ANNUAL BITTERROOT MAINSTEM LONG-TERM TRENDS MONITORING REPORT

2019

6/30/2020

Prepared by: Clark Fork Coalition, P.O. Box 7593, Missoula, MT 59807

Table of Contents

Figures

TABLES

Attachments

1. QA/QC Report for Clark Fork River Monitoring (MDEQ)
2. Nonconformance Report for 2019 SRP analysis

1.0 INTRODUCTION

This report presents 2019 nutrient and benthic algae monitoring results from the Bitterroot River Long-Term Trends Monitoring Project (BTMP) collected by the Bitterroot River Protection Association (BRPA), under guidance from the Montana Department of Environmental Quality (MDEQ), and in partnership with the Clark Fork Coalition (CFC), which assists with data management and reporting. This report also summarizes and presents results of quality assurance and quality control analysis by MDEQ. The purpose of the report is to present monitoring results and assess compliance with water quality standards.

2019 represented the first year of what is envision as a long-term monitoring effort on the Bitterroot River. Further analysis of annual results from this monitoring program will be accomplished on a five-year schedule with a statistical evaluation and trends analysis. The first 5-year trends report is anticipated in 2024, and will include data from 2019 through 2023.

2.0 HISTORY AND BACKGROUND

MDEQ completed Total Maximum Daily Loads (TMDLs) for the Bitterroot River watershed beginning with the 2003 Upper Lolo Creek TMDLs. The Bitterroot Headwaters TMDLs (the West and East Forks of the Bitterroot River) were completed in 2005. In 2011, DEQ completed the Bitterroot Temperature and Tributary Sediment TMDLs and in 2014 completed the remaining Bitterroot Watershed TMDLs.

In 2019, the Bitterroot watershed became the Water Quality Division's Nonpoint Source Program priority watershed for a 2-3 year timeframe (MDEQ 2019a). More detail about concurrent water quality improvement activities and objectives can be found within the Pilot Level I Priority: Bitterroot Watershed Protect Plan (MDEQ 2019b). A major focus of the priority project includes tracking nutrient trends on the mainstem Bitterroot River, which led to the creation of the BTMP.

3.0 MONITORING PROGRAM

The sampling design and primary objective of this monitoring effort is to detect long-term trends in nutrient and benthic algae chlorophyll concentrations in the Bitterroot River. Additional details on the project's objectives can be found in the Quality Assurance Project Plan (MDEQ 2019c).

The objectives will be met by:

1. **Summer monitoring:** The BRPA collects nutrient samples, TSS, and field constituents in summer at six sites on the Bitterroot River on eight sampling occasions – twice monthly, July through October.
2. **Benthic algae monitoring:** The BRPA, with assistance from the UM Watershed Health Clinic, collects summer benthic algae samples for chlorophyll-*a* and ash-free dry weight at six sites on the Bitterroot River in early September.

Specifically, the BTMP measures:

- Nutrients: total phosphorus (TP), total persulfate nitrogen (TPN), nitrate + nitrite nitrogen (NO_2+NO_3-N), ammonia nitrogen (NH_3+NH_4-N), and soluble reactive phosphorus (SRP).
- Total Suspended Solids (TSS).

- Field parameters: water temperature (˚C), dissolved oxygen (mg/l), pH (standard units), redox potential (mv), specific conductance (µs/cm), total dissolved solids (mg/l), and turbidity (NTU).
- Benthic algae: chlorophyll-*a* (mg/m^2) and ash-free dry weight (g/m^2).

All nutrient samples were analyzed by Energy Laboratory in Helena, MT, and benthic algae samples were analyzed by the UM Watershed Health Clinic. Sampling, QA/QC and analytical methods are described in the QAPP (MDEQ, 2019c). The **QA/QC Report for 2019 Bitterroot Mainstem Long-Term Nutrient Trends Monitoring** is attached to this report. Monitoring station locations are provided in **Table 1.** Rationale for sampling locations in explained in more detail in the QAPP (MDEQ 2019c).

All 2019 project data are available at the project website, hosted by the Clark Fork Coalition at https://clarkfork.org/our-work/what-we-do/monitor-watershed-health/nutrient-monitoring/.

Table 1: BTMP Monitoring Locations, from upstream to downstream

Station	Name/Location	Latitude	Longitude
COMBITR02	Bitterroot River at Buckhouse Bridge	46.83194	-114.05306
COMBITR03	Bitterroot River at Florence Bridge	46.63309	-114.05096
BITR-C05BITRR24	Bitterroot River at Bell Crossing	46.4436	-114.12630
COMBITR04	Bitterroot River at Veterans Bridge, Hamilton*	46.2792	-114.1606
BITR-C05BITRR03	Bitterroot River at Main Street, Hamilton	46.2475	-114.17722
BITR-C05BITTR06	Bitterroot River at Hannon Memorial Bridge	45.9725	-114.1411

*Veterans Bridge is not formally part of the BTMP. The site is part of a separate BRPA monitoring program and data form the site are included in this report courtesy of BRPA. Note that sites in Table 1 are listed in downstream to upstream order starting at Buckhouse Bridge.

4.0 DATA QA/QC SUMMARY

All laboratory and field data were reviewed and validated per guidance in the QAPP (MDEQ, 2019c). Montana DEQ analyzes and flags the monitoring data each year for quality assurance/quality control and provides the **QA/QC Report for 2019 Bitterroot Mainstem Long-Term Nutrient Trends Monitoring** that is attached to this report. This section briefly summarizes the results.

The overall project data had:
• 16 results H flagged for exceeding method holding time
• 51 results B flagged for field blank contamination
• 58 results J flagged for result value between the MDL and LRL
• 96 results J flagged for SRP>TP
• 23 results J flagged for MS/MSD failed high, expect high bias
• 11 results J flagged for MS/MSD failed low, expect low bias
• 23 results J flagged for field duplicate RPD>25%

In addition, as explained in greater detail in Section 6.2, a laboratory issue resulted in the rejection of all 2019 results for soluble reactive phosphorous.

The BRPA, UM, CFC, and DEQ discussed ways to improve data quality and QA/QC reporting at their annual meeting, and the QAPP and SAPs were updated accordingly prior to the start of the 2020 field season.

5.0 NUTRIENT STANDARDS

The Bitterroot River is located within the Middle Rockies ecoregion, thus these standards apply from July 1st to September 30th:

- Total phosphorus as P: 30 µg/L
- Total Nitrogen as N: 300 µg/L

There are no numeric standards for nitrate + nitrite nitrogen for protecting the Bitterroot River from euthrophic impacts. However, DEQ uses 100 ug/L nitrate + nitrite as a benchmark for assessment purposes. When concentrations are equal or greater than 100 ug/L during the growing season it can be assumed that the stream is saturated for nitrate and detrimental eutrophication impacts may ensure (Suplee 2013).

Although no standards currently exist for algal growth in the Bitterroot River, standards developed for the Clark Fork River as part of the Voluntary Nutrient Reduction Program may be useful to provide context for interpretation of chlorophyll a results and are included here for that purpose:

- (Summer mean) - Benthic 100 mg/square meter algal chlorophyll a
- (Maximum) - Benthic 150 mg/square meter algal chlorophyll a

6.0 NUTRIENT RESULTS

Streamflow conditions during spring runoff and summer months influence nutrient concentrations and algal densities. Years with less-than-average peak flows and early summer low flows typically see higher algal densities, and conversely, years with higher peak flows tend to produce less algal density. **Figure 1** presents three 2019 annual hydrographs (including the median daily flow for the period of record at each site) from stations in the study area, arranged upstream to downstream, to provide context for interpreting nutrient and algae results (USGS, 2020).

In general, discharge in the Bitterroot River during 2019 closely tracked with the historical average, though the rising limb of all three hydrographs included several mini-peak flow events on the way to the actual annual peak, which at all three locations was slightly higher than average. (**Figure 1**).

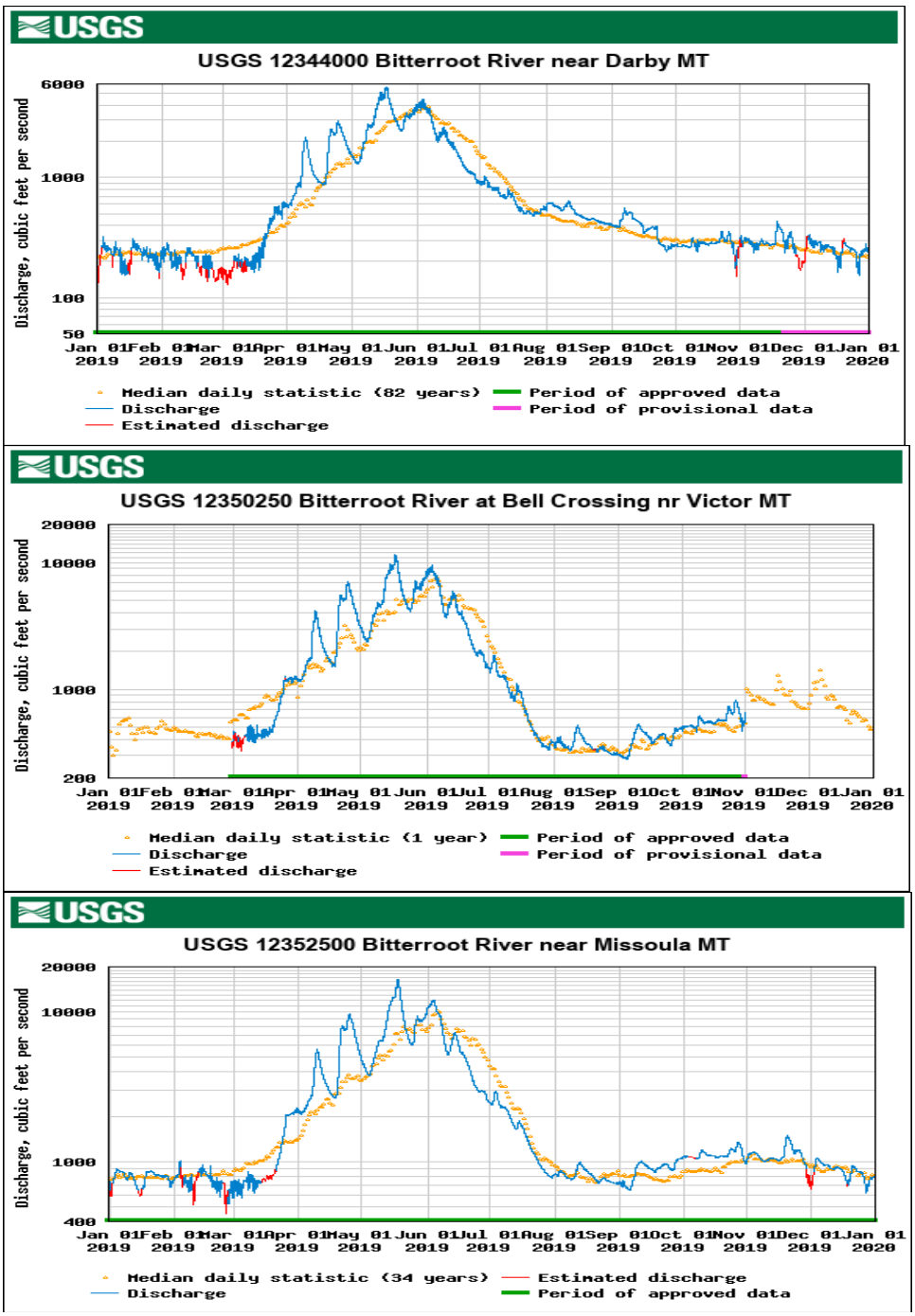


Figure 1: 2019 Hydrographs from USGS continuous monitoring stations (USGS, 2020).

6.1 TOTAL PHOSPHORUS

Results of total phosphorus (TP) monitoring are presented in **Figure 2**. TP concentrations were below the standard of 30 ug/l on all occasions at all sampling locations in 2019. Concentrations were generally below 15 ug/l, except in mid-July at Hannon and late July through early September at Veterans Bridge in Hamilton.

6.2 SOLUBLE REACTIVE PHOSPHORUS

Due to problems at the analytical laboratory, reported SRP concentrations exceeded TP concentrations in numerous samples and thus 2019 SRP results were rejected by DEQ and are not presented in this report. A more detailed explanation of the laboratory problem is included as **Attachment 2**.

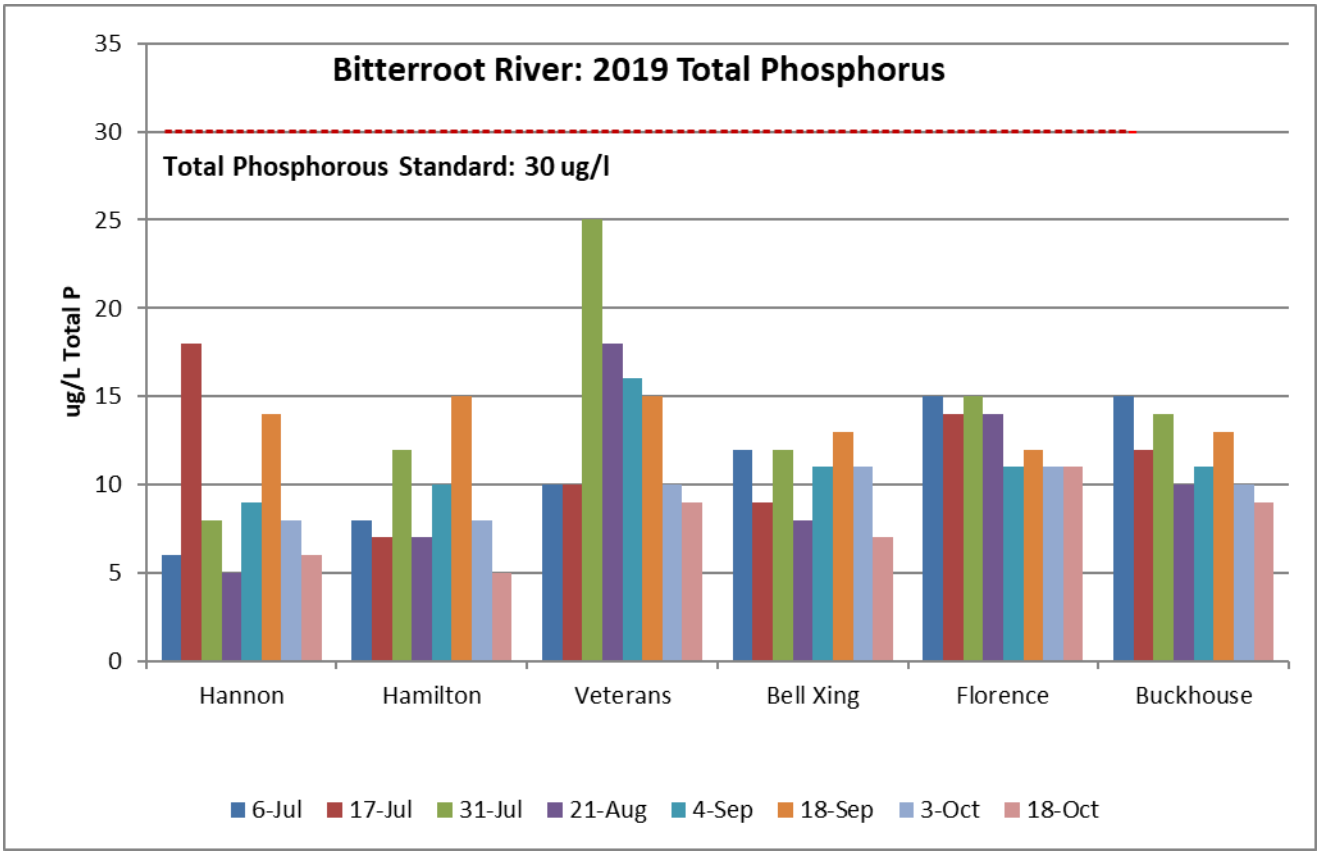


Figure 2: Bitterroot River: 2019 Total Phosphorous

Samples below detection are shown at ½ the lower reporting limit of 2 µg/L. Sites appear in upstream to downstream order from Hannon to Buckhouse.

6.3 TOTAL NITROGEN

Results of total nitrogen (TN) monitoring are presented in **Figure 3**. Total nitrogen concentrations were well below the standard of 300 ug/l at all sites and on all occasions. Total nitrogen was noticeably higher at the two downstream sites, Florence and Buckhouse Bridge, than it was at the four upper sites. On a seasonal basis, all sites followed a general pattern of relatively low TN concentrations during the early and mid-July sampling events, increasing slightly through August, and then tapering off again in late summer and early fall.

6.4 NITRATE + NITRITE

Results of nitrate + nitrite monitoring are presented in **Figure 4**. There are no numeric standards for nitrate + nitrite, but as discussed in Section 5.0, MDEQ uses 100 ug/L as a benchmark for assessment purposes. Nitrate + nitrite concentrations were at or below this benchmark on all sampling occasions in 2019. As with TN, concentrations of nitrate+nitrite were highest at the two downstream sites, Florence and Buckhouse Bridge, where nitrate+nitrite generally ranged from 30 to 60 ug/l, except during the mid-July sampling event, when an unusually high concentration of 100 ug/l was measured at Buckhouse. At the four upstream sites, concentrations were generally near 20 ug/l or below, except for an usual spike to 48 ug/l, also during the mid-July monitoring event. Nitrate + nitrite as a percentage of total nitrogen is shown in **Table 2**.

Table 2: Nitrate + nitrite as a percentage of total nitrogen

Site	Mean Percentage Nitrate+Nitrite of Total Nitrogen
Hannon	17%
Hamilton Main Street	18%
Veterans Bridge	13%
Bell Crossing	7%
Florence	26%
Buckhouse Bridge	24%

(Note: below detect values calculated at ½ detection limit)

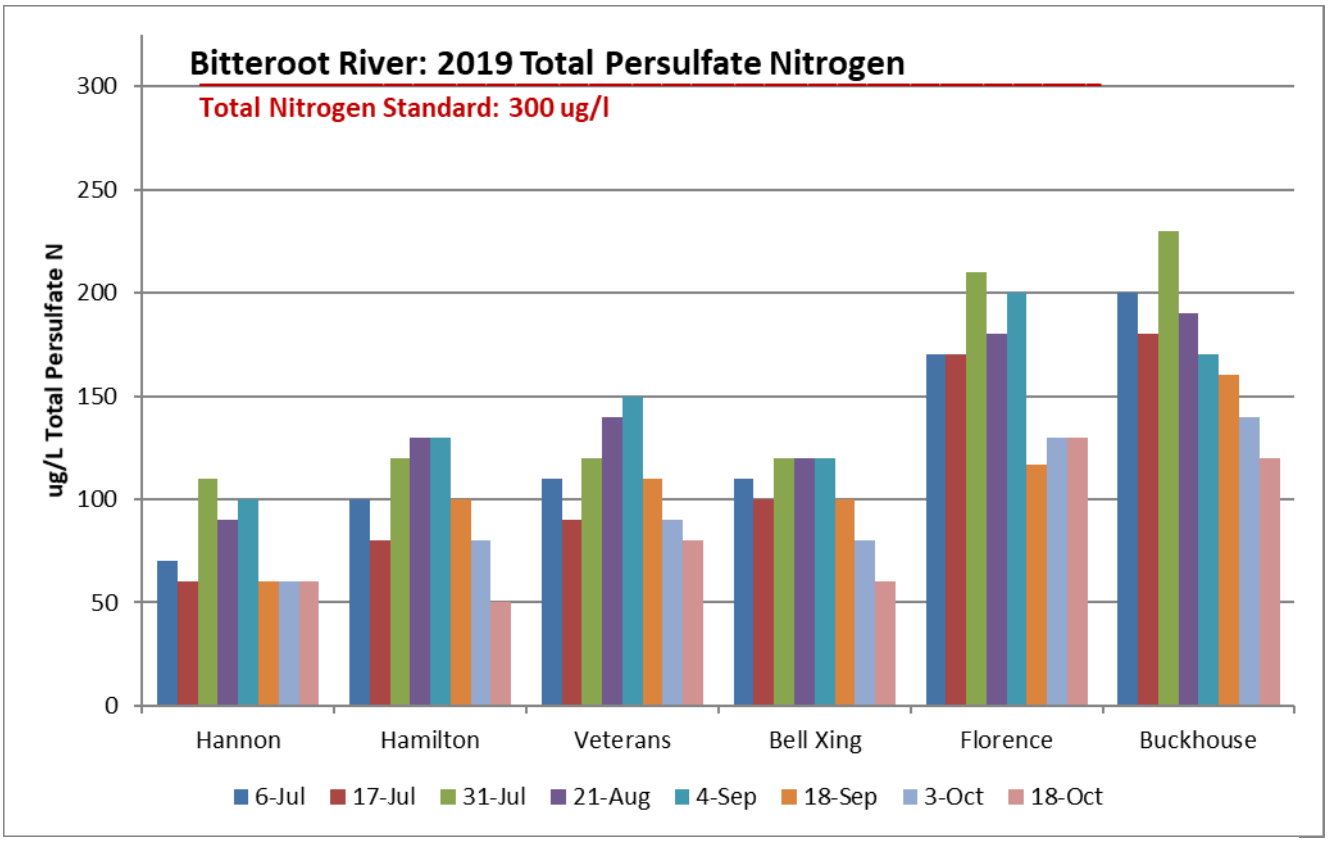


Figure 3: Bitterroot River: 2019 Total Persulfate Nitrogen

Samples below detection are shown at ½ the lower reporting limit of 50 µg/L. Sites appear in upstream to downstream order from Hannon to Buckhouse.

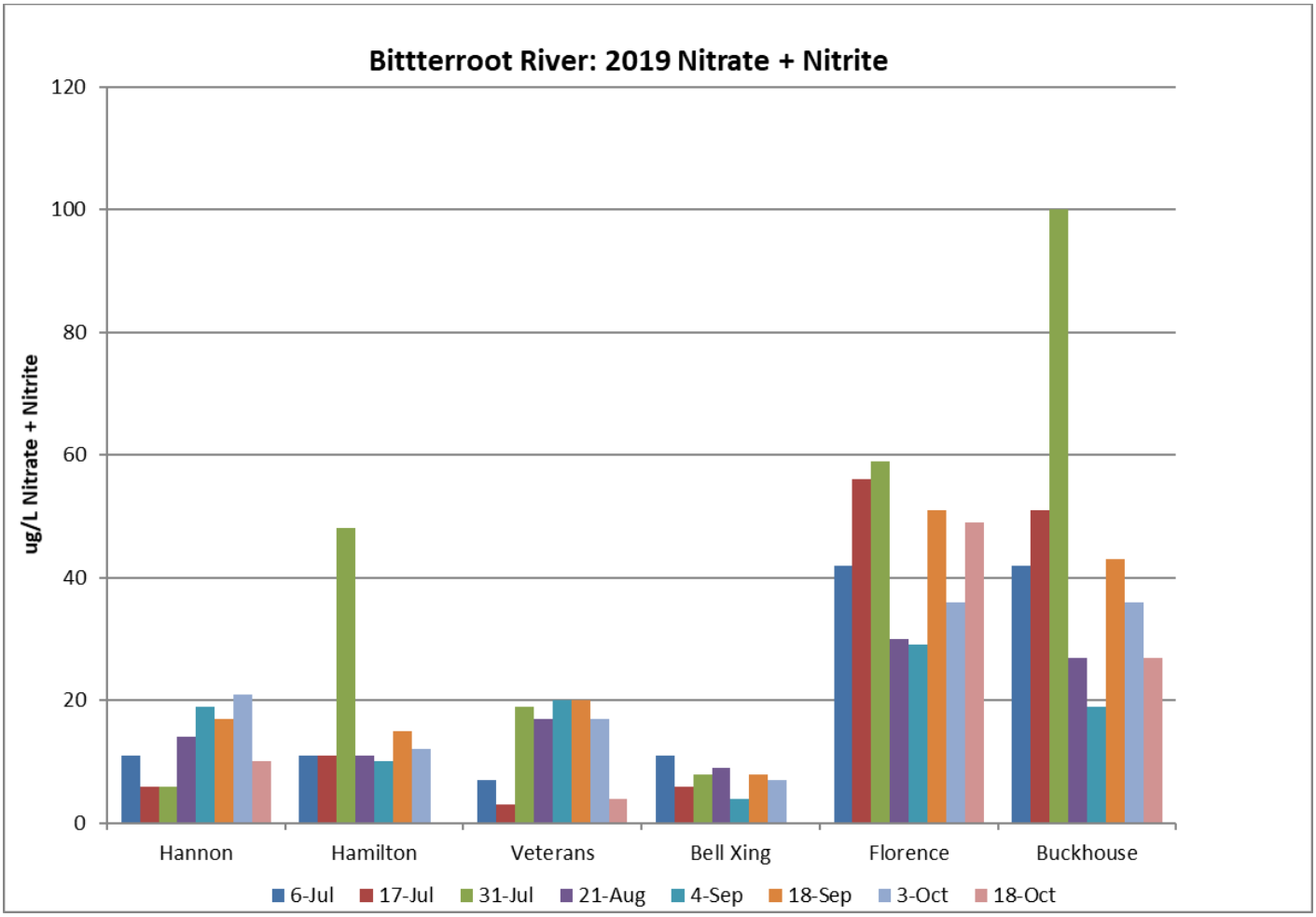


Figure 4: Bitterroot River: 2019 Nitrate + Nitrite

Samples below detection are shown at ½ the lower reporting limit of 2 µg/L. Sites appear in upstream to downstream order from Hannon to Buckhouse.

6.5 AMMONIA

Results of ammonia monitoring are presented in **Figure 5**. Concentrations were generally 30 ug/L or lower except for an early July concentration of 40 ug/l at Hannon, and mid-July concentrations of 40 ug/l at Bell Crossing and Florence, and 50 ug/l at Buckhouse Bridge.

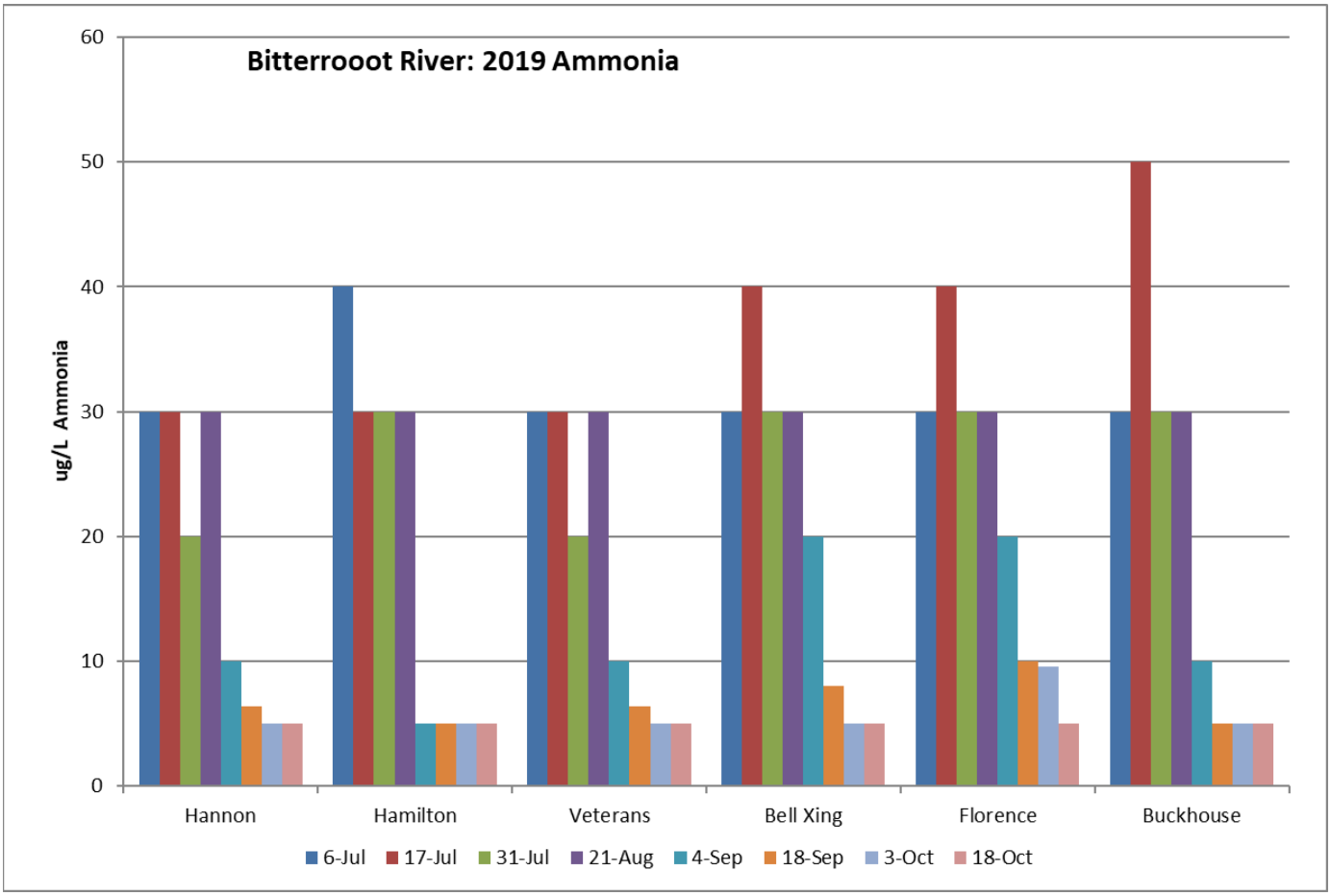


Figure 5: Bitterroot River: 2019 Ammonia

Samples below detection are shown at ½ the lower reporting limit of 10 µg/L. Sites appear in upstream to downstream order from Hannon to Buckhouse.

7.0 NITROGEN – PHOSPHORUS RATIOS

Since the observation of Redfield (1934 and 1958) that marine phytoplankton contains a molecular C:N:P ratio of 106:16:1 (40:7:1 by mass), the relative concentrations of N and P have been used to estimate which of these nutrients might be limiting, preventing additional primary production (algae growth) in aquatic ecosystems. Redfield also recognized that the ratio is an average with considerable variation by species, season, and environment. A departure from this ratio is assumed to imply nutrient deficiency such that by identifying which nutrient is responsible for enhanced algae growth, management actions can be directed toward the nutrient with the highest impact.

It is important to note that the C:N:P ratios in the above literature for benthic algae are for the internal contents of the algal matrix (cellular C:N:P concentration), not water column concentrations. The C:N:P of the benthic algal material is a much better estimator of nutrient limitation than water column TN:TP ratio. This is especially true for benthic algae; while water column total nutrients can be good estimators of optimal stoichiometry for phytoplankton (where suspended algal biomass is a large fraction of the total nutrients in the water column) benthic algae are more loosely coupled with the water column and respond only to bioavailable nutrients.

Total nitrogen-phosphorus ratios (by mass) were calculated for 2019 results and are shown below in **Table 3**. The N:P Redfield ratio (by mass) is 7:1, and the color-coded thresholds in Table 4 are based on the following from Suplee and Watson (2013): "*Studies of benthic algae show that it is necessary to move some distance above or below the Redfield ratio in order to be strongly convinced that a lotic waterbody is P or N limited (Dodds, 2003). When a benthic algal Redfield ratio (by mass) is <6, N limitation is suggested, and when it is >10 P limitation is indicated (Hillebrand and Sommer, 1999). Thus, there is a range of N:P values between about 6 and 10 where one can state, for practical purposes, that algal growth is co-limited by N and P.*"

We also include dissolved N: P ratios (by mass) in Table 4 with caveats: the Redfield ratio is based on total N: P, but dissolved concentrations may better reflect nutrient limitation if total concentrations are dominated by particulates (including sediment particles and terrestrial material) which are not necessarily reflective of the condition of the benthic algae. The dissolved N:P ratios are simply presented for comparison.

For total N:P ratios, phosphorous limitation was far more common than nitrogen limitation, which was evident in only 3 of 48 samples, two of them at Hannon and one at Veterans Bridge. In contrast, 28 samples suggested phosphorous limitation and another 16 were indeterminate. Dissolved N:P ratios indicate N limitation at all sites and on all occasions. As reported previously in this report, technical problems at the analytical laboratory resulted in reported SRP concentrations that exceeded TP concentrations in most of the samples collected in 2019. The prevalence of N limitation in the dissolved N:P analysis likely results from this issue rather than from biological conditions in the Bitterroot River.

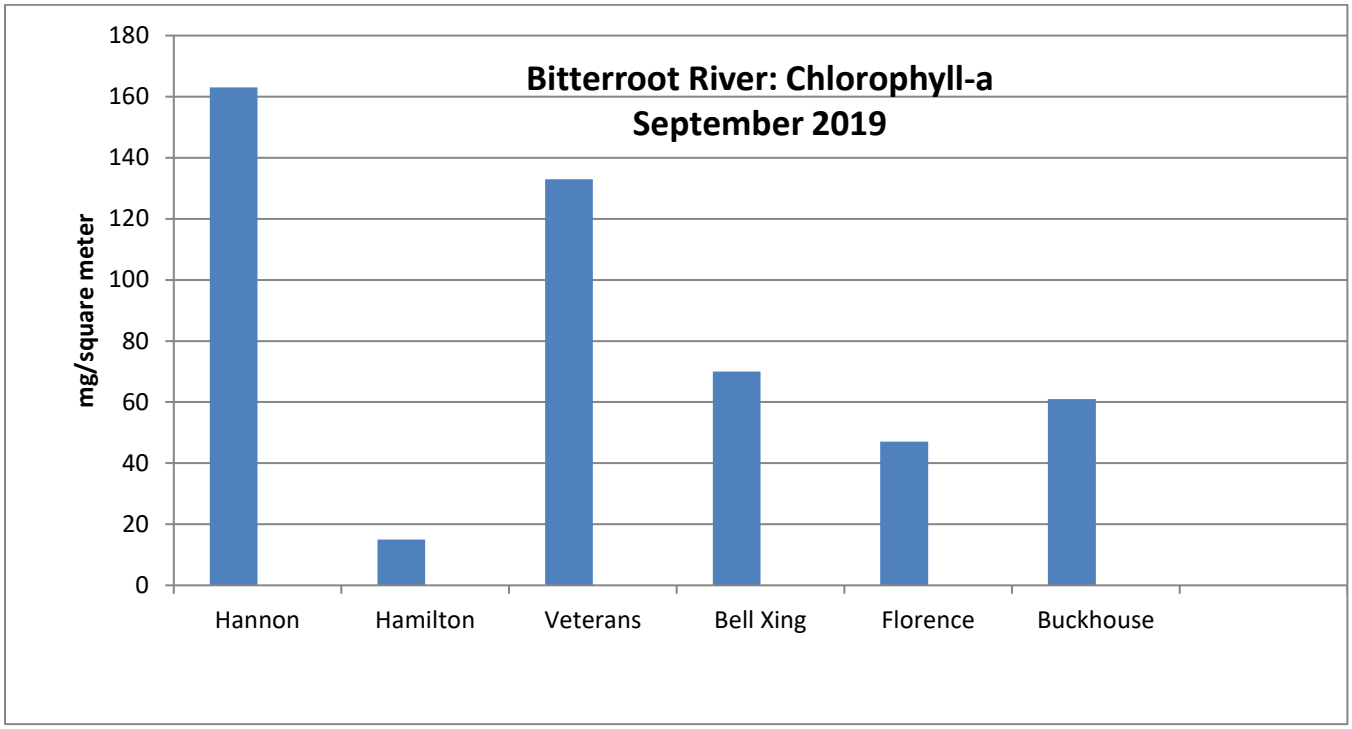
Table 3: 2019 Mass-based N:P ratios for Total N:P (upper) and Dissolved N:P (lower)

Total N:P					
Hannon	Hamilton	Veterans	Bell Xing	Florence	Buckhouse
11.7	12.5	11.0	9.2	11.3	
3.3	11.4	9.0	11.1	12.1	15.0
13.8	10.0	4.8	10.0	14.0	16.4
18.0	18.6	7.8	15.0	12.9	19.0
11.1	13.0	7.5	10.9	18.2	15.5
4.3	6.7	9.3	7.7	9.8	12.3
7.5	10.0	15.0	7.3	11.8	14.0
10.0	10.0	12.2	8.6	11.8	13.3
	<6 indicates N-limited				
	>10 indicates P-limited				
	6 - 10 indicates either N or P may be limiting				
Dissolved N:P					
0.9	0.7	0.4	0.7	2.8	
0.2	0.3	0.1	0.2	1.4	1.3
0.3	1.9	0.6	0.3	2.6	4.0
0.6	0.5	0.5	0.4	1.1	1.1
1.4	0.9	1.3	0.3	2.2	1.2
1.1	0.9	1.3	0.5	3.2	3.1
1.2	0.8	1.7	0.4	4.0	4.5
0.5	0.0	0.2	0.0	3.8	2.1
	<6 indicates N-limited				
	>10 indicates P-limited				
	6 - 10 indicates either N or P may be limiting				

8.0 BENTHIC ALGAE RESULTS

Benthic algae were sampled according to the QAPP at all sites in early September. Averages for chlorophyll-*a* and ash free dry weight from each sample date are shown in **Figure 6**. Although no numeric standards for benthic algae chlorophyll-*a* are established for the Bitterroot River, the standards

developed for upper Clark Fork River include a summer maximum of 150 mg/$m^2$and a summer mean of 100 mg/m^2. These standards are included here to provide context for interpreting the Bitterroot results. Somewhat surprisingly, chlorophyll a concentration in the Bitterroot were highest at the Hannon, the uppermost site, which is upstream of the major WWTP discharges and where nutrient concentrations were relatively low. The chlorophyll a concentration of 163 mg/m^2at this site exceeded both the maximum and mean standard that has been developed for the Clark Fork. The concentration dropped to below 20 mg/m^2 at Hamilton and then rose sharply to 133 mg/m^2 at Veterans Bridge, which exceeded the Clark Fork summer mean standard. From there, the concentrations ranged from 47 to 70 mg/m^2 at the three remaining sites. AFWD concentrations followed a very similar pattern.



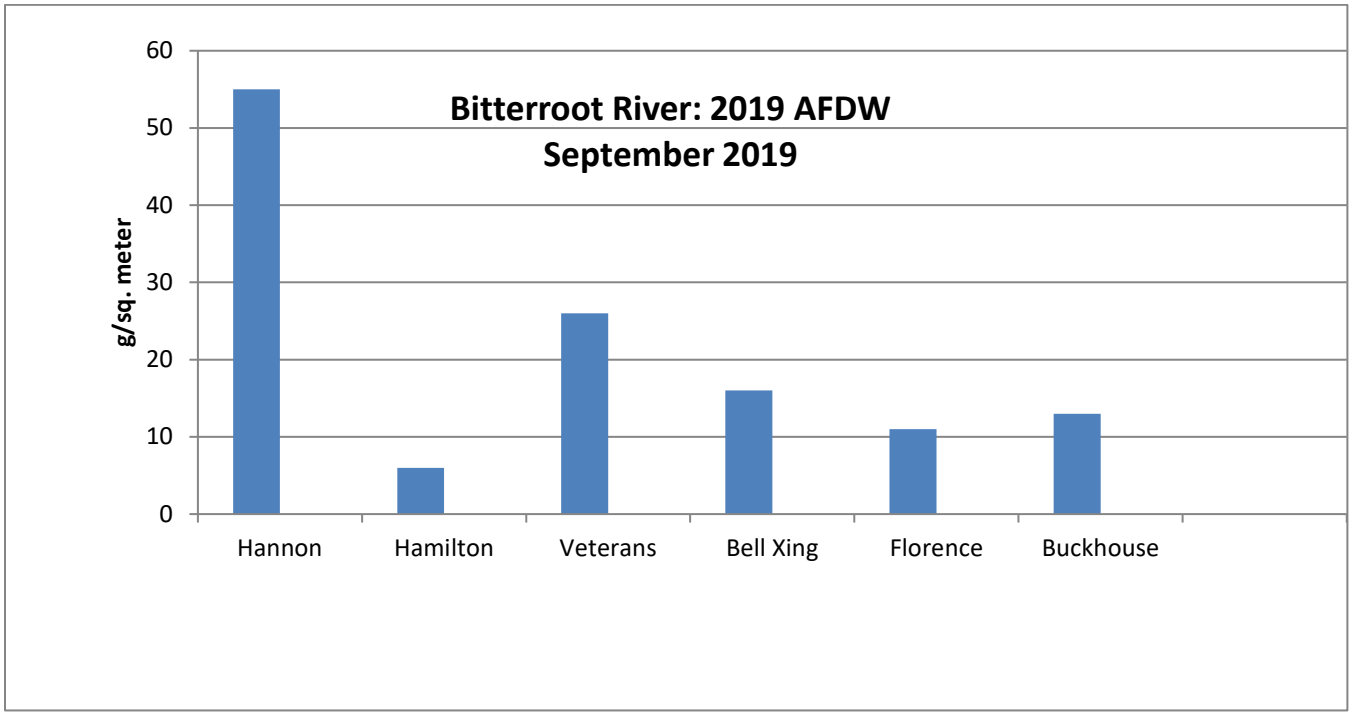


Figure 6: Bitterroot River: 2019 Benthic algae chlorophyll-a and ash free dry weight results

Sites appear in upstream to downstream order from Hannon to Buckhouse.

9.0 REFERENCES

Dodds, W.K., 2003. Misuse of Inorganic N and Soluble Reactive P Concentrations to Indicate Nutrient Status of Surface Waters. *Journal of the North American Benthological Society.* 22(2): 171-181.

Hillebrand, H. and U. Sommer. 1999. The Nutrient Stoichiometry of Benthic Microalgal Growth: Redfield Proportions Are Optimal. *Limnology and Oceanography.* 44: 440-446.

Montana DEQ. 2019a. Draft Nonpoint Source Program 20-Year Vision and Strategic Plan. Helena, MT: Montana Dept. of Environmental Quality.

Montana DEQ. 2019b. Bitterroot Watershed Focus Area Project Plan. Helena, MT: Montana Dept. of Environmental Quality

Montana DEQ. 2019c. Quality Assurance Project Plan Bitterroot Mainstem Long-term Nutrient Trends Monitoring. Helena, MT: Montana Dept. of Environmental Quality.

Montana DEQ, 2020. QA/QC Report for 2019 Bitterroot River Monitoring, QAPP ID: WQPBQAP-10, Water Quality Planning Bureau, April.

Redfield A.C., 1934. On the proportions of organic derivatives in sea water and their relation to the composition of plankton. Liverpool University Press, Liverpool, p. 176–192

Redfield A.C., 1958. The biological control of chemical factors in the environment. Am Sci 46:205–221.

Suplee, M.W., Watson, V., Dodds, W., and C. Shirley, 2012. Response of algal biomass to large scale nutrient controls in the Clark Fork River, Montana, USA. Journal of American Water Resources Association 48:1008-1021.

Suplee, M. 2013. Benchmark for Nitrate + Nitrite in Assessing Ambient Water. Technical Memorandum. Montana Department of Environmental Quality, Water Quality Standards Section.

Suplee, M.W., and V. Watson, 2013. Scientific and Technical Basis of the Numeric Nutrient Criteria for Montana's Wadeable Streams and Rivers—Update 1. Helena, MT: Montana Dept. of Environmental Quality.

U. S. Geological Survey, 2020. National Water Information System, Web Interface. Graphs created and downloaded May, 2020. https://waterdata.usgs.gov/mt/nwis/rt/

QA/QC REPORT FOR 2019 BITTERROOT MAINSTEM LONG-TERM NUTRIENT TRENDS MONITORING

QAPP ID: BRMMASQAPP-19

April 2020

Prepared for:

Randy Apfelbeck, Bitterroot River Monitoring Project Manager
Montana Department of Environmental Quality
Water Quality Planning Bureau
Monitoring and Assessment Section

Prepared by:
Jolene McQuillan, Water Quality Database Manager and Deanna Tarum, Water Quality Data Specialist
Montana Department of Environmental Quality
Water Quality Division

TABLE OF CONTENTS

ACRONYM LIST

Acronym	Definition
AFDW	Ash-free Dry Weight
BRPA	Bitterroot River Protection Association
CFC	Clark Fork Coalition
COC	Chain-of-Custody
DEQ	Department of Environmental Quality
DQI	Data Quality Indicators
DQO	Data Quality Objectives
EDD	Electronic Data Deliverable
FB	Field Blank
FD	Field Duplicate
LRL	Lower Reporting Limit
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MT-eWQX	Montana EQuIS Water Quality Exchange
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SRP	Soluble Reactive Phosphorus (Orthophosphate)
TP	Total Phosphorus
TPN	Total Persulfate Nitrogen
TSS	Total Suspended Solids

1.0 INTRODUCTION

A data quality control (QC) review has been completed on all data collected and submitted to DEQ in 2019 for the Bitterroot Mainstem Nutrient Monitoring Program. Monitoring activities were performed in accordance with the *"Bitterroot Mainstem Long-term Nutrient Trends Monitoring-Quality Assurance Project Plan (QAPP)"* (QAPP ID: BRMMASQAPP-19) and associated SAP for the Clark Fork Coalition (CFC) and Bitterroot River Protection Association (BRPA). The scope of the QC evaluation was to evaluate documentation associated with sampling and measurement (i.e., field logbooks and site visit forms) and laboratory analytical results to verify data quality. The QC evaluation included a review of the data quality objectives (DQOs) and data quality indicators (DQIs) as outlined in the QAPP and an assessment of compliance with the DEQ QA/QC process. The review also included:

- Review of field data sheets to verify calibration and to identify field notes that explain any deviations from the QAPP.
- Review of field notes and field data sheets for a data logic check and to identify any notes indicating deviations from the QAPP.
- Review of the sample delivery group to evaluate the overall quality of the data including reporting errors, data omissions, and suspect or anomalous values.

The QC review applies to the nutrient monitoring for the months of July through October and the benthic algae monitoring in September, all conducted by the Bitterroot River Protection Agency.

2.0 FIELD COMPONENTS

FIELD DOCUMENTATION

The BRPA submitted monthly nutrient field forms as part of their data deliverable. Several field forms were not received until after the data had been loaded into MT-eWQX. Algae field forms were received, but not until after the data was already loaded into MT-eWQX. There were no detailed calibration logs provided. All the field forms were a consistent format and contained most of the relevant field metadata including station IDs, site coordinates, collection date, and personnel. Some of the forms were incomplete, missing field personnel and three forms did not indicate if water samples were collected. The Sample ID was not on the field forms and would be a suggested addition for 2020. Lastly, there were some comments that were difficult to read.

CHAIN OF CUSTODY FORMS

The BRPA submitted COC forms for each monthly nutrient sampling date that included a relinquished signature by BRPA field personnel but were not the final COC with lab signatures. Although BRPA did not submit final COCs, a scan of the final COC forms was included in the Energy Lab reports. The monthly nutrient samples were relinquished by BRPA field personnel the same day to two days after the samples were collected.

The algae field forms acted as the COC, although they were not signed and dated and were not submitted to DEQ until after the data was loaded into MT-eWQX. It is unknown what day the UM Watershed Health Clinic received the samples.

SAMPLE SITES

The BRPA's monthly nutrient field forms included site name, descriptions, station IDs, and coordinates that matched locations specified in the QAPP. The algae field forms included all the above information except site name. It is recommended to add site name to the algae field forms for 2020. There was one site on both the nutrient and algae field forms that was not listed in the SAP: COMBITR04 – Bitterroot River at Veteran's Bridge. If long-term monitoring is intended for this site, it should be added to the SAP.

FREQUENCY OF FIELD BLANKS AND FIELD DUPLICATES

At least one field blank sample and one duplicate sample were collected for each nutrient monitoring event. This frequency met the frequency outlined in the requirements as described in the QAPP.

3.0 SAMPLE HANDLING

PRESERVATION

Preservation methods were reviewed for all sampling using the SAP, field forms, and lab reports. Table 3.1 summaries the planned preservation methods. The following deviation occurred:

- Lab batch H19070456: Cooler temp upon receipt by lab was 24.5 deg C with melted ice. All associated orthophosphate results are H flagged.

Table 3.1: Sample Preservation Summary

Characteristic	SAP Preservation	Preservation from Field Forms
Total Nitrogen	Cool on ice in field (freeze if need be)	Cool on ice (<6 deg C)
Total Phosphorus	H_2SO_4, cool on ice in field	H_2SO_4, cool on ice (<6 deg C)
Nitrate + Nitrite		
Ammonia		
Orthophosphate	Filter, cool on ice in field, then freeze solid*	Filter, freeze
Total Suspended Solids	Cool on ice in field	Cool on ice (<6 deg C)
Chlorophyll a	Prevent light exposure; cool on ice in field, freeze in lab	Freeze
Ash-free Dry Weight	Cool on ice in field; freeze in lab	Freeze

*SAP indicates: "If samples are to be shipping the day following data collection activities, freeze applicable samples in a freezer overnight upon completion of field work. If samples are to be shipped immediately after data collection activities (on the same day), ship on ice."

HOLDING TIMES

Analytical holding times were reviewed for Bitterroot River monthly and summer nutrient monitoring. The following results were H flagged for exceeding the method holding time. For orthophosphate, the holding time is 45 days if received frozen, or two days if not frozen. The flagged orthophosphate samples were all originally frozen, but received by the lab melted with a cooler temp of 24.5 deg C. For total suspended solids (TSS), the holding time is seven days.

Table 3.2: Results H flagged for exceeding method holding time

Activity ID	Characteristic Name	Lab Method	Sample Date	Analysis Date	Holding Time (days)
BITR-C05BITRR03-071719-S	Orthophosphate	365.1	7/17/2019	7/24/2019	7
BITR-C05BITRR06-071719-S	Orthophosphate	365.1	7/16/2019	7/24/2019	8
BITR-C05BITRR24-071619-S	Orthophosphate	365.1	7/16/2019	7/24/2019	8
COMBITR02-071619-S	Orthophosphate	365.1	7/16/2019	7/24/2019	8
COMBITR03-071619-QC-FB	Orthophosphate	365.1	7/16/2019	7/24/2019	8
COMBITR03-071619-QC-FD	Orthophosphate	365.1	7/16/2019	7/24/2019	8
COMBITR03-071619-S	Orthophosphate	365.1	7/16/2019	7/24/2019	8
COMBITR04-071719-S	Orthophosphate	365.1	7/17/2019	7/24/2019	7
BITR-C05BITRR03-091819-S	Total suspended solids	2540-D	9/18/2019	9/27/2019	9
BITR-C05BITRR06-091819-S	Total suspended solids	2540-D	9/18/2019	9/27/2019	9
BITR-C05BITRR24-091819-S	Total suspended solids	2540-D	9/18/2019	9/27/2019	9
COMBITR02-091919-QC-FB	Total suspended solids	2540-D	9/19/2019	9/27/2019	8
COMBITR02-091919-QC-FD	Total suspended solids	2540-D	9/19/2019	9/27/2019	8
COMBITR02-091919-S	Total suspended solids	2540-D	9/19/2019	9/27/2019	8
COMBITR03-091919-S	Total suspended solids	2540-D	9/19/2019	9/27/2019	8
COMBITR04-091819-S	Total suspended solids	2540-D	9/18/2019	9/27/2019	9

4.0 ANALYSIS

REQUIRED ANALYTICAL METHODS

All requested parameters specified in the SAP were reported. All analytical analyses were performed in accordance with the primary method as defined in the QAPP and SAP.

Table 4.1: Analytical Methods

Parameter	Method Reported	Method in QAPP/SAP
Total Phosphorus (TP)	EPA 365.1	EPA 365.1
Total Persulfate Nitrogen (TPN)	4500-N-C	4500-N-B or C
Nitrate + Nitrite-Nitrogen (NO2+NO3-N)	EPA 353.2	EPA 353.2
Total Ammonia-Nitrogen (NH3+NH4-N)	EPA 350.1	EPA 350.1
Orthophosphate (SRP)	EPA 365.1	EPA 365.1

REQUIRED DETECTION LIMITS

The laboratory lower reporting limits (LRL) met the project-required detection limits defined in the QAPP and SAP for all parameters except Ash-free Dry Weight (AFDW). Although AFDW's LRL did not meet the SAP and QAPP requirements, the method detection limit (MDL) did.

Table 4.2: Detection Limit Variations

Parameter	Lab Lower Reporting Limit	Lab Method Detection Limit	Project Limit in SAP	Project Limit in QAPP
Ash Free Dry Weight	Template – 4 g/m2 Hoop – 0.1 g/m2	Template – 0.4 g/m2 Hoop – 0.01 g/m2	Template – 0.4 g/m2	0.5 g/m2

FIELD BLANKS

The following field blanks had detections above the lower reporting limit. Field blank detected results are not B flagged.

Table 4.3: Field blanks with detects above the LRL

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	MDL (mg/l)
COMBITR02-070719-QC-FB	Ammonia	0.03	0.01	0.0064
COMBITR03-071619-QC-FB	Ammonia	0.02	0.01	0.0064
BITR-C05BITRR24-073019-QC-FB	Ammonia	0.02	0.01	0.0064
BITR-C05BITRR03-082119-QC-FB	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR06-090419-QC-FB	Ammonia	0.01	0.01	0.0064
BITR-C05BITRR06-101619-QC-FB	Ammonia	0.13	0.01	0.0064
COMBITR03-071619-QC-FB	Nitrate + Nitrite	0.004	0.002	0.00239
BITR-C05BITRR06-101619-QC-FB	Nitrate + Nitrite	0.220	0.002	0.00239
COMBITR03-071619-QC-FB	Orthophosphate	0.003	0.001	0.001
BITR-C05BITRR06-090419-QC-FB	Orthophosphate	0.011	0.001	0.001
BITR-C05BITRR06-101619-QC-FB	Orthophosphate	0.016	0.001	0.001
BITR-C05BITRR06-101619-QC-FB	Total nitrogen, mixed forms	0.34	0.03	0.04
BITR-C05BITRR24-073019-QC-FB	Total Phosphorus	0.007	0.002	0.002
BITR-C05BITRR06-101619-QC-FB	Total Phosphorus	0.004	0.002	0.002

B – Flags:

Results that are associated with a field blank are B flagged if the result is equal or <10x the detected blank value. A result is considered associated if it is the same parameter and collected on the same sampling trip. The following results were B flagged for being associated to a field blank detection.

BITR-C05BITRR06-101619-QC-FB had unusually high field blank hits. Energy Lab confirmed the results with duplicate analysis. After talking with the lab and BRPA, it was decided store water was probably used for the blank instead of lab de-ionized water. Due to this, no B flags were applied to associated results.

Table 4.4: Results B flagged for being associated to a detected field blank

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	MDL (mg/l)
BITR-C05BITRR06-070619-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR03-070619-S	Ammonia	0.04	0.01	0.0064
COMBITR04-070619-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR24-070719-S	Ammonia	0.03	0.01	0.0064
COMBITR03-070719-S	Ammonia	0.03	0.01	0.0064
COMBITR02-070719-S	Ammonia	0.03	0.01	0.0064
COMBITR02-070719-QC-FD	Ammonia	0.02	0.01	0.0064
COMBITR02-071619-S	Ammonia	0.05	0.01	0.0064
COMBITR03-071619-S	Ammonia	0.04	0.01	0.0064
BITR-C05BITRR24-071619-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR06-071719-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR03-071719-S	Ammonia	0.03	0.01	0.0064
COMBITR04-071719-S	Ammonia	0.04	0.01	0.0064
COMBITR03-071619-QC-FD	Ammonia	0.04	0.01	0.0064

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	MDL (mg/l)
BITR-C05BITRR24-073019-S	Ammonia	0.02	0.01	0.0064
COMBITR03-073019-S	Ammonia	0.03	0.01	0.0064
COMBITR02-073019-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR06-073119-S	Ammonia	0.02	0.01	0.0064
BITR-C05BITRR03-073119-S	Ammonia	0.03	0.01	0.0064
COMBITR04-073119-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR24-073019-QC-FD	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR24-082019-S	Ammonia	0.03	0.01	0.0064
COMBITR03-082019-S	Ammonia	0.03	0.01	0.0064
COMBITR02-082019-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR06-082119-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR03-082119-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR03-082119-QC-FD	Ammonia	0.02	0.01	0.0064
COMBITR04-082119-S	Ammonia	0.03	0.01	0.0064
BITR-C05BITRR06-090419-S	Ammonia	0.01	0.01	0.0064
BITR-C05BITRR06-090419-QC-FD	Ammonia	0.01	0.01	0.0064
COMBITR04-090419-S	Ammonia	0.02	0.01	0.0064
BITR-C05BITRR24-090519-S	Ammonia	0.01	0.01	0.0064
COMBITR03-090519-S	Ammonia	0.02	0.01	0.0064
COMBITR02-090519-S	Ammonia	0.01	0.01	0.0064
BITR-C05BITRR03-071719-S	Nitrate + Nitrite	0.011	0.002	0.00239
BITR-C05BITRR06-071719-S	Nitrate + Nitrite	0.006	0.002	0.00239
BITR-C05BITRR24-071619-S	Nitrate + Nitrite	0.006	0.002	0.00239
COMBITR04-071719-S	Nitrate + Nitrite	0.003	0.002	0.00239
BITR-C05BITRR03-090419-S	Orthophosphate	0.011	0.001	0.001
BITR-C05BITRR06-090419-S	Orthophosphate	0.014	0.001	0.001
BITR-C05BITRR24-090519-S	Orthophosphate	0.016	0.001	0.001
COMBITR02-090519-S	Orthophosphate	0.016	0.001	0.001
COMBITR03-090519-S	Orthophosphate	0.013	0.001	0.001
COMBITR04-090419-S	Orthophosphate	0.016	0.001	0.001
BITR-C05BITRR03-073119-S	Total Phosphorus	0.012	0.002	0.002
BITR-C05BITRR06-073119-S	Total Phosphorus	0.008	0.002	0.002
BITR-C05BITRR24-073019-QC-FD	Total Phosphorus	0.021	0.002	0.002
BITR-C05BITRR24-073019-S	Total Phosphorus	0.012	0.002	0.002
COMBITR02-073019-S	Total Phosphorus	0.014	0.002	0.002
COMBITR03-073019-S	Total Phosphorus	0.015	0.002	0.002
COMBITR04-073119-S	Total Phosphorus	0.025	0.002	0.002

FIELD DUPLICATES

J – Flags:

The following field duplicates were outside the data quality objective for relative percent difference (RPD). As specified in the QAPP, field duplicate RPD should be <25% for duplicate results that are >5 times the lower reporting limit (LRL). Field duplicate results, along with the parent duplicate, that exceed the objective are J flagged.

Table 4.5: Field duplicates and parents with RPD >25% for results that are >5x the LRL

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	Relative Percent Difference
BITR-C05BITRR06-090419-S	Nitrate + Nitrite	0.019	0.002	45%
BITR-C05BITRR06-090419-QC-FD	Nitrate + Nitrite	0.012	0.002	
BITR-C05BITRR06-090419-S	Orthophosphate	0.014	0.001	173%
BITR-C05BITRR06-090419-QC-FD	Orthophosphate	Not Detected	0.001	
BITR-C05BITRR24-073019-S	Total Phosphorus	0.012	0.002	55%
BITR-C05BITRR24-073019-QC-FD	Total Phosphorus	0.021	0.002	

J – Flags:

The following results are J flagged for being associated to a field duplicate that exceeds the DQO for RPD. A result is considered associated if it is the same parameter and collected on the same sampling trip.

Table 4.6: Results associated with field duplicates that exceeded their RPD objective

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)
BITR-C05BITRR03-090419-S	Nitrate + Nitrite	0.010	0.002
COMBITR04-090419-S	Nitrate + Nitrite	0.020	0.002
BITR-C05BITRR24-090519-S	Nitrate + Nitrite	0.004	0.002
COMBITR03-090519-S	Nitrate + Nitrite	0.029	0.002
COMBITR02-090519-S	Nitrate + Nitrite	0.019	0.002
BITR-C05BITRR06-090419-QC-FB	Orthophosphate	0.011	0.001
BITR-C05BITRR03-090419-S	Orthophosphate	0.011	0.001
COMBITR04-090419-S	Orthophosphate	0.016	0.001
BITR-C05BITRR24-090519-S	Orthophosphate	0.016	0.001
COMBITR03-090519-S	Orthophosphate	0.013	0.001
COMBITR02-090519-S	Orthophosphate	0.016	0.001
COMBITR03-073019-S	Total Phosphorus	0.015	0.002
COMBITR02-073019-S	Total Phosphorus	0.014	0.002
BITR-C05BITRR06-073119-S	Total Phosphorus	0.008	0.002
BITR-C05BITRR03-073119-S	Total Phosphorus	0.012	0.002
COMBITR04-073119-S	Total Phosphorus	0.025	0.002
BITR-C05BITRR24-073019-QC-FB	Total Phosphorus	0.007	0.002

REJECTED

No results were rejected.

GENERAL QUALITY CHECKS

Total phosphorus was compared to orthophosphate and total nitrogen was compared to nitrate+nitrite plus ammonia. The results were reviewed to make sure the individual components were not more than the total. Total nitrogen results were all greater than the individual nitrogen values. In comparison, many total phosphorus results were less than orthophosphate. If the results had a RPD >10%, both the TP and SRP result were J flagged to indicate the result is estimated.

Table 4.7: Results J flagged for TP<SRP

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	Relative Percent Difference
BITR-C05BITRR06-070619-S	Orthophosphate	0.012	0.001	67%
BITR-C05BITRR06-070619-S	Total Phosphorus	0.006	0.002	
BITR-C05BITRR03-070619-S	Orthophosphate	0.015	0.001	61%
BITR-C05BITRR03-070619-S	Total Phosphorus	0.008	0.002	
COMBITR04-070619-S	Orthophosphate	0.017	0.001	52%
COMBITR04-070619-S	Total Phosphorus	0.010	0.002	
BITR-C05BITRR24-070719-S	Orthophosphate	0.015	0.001	22%
BITR-C05BITRR24-070719-S	Total Phosphorus	0.012	0.002	
COMBITR02-070719-S	Orthophosphate	0.018	0.001	18%
COMBITR02-070719-S	Total Phosphorus	0.015	0.002	
COMBITR02-070719-QC-FD	Orthophosphate	0.016	0.001	13%
COMBITR02-070719-QC-FD	Total Phosphorus	0.014	0.002	
COMBITR02-071619-S	Orthophosphate	0.039	0.001	106%
COMBITR02-071619-S	Total Phosphorus	0.012	0.002	
COMBITR03-071619-S	Orthophosphate	0.039	0.001	102%
COMBITR03-071619-S	Total Phosphorus	0.014	0.002	
BITR-C05BITRR24-071619-S	Orthophosphate	0.039	0.001	125%
BITR-C05BITRR24-071619-S	Total Phosphorus	0.009	0.002	
BITR-C05BITRR06-071719-S	Orthophosphate	0.038	0.001	91%
BITR-C05BITRR06-071719-S	Total Phosphorus	0.018	0.002	
BITR-C05BITRR03-071719-S	Orthophosphate	0.037	0.001	136%
BITR-C05BITRR03-071719-S	Total Phosphorus	0.007	0.002	
COMBITR04-071719-S	Orthophosphate	0.039	0.001	118%
COMBITR04-071719-S	Total Phosphorus	0.010	0.002	
COMBITR03-071619-QC-FD	Orthophosphate	0.043	0.001	113%
COMBITR03-071619-QC-FD	Total Phosphorus	0.012	0.002	
BITR-C05BITRR24-073019-S	Orthophosphate	0.023	0.001	63%
BITR-C05BITRR24-073019-S	Total Phosphorus	0.012	0.002	
COMBITR03-073019-S	Orthophosphate	0.023	0.001	40%
COMBITR03-073019-S	Total Phosphorus	0.015	0.002	
COMBITR02-073019-S	Orthophosphate	0.025	0.001	56%
COMBITR02-073019-S	Total Phosphorus	0.014	0.002	
BITR-C05BITRR06-073119-S	Orthophosphate	0.022	0.001	93%
BITR-C05BITRR06-073119-S	Total Phosphorus	0.008	0.002	
BITR-C05BITRR03-073119-S	Orthophosphate	0.025	0.001	70%
BITR-C05BITRR03-073119-S	Total Phosphorus	0.012	0.002	
COMBITR04-073119-S	Orthophosphate	0.033	0.001	28%
COMBITR04-073119-S	Total Phosphorus	0.025	0.002	
BITR-C05BITRR24-073019-QC-FD	Orthophosphate	0.024	0.001	13%
BITR-C05BITRR24-073019-QC-FD	Total Phosphorus	0.021	0.002	
BITR-C05BITRR24-082019-S	Orthophosphate	0.024	0.001	141%
BITR-C05BITRR24-082019-S	Total Phosphorus	0.008	0.002	
COMBITR03-082019-S	Orthophosphate	0.028	0.001	67%
COMBITR03-082019-S	Total Phosphorus	0.014	0.002	
COMBITR02-082019-S	Orthophosphate	0.025	0.001	86%
COMBITR02-082019-S	Total Phosphorus	0.010	0.002	

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	Relative Percent Difference
BITR-C05BITRR06-082119-S	Orthophosphate	0.024	0.001	131%
BITR-C05BITRR06-082119-S	Total Phosphorus	0.005	0.002	
BITR-C05BITRR03-082119-S	Orthophosphate	0.023	0.001	106%
BITR-C05BITRR03-082119-S	Total Phosphorus	0.007	0.002	
BITR-C05BITRR03-082119-QC-FD	Orthophosphate	0.023	0.001	129%
BITR-C05BITRR03-082119-QC-FD	Total Phosphorus	0.005	0.002	
COMBITR04-082119-S	Orthophosphate	0.031	0.001	53%
COMBITR04-082119-S	Total Phosphorus	0.018	0.002	
BITR-C05BITRR06-090419-S	Orthophosphate	0.014	0.001	43%
BITR-C05BITRR06-090419-S	Total Phosphorus	0.009	0.002	
BITR-C05BITRR06-090419-QC-FB	Orthophosphate	0.011	0.001	100%
BITR-C05BITRR06-090419-QC-FB	Total Phosphorus	Not Detected	0.002	
BITR-C05BITRR24-090519-S	Orthophosphate	0.016	0.001	37%
BITR-C05BITRR24-090519-S	Total Phosphorus	0.011	0.002	
COMBITR03-090519-S	Orthophosphate	0.013	0.001	17%
COMBITR03-090519-S	Total Phosphorus	0.011	0.002	
COMBITR02-090519-S	Orthophosphate	0.016	0.001	37%
COMBITR02-090519-S	Total Phosphorus	0.011	0.002	
BITR-C05BITRR06-091819-S	Orthophosphate	0.016	0.001	13%
BITR-C05BITRR06-091819-S	Total Phosphorus	0.014	0.002	
BITR-C05BITRR24-091819-S	Orthophosphate	0.015	0.001	14%
BITR-C05BITRR24-091819-S	Total Phosphorus	0.013	0.002	
COMBITR03-091919-S	Orthophosphate	0.016	0.001	29%
COMBITR03-091919-S	Total Phosphorus	0.012	0.002	
COMBITR02-091919-QC-FD	Orthophosphate	0.015	0.001	22%
COMBITR02-091919-QC-FD	Total Phosphorus	0.012	0.002	
BITR-C05BITRR06-100219-S	Orthophosphate	0.018	0.001	77%
BITR-C05BITRR06-100219-S	Total Phosphorus	0.008	0.002	
BITR-C05BITRR03-100219-S	Orthophosphate	0.015	0.001	61%
BITR-C05BITRR03-100219-S	Total Phosphorus	0.008	0.002	
BITR-C05BITTRR24-100219-S	Orthophosphate	0.016	0.001	37%
BITR-C05BITTRR24-100219-S	Total Phosphorus	0.011	0.002	
BITR-C05BITTRR24-100219-QC-FD	Orthophosphate	0.019	0.001	62%
BITR-C05BITTRR24-100219-QC-FD	Total Phosphorus	0.010	0.002	
BITR-C05BITRR06-101619-S	Orthophosphate	0.020	0.001	108%
BITR-C05BITRR06-101619-S	Total Phosphorus	0.006	0.002	
BITR-C05BITRR06-101619-QC-FD	Orthophosphate	0.020	0.001	108%
BITR-C05BITRR06-101619-QC-FD	Total Phosphorus	0.006	0.002	
BITR-C05BITRR06-101619-QC-FB	Orthophosphate	0.016	0.001	120%
BITR-C05BITRR06-101619-QC-FB	Total Phosphorus	0.004	0.002	
BITR-C05BITRR03-101619-S	Orthophosphate	0.019	0.001	117%
BITR-C05BITRR03-101619-S	Total Phosphorus	0.005	0.002	
COMBITR04-101619-S	Orthophosphate	0.021	0.001	80%
COMBITR04-101619-S	Total Phosphorus	0.009	0.002	
BITR-C05BITTRR24-101819-S	Orthophosphate	0.015	0.001	73%
BITR-C05BITTRR24-101819-S	Total Phosphorus	0.007	0.002	
COMBITR03-101819-S	Orthophosphate	0.013	0.001	17%
COMBITR03-101819-S	Total Phosphorus	0.011	0.002	

Activity ID	Characteristic Name	Result Value (mg/l)	LRL (mg/l)	Relative Percent Difference
COMBITR02-101819-S	Orthophosphate	0.013	0.001	36%
COMBITR02-101819-S	Total Phosphorus	0.009	0.002	

LABORATORY QC

Percent Recovery: The percent recovery for all lab samples, particularly the matrix spike and matrix spike duplicate (MS/MSD), should be within the low and high limits established by the lab. If result is outside the limits, the associated results are J flagged and include the comment "MS/MSD failed [high/low] (xx/xx%), expect [high/low] bias." A result is considered associated if it is the same parameter and analyzed in the same lab batch as the MS/MSD.

Table 4.8: Results J flagged for high MS/MSD, expect high bias

Activity ID	Characteristic Name	Result Value (mg/l)	Matrix Spike (%)	Matrix Spike Duplicate (%)
BITR-C05BITRR03-071719-S	Total Phosphorus	0.007	113	114
BITR-C05BITRR03-100219-S	Total Phosphorus	0.008	113	114
BITR-C05BITRR06-071719-S	Total Phosphorus	0.018	113	114
BITR-C05BITRR06-100219-S	Total Phosphorus	0.008	113	114
BITR-C05BITRR24-071619-S	Total Phosphorus	0.009	113	114
BITR-C05BITRR24-100219-QC-FB	Total Phosphorus	0.002	113	114
BITR-C05BITRR24-100219-QC-FD	Total Phosphorus	0.010	113	114
BITR-C05BITRR24-100219-S	Total Phosphorus	0.011	113	114
COMBITR02-071619-S	Total Phosphorus	0.012	113	114
COMBITR02-100319-S	Total Phosphorus	0.010	113	114
COMBITR03-071619-QC-FB	Total Phosphorus	0.002	110	121
COMBITR03-071619-QC-FD	Total Phosphorus	0.012	110	121
COMBITR03-071619-S	Total Phosphorus	0.014	110	121
COMBITR03-100319-S	Total Phosphorus	0.011	110	121
COMBITR02-071719-S	Total Phosphorus	0.010	110	121
COMBITR02-100219-S	Total Phosphorus	0.010	110	121
BITR-C05BITRR03-073119-S	Nitrate + Nitrite	0.048	110	121
BITR-C05BITRR06-073119-S	Nitrate + Nitrite	0.006	110	121
BITR-C05BITRR24-073019-QC-FD	Nitrate + Nitrite	0.010	110	121
BITR-C05BITRR24-073019-S	Nitrate + Nitrite	0.008	110	121
COMBITR02-073019-S	Nitrate + Nitrite	0.100	110	121
COMBITR03-073019-S	Nitrate + Nitrite	0.059	110	121
COMBITR04-073119-S	Nitrate + Nitrite	0.019	110	121

Table 4.9: Results J flagged for low MS/MSD, expect low bias

Activity ID	Characteristic Name	Result Value (mg/l)	Matrix Spike (%)	Matrix Spike Duplicate (%)
BITR-C05BITRR03-071719-S	Nitrate + Nitrite	0.011	86	85
BITR-C05BITRR06-071719-S	Nitrate + Nitrite	0.006	86	85
BITR-C05BITRR24-071619-S	Nitrate + Nitrite	0.006	86	85
COMBITR02-071619-S	Nitrate + Nitrite	0.051	86	85
COMBITR03-071619-QC-FB	Nitrate + Nitrite	0.004	86	85
COMBITR03-071619-QC-FD	Nitrate + Nitrite	0.049	86	85
COMBITR03-071619-S	Nitrate + Nitrite	0.056	86	85

Activity ID	Characteristic Name	Result Value (mg/l)	Matrix Spike (%)	Matrix Spike Duplicate (%)
COMBITR04-071719-S	Nitrate + Nitrite	0.003	86	85
BITR-C05BITRR24-101819-S	Total Nitrogen	0.006	88	87
COMBITR02-101819-S	Total Nitrogen	0.012	88	87
COMBITR03-101819-S	Total Nitrogen	0.013	88	87

5.0 QC SUMMARY

FLAGGED DATA

The overall project data had:

- 16 results H flagged for exceeding method holding time
- 51 results B flagged for field blank contamination
- 58 results J flagged for result value between the MDL and LRL
- 96 results J flagged for SRP>TP
- 23 results J flagged for MS/MSD failed high, expect high bias
- 11 results J flagged for MS/MSD failed low, expect low bias
- 23 results J flagged for field duplicate RPD>25%

COMPLETENESS

The overall project sample completeness rate for sites included in the QAPP is 92.42%. No sampling was done for Chlorophyll-a in the month of August due to staffing issues. This rate does not include results for site COMBITR04, which was not in the QAPP. When including sample numbers from that site in the total, the completeness rate is 93.33%, both of which are above the 90% requirement set forth in the QAPP. If any sample collection is missed, rationale should be documented and clearly communicated in a report to DEQ at the time of EDD submission. The only missing project files at the time of this report are photos. BRPA plans to mail the photos to DEQ on a flash drive.

6.0 CORRECTIVE ACTIONS

As a result of the QA review, the following are corrective actions items for 2020:

- BRPA field forms and fully signed COCs should be delivered to DEQ when the MT-eWQX electronic data deliverable (EDD) is delivered.
- Photos for benthic algae should be delivered to DEQ with the field forms and EDD. Both the SAP and QAPP indicate digital photos will be taken and submitted.
- BRPA field forms should be completely filled out and clearly indicate what samples were collected.
- A Sample ID field should be added to the field forms and should be populated with an ID that matches the ID used on the BRPA COC.
- Sample ID on COC and bottle labels should match.
- Add COMBITR04 (Bitterroot River at Veteran's Bridge) to SAP if long-term monitoring is intended for this site.

ELI NonConformance Report CAR ID:Omega 86

Date Initiated:	Initiated By:	Delegated To:	Target Date:	Department:
11/7/19	*Jon Hager*	*Amanda Carlson*		*Nutrients*
Instrument ID:	Prep Batch ID:	Analytical Run ID:	Work Order:	Status/Date:
FIA-202_He	*NA*	*NA*	*NA*	

Detailed Description:

Amanda Osborne contacted Wanda Johnson regarding samples for the Clark Fork Volunteer monitoring group for samples where ortho-phosphorous is greater than the associated total phosphorous.

For workorders where SRP is greater than the associated TP, the samples are re-analyzed prior to releasing the final report to confirm the reported values. The results were confirmed prior to finalizing the report.

After discussion with Amanda, a nonconformance investigation was initiated to determine if the nonconformance was related to the samples as submitted, or if it was a method performance issue.

Samples for Clark Fork were re-analyzed at this time using samples stored from previous SDGs. These samples were filtered in the lab using filters rinsed using laboratory reagent water to remove any contaminants. The results of this re-analysis were consistent with the reported results.

Initial review of the procedure included a review of the control charts and a recalculation of the MDL. MDL evaluation reviewed MBLK performance and the performance of two low level standards analyzed on two separate days for each quarter.
The EPA 365.1 method was reviewed, in addition to the ortho-phosphorous and total phosphorous Lachat method. The ELI SOP details analysis based on a combination of both EPA 365.1 and the Lachat method. The components of the Lachat method which differ from EPA 365.1 are listed in the deviations section of the ELI SOP. Specifically, the Lachat method specifications utilized are:

4.1 Ascorbic Acid solution is prepared according to the Lachat method except does not use sodium dodecyl sulfate (SDS).
4.2 Color Reagent is prepared following the orthophosphate Lachat method.
4.3 Total phosphorous samples are digested with potassium persulfate, rather than ammonium persulfate, per the Lachat method.
4.4 Total phosphorus carrier is made with 10 mL sulfuric acid to better match the sample digestate matrix.

Determination of the root cause of this nonconformance required significant troubleshooting of the method and instrument performance. Blank performance, both method blank and field blanks, was consistent with historical performance. Additionally, the occurrence of samples where total phosphorous was less than ortho-phosphorous appeared to be inconsistent as some sample delivery groups yielded results with the expected OP/TP relationship, and some SDGs had a mix of OP/TP results. Additionally, upon re-analysis on a separate day, the results were within duplication. There were also analytical runs where one SDG yielded the expected relationship; whereas other samples did not.

The same set of stock standards are used for both total phosphorous and ortho-phosphorous. The low level standards for ortho-phosphorous are prepared fresh daily from a high concentration stock using serial dilutions. The total phosphorous standards are digested in accordance with EPA 365.1, undergoing the same digestion procedure as the analytical samples. As confirmation there were no degradation issues with the standards, all standards and reagents used in the analysis were re-prepared. A second source of the stock chemicals was also tested to ensure there were no contamination issues with the original stock. Additionally, the reagents and acids used for the total phosphorous digestion were re-prepared.

An evaluation of the MDL using the spike values and blank values from 2019 was evaluated to see if there was a measurable shift in method performance at low levels. The table below summarizes the MDL evaluations since June 2018 when the initial MDL study (in accordance with 40CFR136 Appendix B, 2017 Revision.

Type	Samp ID	Final Val	Conc	Units	RunID	Analysis Date
MDL	H18060330-001A	0.00272	0.003	mg/L	FIA202-HE_180621B	06/21/2018
MDL	H18060330-002A	0.0027	0.003	mg/L	FIA202-HE_180621B	06/21/2018
MDL	H18060330-003A	0.00285	0.003	mg/L	FIA202-HE_180623A	06/23/2018
MDL	H18060330-004A	0.00318	0.003	mg/L	FIA202-HE_180626B	06/26/2018
MDL	H18060330-005A	0.00327	0.003	mg/L	FIA202-HE_180626B	06/26/2018
MDL	H18060330-006A	0.00304	0.003	mg/L	FIA202-HE_180626B	06/26/2018
MDL	H18060330-007A	0.00329	0.003	mg/L	FIA202-HE_180626B	06/26/2018

MDL	H18060330-008A	0.00361	0.003	mg/L	FIA202-HE_180626B	06/26/2018
MDL	H18070195-039A	0.00266	0.003	mg/L	FIA202-HE_180719A	07/19/2018
MDL	H18070195-040A	0.00347	0.003	mg/L	FIA202-HE_180720C	07/20/2018
MDL	H18100012-039A	0.0032	0.003	mg/L	FIA202-HE_181002A	10/02/2018
MDL	H18100012-040A	0.00409	0.003	mg/L	FIA202-HE_181003A	10/03/2018
MDL	H19010052-039A	0.00411	0.003	mg/L	FIA202-HE_190109A	01/09/2019
MDL	H19010052-040A	0.0036	0.003	mg/L	FIA202-HE_190117A	01/17/2019
MDL	H19040004-039A	0.00293	0.003	mg/L	FIA202-HE_190404A	04/04/2019
MDL	H19040004-040A	0.00364	0.003	mg/L	FIA202-HE_190430B	04/30/2019
MDL	H19070238-039A	0.00355	0.003	mg/L	FIA202-HE_190718A	07/18/2019
MDL	H19070238-040A	0.00278	0.003	mg/L	FIA202-HE_190719A	07/19/2019
MDL	H19100307-039A	0.00394	0.003	mg/L	FIA202-HE_191022A	10/22/2019
MDL	H19100307-040A	0.00447	0.003	mg/L	FIA202-HE_191029A	10/29/2019

The 2020 MDL evaluation study summary, including MDL samples analyzed quarterly from 2019 calculated a MDL(spike) value of 0.00133 mg/L.

The table below summarizes the calibration and the analysis of a 4th quarter MDL sample.

Known Conc. (mg/L)	Peak Area (V.s)	Peak Height (V)	% Residual	Det. Conc (mg/L)	Detection Date	Detection Time
0.50000	9.66036	0.77323	0.5	0.49750	10/29/2019	11:12:30 AM
0.25000	4.99815	0.39843	-2.8	0.25628	10/29/2019	11:13:32 AM
0.10000	1.90063	0.15039	2.4	0.09712	10/29/2019	11:14:34 AM
0.05000	0.91184	0.07089	6.5	0.04649	10/29/2019	11:15:37 AM
0.01000	0.19514	0.01460	1.0	0.00985	10/29/2019	11:16:38 AM
0.00500	0.10687	0.00796	-7.0	0.00534	10/29/2019	11:17:39 AM
0.00300	0.07310	0.00516	-20.0	0.00362	10/29/2019	11:18:40 AM
0.00100	0.03129	0.00232	-42.1	0.00148	10/29/2019	11:23:34 AM
0.00000	-0.01068	-0.00113		-0.00066	10/29/2019	11:24:54 AM
MDL	0.08985	0.00535	N/A	0.00447	10/29/19	11:32:29 AM

The same FIA Lachat phosphorous manifold is utilized for both ortho-phosphorous and total phosphorous. Reviewing the Lachat procedures, there are differences in manifold (back pressure loop andd alternate coil length) recommended by the Lachat procedure. Historical performance, verified by MDLs, blank evaluations, second source QAQC and PT studies have confirmed performance with the current manifold. With the current manifold however, the same flow cell, sample heater and detector are utilized therefore performance should be consistent between the two methods. The sample heater temperature was verified using an IR thermometer and was found to be operating within method specifications. The back pressure loop was changed to the length specified in the Lachat ortho-phosphorous method; however there were no significant differences in performance of samples.

From Hach (Lachat) a discussion on the Question board regarding back pressure loops:

In general, back pressure loops are added to help minimize air spikes. In some heated chemistries (like ammonia), as the temperature increases, gas solubility decreases and so air spikes are more likely to form. Back pressure loops are added to help force gas back into solution (increases in pressure result in increased gas solubility). For chemistries like phosphorous where the temperature only reaches 37 °C, back pressure loops may not be necessary depending on how many air spikes are observed.

If one decides to add a back pressure loop, additions of only 50 cm at a time are recommended (use the shortest length of coiled tubing that helps with air spikes). If too large of a back pressure loop is added, it could restrict and slow down fluid flow which will increase reaction time and result in increased peak heights over time.

Calibrations were reviewed for % residuals when the standard response is compared against the calibration curve. Example documentation is included in the NCAR files. Below is an example of the evaluation during the troubleshooting process of the calibration standards when the concentration is calculated against the calibration curve.

	Known Conc. (mg/L)	Peak Area (V.s)	Peak Height (V)	% RSD	% Residual	Det. Conc (mg/L)	Detection Date	Detection Time
1	0.5	10.06918	0.7277	0	0.5	0.49729	12/10/2019	8:54:57 AM
2	0.25	4.86503	0.347	0	-2.4	0.25636	12/10/2019	8:55:59 AM
3	0.1	1.82819	0.12418	0	0.3	0.09938	12/10/2019	8:57:02 AM

4	0.05	0.88702	0.05927	0	2.8	0.04829	12/10/2019	8:58:05 AM
5	0.01	0.16462	0.01131	0	15.1	0.00828	12/10/2019	8:59:06 AM
6	0.005	0.10448	0.00609	0	0.8	0.00492	12/10/2019	9:00:06 AM
7	0.003	0.06627	0.00483	0	5.3	0.00278	12/10/2019	9:01:07 AM
8	0.001	0.0365	0.00239	0	-5.4	0.00111	12/10/2019	9:02:07 AM
9	0	0.01968	0.00117			0.00017	12/10/2019	9:03:11 AM

Samples were analyzed for ortho-phosphorous both unfiltered and filtered, and the filtered samples did have a lower concentration.

An evaluation of the calibration range of the instrument was reviewed. It was tested for ortho-phosphorous to remove the highest calibration standards and evaluate the impact of a calibration range from 0.001 mg/L - 0.05 mg/L from an existing study then recalculating the results. There was not a significant impact in the analytical results from this. The calibration range was lowered for evaluation and a set of test samples re-evaluated to determine if a smaller calibrated range has an impact. The lower calibration range 0.001-0.01 did not yield a difference in results.

An analysis using the calibration standards used for Ion Chromatography (EPA 300.0) was evaluated. The higher concentration standards did show some deviation; however the low level standards were consistent in performance.

A set of standards were evaluated having been prepared in the analysis tubes with calibration standards and field samples. 10mL of sample was added with proportional amounts of the reagents used for analysis. Under room temperature conditions, it was observed that the reaction rate of the calibration standards was slower than the reaction rate of some field samples. Using TMDL samples where the ortho-phosphorous was greater than the total phosphorous, the observed reaction rate in sample tubes was accelerated compared to standards. Verifying field blanks, other client samples, and samples where previously the total phosphorous was greater than the ortho-phosphorous, the reaction rate was more consistent with the laboratory standards as it appeared to the eye. This indicated the difference in reaction rate was sample specific and did not apply to all samples analyzed for ortho-phosphorous. This was consistent with the method performance observed by the lab. Sample peaks were not routinely detected on field blanks and method blanks. Samples where TP<OP, the peak areas were greater than the associated total phosphorous peak when analyzed.

The sample heater used in the Lachat manifold should serve as a mechanism to create equilibrium in the reaction rates for samples and standards. In the QuikChemFIA+ User Manual, under the section on wrapping a heating block, it states "wrap the 175 or 650 cm of tubing on the block. Make sure that you leave between 30 and 40 cm of tubing unwrapped at both ends. These long leads are necessary for connecting the tubing to the manifolds. Do not wrap the tubing too tightly, but make sure that it is in contact with the block surface for good heat transference."

Evaluation of various lengths of tubing to leave unwrapped did indicate that this can have an impact in sample results at low levels. The tubing is considered a consumable material and requires replacement periodically. A discussion of these lengths was not in the EPA or Lachat analytical method. Measuring the tubing to a length within this range yielded lower concentration results, more consistent with intralaboratory duplicate data comparisons. Below is the calibration table after adjusting the tubing length left off the heater:

	Known Conc. (mg/L)	Peak Area (V.s)	Peak Height (V)	% RSD	% Residual	Det. Conc (mg/L)	Detection Date	Detection Time
1	0.5	10.39154	0.8142	0	0.2	0.4993	12/11/2019	1:23:34 PM
2	0.25	5.19312	0.4042	0	-0.6	0.25142	12/11/2019	1:24:37 PM
3	0.1	2.05782	0.15966	0	0.2	0.0997	12/11/2019	1:25:39 PM
4	0.05	1.05129	0.07973	0	-1.4	0.05063	12/11/2019	1:26:42 PM
5	0.01	0.20327	0.01501	0	7.6	0.00916	12/11/2019	1:27:43 PM
6	0.005	0.1142	0.00828	0	3.4	0.0048	12/11/2019	1:28:44 PM
7	0.003	0.07599	0.00567	0	1.9	0.00293	12/11/2019	1:29:44 PM
8	0.001	0.03182	0.00228	0	13.3	0.00076	12/11/2019	1:30:45 PM
9	0	0.02379	0.00135			0.00037	12/11/2019	1:31:48 PM

Additionally, new instruments for phosphorous analysis are being evaluated as part of our continual improvement plan. Two instruments are under evaluation, a FIA and a segmented flow analyzer. The segmented flow analysis does have the option to purchase an alternate flow cell which achieves lower detection limits. New instrumentation is anticipated in the first quarter of 2020.

Containment Action:

A split of the samples for H19110431 was subcontracted to ELI-B for total phosphorous and ortho-phosphorous. Total Phosphorous was within duplication between the two lab analyses; however ortho-phosphorous did indicate a high bias for analysis performed in the Helena lab. This bias appears to be 0.004-0.005 mg/L for some samples. It appears the additional sulfuric acid and the digestion procedure for total phosphorous are factors in stabilizing the reaction rate.

The ortho-phosphorous testcode was updated to reflect that samples required a split and an aliquot subcontracted to ELI-B for ortho-phosphorous analysis until the source of the bias was determined.

Root Cause Analysis:

Description:	*Type*:* ***Design Issue***
Method and instrument manual does not provide specific instructions regarding significance of how the reaction coil is wrapped around the heater. Troubleshooting to determine source of bias indicated this has the potential to impact sample results at low concentrations.	

*Choose Type from: Continuous Improvement, Design Issue, Equipment Malfunction, Human Error – Failure to follow procedure, Human Error – mistake, Ineffective Training, Management, No Training, No Procedure, SOP Error, Unknown

Required Corrective/Preventative Actions:

Action:	*Designee:* ***K. Devault***	*(Include Acceptance Criteria)*		
Specify in the maintenance rules the specific measurements for the tubing lengths on both sides of the column heater used for analysis.				
Target Date:	Status/Date:	Validated By:	Validation Date:	Comments:

Action:	*Designee:* ***Wanda/Amanda***	*(Include Acceptance Criteria)*		
Within reporting, evaluate client sample data trends and if a trend becomes apparent, escalate the corrective action process beyond re-analysis.				
Target Date:	Status/Date:	Validated By:	Validation Date:	Comments:

Validation:

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	01/09/19 14:26	R141171		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	01/17/19 12:30	R141362		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	01/24/19 12:42	R141569		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	01/25/19 11:19	R141591		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	02/15/19 11:26	R142133		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	02/21/19 10:54	R142222		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	02/22/19 10:50	R142253		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	02/28/19 14:05	R142359		E365.1	Aqueous	SRW	90	110	97.0
ICV	ICV	03/07/19 11:53	R142487		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	03/13/19 14:23	R142585		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	03/15/19 12:50	R142617		E365.1	Aqueous	SRW	90	110	95.0
ICV	ICV	03/15/19 12:51	R142617		E365.1	Aqueous	SRW	90	110	95.0
ICV	ICV	03/15/19 12:53	R142617		E365.1	Aqueous	SRW	90	110	95.0
ICV	ICV	03/20/19 13:28	R142717		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	03/21/19 14:20	R142751		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	03/22/19 12:57	R142780		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	03/26/19 12:15	R142849		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	03/28/19 14:16	R142924		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	03/29/19 11:48	R142947		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	04/04/19 14:34	R143098		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	04/18/19 11:10	R143474		E365.1	Aqueous	kmd	90	110	94.0
ICV	ICV	04/25/19 11:19	R143668		E365.1	Aqueous	cmm	90	110	92.0
ICV	ICV	04/30/19 14:05	R143831		E365.1	Aqueous	kmd	90	110	90.0
ICV	ICV	05/01/19 16:09	R143886		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	05/02/19 12:29	R143912		E365.1	Aqueous	kmd	90	110	96.0
ICV	ICV	05/06/19 12:15	R143994		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	05/07/19 14:59	R144034		E365.1	Aqueous	kmd	90	110	95.0
ICV	ICV	05/10/19 16:59	R144148		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	05/14/19 12:47	R144210		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	05/14/19 15:41	R144219		E365.1	Aqueous	kmd	90	110	93.0
ICV	ICV	05/16/19 11:06	R144265		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	05/22/19 13:18	R144408		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	05/24/19 11:49	R144481		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	05/31/19 10:49	R144653		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	05/31/19 16:00	R144686		E365.1	Aqueous	kmd	90	110	94.0
ICV	ICV	06/06/19 8:28	R144818		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	06/07/19 11:23	R144875		E365.1	Aqueous	kmd	90	110	96.0
ICV	ICV	06/10/19 15:58	R144940		E365.1	Aqueous	kmd	90	110	95.0
ICV	ICV	06/12/19 17:43	R145012		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	06/13/19 14:49	R145050		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	06/14/19 14:25	R145086		E365.1	Aqueous	kmd	90	110	95.0
ICV	ICV	06/17/19 10:42	R145123		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	06/19/19 11:42	R145209		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	06/20/19 16:15	R145259		E365.1	Aqueous	kmd	90	110	95.0
ICV	ICV	06/21/19 15:06	R145284		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	06/24/19 14:13	R145332		E365.1	Aqueous	kmd	90	110	96.0
ICV	ICV	06/26/19 9:26	R145388		E365.1	Aqueous	cmm	90	110	94.0
ICV	ICV	06/28/19 14:09	R145494		E365.1	Aqueous	kmd	90	110	95.0

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	07/02/19 12:48	R145572		E365.1	Aqueous	kmd	90	110	98.0
ICV	ICV	07/03/19 12:12	R145624		E365.1	Aqueous	kmd	90	110	96.0
ICV	ICV	07/11/19 9:23	R145804		E365.1	Aqueous	kmd	90	110	95.0
ICV	ICV	07/12/19 9:00	R145832		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/16/19 13:15	R145921		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/16/19 15:28	R145921		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/18/19 9:14	R145998		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/19/19 8:32	R146059		E365.1	Aqueous	cmm	90	110	94.0
ICV	ICV	07/21/19 9:52	R146076		E365.1	Aqueous	cmm	90	110	91.0
ICV	ICV	07/24/19 10:23	R146171		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/26/19 9:27	R146256		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	07/30/19 9:43	R146350		E365.1	Aqueous	SRW	90	110	97.0
ICV	ICV	07/31/19 13:43	R146404		E365.1	Aqueous	jdh	90	110	98.0
ICV	ICV	07/31/19 13:44	R146404		E365.1	Aqueous	jdh	90	110	99.0
ICV	ICV	07/31/19 13:45	R146404		E365.1	Aqueous	jdh	90	110	99.0
ICV	ICV	07/31/19 13:46	R146404		E365.1	Aqueous	jdh	90	110	98.0
ICV	ICV	08/02/19 9:03	R146478		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	08/02/19 14:56	R146503		E365.1	Aqueous	cmm	90	110	92.0
ICV	ICV	08/07/19 9:33	R146622		E365.1	Aqueous	cmm	90	110	91.0
ICV	ICV	08/07/19 13:07	R146637		E365.1	Aqueous	cmm	90	110	90.0
ICV	ICV	08/08/19 13:10	R146692		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	08/09/19 12:30	R146721		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	08/13/19 12:36	R146802		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	08/14/19 15:34	R146843		E365.1	Aqueous	cmm	90	110	94.0
ICV	ICV	08/16/19 12:15	R146936		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	08/20/19 16:04	R147042		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	08/21/19 11:42	R147082		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	08/22/19 12:54	R147119		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	08/26/19 9:38	R147211		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	08/29/19 13:48	R147357		E365.1	Aqueous	cmm	90	110	92.0
ICV	ICV	09/03/19 15:16	R147451		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	09/05/19 14:02	R147507		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	09/06/19 11:06	R147541		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/06/19 12:02	R147541		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	09/09/19 15:47	R147618		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/13/19 16:40	R147773		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/19/19 11:38	R147923		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/19/19 16:02	R147941		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	09/20/19 16:12	R147973		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/21/19 11:16	R147985		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	09/24/19 9:20	R148053		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	09/26/19 11:52	R148138		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	09/27/19 10:25	R148164		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	10/01/19 9:26	R148265		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	10/01/19 12:30	R148272		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	10/03/19 12:26	R148356		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	10/08/19 10:32	R148490		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	10/09/19 11:26	R148528		E365.1	Aqueous	kmd	90	110	101.0

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

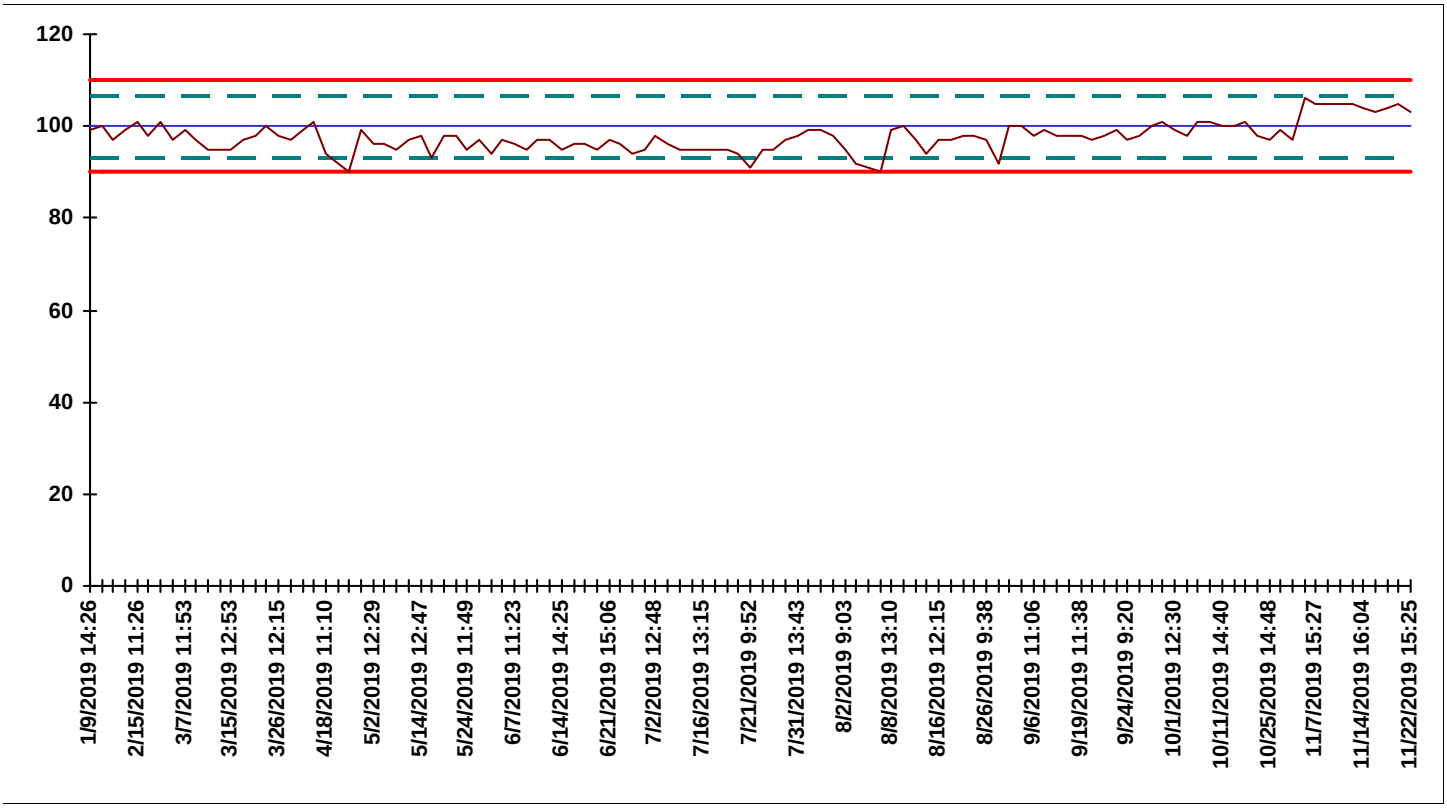
Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	10/11/19 14:40	R148636		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	10/17/19 11:38	R148799		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	10/22/19 9:11	R148908		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	10/23/19 15:26	R148955		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	10/25/19 14:48	R149040		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	10/29/19 11:27	R149125		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	11/01/19 15:46	R149277		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	11/06/19 10:47	R149385		E365.1	Aqueous	sbf	90	110	106.0
ICV	ICV	11/07/19 15:27	R149424		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	11/08/19 10:58	R149465		E365.1	Aqueous	sbf	90	110	105.0
ICV	ICV	11/08/19 14:49	R149491		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	11/13/19 13:35	R149593		E365.1	Aqueous	sbf	90	110	105.0
ICV	ICV	11/14/19 16:04	R149634		E365.1	Aqueous	sbf	90	110	104.0
ICV	ICV	11/15/19 15:29	R149670		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	11/20/19 9:19	R149785		E365.1	Aqueous	sbf	90	110	104.0
ICV	ICV	11/21/19 11:45	R149855		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	11/22/19 15:25	R149909		E365.1	Aqueous	sbf	90	110	103.0

Energy Laboratories Inc **REC QUALITY CONTROL CHART**

Date: ***06-Dec-19***

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec



Phosphorus,	***% Recovery Low***	***% Recovery High***	***% Recovery Statistical Data***	
Calculated Control	88.0	107	***Average***	97.6
Calculated Warning	91.2	104	***Std Dev***	3.22

Calculated Limits: Updated: Yes ☐ No ☐ Reviewed By: _____ Date: _____

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	01/10/18 8:26	R131564		E365.1	Aqueous	cmm	90	110	108.0
ICV	ICV	01/18/18 13:14	R131758		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	01/19/18 19:16	R131818		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	01/24/18 13:47	R131910		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	01/26/18 14:07	R131985		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	02/01/18 12:30	R132099		E365.1	Aqueous	cmm	90	110	105.0
ICV	ICV	02/02/18 12:59	R132143		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	02/06/18 11:52	R132209		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	02/07/18 12:43	R132247		E365.1	Aqueous	cmm	90	110	105.0
ICV	ICV	02/08/18 8:07	R132256		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	02/08/18 12:28	R132276		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	02/09/18 16:01	R132316		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	02/09/18 17:00	R132316		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	02/13/18 16:16	R132391		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	02/15/18 10:29	R132432		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	02/15/18 12:31	R132448		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	02/15/18 13:51	R132452		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	02/16/18 15:19	R132495		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	02/16/18 16:23	R132508		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	02/23/18 14:34	R132668		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	03/01/18 9:38	R132815		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	03/01/18 11:13	R132826		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	03/07/18 16:05	R132948		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	03/15/18 12:35	R133111		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	03/16/18 13:17	R133154		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	03/21/18 13:13	R133241		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	03/22/18 8:23	R133250		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	03/23/18 11:46	R133310		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	03/28/18 12:55	R133428		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	03/29/18 9:29	R133447		E365.1	Aqueous	cmm	90	110	94.0
ICV	ICV	03/29/18 11:31	R133454		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	03/30/18 11:39	R133501		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	04/03/18 11:57	R133557		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	04/05/18 13:41	R133657		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	04/09/18 14:09	R133726		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	04/10/18 13:12	R133802		E365.1	Aqueous	cmm	90	110	106.0
ICV	ICV	04/11/18 12:50	R133811		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	04/12/18 9:35	R133830		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	04/12/18 10:46	R133841		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	04/12/18 12:35	R133845		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	04/12/18 14:25	R133845		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	04/13/18 12:46	R133887		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	04/13/18 15:44	R133908		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	04/18/18 8:56	R133994		E365.1	Aqueous	cmm	90	110	105.0
ICV	ICV	04/18/18 10:43	R134000		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	04/18/18 14:08	R134016		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	04/18/18 15:46	R134016		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	04/20/18 13:32	R134096		E365.1	Aqueous	cmm	90	110	101.0

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	04/24/18 16:51	R134190		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	04/25/18 10:56	R134210		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	04/26/18 8:52	R134255		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	04/26/18 14:42	R134280		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	04/26/18 15:14	R134280		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	04/27/18 12:05	R134311		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	04/27/18 12:32	R134311		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	05/02/18 14:18	R134425		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	05/03/18 11:26	R134443		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	05/04/18 10:36	R134472		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	05/09/18 12:21	R134598		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	05/10/18 14:22	R134638		E365.1	Aqueous	kmd	90	110	102.0
ICV	ICV	05/11/18 13:06	R134668		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	05/15/18 11:19	R134731		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	05/16/18 12:32	R134785		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	05/17/18 13:42	R134822		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	05/18/18 12:04	R134848		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	05/21/18 12:05	R134921		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	05/22/18 16:02	R134964		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	05/25/18 12:31	R135048		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	05/25/18 16:42	R135062		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	05/31/18 8:38	R135168		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	05/31/18 12:50	R135188		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	06/05/18 12:59	R135301		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	06/08/18 11:31	R135405		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	06/12/18 12:14	R135477		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	06/13/18 11:29	R135520		E365.1	Aqueous	cmm	90	110	97.0
ICV	ICV	06/14/18 10:52	R135561		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	06/14/18 12:43	R135563		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	06/15/18 12:40	R135603		E365.1	Aqueous	cmm	90	110	95.0
ICV	ICV	06/19/18 9:19	R135673		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	06/19/18 10:49	R135673		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	06/20/18 15:44	R135742		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	06/21/18 11:54	R135771		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	06/22/18 12:10	R135810		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	06/22/18 15:33	R135820		E365.1	Aqueous	cmm	90	110	96.0
ICV	ICV	06/23/18 12:24	R135827		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	06/23/18 13:09	R135828		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	06/26/18 11:33	R135898		E365.1	Aqueous	kmd	90	110	96.0
ICV	ICV	06/26/18 14:25	R135898		E365.1	Aqueous	kmd	90	110	93.0
ICV	ICV	06/28/18 12:58	R135992		E365.1	Aqueous	kmd	90	110	94.0
ICV	ICV	06/29/18 12:53	R136038		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	07/03/18 15:22	R136144		E365.1	Aqueous	cmm	90	110	94.0
ICV	ICV	07/05/18 9:11	R136175		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	07/10/18 13:50	R136315		E365.1	Aqueous	cmm	90	110	98.0
ICV	ICV	07/11/18 12:35	R136376		E365.1	Aqueous	cmm	90	110	99.0
ICV	ICV	07/12/18 12:25	R136399		E365.1	Aqueous	cmm	90	110	100.0
ICV	ICV	07/13/18 15:42	R136434		E365.1	Aqueous	cmm	90	110	97.0

Energy Laboratories Inc

REC QUALITY CONTROL CHART

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

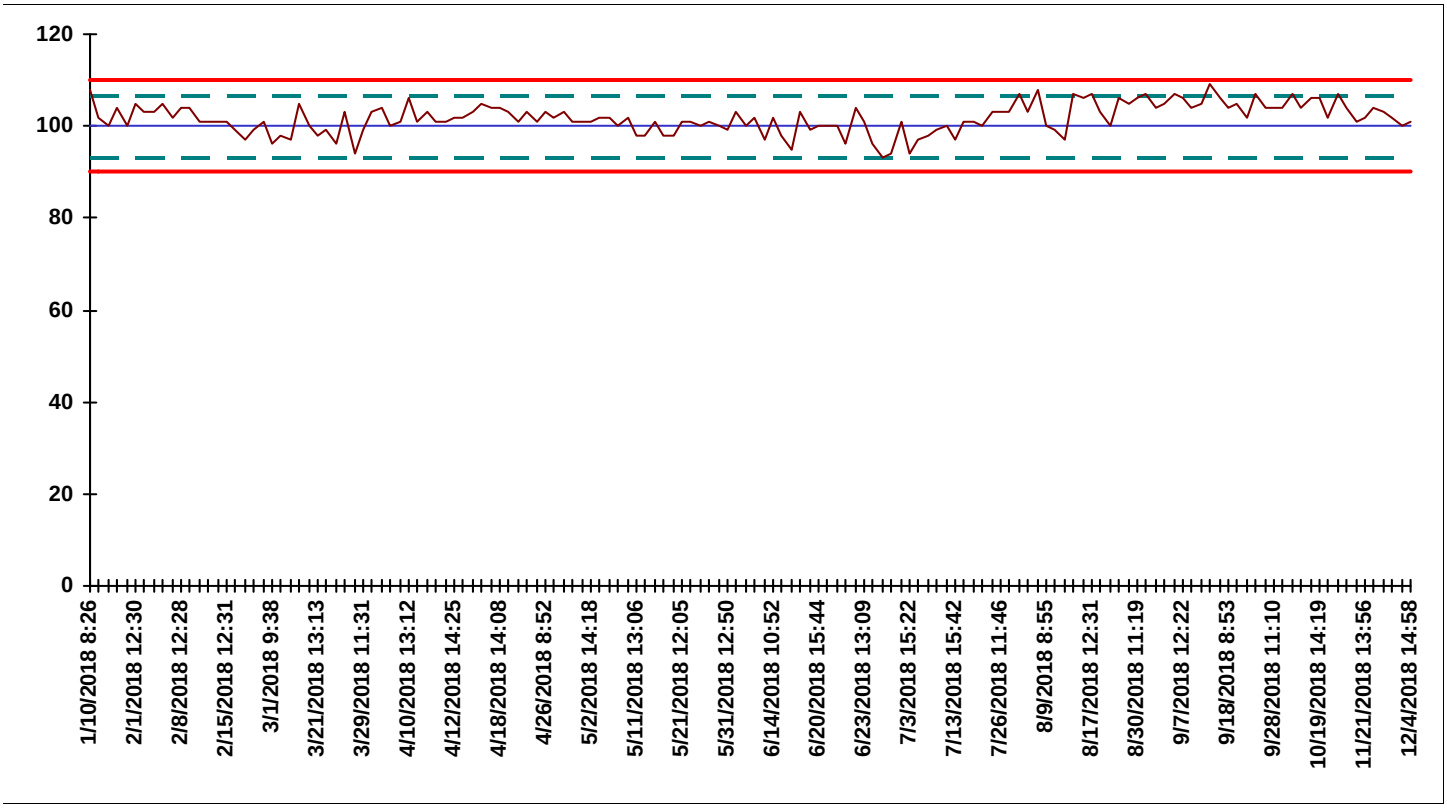
Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	07/19/18 12:01	R136605		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	07/20/18 16:53	R136672		E365.1	Aqueous	kmd	90	110	101.0
ICV	ICV	07/24/18 14:47	R136766		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	07/25/18 11:31	R136828		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	07/26/18 11:46	R136845		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	07/27/18 12:07	R136873		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	08/01/18 14:09	R136999		E365.1	Aqueous	cmm	90	110	107.0
ICV	ICV	08/02/18 11:24	R137030		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	08/08/18 15:06	R137194		E365.1	Aqueous	kmd	90	110	108.0
ICV	ICV	08/09/18 8:55	R137216		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	08/09/18 11:47	R137235		E365.1	Aqueous	kmd	90	110	99.0
ICV	ICV	08/13/18 12:33	R137329		E365.1	Aqueous	kmd	90	110	97.0
ICV	ICV	08/14/18 10:45	R137345		E365.1	Aqueous	cmm	90	110	107.0
ICV	ICV	08/16/18 14:06	R137450		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	08/17/18 12:31	R137457		E365.1	Aqueous	cmm	90	110	107.0
ICV	ICV	08/22/18 13:13	R137574		E365.1	Aqueous	cmm	90	110	103.0
ICV	ICV	08/24/18 14:26	R137650		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	08/28/18 11:15	R137748		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	08/29/18 11:50	R137779		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	08/30/18 11:19	R137822		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	08/31/18 11:19	R137839		E365.1	Aqueous	cmm	90	110	107.0
ICV	ICV	09/05/18 9:42	R137921		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	09/05/18 12:53	R137931		E365.1	Aqueous	cmm	90	110	105.0
ICV	ICV	09/06/18 13:59	R137971		E365.1	Aqueous	cmm	90	110	107.0
ICV	ICV	09/07/18 12:22	R137999		E365.1	Aqueous	cmm	90	110	106.0
ICV	ICV	09/10/18 11:42	R138034		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	09/10/18 11:44	R138034		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	09/13/18 13:23	R138158		E365.1	Aqueous	cmm	90	110	109.0
ICV	ICV	09/14/18 9:03	R138188		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	09/18/18 8:53	R138262		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	09/20/18 9:27	R138341		E365.1	Aqueous	kmd	90	110	105.0
ICV	ICV	09/25/18 14:12	R138500		E365.1	Aqueous	kmd	90	110	102.0
ICV	ICV	09/26/18 11:47	R138521		E365.1	Aqueous	kmd	90	110	107.0
ICV	ICV	09/27/18 11:28	R138563		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	09/28/18 11:10	R138591		E365.1	Aqueous	cmm	90	110	104.0
ICV	ICV	10/02/18 11:33	R138660		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	10/03/18 9:22	R138690		E365.1	Aqueous	kmd	90	110	107.0
ICV	ICV	10/11/18 14:47	R138944		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	10/15/18 13:55	R139018		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	10/19/18 14:19	R139190		E365.1	Aqueous	kmd	90	110	106.0
ICV	ICV	11/02/18 12:21	R139594		E365.1	Aqueous	kmd	90	110	102.0
ICV	ICV	11/08/18 15:04	R139761		E365.1	Aqueous	kmd	90	110	107.0
ICV	ICV	11/15/18 11:01	R139918		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	11/21/18 13:30	R140057		E365.1	Aqueous	cmm	90	110	101.0
ICV	ICV	11/21/18 13:56	R140067		E365.1	Aqueous	cmm	90	110	102.0
ICV	ICV	11/28/18 8:50	R140194		E365.1	Aqueous	kmd	90	110	104.0
ICV	ICV	11/28/18 15:02	R140219		E365.1	Aqueous	kmd	90	110	103.0
ICV	ICV	11/29/18 13:16	R140253		E365.1	Aqueous	kmd	90	110	102.0

Energy Laboratories Inc **REC QUALITY CONTROL CHART**

Date: *06-Dec-19*

Test Code: P-W-ORTHO **Analyte: PHOSPHORUS, ORTHOPHOSPHATE AS P**

Samp Type	Sample ID	Analysis Date	Batch ID	Prep Analyst	Method	Matrix	Analyst	Low Limit	High Limit	% Rec
ICV	ICV	11/30/18 15:06	R140294		E365.1	Aqueous	kmd	90	110	100.0
ICV	ICV	12/04/18 14:58	R140366		E365.1	Aqueous	kmd	90	110	101.0



Phosphorus,	*% Recovery Low*	*% Recovery High*	*% Recovery Statistical Data*	
Calculated Control	92.1	111	*Average*	101.7
Calculated Warning	95.3	108	*Std Dev*	3.21

Calculated Limits: Updated: Yes ☐ No ☐ Reviewed By: _____ Date: _____

Energy Laboratories, Inc.
Determination of Method Detection Limits (MDL)
40 CFR, Part 136, AppendixB, Rev 2 (EPA 821-R-16-006)

Study Number: 1475

Analyst: Kristine M. Devault | **Study Date:** 01/10/2020 | **Study Type:** On-Going

Instrument ID: FIA202-HE | **Matrix:** Aqueous | **Test Code:** P-W-ORTHO

Method: E365.1 | **Zero Type:** Numeric | **Units:** mg/L

Analyte	Analyte Data							
Phosphorus, Orthophosphate as P	**MDL**	**Ver MDL**	**Rpt Limit**	**Source**	**Prv MDL**	**Rev2Cmpl**	**tValue**	**MBLK Used**
	0.00139	Previous	0.005	Previous	0.00139	Yes	2.373	Last 6 mos
	Average	**Avg Rec**	**Stnd Dev**	**MDLs**	**MDLb**	**Conc**	**Prep Mthd**	
	8.831E-05	MDLb	0.0007542	0.00133	0.00188	MDLb		
	Analyte Comments:							

Repl Num	Type	Samp ID	Final Val	Conc	Units	RunID	Analysis Date	Analyst
1	MDL	H18060330-001A	0.00272	0.003	mg/L	FIA202-HE_180621B	06/21/2018	Kristine M. Devault
2	MDL	H18060330-002A	0.0027	0.003	mg/L	FIA202-HE_180621B	06/21/2018	Kristine M. Devault
3	MDL	H18060330-003A	0.00285	0.003	mg/L	FIA202-HE_180623A	06/23/2018	Kristine M. Devault
4	MDL	H18060330-004A	0.00318	0.003	mg/L	FIA202-HE_180626B	06/26/2018	Kristine M. Devault
5	MDL	H18060330-005A	0.00327	0.003	mg/L	FIA202-HE_180626B	06/26/2018	Kristine M. Devault
6	MDL	H18060330-006A	0.00304	0.003	mg/L	FIA202-HE_180626B	06/26/2018	Kristine M. Devault
7	MDL	H18060330-007A	0.00329	0.003	mg/L	FIA202-HE_180626B	06/26/2018	Kristine M. Devault
8	MDL	H18060330-008A	0.00361	0.003	mg/L	FIA202-HE_180626B	06/26/2018	Kristine M. Devault
9	MDL	H18070195-039A	0.00266	0.003	mg/L	FIA202-HE_180719A	07/19/2018	Kristine M. Devault
10	MDL	H18070195-040A	0.00347	0.003	mg/L	FIA202-HE_180720C	07/20/2018	Kristine M. Devault
11	MDL	H18100012-039A	0.0032	0.003	mg/L	FIA202-HE_181002A	10/02/2018	Kristine M. Devault
12	MDL	H18100012-040A	0.00409	0.003	mg/L	FIA202-HE_181003A	10/03/2018	Kristine M. Devault
13	MDL	H19010052-039A	0.00411	0.003	mg/L	FIA202-HE_190109A	01/09/2019	Kristine M. Devault
14	MDL	H19010052-040A	0.0036	0.003	mg/L	FIA202-HE_190117A	01/17/2019	Kristine M. Devault
15	MDL	H19040004-039A	0.00293	0.003	mg/L	FIA202-HE_190404A	04/04/2019	Kristine M. Devault
16	MDL	H19040004-040A	0.00364	0.003	mg/L	FIA202-HE_190430B	04/30/2019	Kristine M. Devault
17	MDL	H19070238-039A	0.00355	0.003	mg/L	FIA202-HE_190718A	07/18/2019	Cole Mergenthaler
18	MDL	H19070238-040A	0.00278	0.003	mg/L	FIA202-HE_190719A	07/19/2019	Cole Mergenthaler
19	MDL	H19100307-039A	0.00394	0.003	mg/L	FIA202-HE_191022A	10/22/2019	Kristine M. Devault
20	MDL	H19100307-040A	0.00447	0.003	mg/L	FIA202-HE_191029A	10/29/2019	Kristine M. Devault
1	MBLK	MBLK	-0.00015	0.000	mg/L	FIA202-HE_190711A	07/11/2019	Kristine M. Devault
2	MBLK	MBLK	0.00063	0.000	mg/L	FIA202-HE_190712A	07/12/2019	Cole Mergenthaler
3	MBLK	MBLK	-0.00114	0.000	mg/L	FIA202-HE_190716B	07/16/2019	Cole Mergenthaler
4	MBLK	MBLK	0.00096	0.000	mg/L	FIA202-HE_190718A	07/18/2019	Cole Mergenthaler
5	MBLK	MBLK	-0.00286	0.000	mg/L	FIA202-HE_190719A	07/19/2019	Cole Mergenthaler
6	MBLK	MBLK	0.00053	0.000	mg/L	FIA202-HE_190721A	07/21/2019	Cole Mergenthaler
7	MBLK	MBLK	0.00032	0.000	mg/L	FIA202-HE_190724A	07/24/2019	Cole Mergenthaler
8	MBLK	MBLK	0.0007	0.000	mg/L	FIA202-HE_190726B	07/26/2019	Cole Mergenthaler
9	MBLK	MBLK	-0.00187	0.000	mg/L	FIA202-HE_190730A	07/30/2019	Scott R. Wunderlich
10	MBLK	MBLK	-0.00162	0.000	mg/L	FIA202-HE_190731A	07/31/2019	Jonathan Hager
11	MBLK	MBLK	-0.0000257	0.000	mg/L	FIA202-HE_190802A	08/02/2019	Cole Mergenthaler
12	MBLK	MBLK	0.00000498	0.000	mg/L	FIA202-HE_190802C	08/02/2019	Cole Mergenthaler
13	MBLK	MBLK	0.00063	0.000	mg/L	FIA202-HE_190807A	08/07/2019	Cole Mergenthaler
14	MBLK	MBLK	-0.00079	0.000	mg/L	FIA202-HE_190807D	08/07/2019	Cole Mergenthaler
15	MBLK	MBLK	-0.00054	0.000	mg/L	FIA202-HE_190807D	08/07/2019	Cole Mergenthaler
16	MBLK	MBLK	-0.00019	0.000	mg/L	FIA202-HE_190808B	08/08/2019	Cole Mergenthaler
17	MBLK	MB-47067	0.00039	0.000	mg/L	FIA202-HE_190808B	08/08/2019	Cole Mergenthaler
18	MBLK	MB-47087	-0.00042	0.000	mg/L	FIA202-HE_190809A	08/09/2019	Cole Mergenthaler
19	MBLK	MBLK	0.00113	0.000	mg/L	FIA202-HE_190813B	08/13/2019	Cole Mergenthaler
20	MBLK	MBLK	-0.00034	0.000	mg/L	FIA202-HE_190814C	08/14/2019	Cole Mergenthaler
21	MBLK	MB-47193	-0.00091	0.000	mg/L	FIA202-HE_190814C	08/14/2019	Cole Mergenthaler
22	MBLK	MBLK	-0.0000422	0.000	mg/L	FIA202-HE_190816A	08/16/2019	Cole Mergenthaler
23	MBLK	MB-47269	0.00061	0.000	mg/L	FIA202-HE_190816A	08/16/2019	Cole Mergenthaler
24	MBLK	MBLK	-0.00049	0.000	mg/L	FIA202-HE_190821A	08/21/2019	Cole Mergenthaler
25	MBLK	MB-47340	0.0000448	0.000	mg/L	FIA202-HE_190821A	08/21/2019	Cole Mergenthaler
26	MBLK	MBLK	0.00088	0.000	mg/L	FIA202-HE_190822A	08/22/2019	Cole Mergenthaler

27	MBLK	MBLK	0.0005	0.000	mg/L	FIA202-HE_190826A	08/26/2019	Cole Mergenthaler
28	MBLK	MBLK	0.00125	0.000	mg/L	FIA202-HE_190829A	08/29/2019	Cole Mergenthaler
29	MBLK	MBLK	-0.00023	0.000	mg/L	FIA202-HE_190903A	09/03/2019	Cole Mergenthaler
30	MBLK	MBLK	0.00035	0.000	mg/L	FIA202-HE_190905A	09/05/2019	Cole Mergenthaler
31	MBLK	MBLK	0.00058	0.000	mg/L	FIA202-HE_190906A	09/06/2019	Cole Mergenthaler
32	MBLK	MBLK	0.00115	0.000	mg/L	FIA202-HE_190906A	09/06/2019	Cole Mergenthaler
33	MBLK	MBLK	0.0007	0.000	mg/L	FIA202-HE_190909B	09/09/2019	Cole Mergenthaler
34	MBLK	MBLK	0.00088	0.000	mg/L	FIA202-HE_190913B	09/13/2019	Cole Mergenthaler
35	MBLK	MBLK	0.00029	0.000	mg/L	FIA202-HE_190919B	09/19/2019	Cole Mergenthaler
36	MBLK	MB-47889	0.00076	0.000	mg/L	FIA202-HE_190919B	09/19/2019	Cole Mergenthaler
37	MBLK	MBLK	0.00038	0.000	mg/L	FIA202-HE_190919D	09/19/2019	Cole Mergenthaler
38	MBLK	MBLK	0.00109	0.000	mg/L	FIA202-HE_190921A	09/21/2019	Cole Mergenthaler
39	MBLK	MB-47908	-0.00029	0.000	mg/L	FIA202-HE_190921A	09/21/2019	Cole Mergenthaler
40	MBLK	MBLK	0.0000645	0.000	mg/L	FIA202-HE_190924A	09/24/2019	Cole Mergenthaler
41	MBLK	MBLK	0.00032	0.000	mg/L	FIA202-HE_190926A	09/26/2019	Cole Mergenthaler
42	MBLK	MBLK	-0.00082	0.000	mg/L	FIA202-HE_190927B	09/27/2019	Cole Mergenthaler
43	MBLK	MB-48058	-0.00074	0.000	mg/L	FIA202-HE_190927B	09/27/2019	Cole Mergenthaler
44	MBLK	MBLK	-0.00021	0.000	mg/L	FIA202-HE_191001A	10/01/2019	Cole Mergenthaler
45	MBLK	MBLK	-0.0000126	0.000	mg/L	FIA202-HE_191001B	10/01/2019	Cole Mergenthaler
46	MBLK	MB-48125	0.00052	0.000	mg/L	FIA202-HE_191001B	10/01/2019	Cole Mergenthaler
47	MBLK	MBLK	0.00097	0.000	mg/L	FIA202-HE_191003B	10/03/2019	Cole Mergenthaler
48	MBLK	MB-48155	0.00036	0.000	mg/L	FIA202-HE_191003B	10/03/2019	Cole Mergenthaler
49	MBLK	MBLK	0.00097	0.000	mg/L	FIA202-HE_191008B	10/08/2019	Kristine M. Devault
50	MBLK	MBLK	-0.0000293	0.000	mg/L	FIA202-HE_191009A	10/09/2019	Kristine M. Devault
51	MBLK	MBLK	0.00017	0.000	mg/L	FIA202-HE_191011C	10/11/2019	Kristine M. Devault
52	MBLK	MBLK	-0.0002	0.000	mg/L	FIA202-HE_191017A	10/17/2019	Kristine M. Devault
53	MBLK	MBLK	0.00084	0.000	mg/L	FIA202-HE_191022A	10/22/2019	Kristine M. Devault
54	MBLK	MBLK	0.00014	0.000	mg/L	FIA202-HE_191023A	10/23/2019	Cole Mergenthaler
55	MBLK	MBLK	-0.00157	0.000	mg/L	FIA202-HE_191025B	10/25/2019	Cole Mergenthaler
56	MBLK	MBLK	0.00088	0.000	mg/L	FIA202-HE_191029A	10/29/2019	Kristine M. Devault
57	MBLK	MBLK	0.000043	0.000	mg/L	FIA202-HE_191101B	11/01/2019	Kristine M. Devault
58	MBLK	MBLK	0.00043	0.000	mg/L	FIA202-HE_191106B	11/06/2019	Shayla B. Ferguson
59	MBLK	MBLK	0.00026	0.000	mg/L	FIA202-HE_191107A	11/07/2019	Kristine M. Devault
60	MBLK	MB-48853	0.00115	0.000	mg/L	FIA202-HE_191107A	11/07/2019	Kristine M. Devault
61	MBLK	MBLK	-0.0000846	0.000	mg/L	FIA202-HE_191108A	11/08/2019	Shayla B. Ferguson
62	MBLK	MBLK	0.00076	0.000	mg/L	FIA202-HE_191108B	11/08/2019	Kristine M. Devault
63	MBLK	MBLK	0.00087	0.000	mg/L	FIA202-HE_191113A	11/13/2019	Shayla B. Ferguson
64	MBLK	MB-48930	-0.00036	0.000	mg/L	FIA202-HE_191113A	11/13/2019	Shayla B. Ferguson
65	MBLK	MB-48996	0.0012	0.000	mg/L	FIA202-HE_191114B	11/14/2019	Shayla B. Ferguson
66	MBLK	MBLK	-0.00069	0.000	mg/L	FIA202-HE_191115A	11/15/2019	Kristine M. Devault
67	MBLK	MB-49010	0.00025	0.000	mg/L	FIA202-HE_191115A	11/15/2019	Kristine M. Devault
68	MBLK	MBLK	0.0000653	0.000	mg/L	FIA202-HE_191120A	11/20/2019	Shayla B. Ferguson
69	MBLK	MB-49079	-0.0007	0.000	mg/L	FIA202-HE_191120A	11/20/2019	Shayla B. Ferguson
70	MBLK	MBLK	0.00000597	0.000	mg/L	FIA202-HE_191121A	11/21/2019	Kristine M. Devault
71	MBLK	MB-49115	-0.0000624	0.000	mg/L	FIA202-HE_191121A	11/21/2019	Kristine M. Devault
72	MBLK	MBLK	-0.00071	0.000	mg/L	FIA202-HE_191122A	11/22/2019	Shayla B. Ferguson
73	MBLK	MB-49141	-0.00031	0.000	mg/L	FIA202-HE_191122A	11/22/2019	Shayla B. Ferguson

74	MBLK	MBLK	-0.00013	0.000	mg/L	FIA202-HE_191213A	12/13/2019	Kristine M. Devault
75	MBLK	MB-49396	-0.0001	0.000	mg/L	FIA202-HE_191213A	12/13/2019	Kristine M. Devault
76	MBLK	MBLK	-0.00081	0.000	mg/L	FIA202-HE_191219A	12/19/2019	Kristine M. Devault
77	MBLK	MBLK	0.00043	0.000	mg/L	FIA202-HE_191220A	12/20/2019	Kristine M. Devault
78	MBLK	MBLK	0.00052	0.000	mg/L	FIA202-HE_191224A	12/24/2019	Jonathan Hager
79	MBLK	MB-49499	-0.00037	0.000	mg/L	FIA202-HE_191224A	12/24/2019	Jonathan Hager
80	MBLK	MBLK	0.00035	0.000	mg/L	FIA202-HE_191231A	12/31/2019	Shayla B. Ferguson
81	MBLK	MB-49576	-0.00039	0.000	mg/L	FIA202-HE_191231A	12/31/2019	Shayla B. Ferguson
82	MBLK	MBLK	0.00112	0.000	mg/L	FIA202-HE_191231B	12/31/2019	Kristine M. Devault