Inorganic Nitrogen	Salinity (Field reading)
	D.O. - Dissolved Oxygen (Winkler)	Temperature (Field reading)
	D.O. CONC - Field Dissolved Oxygen	TDN - Total Dissolved Nitrogen
	D.O. PERC - Field Dissolved Oxygen Percent	TON - Total Organic Nitrogen
	DON - Dissolved Organic Nitrogen	TKN - Total Kjeldhal Nitrogen
	Ecoli	TN - Total Nitrogen
	Enterococci	TP - Total Phosphorus
	Fecal Coliform	TSS - Total Suspended Solids
	NH4 - Ammonium	Turbidity (Field reading)

Samples in SDG: See Attached Sample Result Tables for the following:
 Sampling Event 1 (Dry Weather Event)

Reference Documents Used in Data Validation:
 USEPA National Functional Guidelines for Inorganic Superfund Data Validation, August 2014; Quality Assurance Project Plan (QAPP), CDM Smith, May 2014.

Wet Chemistry Parameters

Precision:	Yes	No	N/A
Are the field duplicate relative percent differences (RPD) ≤ 30% for water or within CRQL criteria?		No	
Are the laboratory duplicate RPDs ≤ 20% for water or within CRQL criteria?		N/A	
Are the matrix spike duplicates RPD ≤ 20%?		N/A	

Comments (note deviations): All field duplicate RPD results were within criteria except for the analytes listed below. The sample results for the parent sample and the field duplicate sample were qualified as estimated J.

Field Duplicate Pairs	Analyte	RPD	Qualifier	Associated Samples
M010-G-EVENT1/ DUP2-D-EVENT1	C/N	53.5%	J	M010-G-EVENT1/ DUP2-D-EVENT1
T010-G-EVENT1/DUP3-D-EVENT1	C/N	72.3%	J	T010-G-EVENT1/DUP3-D-EVENT1
M024D-G-EVENT1/ DUP4-D-EVENT1	Chlorophyll-a	135.0%	J	M024D-G-EVENT1/ DUP4-D-EVENT1
M004-G-EVENT1/ DUP1-D-EVENT1	DON	34.0%	J	M004-G-EVENT1/ DUP1-D-EVENT1
M010-G-EVENT1/ DUP2-D-EVENT1	DON	30.9%	J	M010-G-EVENT1/ DUP2-D-EVENT1
M024D-G-EVENT1/ DUP4-D-EVENT1	E. Coli	44.6%	J	M024D-G-EVENT1/ DUP4-D-EVENT1
M010-G-EVENT1/ DUP2-D-EVENT1	PO4	37.7%	J	M010-G-EVENT1/ DUP2-D-EVENT1
M010-G-EVENT1/ DUP2-D-EVENT1	PON	49.8%	J	M010-G-EVENT1/ DUP2-D-EVENT1
T010-G-EVENT1/DUP3-D-EVENT1	PON	73.7%	J	T010-G-EVENT1/DUP3-D-EVENT1
M024D-C-EVENT1/ DUP4-D-EVENT1	TSS	33.3%	J	M024D-C-EVENT1/ DUP4-D-EVENT1

Accuracy:	Yes	No	N/A
Was matrix spike criteria met (frequency 20% and % recovery 75-125%)?		N/A	
Was post digestion spike criteria met (if applicable)?		N/A	
Was laboratory control sample criteria met?		Yes (Only provided for select parameters in EAI report 133001)	
Was field blanks and rinsate blank criteria met?		No	
Was laboratory blank criteria met (within control limits)?		Yes (Only provided for EAI report 133001)	
Were ICV/CCV % recoveries within 90-110%?		N/A	
Were field measurements within the acceptable ranges?		All except turbidity	

Comments (note deviations): Field blanks and field equipment blanks were collected. The majority of the blank concentrations are less than the sample concentrations. Blank results that are greater than some of the sample results are listed below. Initial and final field turbidity readings were slightly below the acceptable range for those stations listed on the next page, with readings ranging from -1.90 NTU to -7.40 NTU. The negative results were rejected.

Field Blank

<u>Analyte</u>	<u>Blank concentration or Range</u> (4 field blanks and 4 field equipment blanks were collected for each analyte)	<u>Sample Results</u>	Land 2: T010 Boat 1: M004 Boat 2: M010 Boat 4: M024D
DIN	1.62-54.3	All Teams	All sample results greater than 54.3
DON	41.4-169.6	All Teams	All sample results greater than 169.6
NH4*	1.27	Land 2	All sample results greater than 1.27 ug/L.
	54 ug/L	Boat 1	8 sample results on Boat 1 less than 54 ug/L, including M004.
	31.5 ug/L	Boat 2	M010 greater than 31.5 ug/L. 3 other samples on Boat 2 less than 31.5 ug/L.
	4.69 ug/L	Boat 4	All sample results on Boat 4 greater than 4.69 ug/L.
POC	17.1-45.2	All Teams	All sample results greater than 45.2
PON	0.66-8.82	All Teams	All sample results greater than 8.82
TDN	43.1-223.9	All Teams	All sample results greater than 223.9
TN	43.7-225.1	All Teams	All sample results greater than 225.1
TON	42.1-170.8	All Teams	All sample results greater than 170.8
TP	2.21-2.57	All Teams	All sample results greater than 2.57
TSS	ND	Land 2	All Land 2 sample results greater than field blank.
	ND	Boat 1	All Boat 1 sample results greater than field blank.
	ND	Boat 2	All Boat 2 sample results greater than field blank.
	1 mg/L	Boat 4	All Boat 4 sample results greater than 1 mg/L.

*An audit performed for ammonia field blank samples indicated the source of these trace ammonia concentrations was the distilled water used for sampling.

Equipment Rinsate Blanks

<u>Analyte</u>	<u>Blank detection concentration or Range</u> (4 field blanks and 4 field equipment blanks were collected for each analyte)	<u>Sample Results</u>	Land 2: T010 Boat 1: M004 Boat 2: M010 Boat 4: M024D
CBOD5	ND	Land 2	All sample results ND.
	ND	Boat 1	All sample results ND.
	ND	Boat 2	All sample results ND.
	3 mg/L	Boat 4	Sample M024D=3.0 mg/L. 3 other samples on Boat 4 ≤3.0 mg/L.
CBOD20	6 mg/L	Boat 4	Sample M024D=6.0 mg/L. 2 other samples on Boat 4 ≤6.0 mg/L.
DIN	7.09-22.1	All Teams	All sample results greater than respective rinsate blank.
DON	97.3-119.3	All Teams	All sample results greater than respective rinsate blank.
NH4	6.15 ug/L	Land 2	All Land 1 sample results greater than 6.15 ug/L.
	20.8 ug/L	Boat 1	All Boat 1 sample results greater than 20.8 ug/L.
	17.4 ug/L	Boat 2	Sample M010 greater than 17.4 ug/L. 1 other sample on Boat 2 less than 17.4 mg/L.
	21.8 ug/L	Boat 4	Sample M024D greater than 21.8 ug/L. 2 other samples on Boat 4 less than 21.8 ug/L.
NH4 (adjusted for field blank detections)	4.88 ug/L	Land 2	All Land 1 sample results greater than adjusted rinsate blank result (4.88 ug/L).
	ND	Boat 1	All Boat 1 sample results greater than adjusted rinsate blank result.
	ND	Boat 2	All Boat 2 sample results greater than adjusted rinsate blank result.
	17.11 ug/L	Boat 4	All Boat 4 sample results greater than adjusted rinsate blank result (17.11 ug/L).
NOX	0.939-2.55	All Teams	All sample results greater than respective rinsate blank.
PO4	3.87 ug/L	Land 2	Sample T010 greater than 3.87 ug/L. 2 other samples on Land 1 less than 3.87 ug/L.
	1.55 ug/L	Boat 1	All sample results ND or greater than 1.55 ug/L.
	ND	Boat 2	All sample results greater than rinsate blank.
	1.55 ug/L	Boat 4	All sample results greater than 1.55 ug/L.
POC	22.7-66.5	All Teams	All sample results greater than respective rinsate blank.
PON	1.32-20.5	All Teams	All sample results greater than respective rinsate blank.
TDN	108.9-139.2	All Teams	All sample results greater than respective rinsate blank.
TON	103.1-122.8	All Teams	All sample results greater than respective rinsate blank.
TN	110.2-142.7	All Teams	All sample results greater than respective rinsate blank.
TP	3.91-11.4	All Teams	All sample results greater than respective rinsate blank.

The field blank samples were prepared from distilled water. The individual sample bottles were filled at the sampling location with distilled water. The rinsate blank samples were prepared with distilled water that was passed over the decontaminated sampling equipment and transferred to the appropriate sample bottles.

No qualifiers were applied to the samples based on field blank and rinsate blank contamination but the data user should note that blank samples had some minor contamination. Ammonia rinsate blanks were adjusted based on the field blank concentrations as the source was determined to be the distilled water. Sample concentrations that were less than the blank concentrations have been highlighted.

Sensitivity:

Is a verification report present for method detection limits, interelement correction factors and linear ranges?

Are MDLs present and reported?

Do the reporting limits meet project requirements?

Are results above the linear range of the instrument?

Comments (note deviations): None.

Yes No N/A**No****Yes (in lab QA manuals)****Yes**

Data Validator:

Sue Gryzkiewicz

Date: 12/1/2014; Rev 5/17/2017

Data Reviewer:

Jamie Lefkowitz

Date: 1/14/2015

**Attachment 1
Lower Merrimack River Study
Data Validation Worksheet**

Sample Event: Event 2 (Wet Weather Event)
 Laboratory: School for Marine Science and Technology at UMASS-Darmouth (SMASST)- Report CDM 2015
Eastern Analytical Laboratory (EAI)- Reports 148529R, 148530, & 148531

Matrix:	<u>Water</u>	
Collection date:	<u>10/1/2015</u>	
Analysis/Methods:	C/N - Carbon to Nitrogen Ratio	NOX - Nitrates
	CBOD20 - 20 day Carbonaceous Biological Oxygen Demand	pH (Field reading)
	CBOD5 - 5 day Carbonaceous Biological Oxygen Demand	PO4 - Orthophosphates
	CHLA - Chlorophyll-a	POC - Particulate Organic Carbon
	COND - Conductivity (Field reading)	PON - Particulate Organic Nitrogen
	DIN - Dissolved Inorganic Nitrogen	Salinity (Field reading)
	D.O. - Dissolved Oxygen (Winkler)	Temperature (Field reading)
	D.O. CONC - Field Dissolved Oxygen	TDN - Total Dissolved Nitrogen
	D.O. PERC - Field Dissolved Oxygen Percent	TON - Total Organic Nitrogen
	DON - Dissolved Organic Nitrogen	TKN - Total Kjeldhal Nitrogen
	E. coli	TN - Total Nitrogen
	Enterococci	TP - Total Phosphorus
	Fecal Coliform	TSS - Total Suspended Solids
	NH4 - Ammonium	Turbidity (Field reading)

Samples in SDG: See Attached Sample Result Tables for the following:
 Sampling Event 2 (Wet Weather Event)

Reference Documents Used in Data Validation:
 USEPA National Functional Guidelines for Inorganic Superfund Data Validation , August 2014; Quality Assurance Project Plan (QAPP), CDM Smith, May 2014.

Wet Chemistry Parameters

Precision:	Yes	No	N/A
Are the field duplicate relative percent differences (RPD) ≤ 30% for water or within CRQL criteria?		No	
Are the laboratory duplicate RPDs ≤ 20% for water or within CRQL criteria?		Yes (Only provided for chlorophyll a in EAI report 148529R)	
Are the matrix spike duplicates RPD ≤ 20%?		N/A	
<u>Comments (note deviations):</u> All field duplicate RPD results were within criteria except for the analytes listed below. The sample results for the parent sample and the field duplicate sample were qualified as estimated J.			

Field Duplicate Pairs	Analyte	RPD	Qualifier	Associated Samples
M004-G-EVENT2/M004-D-EVENT2	NH ₄	32.6%	J	M004-G-EVENT2/M004-D-EVENT2
M004-G-EVENT2/M004-D-EVENT2	TSS	31.6%	J	M004-G-EVENT2/M004-D-EVENT2
M001-F-EVENT2 (Field)/M001-G-EVENT2 (Winkler)	DO (mg/L)	130.2%	J	M001-F-EVENT2 (Field)/M001-G-EVENT2 (Winkler)
M001-F-EVENT2 (Field)/M001-G-EVENT2 (Winkler- calculated)	DO (%)	130.3%	J	M001-F-EVENT2 (Field)/M001-G-EVENT2 (Winkler-calculated)

Accuracy:	Yes	No	N/A
Was matrix spike criteria met (frequency 20% and % recovery 75-125%)?		N/A	
Was post digestion spike criteria met (if applicable)?		N/A	
Was laboratory control sample criteria met?		Yes (Only provided for select parameters in EAI reports 148530, and 148531)	
Were field blanks and rinsate blank criteria met?		No	
Was laboratory blank criteria met (within control limits)?		Yes (Only provided for select parameters in EAI reports 148529R, 148530, and 148531)	
Were ICV/CCV % recoveries within 90-110%?		N/A	
Were field measurements within the acceptable ranges?		Yes	
<u>Comments (note deviations):</u> Field blanks and field equipment blanks were collected. The majority of the blank concentrations are less than the sample concentrations. Blank results that are greater than some of the sample results are highlighted below.			

Field Blank

<u>Analyte</u>	<u>Blank concentration or Range</u> (5 field blanks and 5 field equipment blanks were collected for each analyte listed, except for CHLA which had 4)	<u>Sample Results</u>	Land 1: O002D Land 2: T010 Boat 1: M004 Boat 3: M016D Boat 4: M024D
CHLA	ND-0.7 ug/L	All Teams	All sample results greater than 0.7 ug/L.
DIN	27.04 ug/L	Land 1	All Land 1 sample results greater than 27.04 ug/L.
	34.17 ug/L	Land 2	All Land 2 sample results greater than 34.17 ug/L.
	25.28 ug/L	Boat 1	All Boat 1 sample results greater than 25.28 ug/L.
	32.66 ug/L	Boat 3	All Boat 3 sample results greater than 32.66 ug/L.
	36.37 ug/L	Boat 4	All Boat 4 sample results greater than 36.37 ug/L.
DON	22.68-66.55 ug/L	All Teams	All sample results greater than 66.55 ug/L.
NH4*	18.82 ug/L	Land 1	Samples T002-G and T007-G <18.82 ug/L. All other Land 1 results > 18.82 ug/L.
	27.71 ug/L	Land 2	All Land 2 sample results greater than 27.71 ug/L.
	22.63 ug/L	Boat 1	All Boat 1 sample results greater than 22.63 ug/L.
	30.25 ug/L	Boat 3	All Boat 3 sample results greater than 30.25 ug/L.
	32.79 ug/L	Boat 4	All Boat 4 sample results greater than 32.79 ug/L.
NOX	2.40-8.22 ug/L	All Teams	All sample results greater than 8.22 ug/L.
PO4	ND (<3.1 ug/L)	All Teams	All sample results nondetect or greater than 3.1 ug/L.
POC	34.11-48.30 ug/L	All Teams	All sample results greater than 48.30 ug/L.
PON	ND (<9.80 ug/L)	All Teams	All sample results greater than 9.80 ug/L.
TDN	0.05-0.09 mg/L	All Teams	All sample results greater than 0.09 mg/L.
TKN	0.05-0.09 mg/L	All Teams	All sample results greater than 0.09 mg/L.
TN	0.06-0.09 ug/L	All Teams	All sample results greater than 0.09 mg/L.
TON	25.15-69.06 ug/L	All Teams	All sample results greater than 69.06 ug/L.
TP	4.11-6.17 ug/L	All Teams	All sample results greater than 6.11 ug/L.

*An audit performed for Event 1 ammonia field blank samples indicated the source of these trace ammonia concentrations was the distilled water used for sampling.

Equipment Rinsate Blanks

<u>Analyte</u>	<u>Blank detection concentration or Range</u> (5 field blanks and 5 field equipment blanks were collected for each analyte listed, except for CHLA which had 4)	<u>Sample Results</u>	Land 1: O002D Land 2: T010 Boat 1: M004 Boat 3: M016D Boat 4: M024D
CHLA	ND-0.7 ug/L	All Teams	All sample results greater than 0.7 ug/L.
DIN	17.37 ug/L	Land 1	All Land 1 sample results greater than 17.37 ug/L.
	16.89 ug/L	Land 2	All Land 2 sample results greater than 16.89 ug/L.
	31.18 ug/L	Boat 1	All Boat 1 sample results greater than 31.18 ug/L.
	44.34 ug/L	Boat 3	All Boat 3 sample results greater than 44.34 ug/L.
	50.07 ug/L	Boat 4	All Boat 4 sample results greater than 50.07 ug/L.
DON	161.32 ug/L	Land 1	Sample O002U-G <161.32 ug/L. All other Land 1 results greater than 161.32 ug/L.
	34.38 ug/L	Land 2	All Land 2 sample results greater than 34.38 ug/L.
	87.29 ug/L	Boat 1	All Boat 1 sample results greater than 87.29 ug/L.
	45.03 ug/L	Boat 3	All Boat 3 sample results greater than 45.03 ug/L.
	110.59 ug/L	Boat 4	All Boat 4 sample results greater than 110.59 ug/L.
NH4	16.28 ug/L	Land 1	Sample T002-G and T007-G <16.28 ug/L. All other Land 1 results were > 16.28 ug/L.
	15.01 ug/L	Land 2	All Land 2 sample results greater than 15.01 ug/L.
	28.98 ug/L	Boat 1	All Boat 1 sample results greater than 28.98 ug/L.
	35.33 ug/L	Boat 3	All Boat 3 sample results greater than 35.33 ug/L.
	43.59 ug/L	Boat 4	All Boat 4 sample results greater than 43.59 ug/L.
NH4 (adjusted for field blank detections)	ND	Land 1	All Land 1 sample results greater than adjusted rinsate blank result.
	ND	Land 2	All Land 2 sample results greater than adjusted rinsate blank result.
	6.35 ug/L	Boat 1	All Boat 1 sample results greater than adjusted rinsate blank result (6.35 ug/L).
	5.08 ug/L	Boat 3	All Boat 3 sample results greater than adjusted rinsate blank result (5.08 ug/L).
	10.80 ug/L	Boat 4	All Boat 4 sample results greater than adjusted rinsate blank result (10.80 ug/L).
NOX	1.09-9.0 ug/L	All Teams	All sample results greater than 9.0 ug/L.
PO4	ND (<3.1 ug/L)	All Teams	All sample results nondetect or greater than 3.1 ug/L.
POC	31.06-125.64 ug/L	All Teams	All sample results greater than 125.64 ug/L.
PON	ND (<9.80 ug/L)	All Teams	All sample results greater than 9.80 ug/L.
TDN	0.05-0.18 mg/L	All Teams	All sample results greater than 0.18 mg/L.
TKN	0.05-0.18 mg/L	All Teams	All sample results greater than 0.18 mg/L.
TN	0.05-0.18 mg/L	All Teams	All sample results greater than 0.18 mg/L.
TON	36.57-161.81 ug/L	All Teams	All sample results greater than 161.81 ug/L.
TP	ND-6.17 ug/L	All Teams	All sample results greater than 6.17 ug/L.

The field blank samples were prepared from distilled water. The individual sample bottles were filled at the sampling location with distilled water. The rinsate blank samples were prepared with distilled water that was passed over the decontaminated sampling equipment and transferred to the appropriate sample bottles.

No qualifiers were applied to the samples based on field blank and rinsate blank contamination but the data user should note that blank samples had some minor contamination. Ammonia rinsate blanks were adjusted based on the field blank concentrations as the source was determined to be the distilled water. Sample concentrations that were less than the blank concentrations have been highlighted.

Representativeness:

Were sampling procedures and design criteria met?

Were holding times met?

Was preservation criteria met? (4° C ± 2° C)?

Were Chain-of-Custody records complete and provided in data package?

Yes	No	N/A
Yes		
Yes		
Yes		
Yes (EAI); No (SMAST)		

Comments (note deviations): Although some samples were received at EAI slightly below 2°C or above 6°C, the laboratory indicated that the samples adhered to the sample acceptance policy. No samples were grossly outside of the guidance temperature range, and therefore no qualifiers were applied. All samples except the Merrimac MA WWTP Effluent 1 CBOD5 and CBOD₂₀ samples and reanalyzed M027-G-EVENT2 enterococcus sample were analyzed within their respective hold times. The Merrimac MA WWTP Effluent 1 sample was analyzed for CBOD and CBOD₂₀ 50 hours and 45 minutes after sampling; 2 hours and 45 minutes past the hold time of 48 hours. The M027-G-EVENT2 enterococcus sample was diluted and re-analyzed just outside the hold time of 8 hours (8 hours and 54 minutes after sample collection). These hold time exceedances have been evaluated to be insignificant, and since no samples were analyzed grossly outside their hold times, no qualifiers were applied. Although all analytical procedures were followed and no qualifiers were applied, it should be noted that some E. coli species were less tolerant to the higher temperatures required by the Fecal Coliform test resulting in Fecal Coliform < E. coli results.

Select chlorophyll-a results (30 total) were adjusted by the lab to account for pheophytin interferences, as detailed below.

Adjusted Chlorophyll-a Results

<u>Sampling Station</u>	<u>Original (ug/L)</u>	<u>Revised (ug/L)</u>	<u>Reduction (ug/L)</u>	<u>Reduction (%)</u>
DUP4-D (M024D-C)	32	22	10	31%
M015-G	21	6.8	14.2	68%
M017-G	18	9.4	8.6	48%
M018-G	18	10	8	44%
M019-G	26	14	12	46%
M020-G	22	12	10	45%
M021D-C	22	10	12	55%
M021U-G	30	15	15	50%
M022-G	26	16	10	38%
M023D-G	31	17	14	45%
M023U-G	33	17	16	48%
M024D-C	34	25	9	26%
M024U-G	30	18	12	40%
M025D-C	33	21	12	36%
M025U-G	36	22	14	39%
M026D-C	34	21	13	38%
M026U-G	32	20	12	38%
M028D-C	31	18	13	42%
M028U-G	35	25	10	29%
M029D-C	22	13	9	41%
M029U-G	26	14	12	46%
M030-G	25	15	10	40%
O007D-G	16	10	6	38%
O009D-G	29	14	15	52%
O009U-G	31	15	16	52%
O010D-G	34	22	12	35%
O010U-G	36	19	17	47%
T002-G	15	11	4	27%
T008-G	28	18	10	36%
T011-G	32	23	9	28%

Comparability:

Were analytical procedures and methods follows as defined in the QAPP or field change documentation?

Comments (note deviations): The analysis for the enterococcus bacteria requires a level of salinity that was exceeded in samples M027-G-EVENT2 and M029D-G-EVENT2. The M027-G-EVENT2 sample was diluted and re-analyzed. EAI considers the diluted M027-G-EVENT2 sample to be most representative and as such, the results have been accepted. The M029D-G-EVENT2 sample was analyzed without dilution, and as a result the enterococcus result may be biased high and was qualified as estimated J.

Yes No N/A

No - See Comments

Associated Sample

M029D-G-EVENT2

Analyte

Enterococcus

Qualifier

J

Completeness (90%):

Are all data in this SDG usable?

Comments (note deviations): None.

Yes No N/A

Yes

Sensitivity:

Is a verification report present for method detection limits, interelement correction factors and linear ranges?

Are MDLs present and reported?

Do the reporting limits meet project requirements?

Are results above the linear range of the instrument?

Comments (note deviations): None.

Yes No N/A

No

Yes (in lab QA manuals)

Yes

Yes

Data Validator:

Patrick Donohue

Date: 2/17/2016

Data Reviewer:

Sue Gryskiewicz

Date: 3/28/2016; Rev 5/17/17

**Attachment 1
Lower Merrimack River Study
Data Validation Worksheet**

Sample Event: Event 3 (Hybrid Dry/Wet Weather Event)
 Laboratory: School for Marine Science and Technology at UMASS-Darmouth (SMAS)- Report CDM 2016
Eastern Analytical Laboratory (EAL)- Reports 159240, 159241, & 159348

Matrix:	<u>Water</u>	
Collection date:	<u>8/10/2016</u>	
Analysis/Methods:	C/N - Carbon to Nitrogen Ratio	NOX - Nitrates
	CBOD20 - 20 day Carbonaceous Biological Oxygen Demand	pH (Field reading)
	CBOD5 - 5 day Carbonaceous Biological Oxygen Demand	PO4 - Orthophosphates
	CHLA - Chlorophyll-a	POC - Particulate Organic Carbon
	COND - Conductivity (Field reading)	PON - Particulate Organic Nitrogen
	DIN - Dissolved Inorganic Nitrogen	Salinity (Field reading)
	D.O. - Dissolved Oxygen (Winkler)	Temperature (Field reading)
	D.O. CONC - Field Dissolved Oxygen	TDN -Total Dissolved Nitrogen
	D.O. PERC - Field Dissolved Oxygen Percent	TON - Total Organic Nitrogen
	DON - Dissolved Organic Nitrogen	TKN -Total Kjeldhal Nitrogen (Calculated)
	E. coli	TN - Total Nitrogen
	Enterococci	TP - Total Phosphorus
	Fecal Coliform	TSS - Total Suspended Solids
	NH4 - Ammonium	Turbidity (Field reading)

Samples in SDG: See Attached Sample Result Tables for the following:
 Mainstem Sampling Event 3 (Hybrid Dry/Wet Weather Event)

Reference Documents Used in Data Validation:
 USEPA National Functional Guidelines for Inorganic Superfund Data Validation , August 2014; Quality Assurance Project Plan (QAPP), CDM Smith, May 2014.

Wet Chemistry Parameters

Precision:	Yes	No	N/A
Are the field duplicate relative percent differences (RPD) ≤ 30% for water or within CRQL criteria?		No	
Are the laboratory duplicate RPDs ≤ 20% for water or within CRQL criteria?		Yes (Only provided for CBOD, CBOD-20 and chlorophyll-a in EAL reports 159240 and 159241)	
Are the matrix spike duplicates RPD ≤ 20%?			N/A

Comments (note deviations): All field duplicate RPD results were within criteria except for the analytes listed below. The sample results for the parent sample and the field duplicate sample were qualified as estimated J. As a conservative measure based on the variability observed in samples M001 and M004 shown below, the DO concentration and percent saturation results were qualified as estimated "J" for all field and laboratory samples collected by Boat 1 (Stations M001, M002, M003, M004, M006D, O001U, O001D, O003U, and O003D).

Field Duplicate Pairs	Analyte	RPD	Qualifier	Associated Samples
O002D-G-EVENT3/DUP2-D-EVENT3	NH ₄	46.41%	J	O002D-G-EVENT3/DUP2-D-EVENT3
T010-G-EVENT3/DUP3-D-EVENT3	POC	58.59%	J	T010-G-EVENT3/DUP3-D-EVENT3
T010-G-EVENT3/DUP3-D-EVENT3	PON	38.91%	J	T010-G-EVENT3/DUP3-D-EVENT3
M024D-G-EVENT3/DUP4-D-EVENT3	FECCOL	60.22%	J	M024D-G-EVENT3/DUP4-D-EVENT3
M024D-C-EVENT3/DUP4-D-EVENT3	DON	113.32%	J	M024D-C-EVENT3/DUP4-D-EVENT3
M024D-C-EVENT3/DUP4-D-EVENT3	TON	48.29%	J	M024D-C-EVENT3/DUP4-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	TSS	51.85%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	CBOD5	46.15%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	DON	75.03%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	NOX	40.98%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	PON	36.15%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M016D-C-EVENT3/DUP5-D-EVENT3	TON	51.32%	J	M016D-C-EVENT3/DUP5-D-EVENT3
M001-F-EVENT3 (Field)/M001-G-EVENT3 (Winkler)	DO (mg/L)	130.2%	J	M001-F-EVENT3 (Field)/M001-G-EVENT3 (Winkler)
M001-F-EVENT3 (Field)/M001-G-EVENT3 (Winkler- calculated)	DO (%)	130.3%	J	M001-F-EVENT3(Field)/M001-G-EVENT3 (Winkler-calculated)
M004-F-EVENT3 (Field)/M004-G-EVENT3 (Winkler)	DO (mg/L)	130.2%	J	M004-F-EVENT3 (Field)/M004-G-EVENT3 (Winkler)
M004-F-EVENT3 (Field)/M004-G-EVENT3 (Winkler- calculated)	DO (%)	130.3%	J	M004-F-EVENT3 (Field)/M004-G-EVENT3 (Winkler-calculated)

Accuracy:

Was matrix spike criteria met (frequency 20% and % recovery 75-125%)?

Yes No N/A
Yes (Only provided for select parameters in EAI report 133001)

Was post digestion spike criteria met (if applicable)?

N/A

Was laboratory control sample criteria met?

Yes (Only provided for select parameters in EAI reports 159240, 159241, and 159348)

Were field blanks and rinsate blank criteria met?

No

Was laboratory blank criteria met (within control limits)?

Yes (Only provided for select parameters in EAI reports 59240, 159241, and 159348)

Were ICV/CCV % recoveries within 90-110%?

N/A

Were field measurements within the acceptable ranges?

Yes

Comments (note deviations): Field blanks and equipment rinsate blanks were collected. The majority of the blank concentrations are less than the sample concentrations. Blank results that are greater than some of the sample results are highlighted below.

Field Blank

<u>Analyte</u>	<u>Blank concentration or Range</u> (5 field blanks and 5 field equipment blanks were collected for each analyte listed, except for bacteria, CHLA and CBOD20)	<u>Sample Results</u>	Land 1: O002D Land 2: T010 Boat 1: M004 Boat 3: M016D Boat 4: M024D
CHLA	ND (0.5 ug/L)	All Teams	All sample results nondetect or greater than 0.5 ug/L.
CBOD	ND (<3 mg/L)	All Teams	All sample results nondetect or greater than 3 mg/L.
CBOD-20	ND (<3 mg/L)	All Teams	All sample results nondetect or greater than 3 mg/L.
Ecoli	1 MPN/100ml	Boat 1, Land 1, Land 2 Boat 4	Sample M001-G = 1 MPN/100mL. All other results greater than 1 MPN/100mL.
FECCOL	10 MPN/100ml 1 MPN/100ml	Boat 1, Land 1, Land 2 Boat 4	Sample M002-G = 1 MPN/100mL. All other results greater than 1 MPN/100m.
DIN	35.86 ug/L 33.50 ug/L 34.68 ug/L 14.79 ug/L	Boat 1 Boat 3 Boat 4 Land 1	All Boat 1 sample results greater than 35.86 ug/L. All Boat 3 sample results greater than 33.50 ug/L. All Boat 4 sample results greater than 34.68 ug/L. All Land 1 sample results greater than 14.79 ug/L.
DON	66.28 ug/L 50.21 ug/L 46.03 ug/L 63.16 ug/L 42.08 ug/L 84.71 ug/L	Land 2 Boat 1 Boat 3 Boat 4 Land 1 Land 2	Sample T012-G < 66.28 ug/L. All other Land 2 results greater than 66.28 ug/L. All sample results greater than 50.21 ug/L. All sample results greater than 46.03 ug/L. Samples M023D-G and M024D-C < 63.16 ug/L. All other Boat 4 results > 63.16 ug/L. All sample results greater than 42.08 ug/L. All sample results greater than 84.71 ug/L.
NH4*	34.27 ug/L 31.70 ug/L 29.78 ug/L 13.73 ug/L	Boat 1 Boat 3 Boat 4 Land 1	Samples M001-G, M002-G, M003-G, M004-G/D, O001D-G and O001U-G < 34.27 ug/L. All other Boat 1 results > 34.27 ug/L. Samples M011-G, M012-G, M013-G, M018-G, O005D-G and O005U-G < 31.70 ug/L. All other Boat 3 results > 31.70 ug/L. All Boat 4 sample results greater than 29.78 ug/L. All Land 1 sample results greater than 13.73 ug/L.
NOX	34.27 ug/L 1.59 ug/L 1.79 ug/L 4.90 ug/L 1.05 ug/L	Land 2 Boat 1 Boat 3 Boat 4 Land 1	Samples M014-G, O006D-G, O006U-G, and T012-G < 34.27 ug/L. All other Land 2 results > 34.27 ug/L. All sample results greater than 1.59 ug/L. All sample results greater than 1.79 ug/L. All sample results greater than 4.90 ug/L. All sample results greater than 1.05 ug/L.
PO4	32.02 ug/L ND (<3.1 ug/L) ND (<3.1 ug/L) ND (<3.1 ug/L) 3.22 ug/L	Land 2 Boat 1 Boat 3 Boat 4 Land 1 Land 2	Sample T012-G < 32.02 ug/L. All other Land 2 Results greater than 32.02 ug/L. All other Boat 1 results nondetect or greater than 3.1 ug/L. All Boat 3 results greater than 3.1 ug/L. All Boat 4 results greater than 3.1 ug/L. All other Land 1 results nondetect or greater than 3.1 ug/L. All Land 2 sample results greater than 3.22 ug/L.
POC	27.44-177.64 ug/L	All Teams	All sample results greater than respective field blanks.
PON	ND (<9.8 ug/L)	All Teams	All sample results greater than 9.8 ug/L.
TDN	0.06-0.15 mg/L	All Teams	All sample results greater than respective field blanks.
TKN	0.059-0.12 mg/L	All Teams	All sample results greater than respective field blanks.
TN	0.06-0.15 mg/L	All Teams	All sample results greater than respective field blanks.
TON	44.96-87.11 ug/L	All Teams	All sample results greater than respective field blanks.
TP	ND-7.68 ug/L	All Teams	All sample results greater than respective field blanks.

*An audit performed for Event 1 ammonia field blank samples indicated the source of these trace ammonia concentrations was the distilled water used for sampling.

Equipment Rinsate Blanks

<u>Analyte</u>	<u>Blank detection concentration or Range</u> (5 field blanks and 5 field equipment blanks were collected for each analyte listed, except for bacteria, CHLA, and CBOD20)	<u>Sample Results</u>	Land 1: O002D Land 2: T010 Boat 1: M004 Boat 3: M016D Boat 4: M024D
CHLA	ND (0.5 ug/L)	All Teams	All sample results nondetect or greater than 0.5 ug/L.
CBOD	ND (<3 mg/L)	All Teams	All sample results nondetect or greater than 3 mg/L.
CBOD-20	ND (<3 mg/L)	All Teams	All sample results nondetect or greater than 3 mg/L.
Ecoli	1 MPN/100ml	Boat 1	Sample M001-G = 1 MPN/100m. All other Boat 1 results greater than 1 MPN/100m.
	10 MPN/100ml	Boat 4	All Boat 4 sample results greater than 10 MPN/100m
	1 MPN/100ml	Land 1	All Land 1 sample results greater than 1 MPN/100m
	13.1 MPN/100ml	Land 2	All Land 2 sample results greater than 13.1 MPN/100m
FECCOL	1 MPN/100ml	Boat 1	Sample M002-G = 1 MPN/100m. All other results greater than 1 MPN/100m.
	10 MPN/100ml	Boat 4	All Boat 4 sample results greater than 10 MPN/100m
	1 MPN/100ml	Land 1	All Land 1 sample results greater than 1 MPN/100m
	32.3 MPN/100ml	Land 2	Samples M014-G, O006D-G and O006U-G < 32.3 MPN/100ml. All other Land 2 results are greater than 32.3 MPN/100ml.
DIN	38.21 ug/L	Boat 1	All Boat 1 sample results greater than 38.21 ug/L.
	37.20 ug/L	Boat 3	All Boat 3 sample results greater than 37.20 ug/L.
	43.62 ug/L	Boat 4	All Boat 4 sample results greater than 43.62 ug/L.
	108.43 ug/L	Land 1	All Land 1 sample results greater than 108.43 ug/L.
	37.78 ug/L	Land 2	Sample T012-G < 37.78 ug/L. All other Land 2 results greater than 37.78 ug/L.
DON	134.57 ug/L	Boat 1	All Boat 1 sample results greater than 134.57 ug/L.
	104.64 ug/L	Boat 3	All Boat 3 sample results greater than 104.64 ug/L.
	95.17 ug/L	Boat 4	Samples M023D-G and M024D-C < 95.17 ug/L. All other Boat 4 results > 95.17 ug/L.
	87.45 ug/L	Land 1	All Land 1 sample results greater than 87.45 ug/L.
	44.80 ug/L	Land 2	All Land 2 sample results greater than 44.80 ug/L.
NH4	36.83 ug/L	Boat 1	Samples M001-G, M002-G, M003-G, M004-G/D, O001D-G and O001U-G < 36.83 ug/L. All other Boat 1 results > 36.83 ug/L.
	32.98 ug/L	Boat 3	Samples M011-G, M012-G, M013-G, M018-G, O005D-G and O005U-G < 32.98 ug/L. All other Boat 3 results > 32.98 ug/L.
	34.27 ug/L	Boat 4	All Boat 4 sample results greater than 34.27 ug/L.
	105.16 ug/L	Land 1	Samples M005U-G, M006U-G, O002D-G/D, O002U-G, O004D-G, T001-G, T006-G, T007-G and T008-G < 105.16 ug/L. All other Land 1 results > 105.16 ug/L.
	32.34 ug/L	Land 2	Samples M014-G, O006D-G, O006U-G, and T012-G < 32.34 ug/L. All other Land 2 results > 32.34 ug/L.
NH4 (adjusted for field blank detections)	2.56 ug/L	Boat 1	All Boat 1 sample results greater than adjusted rinsate blank result (2.56 ug/L).
	1.28 ug/L	Boat 3	Sample O005D-G < 1.28 ug/L. All other Boat 3 sample results > adjusted rinsate blank result (1.28 ug/L).
	4.49 ug/L	Boat 4	All Boat 4 sample results greater than adjusted rinsate blank result (4.49 ug/L).
	91.43 ug/L	Land 1	Samples M005U-G, M006U-G, O002D-G/D, O002U-G, O004D-G, T001-G, T006-G, T007-G < 91.43 ug/L. All other Land 1 results > adjusted rinsate blank result (91.43 ug/L).
	ND	Land 2	All Land 2 sample results greater than adjusted rinsate blank result (ND).
NOX	1.38-9.36 ug/L	All Teams	All sample results greater than 9.36 ug/L.
PO4	ND (<3.1 ug/L)	Boat 1	All other Boat 1 results nondetect or greater than 3.1 ug/L.
	ND (<3.1 ug/L)	Boat 3	All Boat 3 results greater than 3.1 ug/L.
	ND (<3.1 ug/L)	Boat 4	All Boat 4 results greater than 3.1 ug/L.
	ND (<3.1 ug/L)	Land 1	All other Land 1 results nondetect or greater than 3.1 ug/L.
	ND (<3.1 ug/L)	Land 2	All Land 2 sample results greater than 3.1 ug/L.
POC	50.56-256.81 ug/L	All Teams	All sample results greater than 256.81 ug/L.
PON	ND- 10.73 ug/L	All Teams	All sample results greater than 10.73 ug/L.
TDN	0.08-0.20 mg/L	All Teams	All sample results greater than their respective equipment blank.
TKN	0.08-0.20 mg/L	All Teams	All sample results greater than their respective equipment blank.
TN	0.09-0.20 mg/L	All Teams	All sample results greater than their respective equipment blank.
TON	47.90-140.0 ug/L	All Teams	All sample results greater than their respective equipment blank.
TP	3.84-9.6 ug/L	All Teams	All sample results greater than their respective equipment blank.

The field blank samples were prepared from distilled water. The individual sample bottles were filled at the sampling location with distilled water. The rinsate blank samples were prepared with distilled water that was passed over the decontaminated sampling equipment and transferred to the appropriate sample bottles.

No qualifiers were applied to the samples based on field blank and rinsate blank contamination but the data user should note that blank samples had some minor contamination. Ammonia rinsate blanks were adjusted based on the field blank concentrations as the source was determined to be the distilled water. Sample concentrations that were less than the blank concentrations have been highlighted.

Representativeness:

Were sampling procedures and design criteria met?

Were holding times met?

Was preservation criteria met? (4 C ± 2 C)?

Were Chain-of-Custody records complete and provided in data package?

Comments (note deviations): The laboratory indicated that all samples adhered to the sample acceptance policy. All samples were analyzed within their respective hold times. Although all analytical procedures were followed and no qualifiers were applied, it should be noted that some E. coli species were less tolerant to the higher temperatures required by the Fecal Coliform test resulting in Fecal Coliform < E. coli results.

Yes No N/A
 Yes
 Yes
 Yes
 Yes (EAI); No (SMAST)

Two chlorophyll-a results were adjusted by the lab to account for pheophytin interferences, as detailed below.

Adjusted Chlorophyll-a Results

<u>Sampling Station</u>	<u>Original (ug/L)</u>	<u>Revised (ug/L)</u>	<u>Reduction (ug/L)</u>	<u>Reduction (%)</u>
M028U-G	49	16	33	67%
T012-G	120	90	30	25%

Comparability:

Were analytical procedures and methods follows as defined in the QAPP or field change documentation?

Comments (note deviations): None

Yes No N/A
 Yes

Completeness (90%):

Are all data in this SDG usable?

Comments (note deviations): None.

Yes No N/A
 Yes

Sensitivity:

Is a verification report present for method detection limits, interelement correction factors and linear ranges?

Are MDLs present and reported?

Do the reporting limits meet project requirements?

Are results above the linear range of the instrument?

Comments (note deviations): None.

Yes No N/A
 No
 Yes (in lab QA manuals)
 Yes
 Yes

Data Validator:

Parnian BaniahmadDate: 12/23/2016

Data Reviewer:

Sue GryszkiewiczDate: 1/17/2017; Rev 5/17/17

**Attachment 1
Lower Merrimack River Study
Data Validation Worksheet**

Sample Event: Tributary Event 1 (Dry Weather Tributary Event)
 Laboratory: School for Marine Science and Technology at UMASS-Darmouth (SMAS)- Report CDM 2016
 Eastern Analytical Laboratory (EAI)- Reports 158500 & 158501

Matrix:	<u>Water</u>	
Collection date:	<u>7/21/2016</u>	
Analysis/Methods:	C/N - Carbon to Nitrogen Ratio	NOX - Nitrates
	CBOD20 - 20 day Carbonaceous Biological Oxygen Demand	pH (Field reading)
	CBOD5 - 5 day Carbonaceous Biological Oxygen Demand	PO4 - Orthophosphates
	CHLA - Chlorophyll-a	POC - Particulate Organic Carbon
	COND - Conductivity (Field reading)	PON - Particulate Organic Nitrogen
	DIN - Dissolved Inorganic Nitrogen	Salinity (Field reading)
	D.O. - Dissolved Oxygen (Winkler)	Temperature (Field reading)
	D.O. CONC - Field Dissolved Oxygen	TDN -Total Dissolved Nitrogen
	D.O. PERC - Field Dissolved Oxygen Percent	TON - Total Organic Nitrogen
	DON - Dissolved Organic Nitrogen	TKN -Total Kjeldhal Nitrogen (Calculated)
	E. coli	TN - Total Nitrogen
	Enterococci	TP - Total Phosphorus
	Fecal Coliform	TSS - Total Suspended Solids
	NH4 - Ammonium	Turbidity (Field reading)

Samples in SDG: See Attached Sample Result Tables for the following:
 Tributary Sampling Event 1 (Dry Weather Event)

Reference Documents Used in Data Validation:
 USEPA National Functional Guidelines for Inorganic Superfund Data Validation , August 2014; Quality Assurance Project Plan (QAPP), CDM Smith, May 2014.

Wet Chemistry Parameters

	Yes	No	N/A
Precision:			
Are the field duplicate relative percent differences (RPD) ≤ 30% for water or within CRQL criteria?		No	
Are the laboratory duplicate RPDs ≤ 20% for water or within CRQL criteria?		Yes (Only provided for chlorophyll a in EAI report 158500)	
Are the matrix spike duplicates RPD ≤ 20%?		N/A	

Comments (note deviations): All field duplicate RPD results were within criteria except for the analytes listed below. The sample results for the parent sample and the field duplicate sample were qualified as estimated J.

<u>Field Duplicate Pairs</u>	<u>Analyte</u>	<u>RPD</u>	<u>Qualifier</u>	<u>Associated Samples</u>
Spicket5-G-EVENT1/Dup5-D-EVENT1	E. coli	80.9%	J	Spicket5-G-EVENT1/Dup5-D-EVENT1
Spicket5-G-EVENT1/Dup5-D-EVENT1	Fecal Coliform	58.8%	J	Spicket5-G-EVENT1/Dup5-D-EVENT1
Shawsheen6-G-EVENT1/Dup3-D-EVENT1	E. coli	55.6%	J	Shawsheen6-G-EVENT1/Dup3-D-EVENT1
Shawsheen6-G-EVENT1/Dup3-D-EVENT1	Fecal Coliform	117.5%	J	Shawsheen6-G-EVENT1/Dup3-D-EVENT1
Shawsheen6-G-EVENT1/Dup3-D-EVENT1	CHLA	108.4%	J	Shawsheen6-G-EVENT1/Dup3-D-EVENT1
Concord5D-C-EVENT1/Dup1-D-EVENT1	CBOD-20	31.6%	J	Concord5D-C-EVENT1/Dup1-D-EVENT1

	Yes	No	N/A
Accuracy:			
Was matrix spike criteria met (frequency 20% and % recovery 75-125%)?			N/A
Was post digestion spike criteria met (if applicable)?			N/A
Was laboratory control sample criteria met?		Yes (Only provided for select parameters in EAI reports 158501)	
Were field blanks and rinsate blank criteria met?		No	
Was laboratory blank criteria met (within control limits)?		Yes (Only provided for select parameters in EAI reports 158500 and 158501)	
Were ICV/CCV % recoveries within 90-110%?			N/A
Were field measurements within the acceptable ranges?			Yes (Only provided for select parameters in EAI report 133001)

Comments (note deviations): Field blanks and field equipment blanks were collected. The majority of the blank concentrations are less than the sample concentrations. Blank results that are greater than some of the sample results are highlighted below.

Field Blank

<u>Analyte</u>	<u>Blank concentration or Range</u> (3 field blanks and 3 field equipment blanks were collected for each analyte listed)		<u>Sample Results</u>	Boat 1: Concord5 Land 1: N/A Land 2: Shawsheen6 Land 3: Spicket5
CBOD	ND (<3 mg/L)	All Teams	All sample results greater than 3 mg/L.	
CBOD-20	7 mg/L	Boat 1	All Boat 1 results greater than 7 mg/L.	
	6 mg/L	Land 2	All Land 2 results greater than 6 mg/L.	
	7 mg/L	Land 3	Sample Spicket5-G < 7mg/L. All other Land 3 results were equal to 7mg/L.	
CHLA	ND (0.5 mg/m ³)	All Teams	All sample results greater than 0.5 mg/m ³	
E. coli	ND (<1 MPN/100mL)	All Teams	All sample results greater than 1 MPN/100mL	
Fecal Coliform	ND (<1 MPN/100mL)	All Teams	All sample results ND or greater than 1 MPN/100mL	
TSS	ND (<1 mg/L)	All Teams	All sample results ND or greater than 1 mg/L.	
DIN	38.7 ug/L	Boat 1	Sample Concord2-G < 38.7 ug/L. All other Boat 1 results were greater than 38.7 ug/L.	
	35.3 ug/L	Land 2	All Land 2 sample results greater than 35.3 ug/L.	
	40.3 ug/L	Land 3	Sample Spicket6-G < 40.3 ug/L. All other Land 3 results were greater than 40.3 ug/L.	
DON	48.19- 62.58 ug/L	All Teams	All sample results greater than respective field blank.	
NH4*	36.99 ug/L	Boat 1	Concord1-G, 2-G, and 6-G, and Shawsheen4-G <36.99 ug/L. All other Boat 1 results > 36.99 ug/L.	
	33.3 ug/L	Land 2	Shawsheen3-G,6-G,7-G, & 9-G, and DUP-3< 33.3 ug/L. All other Land 2 results > 33.3 ug/L.	
	38.2 ug/L	Land 3	Sample Spicket6-G and Spicket7-G < 38.2 ug/L. All other Land 3 results were > 38.2 ug/L.	
NOX	1.75 ug/L	Boat 1	All Boat 1 results nondetect or greater than 1.75 ug/L.	
	2.01 ug/L	Land 2	All Land 2 results greater than 2.01 ug/L.	
	2.04 ug/L	Land 3	All Land 3 results greater than 2.04 ug/L.	
PO4	ND (<3.1 ug/L)	All Teams	All sample results nondetect or greater than 3.1 ug/L.	
POC	28.68-29.82 ug/L	All Teams	All sample results greater than respective field blank.	
PON	ND (<9.8 ug/L)	All Teams	All sample results greater than 9.8 ug/L.	
TDN	83.45-101.32 ug/L	All Teams	All sample results greater than respective field blank.	
TKN	0.8-0.10 mg/L	All Teams	All sample results greater than respective field blank.	
TON	48.94-64.12 ug/L	All Teams	All sample results greater than respective field blank.	
TN	84.20-102.85 ug/L	All Teams	All sample results greater than respective field blank.	
TP	ND - 3.44	All Teams	All sample results greater than respective field blank.	

*An audit performed for Event 1 ammonia field blank samples indicated the source of these trace ammonia concentrations was the distilled water used for sampling.

Equipment Rinsate Blanks

<u>Analyte</u>	<u>Blank detection concentration or Range</u> (3 field blanks and 3 field equipment blanks were collected for each analyte listed)		<u>Sample Results</u>	Boat 1: Concord5 Land 1: N/A Land 2: Shawsheen6 Land 3: Spicket5
CBOD	ND (<3 mg/L)	All Teams	All sample results greater than 3 mg/L.	
CBOD-20	ND (<3 mg/L)	Boat 1	All Boat 1 results greater than 3 mg/L.	
	6 mg/L	Land 2	All Land 2 results greater than 6 mg/L.	
	5 mg/L	Land 3	Sample Spicket5-G = 5mg/L. All other Land 3 results were greater than 5mg/L.	
CHLA	ND (<0.5 mg/m ³)	All Teams	All sample results greater than 0.5 mg/m ³	
E. coli	ND (<1 MPN/100mL)	Boat 1	All Boat 1 sample results greater than 1 MPN/100mL	
	6.1 MPN/100mL	Land 2	All Land 2 results greater than 6.1 MPN/100mL	
	ND (<1 MPN/100mL)	Land 3	All Land 3 sample results greater than 1 MPN/100mL	
Fecal Coliform	ND (<1 MPN/100mL)	Boat 1	All Boat 1 sample results ND or greater than 1 MPN/100mL	
	7.4 MPN/100mL	Land 2	All Land 2 results greater than 7.4 MPN/100mL	
	ND (<1 MPN/100mL)	Land 3	All Land 3 sample results greater than 1 MPN/100mL	
TSS	ND (<1 mg/L)	All Teams	All sample results ND or greater than 1 mg/L.	
DIN	157.9 ug/L	Boat 1	Sample Concord2-G and Shawsheen4-G < 157.9 ug/L. All other Boat 1 results were > 157.9 ug/L.	
	34.6 ug/L	Land 2	All Land 2 sample results greater than 34.6 ug/L.	
	44.7 ug/L	Land 3	Sample Spicket6-G < 44.7 ug/L. All other Land 3 results were greater than 44.7 ug/L.	
DON	45.6-116.0 ug/L	All Teams	All sample results greater than respective rinsate blank.	
NH4*	152.9 ug/L	Boat 1	All 7 sample results on Boat 1 less than 152.9 ug/L.	
	33.3 ug/L	Land 2	Shawsheen3-G,6-G,7-G, & 9-G, and DUP-3< 33.3 ug/L. All other Land 2 results > 33.3 ug/L.	
	40.7 ug/L	Land 3	Sample Spicket6-G and Spicket7-G < 40.7 ug/L. All other Land 3 results were > 40.7 ug/L.	
NH4* (adjusted for field blank detections)	115.91 ug/L	Boat 1	All 7 sample results on Boat 1 less than 115.91 ug/L.	
	ND	Land 2	All Land 2 results greater than ND result.	
	2.5 ug/L	Land 3	All Land 3 results greater than 2.5 ug/L.	
NOX	5.00 ug/L	Boat 1	All Boat 1 results nondetect or greater than 5.00 ug/L.	
	1.33 ug/L	Land 2	All Land 2 results greater than 1.33 ug/L.	
	3.99 ug/L	Land 3	All Land 3 results greater than 3.99 ug/L.	
PO4	ND (<3.1 ug/L)	All Teams	All sample results nondetect or greater than 3.1 ug/L.	
POC	35.42-150.05 ug/L	All Teams	All sample results greater than respective rinsate blank.	
PON	ND (<9.8 ug/L)	All Teams	All sample results greater than 9.8 ug/L.	

Equipment Rinsate Blanks (continued)

<u>Analyte</u>	<u>Blank detection concentration or Range (3 field blanks and 3 field equipment blanks were collected for each analyte listed)</u>	<u>Sample Results</u>	Boat 1: Concord5 Land 1: N/A Land 2: Shawsheen6 Land 3: Spicket5
TDN	80.18-273.88 ug/L	All Teams	All sample results greater than respective rinsate blank.
TKN	0.8-0.28 mg/L	All Teams	All sample results greater than respective rinsate blank.
TON	46.35-123.84 ug/L	All Teams	All sample results greater than respective rinsate blank.
TN	80.93-281.73 ug/L	All Teams	All sample results greater than respective rinsate blank.
TP	ND- 4.30 ug/L	All Teams	All sample results greater than respective rinsate blank.

The field blank samples were prepared from distilled water. The individual sample bottles were filled at the sampling location with distilled water. The rinsate blank samples were prepared with distilled water that was passed over the decontaminated sampling equipment and transferred to the appropriate sample bottles.

No qualifiers were applied to the samples based on field blank and rinsate blank contamination but the data user should note that blank samples had some minor contamination. Ammonia rinsate blanks were adjusted based on the field blank concentrations as the source was determined to be the distilled water. Sample concentrations that were less than the blank concentrations have been highlighted.

Representativeness:

Were sampling procedures and design criteria met?
 Were holding times met?
 Was preservation criteria met? (4° C ± 2° C)?
 Were Chain-of-Custody records complete and provided in data package?

<u>Yes</u>	<u>No</u>	<u>N/A</u>
Yes		
Yes		
Yes		
Yes (EAI); No (SMAST)		

Comments (note deviations): Although receipt temperature was not reported for all samples, the laboratory indicated that the samples adhered to the sample acceptance policy. Although all analytical procedures were followed and no qualifiers were applied, it should be noted that some E. coli species were less tolerant to the higher temperatures required by the Fecal Coliform test resulting in Fecal Coliform < E. coli results. All samples were received and analyzed by EAI within respective hold times.

Comparability:

Were analytical procedures and methods follows as defined in the QAPP or field change documentation?
Comments (note deviations): None.

<u>Yes</u>	<u>No</u>	<u>N/A</u>
Yes		

Completeness (90%):

Are all data in this SDG usable?
Comments (note deviations): None.

<u>Yes</u>	<u>No</u>	<u>N/A</u>
Yes		

Sensitivity:

Is a verification report present for method detection limits, interelement correction factors and linear ranges?
 Are MDLs present and reported?
 Do the reporting limits meet project requirements?
 Are results above the linear range of the instrument?
Comments (note deviations): None.

<u>Yes</u>	<u>No</u>	<u>N/A</u>
	No	
Yes (in lab QA manuals)		
	Yes	
	Yes	

Data Validator: Keith Vincelette
 Data Reviewer: Sue Gryzkiewicz

Date: 11/17/2016
 Date: 1/16/2017

Attachment 2

June 2014 and February 2015 Ammonia Field Blank Analysis

Attachment 2
Lower Merrimack River Study
June 2014 and February 2015 Ammonia Field Blank Analysis

ANLS DATE	CURVE #	PROJECT	SAMPLE DATE	SAMPLE ID	NH4 (uM)	NH4 (ug/L)
6/26/2014		CDM	6/25/2014	M004B	3.9	53.96
6/26/2014		CDM	6/25/2014	M010B	2.3	31.52
6/26/2014		CDM	6/25/2014	M024B	0.3	4.69
6/26/2014		CDM	6/25/2014	T010B	0.1	1.27
6/26/2014		CDM	6/26/2014	BLANK	0.0	0.00
6/26/2014		CDM	6/26/2014	BLANK	0.0	-0.19
6/26/2014		CDM	6/26/2014	BLANK	0.0	-0.19
6/26/2014		CDM	6/26/2014	BLANK	0.0	0.00
6/26/2014		CDM	6/26/2014	BLANK	0.0	0.00
6/26/2014		CDM	6/26/2014	10uM STANDARD	9.3	130.07
6/26/2014		CDM	6/26/2014	10uM STANDARD	9.3	130.07
6/26/2014		CDM	6/26/2014	10uM STANDARD	9.6	134.61
6/26/2014		CDM	6/26/2014	10uM STANDARD	9.3	130.07
2/14/2015		CDM	2/12/2015	FB1	10.3	143.97
2/14/2015		CDM	2/12/2015	FB2	10.5	146.47
2/14/2015		CDM	2/12/2015	FB3	11.2	156.47
2/14/2015		CDM	2/12/2015	SMAST1	0.1	0.83
2/14/2015		CDM	2/12/2015	SMAST2	0.1	0.83
2/14/2015		BLANK	2/12/2015	BLANK	0.1	0.83
2/14/2015		STANDARD	2/12/2015	10uM STANDARD	9.1	127.79
2/15/2015		CDM	2/12/2015	FB1	10.9	152.41
2/15/2015		CDM	2/12/2015	FB2	10.3	144.50
2/15/2015		CDM	2/12/2015	FB3	10.9	152.41
2/15/2015		CDM	2/12/2015	SMAST1	0.5	6.80
2/15/2015		CDM	2/12/2015	SMAST2	0.5	6.80
2/15/2015		BLANK	2/12/2015	BLANK	0.2	2.74
2/15/2015		STANDARD	2/12/2015	10uM STANDARD	9.6	133.85