LOWER GALLATIN TMDL PLANNING AREA: FLOW-STATION NUTRIENT SAMPLING 2009-2010

Sampling and Analysis Plan

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1.0 INTRODUCTION AND BACKGROUND

The following nutrient sampling and analysis plan documents activities to be conducted in support of TMDL development in the Lower Gallatin TMDL Planning Area: refer to the *Lower Gallatin TMDL Project Plan*, DEQ **Project ID M05-TMDL-02**.

In support of nutrient TMDL development in the Lower Gallatin TMDL Planning Area, flow and nutrient data is scheduled for five (5) stations in the Lower Gallatin watershed (Table 1).

Table 1: Flow and Nutrient stations in the Lower Gallatin TPA

Station ID	Station Description
EGRF1	The mouth of the East Gallatin River
EGRF2	The East Gallatin River upstream of the Hyalite Creek confluence
EGRF3	The upper East Gallatin River along Kelly Canyon Rd
BCF1	The mouth of Bridger Creek at the Bridger Creek Golf Course
SDCF1	The mouth of Sourdough (Bozeman) Creek

This document constitutes the Sampling and Analysis Plan (SAP) for the completion of nutrient sampling at 5 flow-monitoring stations in the Lower Gallatin TMDL Planning Area for 2009-2010. Flow data collection is detailed in a separate document, *Lower Gallatin TMDL Planning Area Flow Monitoring Project 2009-2010: Sampling and Analysis Plan.*

2.0 OBJECTIVES AND DESIGN

The objective of this sampling plan is to collect water chemistry data and field parameters that will be used to assist in the following:

- Verification of nutrient impairment conditions on 303(d) listed tributaries in the Lower Gallatin TMDL Planning Area to aid in TMDL development decisions
- Quantification of nutrient loads associated with waterbody segments in the Lower Gallatin TMDL Planning Area to assist in TMDL nutrient load allocations

2.1 Study Design

In order to assist in meeting the above objectives, nutrient conditions at five flow-monitoring stations will be determined by water quality sampling. Sampling for nitrogen and phosphorus compounds in the water column will be performed at each of the selected sample sites during **six sampling events: three during summer of 2009 and three during summer of 2010**. Sampling events should occur at a minimum of one week apart, and should be conducted at varying flows. Total suspended solids will be collected at all sample sites where water column parameters are collected. Physical parameters (i.e. water temperature, dissolved oxygen, pH, and conductivity) will be collected with a field meter at all sites.

Streamflow at these five sites is being collected under the guidance of the *Lower Gallatin TMDL Planning Area Flow Monitoring Project 2009-2010: Sampling and Analysis Plan,* and therefore is not included in this document

2.2 Sampling Sites

Sampling sites (Table 2, Figure 1) were chosen to facilitate nutrient load estimations for the range of landscape characteristics and land use/ land cover influences existing in the watershed, as well as the contribution of major tributaries. Sampling sites were identified by assessment of aerial images, GIS data, and field investigation to capture the variability in land use and watershed characteristics potentially contributing to nutrient impairment conditions. Monitoring locations are spatially located to aid in determining the contribution of known sources and the location of and contribution from other sources.

Table 2. Sample locations for nutrient sampling.

Water Body	Station	Station Description	Lat	Long
East Gallatin River	EGRF1	~1/3 mile upstream of confluence with Gallatin	45.8923	-111.3286
East Gallatin River	EGRF2	~3/4 mile upstream of Hyalite Creek confluence	45.7888	-111.1195
East Gallatin River	EGRF3	~1/4 mile downstream of Kelley Creek confluence	45.6712	-110.9751
Bridger Creek	BCF1	near confluence with East Gallatin	45.7104	-111.0332
Sourdough (Bozeman) Creek	SDCF1	just u/s of bridge crossing at Barnard Construction office	45.6935	-111.0277

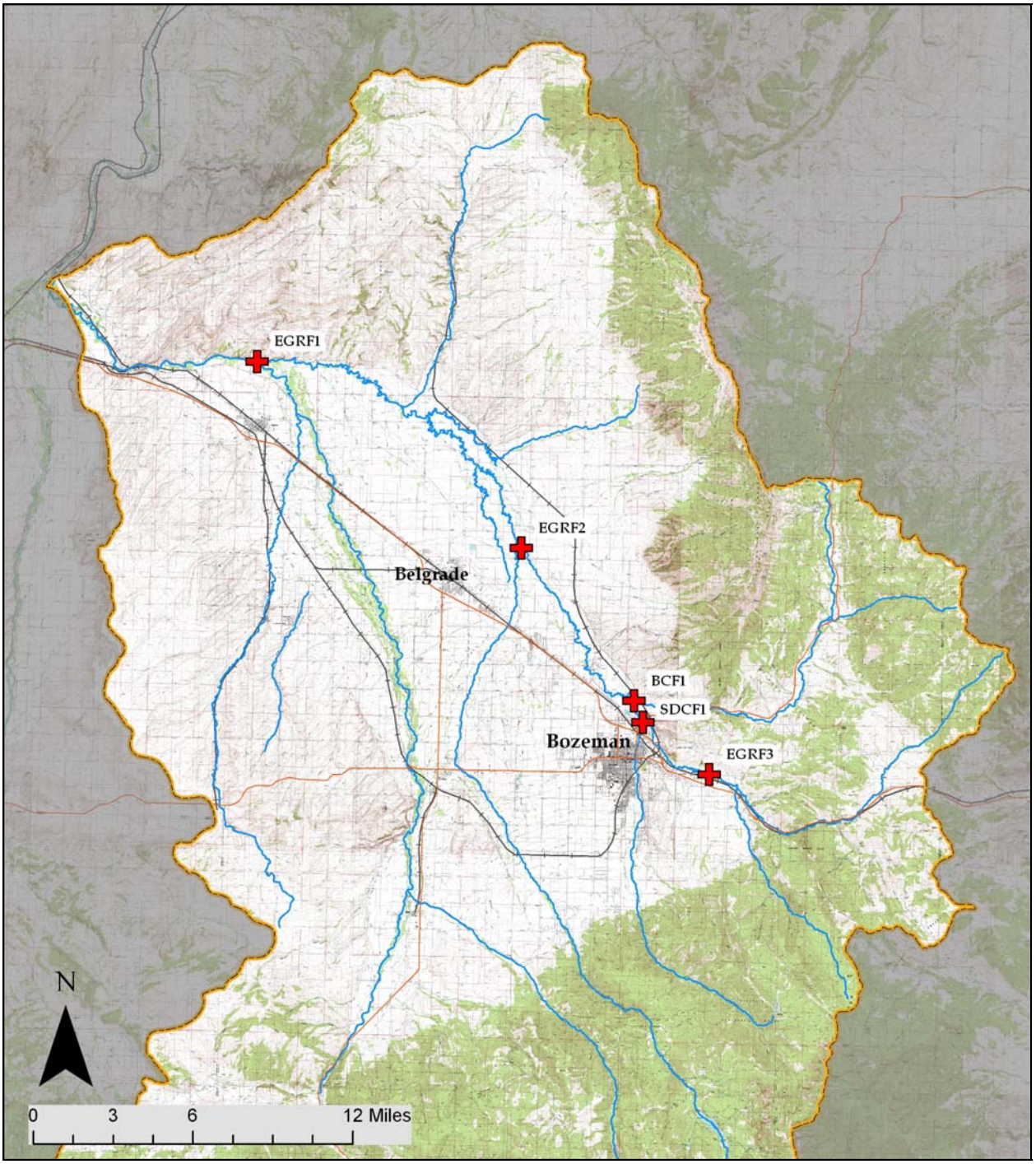

Figure 1: Flow Monitoring Sites for Nutrient Data Collection in the LGTPA

3.0 FIELD SAMPLING METHODS

Water quality samples will be collected in accordance with the MDEQ's Field Procedures Manual which is available on the internet at: http://www.deq.state.mt.us/wqinfo/QAProgram/SOP%20WQPBWQM-020.pdf (DEQ, 2005a). Grab samples will be collected and analyzed for nutrients as identified in **Table 3**. Water samples will be collected directly in the required bottle. Bottles shall be rinsed three times with native water prior to sampling. Samples will be collected in a well-mixed portion of each stream, or, if the stream has ceased flowing (intermittent), the sample will be collected at the surface in a pool without disturbing the sediments. During sampling, the sample bottle opening should face upstream and should be drawn through the water column once, carefully avoiding disturbance of bottom sediments.

Table 3. Analytes, Analytical Methods, RRLs, Holding Times and collection preservation

Parameter	Preferred Method	Req. Report Limit (ug/L)	Holding Time (Days)	Bottle	Preservative
Total Suspended Solids (TSS)	EPA 160.2	4000	7	1L HDPE	≤ 6°C
Total Persulfate Nitrogen (TPN)	SM 4500-N C	50	30	250ml HDPE	≤ 6°C
Total Phosphorus as P	EPA 365.1	5	28	500ml HDPE	H_2SO_4, ≤ 6°C
Nitrate-Nitrite as N	EPA 353.2	10			
Total Ammonia as N	EPA 350.1	50			

3.1 Nutrients

Table 3 shows the suite of parameters that will be measured for each sampling event and site.

Three bottles will be required for the identified nutrient analytes:

- TP, NO_{2+3}, NH_{3+4}: preserved with sulfuric acid; ≤ 6°C
- TN: no preservative; ≤ 6°C
- TSS: no preservative; ≤ 6°C

Total nutrient samples (with the exception of TN) will be acidified to a pH of less than 2 by adding concentrated 1+1 sulfuric acid (H_2SO_4); 4 ml/L. All samples will be properly labeled, stored in coolers and chilled to 6°C or less for transport to the lab. The site names on the sample labels must correspond to the site names provided in this SAP (**Table 1**).

3.2 Other Data

A site form will be completed for each site that includes the site coordinates, time, weather, and any other relevant observations. Separate site visit forms will be completed for each set of duplicate and blank samples, with unique site visit IDs and location IDs applied to both, indicating the sample is either a duplicate or a blank.

Physical parameters (i.e. water temperature, dissolved oxygen, pH, and conductivity) will be collected in the field with a YSI 85 or equivalent meter in accordance with MDEQ's Field Procedures Manual (DEQ, 2005a). The field meter will be calibrated prior to each use according to their respective operation manuals. The GPS coordinate system datum will be NAD 1983

State Plane Montana, in decimal degrees to at least the fourth decimal. All data and information for this project must meet other data reporting requirements identified in the Contract for work. Data formats identified in the contract will be used for TMDL related data analysis.

Pictures will be taken at each sampling location during the first sampling event in summer of 2009 and 2010 and during hi-flow events in order to document the general sample location and stream condition. Pictures that document the sample site location do not need to be retaken for each sampling event, unless the sample location or stream condition has changed. All pictures will be documented on field forms with the following information recorded:

Picture number, if taken on a digital camera
Date/time
Stream name
Sample site ID
Directional reference (facing upstream or downstream and N, S, E, W)

4.0 SAMPLE HANDLING AND LABORATORY ANALYTICAL PROCEDURES

Immediately following grab-sample collection, samples will be put on ice. Sample handling procedures will follow DEQ standard operating procedures as defined in DEQ guidance, *Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005: Quality Assurance Project Plan (QAPP)* (DEQ, 2005b). Standard DEQ Water Quality Planning Bureau site visit/chain of custody forms will be used to document and track all samples collected in the project. Samples will be delivered to Energy Labs in Helena, MT for analysis. **Table 3** contains a table with the collection container, preservative, analytical method, required reporting limit, and holding time for each analyte. *The lab must use "J value" reporting for results between the RL and the MDL.*

5.0 QUALITY ASSURANCE AND QUALITY CONTROL REQUIREMENTS

During each sampling trip, field duplicates will be collected randomly for 10% of all samples and field blanks (not trip blanks) will be prepared for 10% of all samples.

Data quality objectives (DQOs) are the quantitative and qualitative criteria established for a sampling design in order to meet the project's objectives. Data quality indicators (DQIs) are quantitative criteria established for the data acquired within this design to assure it is of sufficient quality for its intended use. Descriptions of data qualifiers and common QC terms and acronyms are included in **Appendix A, QA/QC Checklist**.

5.1 Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This is a judgmental sampling design using the following rationale:

Spatial representation:

> Sampling sites were chosen to represent the potential of landscape characteristics and land use/land cover influences existing in the watershed to influence the nutrient and metals concentrations in the listed waters, as well as the contribution of major tributaries. Sampling sites were identified by both assessment of aerial images and field surveying to

capture the variability in land use and watershed characteristics potentially contributing to pollutant concentrations in streams including: land use/land cover (e.g. known mined areas, forest, grass, riparian area, geology, and soils), watershed residence times, and stream order.

Temporal representation:

Sampling time frames include the low-flow summer streamflow condition in 2009 and 2010 when streams are most susceptible to nuisance algal growth in response to nutrient inputs. The summer low-flow condition (July – September) is also the timeframe when the DEQ's proposed nutrient criteria would apply.

5.2 Comparability

Comparability is the applicability of the project's data to the project's decision rule. The decision rules used for this project are draft nutrient criteria developed by the DEQ Water Quality Bureau. Meeting reporting limits for nutrient parameters will ensure meeting data comparability requirements.

5.3 Completeness

Completeness is a measure of the amount of data prescribed for assessment activities and the usable data actually collected, expressed as a percentage.

Completeness as % = (No. Valid Data Points or Samples / Total # Data Points or Samples) x 100

The overall project goal is 100% completeness. Sampling sites have been established and access is available at all sites. Given that sites have been pre-established, and sampling may occur at a number of times through the summer months, it is expected that 100% completeness can be achieved. Rejected data results will be qualified with R flags and will count against project completeness. Data with B and J flags will not affect completeness. Should 100% completeness not be achieved, it is expected that TMDL project goals will still be met using a subset of nutrient data collected.

5.4 Sensitivity

Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. For analytical methods, sensitivity is expressed as the method detection limit (MDL). Laboratories must determine their MDL's annually and routinely check each method's ability to achieve this level of sensitivity using negative controls (e.g., Method Blanks, Continuing Calibration Blanks, and Laboratory Reagent Blanks).

Sensitivity quality controls for all laboratory methods will follow the frequency and criteria specified in the analytical method or as described in the Laboratory's Quality Assurance Plan (LQAP). The criteria used to assess field method sensitivity for water and sediment samples shall be:

Field method controls (Field Blank) < Reporting Limit in Table 3

Corrective Action: If analytical method controls fail the specified limit, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary. If Field Blanks fail, qualify all associated project data < 10x the detected value with B flags.

5.5 Precision

Precision refers to the degree of agreement among repeated measurements of the same characteristic. This project will rely on analytical and field duplicates to assess precision based on their relative percent difference (RPD).

$$\text{RPD as \%} = ((D1 - D2)/((D1 + D2)/2)) \times 100$$

Where:
D1 is first replicate result
D2 is second replicate result

Lab precision (laboratory duplicates)
Precision quality control for all laboratory methods will follow the frequency specified in the analytical method or as described in the LQAP. The criteria used to assess analytical method precision shall be:

- Water samples: 20 % RPD for duplicate results > 5 times the reporting limit

Overall precision (field duplicates)
Frequency of field co-located duplicates will be 10% of samples collected in the field. The criteria used to assess overall precision shall be:

- Water samples: 25 % RPD for duplicate results > 5 times the RL

Corrective Action: If laboratory duplicates fail this limit, check with the laboratory to see how they addressed or qualified the data and add additional qualifiers and notes as needed. If the field duplicates fail this limit, qualify all associated with a "J".

5.6 Bias and Accuracy

Bias is systematic nonrandom error from the true value. In this context, it is an extension of the representativeness concept applied to an individual sample. Bias can occur either at sample collection or during measurement.

Accuracy is the combination of high precision and low bias. Accuracy of individual measurements will be assessed by reviewing the analytical method controls (i.e. Laboratory Control Sample, Continuing Calibration Verification, Laboratory Fortified Blank, Standard Reference Material) and the analytical batch controls (i.e. Matrix Spike and Matrix Spike Duplicate). The criteria used for this assessment will be the limits that the laboratory has developed through control charting of each method's performance or based on individual method requirements. Method QC descriptions are contained in **Appendix A, QA/QC Checklist**.

Corrective Action: For any QC value outside of the recovery range, check with the laboratory to see how they addressed the non-conformance and qualify data as necessary.

6.0 DATA ANALYSIS, RECORD KEEPING, AND REPORTING REQUIREMENTS

6.1 QC Review and Documentation

A review of field and analytical data will be conducted the Contractor following receipt of the laboratory data package[1] that includes all items on the QC Checklist in **Appendix A**. All water quality data collected as part of this SAP will be evaluated against the criteria listed in section 5.0. Data qualifiers provided in **Appendix A** will be assigned to data that does not meet these target quality control criteria. Qualifiers will be included in both the hardcopy and electronic forms of the data.

A written summary of data quality will be prepared following review of field documentation and receipt of data from the laboratory. The data quality analysis will summarize the QA/QC information from the field event and laboratory analysis (including QC sample results), audit information, corrective actions taken, and the overall results of sampling and analytical activities with respect to compliance with the provisions of this SAP. The primary focus of the data quality analysis will be to assess the effects any deviations from approved procedures may have on the project objectives and credibility of this data for decision making purposes.

6.2 Data Management

Data generated during this project will be stored on field forms, in laboratory reports obtained from Energy Labs, DEQ's MT-eWQX database, and EPA's Water Quality Exchange data system. Site Visit/Chain of Custody forms will be properly completed for all samples.

Details can be found on DEQ's Data Management website at:
http://deq.mt.gov/wqinfo/datamgmt/MTEWQX.mcpx

Written field notes, field forms, and digital photos will be processed by field staff following QA/QC procedures and the requirements set forth in the project's Scope of Work. All project forms and reports will be submitted to the DEQ Project Coordinator upon the completion of this project, following the Scope of Work deliverable dates.

Field data collected and data received from the water quality laboratory will be managed in spreadsheets or database tables compatible with the MT-eWQX database. Data tables will be maintained and managed in record format retaining the unaltered results and meta data recorded in the field or received in a laboratory's electronic data deliverable (EDD). After DEQ approval of the data quality summary, data from all sampling events will be entered into MT-eWQX compatible templates and provided to the DEQ TMDL Project Coordinator for review. Upon approval, data will be loaded into the Environmental Data Processor (EDP) for database QC review prior to data submittal to the MT-eWQX system. Data management tools (including the EDP application) and instructions for submittal to the MT-eWQX system can be found on DEQ's Data Management website noted above. Data entry will follow the requirements of the

[1] A data package includes all hardcopy results from the lab (including QC summary and completed chain of custody), and the electronic data deliverable (EDD in MT eWQX compliant format).

STORET/WQX Characteristic Names and Required Values for MTWTRSHD Org ID document also found at the above web site. Verification of successful data upload (i.e., copy of the MT-eWQX system generated email) will be submitted to DEQ. Further questions regarding data management or data upload shall be directed to the DEQ's TMDL Project Coordinator.

7.0 SCHEDULE FOR COMPLETION

All data and information generated through this project shall be received by the DEQ's TMDL Project Coordinator no later than November 30th, 2010.

8.0 PROJECT TEAM AND RESPONSIBILITIES

This project is a partnership between the Greater Gallatin Watershed Council, Montana Department of Environmental Quality and PBS&J. Personnel involved in this project are presented in **Table 8-1**.

Table 8-1. Project Personnel Roles.

Name	Organization	Title
Sharlyn Izurieta	Greater Gallatin Watershed Council	Executive Director
Pete Schade	MT Dept. of Environmental Quality	Senior TMDL Planner
Gary Ingman	PBS&J	Project Coordinator
Jeff Dunn	PBS&J	Watershed Specialist
Mindy McCarthy	MT Dept. of Environmental Quality	DEQ QA Officer

Sharlyn Izurieta is the Executive Director for the Greater Gallatin Watershed Council. Sharlyn is responsible for contract oversight and review of project deliverables.

Pete Schade is the Senior TMDL Planner for the Lower Gallatin TMDL Planning Area. Pete is responsible for technical project scoping, project oversight and review and acceptance of all project deliverables.

Gary Ingman, senior biologist with PBS&J is the project manager. The project manager will provide general oversight and coordination to the monitoring project and monitoring activities. Gary will also be responsible for reviewing the monitoring procedures and results to ensure that measurement quality objectives and quality control requirements are met.

Jeff Dunn is a Watershed Specialist with PBS&J. Jeff's responsibilities include field data collection and coordination, and data assessment, analysis and reporting. Jeff will collect all field data and conduct field measurements. Jeff will also develop flow rating curves for all flow-monitoring stations.

Mindy McCarthy is the Quality Assurance Officer for the Water Quality Planning Bureau at the Montana Department of Environmental Quality Water Quality. Mindy is responsible for review and approval of Sampling and Analysis Plans associated with this project.

9.0 REFERENCES

DEQ 2005a. Water Quality Planning Bureau Field Procedures Manual for Water Quality Assessment Monitoring. Montana Dept. of Environmental Quality, WQPBWQM-020, revision 2. April 21, 2005. *Available at* http://www.deq.state.mt.us/wqinfo/QAProgram/SOP%20WQPBWQM-020.pdf

DEQ. 2005b. Quality Assurance Project Plan (QAPP) Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005. *Available at* http://www.deq.state.mt.us/wqinfo/QAProgram/WQPBQAP-02.pdf.

DEQ. 2008. Sample Collection and Laboratory Analysis of Chlorophyll-a Standard Operating Procedure. Montana Dept. of Environmental Quality, WQPBWQM-011, revision 4. June 5, 2008. *Available at* http://deq.mt.gov/wqinfo/QAProgram/SOP%20WQPBWQM-011v4_final.pdf

Appendix A

QA/QC Checklist and Data Qualifiers

QUALITY CONTROL CHECKLIST

Site Visit Field Forms

__ All sample sites match locations specified in SAP. If not, provide reasoning.

__ All field forms complete. If incomplete areas cannot be completed, document the issue.

__ Reviewed site visit notes and field logs. Documented:

- __ Failures to calibrate and check field instruments as required in SAP
- __ Field equiment problems or failures
- __ Variations from field protocols described in the SAP (e.g. sampling equipment, sampling methods, preservation methods, photo documentation)

__ Completed cursory review of physical parameter readings and documented inconsitencies

__ Field duplicates collected at the proper frequency (specified in SAP)

__ Field blanks collected at the proper frequency (specified in SAP)

Chains of Custody, Laboratory Forms, and Analytical Results

__ Reviewed Chains of Custody and condition of samples upon receipt:

- __Cooler/sample temperature
- __Proper collection containers
- __All containers intact
- __Sample pH of acidified samples <2

__ Holding times met

__ All sample IDs match those provided in the SAP. Field duplicates are clearly marked on samples and noted as such in lab results

__ Analytical analyses carried out using analytical methods defined in the SAP

__ Reporting detection limit met the project-required detection limit

__ All blanks were less than the project-required detection limit

__ If any blanks exceeded the project-required detection limit, associated data is flagged. (The DEQ PM will set the criteria for determining associated data. Contact the DEQ PM to discuss blank results prior to flagging data)

__ Laboratory blanks/duplicates/matrix spikes/lab control samples were analyzed at a 10% frequency

__ Laboratory blanks/duplicates/matrix spikes/lab control samples were all within the required control limits defined within the SAP

__ Field blanks and duplicates were all within the required control limits specified in the SAP

__ Completed cursory review of chlorophyll a photos. Photo visual estimates appear to be consistent with laboratory values.

QC Summary

__ Project Data Quality Objectives (DQOs) and Data Quality Indicators (DQIs) were met (as described in SAP)

__ Data completeness requirements were met (specified in SAP). If not, explain why.

__ Completed draft summary of QC analysis results, including summary of flagged results, issues encountered, and how issues were addressed (corrective action)

MT-eWQX Electronic Data Deliverable (EDD) Completion, Submittal, & Approval

__ Completed QA review of populated MT-eWQX EDD templates and submitted to DEQ Project Manager. Reviewed for:

- __ Transcription errors
- __ Completeness (all sites and parameters entered)

After receipt of DEQ Project Manager comments:

__ Made necessary edits to EDD and QC Summary Report if necessary

__ Submited Final QC Summary Report to DEQ Project Manager

After DEQ Project Manager approval of Final QC Summary Report:

__ EDD templates checked for errors using EQuIS Data Processor

__ Submitted EDD and PDF of approved Final QC Summary Report to MT-eWQX using MT-eWQX Submittal Form

__ Sent DEQ Project Manager a copy of the final MT-eWQX Submittal Form received from the DEQ e-WQX Database Coordinator

Table C-1. Data qualifiers and descriptions

Result Qualifier	Result Qualifier Description
B	Detection in field and/or trip blank
D	Reporting limit (RL) increased due to sample matrix interference (sample dilution)
H	EPA Holding Time Exceeded
J	Estimated: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.
R	Rejected: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.
U	Not Detected: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted Contract Required Quantitation Limit (CRQL) for sample and method.
UJ	Not Detected/Estimated: The analyte was not detected at a level greater than or equal to the adjusted CRQL or the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

Laboratory flags will be entered in the Result Qualifier field in the WQX templates. Refer to the SAP for more information on how to qualify associated data.

Table C-2. Quality control terminology and descriptions

FIELD QC		
Term	**Description**	**Purpose/Usage**
Trip Blanks	Used only for VOC (Volatile Organic Chemicals). Alias VOA (volatile organic analysis)	To determine if cross contamination occurs between samples.
Field Blank	Reagent water exposed to field sampling conditions	Monitors contamination resulting from field activities and or ambient levels of analytes present at time of sampling.
Field Duplicate	Two independent samples taken under the same conditions. For solids; two samples which are co-located (taken side by side.) Water samples would be two independent samples taken at the same location at the same time.	To determine the homogeneity of the samples collected.
Field Replicate	A single sample is obtained, homogenized, then slit into multiple samples	Monitors laboratory precision independent of laboratory operations.
LABORATORY BATCH QC		
Acronym	**Description**	**Definition**
LRB/Method Blank	Laboratory Reagent Blank	An aliquot of reagent water or other blank matrices that are treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, and internal standards that are used with other samples. The LRB is used to determine if method analytes or other interferences are present.

LFB/LCS	Laboratory Fortified Blank; Laboratory Control Sample	Reagent water spiked with a known amount of analyte. Ideally treated exactly like a MS/LFM. Control used to determine bias in sample spikes.
MS/LFM	Matrix Spike/Laboratory Fortified Matrix .	An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations
MSD/LFMD	Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate	Determine method precision in sample concentrations are < 5X the RL.
DUP	Duplicate	Determine method precision in sample concentrations are > 5X the RL.
QCS	Quality Control Sample	A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance
SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.
LABORATORY ANALYSIS QC		
Acronym	**Description**	**Definition**
ICB	Initial Calibration Blank	Monitors instrument drift at low end of cal curve.
CCB	Continuing Calibration Blank	Monitors instrument drift at low end of cal curve.
ICV	Initial Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of cal curve.
CCV	Continuing Calibration Blank	Monitors instrument drift at a defined concentration near the mid range of cal curve.
IPC	Instrument Performance Check	Monitors instrument drift at a defined concentration near the mid range of cal curve.
MS/LFM	Matrix Spike/Laboratory Fortified Matrix .	An aliquot of an environmental sample to which known quantities of the method analytes are added in the laboratory. The LFM is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the LFM corrected for background concentrations
MSD/LFMD	Matrix Spike Duplicate/Laboratory Fortified Matrix Duplicate	Determine method precision in sample concentrations are < 5X the RL.
DUP	Duplicate	Determine method precision in sample concentrations are > 5X the RL.

QCS	Quality Control Sample	A solution of method analytes of known concentrations which is used to fortify an aliquot of reagent water or sample matrix. The QCS is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check either laboratory or instrument performance
SRM	Standard Reference Material	Primarily used as a QCS to verify instrument calibration.
IDL	Instrument detection limit	Signal just above baseline. 3-5x the STD DEV of 7 replicates of a blank. Not used for quantification.
MDL	Method detection limit	Statistical determination of the lowest concentration of an analyte with 95% certainty the analyte is present.
PQL	Practical Quantitation Limit	3-5x the MDL. Lowest level that quantification is determined
RL	Reporting Limit	Value a Laboratory reports results. Usually the PQL.