

2011 Southeast Wyoming Reservoir Water Quality Sampling and Analysis Plan

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I. Background

The Wyoming lakes sampling project was designed to increase the data available for use in making Wyoming lakes water quality decisions. The 2011 sampling events will continue collect data using similar protocols as the 2010 project. Nutrient criteria data will be a primary focus during this event. The US EPA Region 8 laboratory will provide all of the sampling and analytical support for the project with guidance provided by Jeremy Zumberge of the WY DEQ and Tina Laidlaw of EPA Region 8. Southeast Wyoming lakes were targeted both for the proximity to the laboratory location in Golden, CO and the need for additional data at these lakes. Smaller lakes were also identified for this year's sampling because of the safety limitations of using a canoe in large waterbodies.

II. Project Description

Monthly samples will be collected throughout the most productive season of the lakes (June, July, and August). Typically July, August, and September dates would be selected, but most of the lakes had experienced fall overturn by the first week of September during last year's event. Therefore, the decision was made to move the sampling dates earlier to try to capture times of lake stratification. Sampling throughout the productive period will help provide data to determine the water quality during periods when lakes are most dynamic. Nine lakes will be sampled three times in a monthly circuit during the summer of 2011. Samples will be collected in proximity of the deepest part of the lake and at the largest inflow to the reservoir. A reconnaissance of the lakes was conducted on June 2, 2011 by Jeff McPherson to assist with selection of lakes and to collect onsite lake information (to include GPS coordinates). Selection of reservoirs to be sampled is based on priority lake information received from WY DEQ, lake size, and information collected during the reconnaissance. Gelatt Lake, Meeboer Lake, and Twin Buttes Reservoir will be resampled if time and weather conditions permit; the other six lakes will receive priority over these lakes.

2011 Wyoming Lakes

Lakes to be sampled	Rob Roy Reservoir
	Lake Owen
	Teton Reservoir
	High Savory Reservoir
	Saratoga Reservoir
	Hog Park Reservoir
	Twin Buttes Reservoir*
	Gelatt Lake*
	Meeboer Lake*

*alternate/lower priority lakes

A data packet will be generated for each sampling event that contains field and laboratory analysis data that have been both peer and quality assurance reviewed.

Concept of the Sampling event

The deepest portion of the lakes (index) will be found using a depth finder and the largest inflow will be determined from maps, aerial images, and onsite reconnaissance. Some lakes do not have inflows and will only be sampled at the index site. One to three lakes will be sampled per day. Field sampling will begin on a Monday (Tuesday in June) and finish on Thursday (Friday in June).

a. Timeline

Tentative 2011 Sample Dates

June 28 - July 1 (Tuesday – Friday)

July 18-21 (Monday – Thursday)

August 22-25 (Monday - Thursday)

Estimated Weekly Schedule

Day 1 – Monday or Tuesday

730	Depart lab
1100 to 1330	Sample Lake Owen (preferred campsite)
1430 to 1630	Sample Rob Roy Reservoir
1700	Arrive at Campsite (campsite TBD)

Day 2 – Tuesday or Wednesday

730	Depart campsite
945 to 1145	Sample Teton Reservoir
1245 to 1445	Sample High Savory (Hog Park is alternate)
1545	Sample Saratoga Reservoir
1630	Arrive campsite

Day 3 – Wednesday or Thursday

730	Depart campsite
800 to 1000	Reattempt sampling lakes not sampled (if applicable)
1130 to 130	Sample Twin Buttes Reservoir
1345 to 1515	Sample Gelatt Reservoir
1515 to 1630	Sample Meeboer Reservoir
1700	Arrive campsite

Day 4 – Thursday or Friday

730	Pack up campsite
800	Depart campsite
1000 to 1200	Sample Hog Park Reservoir
1530	Arrive at Golden laboratory

III. Field Sampling

a. Station Selection

If possible, samples will be collected at two stations per reservoir. One site will be at the deepest portion of the reservoir. A depth finder will be used while the canoe is being paddled to determine the deepest part of the lake. Local information, such as topography, dam sites, and local people familiar with the lake will also be used if possible to help minimize time spent searching for the deepest point of the lake. The second station will be located in or as close to the inflow as possible (if one exists). The inflow that is determined to have the greatest flow will be sampled in reservoirs that have multiple inflows. Inflow samples will be treated like stream samples and one surface multiprobe reading and a grab sample will be taken from the surface regardless of depth. GPS coordinates will be taken at each of the stations using the GPS integrated depth finder and saved as waypoints. Trimble Geo XT or XH GPS units will also be available for collecting coordinates at the inflow sites. An anchor will be deployed and a station will be established as close to the deepest portion of the lake as possible. Canoe drift will not allow exact repositioning of the boat on subsequent events. Positions within 50 meters of the original site are acceptable. Subsequent visits to the index site will be based on GPS coordinates. Sampling of the inflow may be conducted outside of the boat if sampling is easier on foot.

b. Water Chemistry

A profile of field parameters will be collected at the index site and one measurement will be collected at the inflow. For profiles, measurements will be recorded every half meter from the surface to two meters and then every meter from two meters until the last increment measured before bottom is contacted when total depth is between 3 and 20 meters. Measurements will be taken at every 0.5 meters for stations with a depth less than 3 meters. Two meter increments will be used in lakes deeper than 20m from 20 to 30 meters to the last 2 meter increment before the bottom is contacted. 30 meters will be the maximum profile depth due to equipment limitations (100 foot cable). A surface check will be completed and recorded after measuring parameters at the deepest depth. A measurement of 1 meter above the bottom will also be taken to coincide with the water quality sample collection depth.

Water chemistry will be collected using a Hydrolab DS5. A backup MS5 will also be available in case the DS5 is not operable. The MS5 does not contain a chlorophyll or turbidity sensor. The following field parameters will be collected at each determined depth:

- Specific Conductance (SC)
- pH
- Temperature
- Luminescent Dissolved Oxygen (LDO)
- Turbidity (DS5)
- In-Vivo Chlorophyll (DS5)

Data will be recorded on a lake field form and electronically in the Hydrolab Surveyor.

NOTE: unlike other sensors, the in-vivo chlorophyll a sensor accuracy is dependent on correlations with extract analysis. Therefore, while the in-vivo chlor a sensor will provide data as intended, it should be used for trending purposes only and accurate chlor a profiles can be estimated by interpolation between these data and the extract data.

c. Secchi Depth

Secchi depth will be collected on the shaded side of the boat. The secchi disk will be lowered until it is no longer visible and then lifted until it becomes visible. This will be done three times to determine secchi depth. Sunglasses will not be worn during secchi observations and secchi observations will be made at approximately 2 feet above the surface of the water on the shaded side of the boat. Secchi measurements will be recorded to the nearest 0.10 meter. If the secchi disk is still visible when it is on the lake bottom, a "b" should be placed next to the secchi depth to indicate that the reading was limited by the bottom depth. The max depth and secchi depth should also be the same.

d. Water quality sample collection

1. Van Dorn sampler collection

A Van Dorn sampler will be used to collect water at a depth of 0.5 meter below the water's surface (to coincide with WY DEQ protocol) and from one meter above the bottom of the reservoir. Bottom samples will only be collected at reservoirs or lakes 3.5 meters or deeper. Depth will be determined by the Hydrolab Multiprobe sensor and verified by the depth finder. The Van Dorn sampler will be lowered to the appropriate depth using a rope with 0.5m and 1m markings. The sampler will be triple rinsed with surface lake water before taking the surface water sample and will be moved horizontally the length of the Van Dorn three times at depth (both surface and bottom) to ensure all water in the Van Dorn is from the desired depth. Chlorophyll, metals, nutrients, alkalinity, and anions samples will be collected at all water quality sites (inflow, surface, and bottom).

e. Water quality sample processing

Water samples will be emptied into a 1 gallon cubitainer triple rinsed with surface reservoir water. The cubitainer will immediately be placed on ice in a dark cooler. Dissolved metal samples will be filtered within 15 minutes of sample collection. Low level nutrients, total metals, and anions samples will be poured off into appropriate bottles and will be immediately placed on ice. Chlorophyll samples will be filtered at the shore in a shaded area. Care will be taken to ensure that as little exposure to sunlight as possible occurs. Sample water will be filtered until there is obvious green on the filter

pad. However, no more than two liters will be filtered for any one chlorophyll sample. Chlorophyll sample filters will be folded in half and wrapped in tinfoil to ensure no light strikes the samples. The samples will be placed in a clean, unused centrifuge tube and placed on dry ice. The sample volume filtered will be recorded on the centrifuge tube or the foil and on the chain of custody. Gloves will be worn during sample collection by samplers in contact with bottles and equipment. Chlorophyll a samples may be filtered without gloves as long as the sampler's hands are rinsed with tap or DI water before processing.

WQ sample	containers	preservatives
Chlorophyll a	GF/F filter, centrifuge tube, tinfoil	dry ice
Total Metals	250 mL HDPE bottle	ice
Dissolved Metals	125 mL HDPE bottle	0.45 micron filter, ice
Total Nitrogen	125 mL HDPE bottle	0.5 mL hydrochloric acid, ice
Total Phosphorous	125 mL HDPE bottle	0.5 mL sulfuric acid, ice
Low level nutrients	125 mL HDPE bottle	dry ice
Anions, Alkalinity	125 mL HDPE bottle	ice

f. GPS

Collection of GPS coordinates. GPS coordinates will be collected at each station using the GPS integrated depth finder, Trimble Geo series XT or XH. The Hydrolab DS5 Surveyor additionally has a less accurate GPS that will collect points at each data recording. Coordinates will be saved on the GPS and recorded onto the lake sampling form.

g. Photographs

Digital photos will be taken at station locations, boat ramps, and at other pertinent locations at the lake. A picture log will be maintained in the field book. Unless unusual conditions warrant additional pictures, pictures may only be taken during the recon and first sampling event in June.

h. Sample summary

The following table indicates which samples will be collected at the index site and specifically in the euphotic zone or the metalimnion of the index site and the inflow to the reservoir.

Sample type	Index	Surface	Bottom	Inflow
Secchi	Yes	-	-	Yes
DS5 multiprobe	Profile	-	-	single
Metals	-	Yes	Yes	Yes
Nutrients	-	Yes	Yes	Yes
Alk/Anions	-	Yes	Yes	Yes
Chlorophyll	-	Yes	Yes	Yes
Low Level Nutrients	-	Yes	Yes	Yes
TN	-	Yes	Yes	Yes
TP	-	Yes	Yes	Yes

IV. Sample Handling and Custody Requirements

Chain-of-custody procedures will follow those listed in Region 8's Minimum Requirements for Field Sampling Activities. A chain-of-custody record will accompany all chemistry and chlorophyll samples to be analyzed. Metals, TN, TP, and alkalinity/anions will be stored on ice and chlor a, low level nutrients will all be stored on dry ice immediately after collection and processing until being relinquished to the Region 8 Laboratory at the end of each event.

Samples will remain in coolers in the bed of the truck (with canopy) throughout the duration of the field event and the truck canopy will be locked when unattended to ensure sample security is maintained. Ice and dry ice will be monitored and sufficient amounts to keep samples at the appropriate temperatures will be maintained throughout the sampling event.

VI. Documentation and Records

A lake field form will be used to collect measurements at each lake (see attachment 1). Field form measurements include a profile of water temperature, pH, conductivity, dissolved oxygen, turbidity, chlorophyll; GPS coordinates; secchi depth; maximum depth; date; time; event name; station ID; weather conditions; and any other data important to this sampling event. Profile data will also be collected electronically on the Hydrolab DS5 multiprobe.

A field notebook will be used for the entire project (started for WY lakes in 2010) that will include information not collected on the field forms, such as photograph information, contact information, ramp location, fees, etc.

1x4 inch adhesive sample labels will be premade and pre-attached to sample bottles prior to each field event. Sample label information includes Station ID, date, time, preservative, sampler initials, and laboratory ID. Chlorophyll sample labels will also have amount filtered on them. Date and time will be entered on the label in the field with indelible ink (Sharpie pen); other label information will be printed on the labels at

the lab prior to the event. Chains of custody will also be created that will contain the sample label information and number of containers.

Sample identification codes are the beginning letters of the first two words in the name of the lake, a hyphen, and an “I” for inflow, “S” for surface, or a “B” for bottom. If a chlorophyll sample is taken from an area other than the surface or bottom, it will be identified with an “M” for metalimnion or middle and the depth will be recorded in the field notebook. An example, of an identification code for the surface sample from Goshen Hole Reservoir is GH-S. The sample identification codes are as follows:

Sample ID Prefixes	Sample ID Suffixes		
High Savory Reservoir	HS	Inflow	I
Hog Park Reservoir	HP	Surface	S
Gelatt Lake	GL	Bottom	B
Lake Owen	LO	Metalimnion	M
Meeboer Lake	ML		
Rob Roy Reservoir	RR		
Saratoga Reservoir	SR		
Teton Reservoir	TR		
Twin Buttes Lake	TB		

VII. Logistics

All sampling, personnel, and analytical support will be provided by the EPA Region 8 Laboratory.

a. Vehicle

An EPA truck (Chevrolet Silverado) with topper will be to transport EPA employees, the canoe, and equipment.

b. Boat

The sampling vessel to be used is a 13-ft Castlecraft Wide-transom canoe. Foam pads and ropes will be used to transport the canoe on top of the truck.

c. Equipment

- 1 Hydrolab DS5 Multiprobe with 100 foot cable
(sensors: temp, SC, pH, LDO, chlor a, depth; calibration solutions/repair supplies)
- 2 Vacuum pumps (if syringes aren't used)
- 1 Hydrolab MS5 (backup)
- 1 Depth finder
- 1 depth finder mount
- 1 anchor
- 4 Personal Flotation Devices (PFDs)

- 2 Secchi disks (one for backup)
- 1 large cooler
- 2 medium coolers
- 1 small cooler (for dry ice)
- 2 Van Dorn Samplers
- 1 Camera
- 1 Trimble GPS
- 1 Garmin Car GPS
- 1 Wyoming Gazetteer
- 2 Funnels (one for backup)

d. Supplies

- 1 bottle filter set/site (1 – 1 gallon cubitainer, 2 - 250 ml HDPE, 2 - 125 ml HDPE, 1 centrifuge tube, 4x4” piece of tinfoil, 1 Whatman GF/F filter, and 1 syringe (if used))
- 2 filters per site
- 1 box of extra filters
- 2 extra boxes Whatmen GF/F filters
- 2.5 gallon of DI water
- Chain of custody forms
- Lake profile forms
- Dry ice (sufficient to keep chlorophyll and nutrient bottles frozen)
- Ice (sufficient to keep samples less than 4 degrees C)
- 3 boxes XL nitrile gloves
- Paper towels
- 2 boxes Kimwipes
- 5 trash bags

VIII. Analysis

a. Analytical Methods Requirements

Analytical Methods for water samples are listed in Attachments 2, 3, and 4. Methods for field measurement of pH, conductivity, temperature, dissolved oxygen, in-vivo chlorophyll a, and turbidity will follow the US EPA Region 8 Laboratory draft SOP EQOP-711: Hydrolab DS5 Multiprobe Operation, Calibration, and Maintenance Procedure, US EPA Region 8 Laboratory FLDM-720: Field Sampling Procedures, and the 2007 US EPA Survey of the Nation’s Field Operations Manual (EPA 841-B-07-004).

IX. Quality Control Requirements

a. Sample quality assurance

1. Laboratory analytical reporting limits, SOPs, and methods used are addressed in Attachments 2, 3, and 4.

2. A quality control duplicate will be collected at the inflow, surface, and bottom during each event. Two sets of quality control blank samples for chemical analyses will be collected during each field event. Quality control samples will be used to determine whether or not sampling procedures introduce contaminants in the field. Field duplicates for chemical analyses will also be collected to determine whether or not the data is reproducible.

3. If QC samples reveal a sampling or analytical problem, field and laboratory personnel will troubleshoot the sampling procedures and attempt to identify the source of contamination. Personnel will take necessary steps to assure that similar problems will not arise during future sampling events. Data may need to be flagged and qualified depending upon the nature and extent of the contamination.

b. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All equipment will be inspected and tested each day prior to use in the field following the guidelines set forth in the US EPA Region 8 Laboratory draft SOP EQOP-711: Hydrolab DS5 Multiprobe Operation, Calibration, and Maintenance Procedure. All multiprobe sensors will be inspected before use. All calibration solutions will be checked prior to the sampling event to make sure they are not expired. All sampling equipment will have backups that will be used if the primary units are not properly calibrating, have defects, or are not working properly. All calibration, maintenance, and defects will be documented in the multiprobe calibration/maintenance log.

c. Instrument Calibration and Frequency

Calibration of the Hydrolab will be conducted each morning before sampling according to US EPA Region 8 Laboratory draft SOP EQOP-711: Hydrolab DS5 Multiprobe Operation, Calibration, and Maintenance Procedure. All multiprobe calibration procedures will be recorded in the unit's calibration/maintenance log. When field meters do not calibrate properly, sensors will be inspected, recalibrated, and not used if necessary. Meters will be checked against standards or will be recalibrated when readings become erratic or appear unusual to samplers. Post calibration checks will be conducted at the end of each day at a minimum.

The precision and accuracy for each chemical parameter produced by the chemistry laboratory will be determined according to the laboratory's SOPs and the EPA methods for chemical analysis. Precision and accuracy for field measurements of pH, LDO, conductivity and temperature will be determined according to the EPA Methods for Chemical Analysis of Water and Wastes Manual, EPA Region 8's Standard Operating Procedures for Field Samplers, or the manufacturer's specifications.

Calibration procedures for metals, nutrients, analyses will be conducted according to manufacturer's specifications and SOPs developed by the EPA Region 8 laboratory.

d. Inspection and Acceptance Requirements for Supplies

All sample containers and filters to be used during this sampling event will conform to specifications listed in Table II of 40 CFR Part 136. The collection of blank samples will help ensure quality sampling is being conducted and supplies and equipment provide quality samples for analysis.

e. Data quality management

Region 8 standard report forms for chemical will be used during all tests. All data and significant observations from field activities will be kept in a bound notebook. Any deviations from required test procedures or field sampling methods will be documented in the field notebook. Laboratory and field data will be kept on file by EPA laboratory personnel.

Results of all chemical samples and field measurements will be compiled into a data package by Region 8 Laboratory personnel following laboratory SOPs. Data will be peer reviewed following laboratory procedures to minimize errors and correct any errors that may occur. All data will be archived in the Laboratory Information Management System (LIMS) and in a hard copy data packet. All data from this field event will be compiled and sent to the project manager.

f. Data verification and usability

All laboratory analytical results will be cross-checked against the field notebook, sample tags and chain of custody documents to ensure that the raw, computer-generated summary of the chemical analyses were correctly assigned to the corresponding sampling stations. All analytical results will be compared to the chain-of-custody documents to ensure that the data are complete. Laboratory QC data will be reviewed for all data to ensure that all data are useable. If any of the data are found outside the QC limits, re-analysis of the samples may be requested.

X. Health and Safety

a. General Safety

Safety is a top priority during this sampling event. An extensive first aid kit will be carried in the truck at all times. Cell phones will be taken to each event and local sheriff department and hospital numbers will be on hand in case of any health any safety issues. 911 will be called during emergency situations. The nearest hospital will be programmed into the GPS and instructions will be provided to each sampler to establish the hospital as a destination prior to sampling.

b. Personnel safety training

EPA field crew members have all taken 24 field safety training. Jeff McPherson, the field lead and safety officer for this event is trained in field safety, 1st Aid, CPR, and is boater safety certified. Jeff McPherson also has extensive experience operating and working onboard boats of different sizes.

c. Boat safety

Personal flotation devices will be worn at all times on the boat. The canoe will only be used with two people on board. Load and sampler weight will also be evaluated to ensure that the canoe is not overloaded beyond its 550 pound maximum capacity. Lake conditions will be evaluated at each site to determine the boating hazards with particular attention being paid to strong wind and wave conditions and lightning. Put-in spots will be as close to the sample site as possible. The canoe is wide-transom and has attached "bumper" flotation devices that will help with stability and makes the boat unsinkable. If winds or waves pick up while sampling to levels that are unsafe to be on the water, sampler will return to the nearest shore to their location and determine their next course of action. Sampling events will be cancelled if wind, wave, lightning or any other conditions pose a safety risk.

d. Vehicle safety

Vehicles will be properly maintained. A visual inspection of the truck will be completed prior to departure. All driving speeds will be at or below the speed limits. 4-wheel operation will be conducted in a safe, slow, and conservative manner. A Warn winch is mounted on the front of the truck that can be used if the vehicle gets stuck. Use will be according to the manufacturers operating instructions.

e. Chemical safety

Gloves and safety glasses will be worn when processing to avoid potential acid burns from the prepreserved bottles of acid. Cryogenic gloves will be used to handle dry ice and dry ice will remain in the cooler in the bed of the truck.

f. Emergency Communications

Cell phone service is spotty at best in most locations being sampled. If an emergency phone call is needed, samplers will have to drive towards I-25 or Saratoga (whichever is closer) until cell phone service is available. Much of the land being travelled on is USDA Forest Service land and USFS employees may also be able to provide emergency assistance and vehicles can usually be identified by the federal license plates, pale green or white color, and small USFS logo on the door of the truck. Rob Roy Reservoir, Lake Owen, and Hog Park Reservoir are on USFS property.

Emergency Contact Information

Reservoir	Law Enforcement	Hospital
Teton Saratoga High Savory Hog Park	Carbon County Sherriff Phone: 307-324-2776	Ivinson Memorial Hospital 255 N. 30th Street Laramie, Wyoming 82072 (307) 742-2141
Rob Roy Owen Meeboer Twin Buttes Gelatt	Albany County Sherriff Phone: 307-721-2526	

Appendix 1: 2011 SE Wyoming Reservoir Water Quality Sampling Contacts

Wyoming DEQ contact:

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EPA laboratory coordinator:

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Medicine Bow-Routt National Forest

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307-745-2300