2023 Recreational Waters Bacterial Monitoring
Sampling and Analysis Plan

Prepared by:

Chase Ackerman
Montana Conservation Corps Intern
Gallatin Local Water Quality District
215 W. Mendenhall, Suite 300
Bozeman, MT 59715

Contact Person:

Nick Banish
District Manager
215 W. Mendenhall St.
Bozeman, MT 59715
406-582-3145 or Nick.Banish@gallatin.mt.gov

This page intentionally left blank.

Introduction

Bacteria contamination of recreational waters is well-documented in the scientific literature (Fogarty et al. 2021). Several sites within Gallatin County are heavily used during the summertime recreation season, but to date, few studies have been conducted that aim to quantify the presence, abundance, and distribution of this threat to human health. Sampling waters for will help to elucidate recreational viability using a common water quality indicator, *E. coli* bacteria. Similarly, harmful algal blooms (HABs) are an emergent issue affecting recreational water bodies throughout the U.S., but little is known about their occurrence at recreational sites within Gallatin County. This Sampling and Analysis Plan (SAP) describes the proposed actions of Local Water Quality District (LWQD) staff to monitor for these summertime water-quality issues.

Description of Program Elements

The overall goal of the Recreational Waters Bacterial Monitoring Program is to regularly monitor for the presence and abundance of bacteria and HAB toxins in the waters associated with public beaches within Gallatin County during times of peak use, and to take necessary corrective actions to protect public health.

Program Objectives include:

- Collection of surface water samples at lentic water bodies (e.g., ponds, lakes) on a scheduled basis.
- Analysis of surface water samples for the presence and enumeration of *E. coli* bacteria and HAB (harmful algal bloom) toxins.
- Notifying the public of results in a timely manner via outreach efforts through the LWQD website, social media(s) and the Gallatin City-County Health Department web site.

List and Description of Sites

Table 1. Proposed Monitoring Sites

Site Description	Site ID	Latitude	Longitude
Gallatin County Regional Park Beach	GCRGP	45.695240	-111.087712
Mall Pond	MLPD	45.674255	-111.082885
Hyalite Reservoir	HYRV	45.485509	-111.979264
Meyers Lake	MYLK	45.682624	-111.099425
Galatin Regional Park Dog Park Pond*	GPDP	45.696838	-111.091867
Bozeman Beach*	BZMBCH	45.704733	-111.037790

Note. Sites denoted with "*" will be sampled only for HAB toxins, beginning in July.

Description of Monitoring Program

Water samples will be collected from various sites from June through September. Due to the cost of analysis, not all sites will be sampled every week. Leading up to the holiday weekend of

the 4th of July, there will be one three day long consecutive sampling conducted during this period. The actual sampling season may vary slightly and a tentative sampling schedule will be posted at each site. Samples will be analyzed at Bridger Analytical Laboratory (Four Corners, MT.) for the enumeration of *E. coli* bacteria using EPA method SM 9223B (Colilert) to determine the MPN (Most Probable Number) E. coli count (EPA, 2012).

Algal toxins (Anatoxin-a and microcystins) will be assessed at a subset of locations using Gold Standard Diagnostics ABRAXIS® Dipstick test kits and procedures will follow the Montana Department of Environmental Quality (MDEQ) HAB Guidance Document (MDEQ, 2021).

Quality Assurance Objectives for Measurement of Data

Sample collection, completion of the Site Visit Form, and evaluation of results to determine whether the water is safe for recreational use will be done by a local health officer or an authorized representative of the Gallatin LWQD.

Completed Site Visit Forms will include potential contamination sources and their locations relative to the testing location, as well as other data potentially relevant to bacterial loading. The threshold for safe recreation will follow *E. coli* MPN levels as determined by the United States EPA (2012) and promulgated by the Montana Department of Environmental Quality (Makarowski, 2020). Indicators for HAB toxin presence will follow Gold Standard Diagnostics ABRAXIS® Dipstick test-kit methods and the assessment of data will follow the MDEQ HAB guidance document (referenced above).

Sampling Procedures

From June through August water samples will be collected from various waterbodies on a routine basis and analyzed that week. Sampling frequency may depend on circumstances such as public recreational use or specific comments made about the water. Additional samples may be collected after a pollution event, heavy rainfall, or if the results from a previous sample exceed water quality standards. In the case of heavy rain, twenty-four-hour precipitation data will be recorded and included in the report. Before sample collection takes place the YSI meter will be deployed and DO (mg/L), DO%, Temperature, Conductivity and pH parameters will be collected.

Using a lab-cleaned graduated beaker affixed to the end of an extendable pole, *E. coli* samples will be collected at one foot below the surface of the water in an area with a depth of at least 2 feet. Samples will be collected within the area most frequently utilized by bathers. The graduated beaker is triple-rinsed with reagent grade deionized water prior to each site, and then triple-rinsed with sample water prior to collection (**Note**: It is important that ambient water conditions are replicated as closely as possible). Duplicate samples will be collected at each site to generate a geometric mean of *E. coli* abundance (MPN/100 mL of sample water). Additional samples may be taken at any inlets (storm drains, creek mouths, etc.).

Sample volumes will be at least 100 milliliters (mL) and collected in sealed lab-grade collection vessels provided by Bridger Analytical Laboratory. During collection a **Site ID** will be formed using the date, time and site name labeled in (i.e., Sharpie) ink, and using the following

nomenclature: **MMDDYY-HHMM-Site ID**. Samples collected at the primary location (i.e., within the area most frequently utilized by bathers) do not need a further descriptor in the Site ID; samples from any other locations should have a further descriptor added.

Example: A sample collected at Gallatin County Regional Park Beach at 9:00am on July 1, 2023, would have a Site ID labeled 070123-0900-GCRGP. Note the use of military time.

Extreme care needs to be taken to avoid contaminating the sample and sample container. The bottle cap should be removed directly prior to obtaining each sample. Persons collecting a water sample should take care not to contaminate the sample by touching the inside of the container, rinsing the sample container, or transporting the samples in a common container with other environmental samples.

Adhering to sample preservation and holding time is critical to the production of reliable data. Samples should be stored and transported in a cooler with ice or icepacks and relinquished to Bridger Analytical Laboratory immediately upon collection. The time and date of collection should be recorded as described in the Sample Custody Procedures. Results should be reported to the Gallatin City-County Health Department in a timely manner, at latest the Friday after samples are collected.

HAB samples will be taken on dates separate from those of *E. coli* monitoring and will be performed from July through August on a scheduled basis. HAB sampling will include two tests, one for microcystins and one for Anatoxin-a. Microcystin toxin was chosen due to its common presence in waters affected by HABs, while Anatoxin-a was chosen due to its common presence in blooms associated with pet deaths. Water samples are collected in acid-washed (10% HCl) 250-mL amber glass bottles and transported at room-temperature to the office for analysis.

Results for these tests will be generated the same day as sampling using Gold Standard Diagnostics ABRAXIS® Dipstick test-kits. Procedures for sample collection and data interpretation are detailed in the respective ABRAXIS® test kit user manuals and within the MDEQ HAB Guidance Document. For more information contact the LWQD. Results that indicate the presence of HAB toxins microcystins and/or anatoxin-a will be promptly shared with the City-County Health Department and MDEQ.

Frequency of sample testing may change based upon factors such as weather conditions, visible algal growth, or increased regularity of human use.

Sample Custody Procedures

E. coli samples should be collected by a local health officer or an authorized representative and delivered to Bridger Analytical Laboratory immediately upon collection. For any site visit, a completed Site Visit Form will verify that the samples were stored properly until they were relinquished to the laboratory.

The LWQD retains custody of water sampled for HAB toxins and testing is performed at the District office.

Equipment Calibration Procedures and Frequency

Before heading into the field for sampling, the YSI meter is to be properly calibrated and a drift check is to be performed frequently. The steps and procedures of performing a drift check can be found in the Surface Water Monitoring Network SOP guide.

Analytical Procedures

E. coli samples will be assayed using USEPA Method 1603. HAB toxin assays are performed using manufacturer-recommended standard operating procedures contained within each kit.

Quality Control Checks

One field replicate (duplicate) will be used as a quality control check during each *E. coli* sampling event.

Field blanks will be collected at a frequency of one blank per sampling day. Blanks will use reagent grade Type I Deionized Water that is sourced form the LWQD Millipore-Sigma system.

There are no field duplicate HAB toxin observations taken. Confirmed presence of algal toxins may warrant more detailed tests by the MDEQ.

Data Quality Assessment

If *E. coli* results for duplicate samples have a relative percent difference (RPD) of greater than 10%, results from that sample are regarded as estimates and appropriate qualifiers are placed on the data. If the RPD is greater than 10% for this program, it is recommended that the local health officer include the associated "reduced confidence" in the dataset when results are reported to the public **(Equation 1)**.

Equation 1: RPD = $[S_1 – S_2/ (S_1 + S_2)/2] \times 100$, where S_1 and S_2 represent the results for the two duplicate samples.

Data Reporting

All data associated with this program, including results that do not warrant further action to protect public health, will be reported on the GLWQD website by Friday of the sampling week. Results will be forward to the Gallatin City-County Health Department website in a timely manner. Completed Site Visit Forms (or scanned copies) should be delivered to the responsible health officer at the Gallatin City-County Health Department and stored with program data.

The EPA recommended recreational water quality standard for full body contact swimming for *E. coli* is 235 organisms per 100 ml for any single sample. The threshold value recommended by the EPA in the 2012 Recreational Water Quality Criteria is a geometric mean of 126 colonies per 100 ml for all samples collected within a sampling period **(Equation 2)**.

Equation 2: Geometric Mean = n^{th} root of: $(S_1 \times S_2 \times \ldots S_n)$, where S_1 through S_n represent the results for the n samples.

Table 1: Program result scenarios and associated reporting actions.

Sample Result	Reporting Action
Result <235 mpn/100 ml for *any* sample collected at a site during a single visit	Results reported in a timely manner on City-County Health Department website.
A geometric mean <126 mpn/100 ml for *all* samples collected at a site during a month	
Result >235 mpn/100 ml for *any* sample collected at a site during a single visit	Results reported in a timely manner on City-County Health Department website. **PLUS** additional steps to inform the public of the health risk, per the discretion of the health officer.
A geometric mean >126 mpn/100 ml for *all* samples collected at a site during a month	
RPD > 10% for duplicates collected at a site	Associated "reduced confidence" reported with results.

Should either of these values be exceeded, the responsible agency should use their discretion to take additional steps to inform the public of the associated health risks **(Table 1).** Examples of action steps include contacting the municipality (e.g., City of Bozeman) or local Homeowner's Associations, posting signage, and developing social media outreach tools.

In general, monitoring and reporting of HABs done by the LWQD will follow the MDEQ HAB Guidance Document. Because ABRAXIS® dip-strip tests (Figure 1) are qualitative and detect the presence or absence of toxins (dip-strip test results do not contain numeric toxin levels), and because MDEQ HAB toxin action criteria to protect public health are based on a range of numeric concentration values of algal toxins (e.g., Microcystins = 4 – 20 ppb), careful assessment of data, re-testing and/or more rigorous testing, and corroboration of results by the State HAB team may be warranted.

The LWQD will use its best discretion to determine the threat level posed by HABs and whether further steps should be taken. At minimum, any positive result from either test will result in the reporting of the observation to the MDEQ HAB Map, an interactive mapper that tracks algal blooms throughout the state. Samples yielding inconclusive or negative results will not be reported, however, these data will be stored in the LWQD project data master sheet (LWQD.sys > Monitoring Data > 2023 Recreational Waters Monitoring). All program data is publicly available upon request.

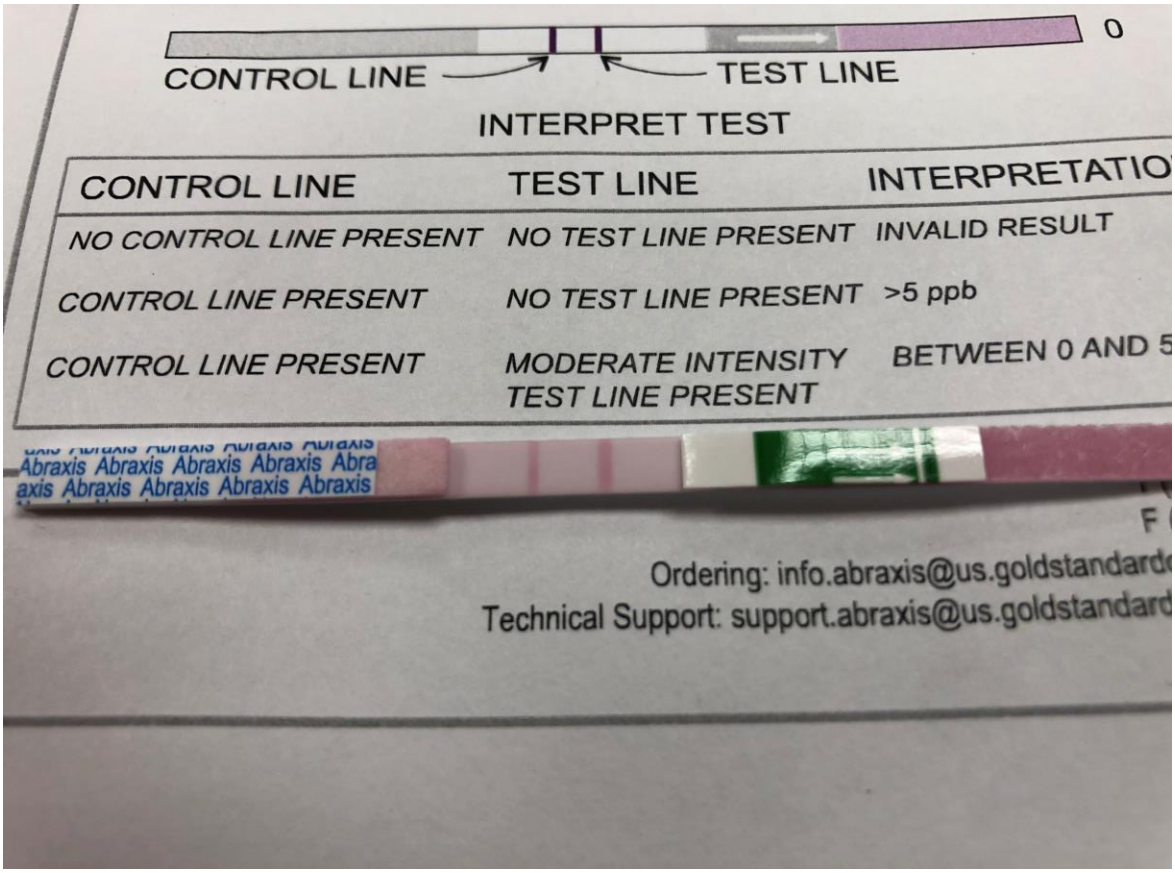

Figure 1. ABRAXIS® test strip for Microcystin. In this sample, the same intensity of the color on the 'Control Line' and 'Test Line' implies a "non-detect" for this algal toxin.

References

Fogarty, L.R., Maurer, J.A., Hyslop, I.M., Totten, A.R., Kephart, C.M., and Brennan, A.K., 2021, Understanding sources and distribution of Escherichia coli at Lake St. Clair Metropark Beach, Macomb County, Michigan: U.S. Geological Survey Scientific Investigations Report 2021–5089, 34 p., https://doi.org/10.3133/sir20215089.

Makarowski, Kathryn. 2020. *Escherichia coli* (E. coli) Assessment Method for State Surface Waters. Helena, MT: Montana Department of Environmental Quality. Document WQDWQPBWQA-01, Version 1.0.

Riedl, Hannah. 2021. Harmful Algal Bloom (HAB) Guidance Document for Montana.

U.S. Environmental Protection Agency (EPA). 2012. Recreational Water Quality Criteria. Document: OFFICE OF WATER 820-F-12-058

Recreational Waters Bacterial Monitoring
Site Visit Form

Site ID:		Site Description:
Date:	Time:	Personnel:

Weather							
cloud cover:	0-25%	25-50%	50-75%	75-100%			
current precipitation:	none	light	moderate	heavy			
recent (36 hours) precipitation:	none	light	moderate	heavy			
wind intensity:	none	light	moderate	heavy			
wind direction (wind coming from):	N	NE	E	SE	S	SW	W	NW
Comments/Observations:							

Potential Pollution Sources (if present, provide details in comments)						
dead fish/animals:	1	2	3	4	5	comment:
wildlife/pet waste:	1	2	3	4	5	comment:
outfall/pipe:	1	2	3	4	5	comment:
beach debris/litter:	1	2	3	4	5	comment:
floating debris/litter:	1	2	3	4	5	comment:
waterfowl:	1	2	3	4	5	comment:
dogs:	1	2	3	4	5	comment:
bathers:	1	2	3	4	5	comment:
Comments/Observations:						

Water Quality Observations				
turbidity	☐ clear	☐ slightly turbid	☐ turbid	☐ opaque
odor	Absent	Present	comment:	
surface sheen	Absent	Present	comment:	
DO (mg/L):	DO%:	Temp:	Conductivity:	pH:

Water Quality Samples			
Sample Type:	☐ bacteria ☐ other:	Sample Time:	
stored/transported on ice?	YES NO	Time Relinquished to Lab:	
Comments/Observations:			